DETERMINING THE ECONOMIC RISK/RETURN PARAMETERS FOR DEVELOPING A MARKET FOR ECOSYSTEM GOODS AND SERVICES FOLLOWING THE RESTORATION OF NATURAL CAPITAL: A SYSTEM DYNAMICS APPROACH

Volume 2: Policy Briefs

James Blignaut, Martin de Wit, Sue Milton, Karen Esler, David le Maitre, Steve Mitchell and Doug Crookes (Editors)

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(WRC Report no. 1803/1/13)

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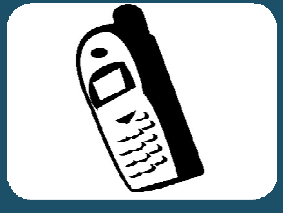
POLICY BRIEF

Implications of the regulatory landscape for the restoration of natural capital



INTRODUCTION

The principle that the person or the organisation responsible for pollution or environmental degradation should be responsible for the restoration of the relevant affected ecosystem has been established in South African legislation by the National Environmental Management Act (NEMA, Act 107 of 1998). This principle is also applied in other acts, such as the National Water Act (NWA, Act 36 of 1998) and the Conservation of Agricultural Resources Act (CARA, Act 43 of 1983).

However, what constitutes successful restoration remains a contentious issue as distinct criteria need to be applied to distinct situations. The lack of regulation of the restoration process may lead to failure in minimising and addressing the adverse environmental impacts as intended in the legislation.

This would be a failure to protect the environment. Therefore, the restoration process must be regulated through appropriate legislation and policies, and the capacity to implement existing legislation must be developed.

EXISTING LEGISLATION

One principle stated in the NEMA, which applies to all environmental management areas in South Africa, is: "The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment." This is known as the "polluter pays" principle.

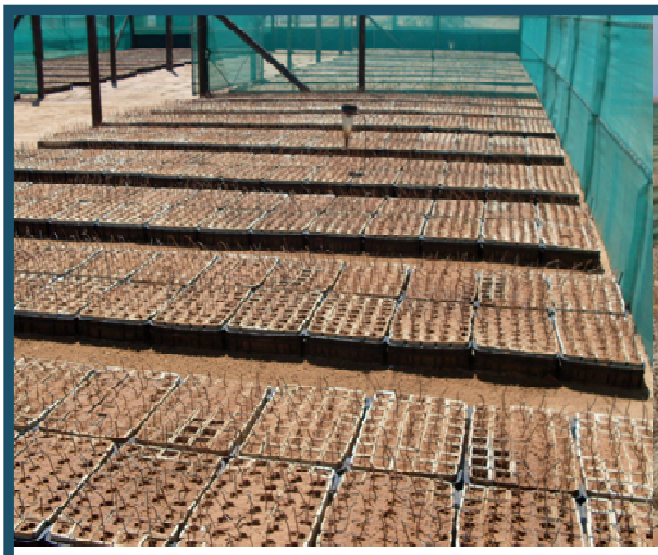
The "polluter pays" principle is also applied in the CARA and the NWA.

CARA gives the Minister of Agriculture the power to publish regulations that force land users to restore land that has been eroded, disturbed or denuded at cost to the land user. It also gives executive officers of the Department of Agriculture the power to direct a land user to comply with such a prescription or to carry out a specific action to achieve the objectives stated in CARA. The Act also states that any land user refusing to comply is guilty of an offense; and the Act then stipulates the penalties to be imposed on the offender.

RECOMMENDATIONS

- Existing legislation should be modified to regulate the process of restoration as prescribed in the South African legislation to ensure that the desired end-points are reached.
- The regulated process should include phased end-points acknowledging that restoration takes a long time and should continue until the desired end-points are met.
- The following should be considered:
  - A monitoring and evaluation requirement to be included in the regulation of restoration to ensure success;
  - Allowing flexibility in the permitting/licensing systems in order to respond appropriately to findings of monitoring and evaluation with minimum bureaucracy;
  - The introduction of incentives for the polluter to comply beyond minimum requirements of permits/licences.
- Capacity to effectively implement existing legislation should be developed to prevent degradation and ensure successful restoration.

March 2012



Restoration at Namakwa Sands

NAMAKWA SANDS

The Exxaro Namakwa Sands mine on the west coast of South Africa extracts mineral-containing ore on a large scale by strip mining. Mined-out sites are backfilled and then revegetated by replacing topsoil, reseeding and transplanting nursery-grown cuttings and mature plants. The aim of these restoration measures is to return the capacity of the land to support small stock farming. The progress of restoration is continuously monitored and evaluated. This is an example of how regulation of the restoration process can ensure that the responsible party carries out restoration to achieve required objectives.

However, research on this site also pointed out a number of gaps in the regulation of restoration. (1) There are no incentives for mining companies to comply beyond the minimum requirements of licences. At Namakwa Sands there are currently no requirements to return the diversity of plants that will buffer the ecosystem against disturbances such as drought when the land-use capability has been restored. Although there is no incentive, Namakwa Sands is one of the few mining companies that do so regardless. However, many other mining companies only aim to meet the minimum requirements so as to increase their profits, often leaving the ecosystem in a vulnerable state. (2) There is a need to include phased end-points in the regulatory process where restoration takes a long time. Development of the diversity at some restoration sites at Namakwa Sands has stagnated, and, although land use capability is restored, these sites will not reach the diverse and resilient state desired by Namakwa Sands without active intervention. This illustrates how easily restoration sites can stagnate if they are not actively managed. Phased end-points will ensure this does not happen while sites are progressing towards the restoration objective. (3) Licensing systems are not flexible enough to respond appropriately to the findings of monitoring and evaluation. Namakwa Sands is currently developing suitable requirements relating to vegetation diversity and cover of restored ecosystems. However, the process to change requirements in the EMP is time-consuming and bureaucratic.

The NWA requires that the person responsible for the pollution of water must minimise and remedy such pollution as well as the effects of disturbance to the bed and banks of a watercourse. The Act also gives catchment management agencies (CMAs) power to order the responsible person to carry out such measures or to do it themselves and retrieve the costs from the polluter.

Although it is implied in these Acts that measures to minimise and remedy adverse environmental effects should be successful, appropriate policies to guide the processes by which the affected ecosystem is restored do not exist; therefore successful restoration is not assured. Since the action of restoration is required by law, but the means are not specified, an opportunity exists for polluters to take shortcuts to decrease the cost of restoration and thus increase their profits. A more thoroughly regulated restoration process would help ensure that restoration achieves the appropriate objectives. This would ideally include regulation of the planning, execution, and monitoring and evaluation phases of the restoration process.

A good example of an Act that does regulate the restoration process (see box above on Namakwa Sands) is the Mineral and Petroleum Resources Development Act (MPRDA, Act 28 of 2002). It requires

Commercial forestry and general degradation have led to a decrease in the water yield in the Sand River Catchment (see box on page 4). Photos: Douglas Crookes

that an Environmental Management Programme (EMP) be developed, which specifies what adverse impacts on the environment will result from prospecting/mining and how these will be minimised and remedied. It requires that end-points for restoration be decided on in conjunction with interested and affected parties. The MPRDA also requires monitoring and evaluation to ensure that companies keep to commitments made in the EMP and to ensure the desired end-points are reached.

This Act also deems the company that has adverse environmental impacts responsible for environmental management and restoration until the actions causing these impacts have ceased and the desired end-points of restoration have been met. Although the MPRDA is not perfect, it has led to a major increase in the environmental management and restoration efforts in the South African mining industry. The way the MPRDA regulates environmental management and restoration could therefore be used as a blueprint for regulation in other sectors, including the agricultural and water sectors.

A major issue is that existing legislation that prevents degradation and prescribes restoration is not always effectively implemented, as illustrated in the box above on the Sand River. In this case study the extent of degradation would have been much smaller if it was prevented and remedied earlier. The capacity of the CMA and Department of Water Affairs to implement the NWA is thus brought into question.

It is also important to note that restoration is an ongoing process. If, for example, invasive alien plants are removed, restoration of the site is not complete until the end-points (usually ecosystem composition, structure or function) are reached. The management of such sites are therefore important and such sites should not be returned to agriculture, forestry or other land-use that will cause further degradation and prevent successful restoration until fully restored.

GAPS IN EXISTING REGULATION

Specific gaps in the existing regulation of restoration, identified in this research, are the following:

- There is no incentive for compliance beyond the end-points specified in permits or licences issued for specific activities. However, there is an economic incentive (increased profits) for holders of permits or licences to comply with only the minimum requirements, which may leave an ecosystem vulnerable to subsequent disturbances. Policymakers should consider incentives such as awards or tax rebates to counter the economic incentive not to comply beyond minimum requirements. Environmental awards, while costing the state much less than tax rebates could improve a company's profile and therefore attract investors. If the benefits of such awards are made apparent to companies it could become a desirable incentive. Numerous environmental and sustainability awards, mostly presented by non-governmental organisation, exist in South Africa, however, they lack the prominence that would give them impact.
- Phased end-points are needed, linked to the restoration goal, some of which may take long periods of time to achieve. Restoration is ongoing and not a once-off activity. In some cases, especially in arid environments such as the Karoo, restoration may take a very long time. If the restoration process is not guided step-by-step it can easily stagnate

SAND RIVER

The water-stressed Sand River Catchment (SRC) is a sub-catchment of the Sabie River Catchment, which forms part of the Inkomati water management area in the Limpopo and Mpumalanga provinces. The most prominent land uses in the SRC are rangeland, conservation areas, residential, crop production, and forestry – in that order. Forestry activities have caused a decrease in water yield and therefore in the water available to downstream users. This has led to a decrease in cultivated land and caused the amount of water that reaches the Sabie Sand Game Reserve to fall below the ecological reserve – the amount of water required to ensure that the ecosystem remains intact – which is prohibited by the National Water Act (NWA, Act 36 of 1998).

Historically, forestry was the largest water user in the catchment. However, as part of a plan to include the SRC in a newly formed national park, a decision was made in the late 1990s to exit all forestry plantations. The clearing of plantations in the catchment started in 2001. The plan to include the SRC in a new national park did not materialise and subsequently the decision to exit forestry came under review. Unfortunately, the clearing of plantations did not lead to increased water yield as expected, mainly because the canal system in the middle catchment was in disrepair. The water users downstream are therefore still not receiving their water entitlements.

If the decision to exit all forestry plantations is reversed and afforestation takes place, water yield could decrease further. This could also be the case if cleared areas are used for irrigated agriculture in future. To remedy the situation, a payment for ecosystem services scheme was proposed, which would compensate farm owners not to pursue forestry in the catchment and help pay the costs of repairing the canal system. This would ensure that downstream water-users receive their due amounts of water.

This case study illustrates two issues about the regulation of restoration. The first is the lack of capability to implement current legislation. Under the NWA it is the state's responsibility to ensure the ecological reserve is conserved and that of the Minister and of CMAs to order the implementation of any measures necessary to ensure that this is done. Although the Inkomati CMA was the first CMA to be established, and it has been known for years that the ecological reserve in the SRC is not being conserved, little has been done to remedy the situation (the decision to exit forestry was made by the Department of Water Affairs for a different reason). Also, the Inkomati CMA should have prioritised the repair of the canal system. This lack of capacity may be due to institutional complexities, shortage of funding or lack of human capital. Through regulation of the restoration process would aid the CMA by guiding the planning and execution of restoration in the catchment.

The second issue is the management of restored sites is not regulated. If cleared sites are afforested or used for irrigated agriculture the ecological reserve would be compromised, however no policies or legislation exists that regulate the restoration process or otherwise preclude these land uses on cleared sites.

over such long time periods. This needs to be taken into account by policymakers and land users. Phased end-points can ensure that the trajectory of restoration proceeds as envisaged in the EMP or similar framework, and so contribute towards achieving the restoration objectives.

- If the process as regulated stops too soon the system may not be sufficiently robust to reach the condition envisaged in the original licence. For example, where a certain land-use is the desired end-point, and ecological integrity is not a requirement, the ecosystem might still be vulnerable to disturbance after the end-point is reached (see box on Namakwa Sands box). It may then deteriorate to a point where the end land-use is not realised, unless managed appropriately. Also, if a site cleared of invasive alien plants is not managed correctly further degradation may take place (see above box on Sand River). The restoration process must therefore be regulated until the ecosystem is fully restored.
- Monitoring and evaluation (M&E) is needed, with flexibility within the permitting system to respond appropriately. Without M&E, the success of restoration cannot be established. If M&E shows that restoration is not progressing according to plan, that it will not be possible to reach the required end-points or the requirements are too lax, the licensing system should be able respond with minimum bureaucracy. The present process of amending requirements is too time-consuming, requiring lots of paperwork and meetings.

CONCLUSION

The principle that a person or the organisation responsible for pollution or environmental degradation needs to pay for the restoration of the affected ecosystem has been established in South African legislation by the NEMA and applied in a number of other Acts. However, this alone does not ensure successful restoration and the need exists to further develop existing legislation to regulate the restoration process. This will help ensure that adverse environmental impacts are successfully remediated to protect the environment. One way of doing this would be to regulate the process in the relevant act for each sector. Alternatively, guidelines for restoration could be developed separately and the use of these made a requirement in each Act.

Recommendations to ensure that successful restoration takes place in future are: (1) To ensure that restored sites are resilient, incentives should be developed to comply beyond minimum requirement of licenses. (2) The regulatory process should include phased end-points where restoration takes a long time and continues until the desired end-points are met. This will ensure that restored sites continuously develop toward the desired end-points and that restoration that takes a long time will ultimately be successful. (3) A M&E requirement should be included to ensure restoration is progressing as planned and that restoration is ultimately successful. (4) Licensing systems must be flexible in order to respond appropriately to the M&E findings.

The suggested regulations can help the state, as custodian, to protect the natural environment for present and future generations and to ensure that all South Africans live in an environment which is not adverse to their health or wellbeing, as required by the Constitution.

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ABOUT THIS POLICY BRIEF

This Policy Brief was prepared by Marco Pauw, Stellenbosch University and ASSET Research, mjp@sun.ac.za

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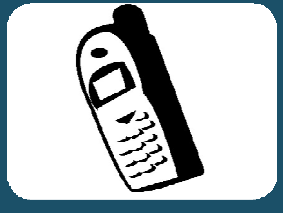
POLICY BRIEF

Urban water use



INTRODUCTION

There has been a global shift in the way that water provision for urban water use is viewed. Governments are increasingly choosing to invest in environmental health. By protecting river systems, governments can reduce management costs. In this brief, examples of international case studies related to such government interventions are presented, followed by a South African case study: the Kromme River.

BACKGROUND

INTERNATIONAL CASE STUDIES

Seattle Municipality: Purchase of the Cedar River Catchment for its water supply by Seattle, one of the unhealthiest cities in the US before the 1890s, made the city one of the healthiest in the US within 10 years.

Before the purchase of the Cedar River Catchment, Seattle was an unhealthy city with epidemics of cholera and typhoid and major water shortages. Purchasing a catchment solely for water provision (i.e. all agriculture and forestry was ceased) was considered expensive and risky at the time, but the endeavour was a huge success**.**

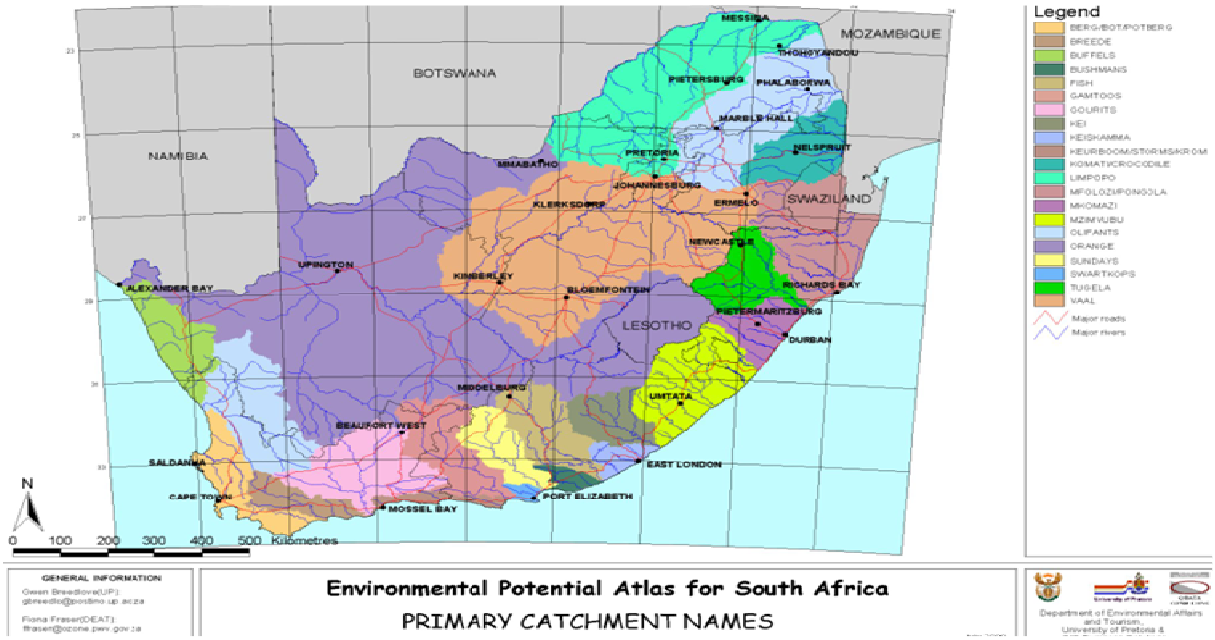
Within 10 years clean water began to flow once more, and outbreaks of cholera and typhoid ceased. This endeavour not only provided the city with clean water and improved the health of its citizens, it also saved the city hundreds of millions of dollars in the long term. This is because the use of natural systems for water provision services proved substantially cheaper than creating an artificial system, such as a water filtration plant (Cosman et al, 2012)**.**

RECOMMENDATIONS – SPECIFIC TO NELSON MANDELA BAY

- **Protect what we have:** Protecting our natural resources will ensure their services are delivered in perpetuity. The Kromme case study, which illustrates this, may be applied to other catchments in South Africa.
- **Forming partnerships:** Landowners (service providers) are based in water-providing catchments and their actions have an impact on the water produced that municipalities (end-users) benefit from. Municipalities need to form partnerships with landowners to assure the supply of high quality of water.
- **Align incentives:** All stakeholders must work towards the same goal. Landowners must be willing to restore and protect the catchment and the end-users must be willing to pay for the delivery of services (e.g. clean and reliable water flow).
- **Communication is vital:** All government departments, implementing agents, conservation initiatives, landowners, and scientists must make earnest attempts to achieve effective communication when it comes to working in important water-producing catchments.
- **Biodiversity Stewardship Programme:** Tax and financial incentives are available to landowners who sign up to the Biodiversity Stewardship Programme through which landowners in ecologically important areas are required to manage invasive alien plants. This programme is one vehicle for such partnerships between landowners and government.
- **Law enforcement:** South Africa has sound laws for the protection of natural resources but these need to be enforced to avoid the degradation of natural resources.

March 2012

WHAT IS A CATCHMENT AREA?



A catchment is an area, often surrounded by mountains, whose rainfall all drains into one body of water, such as the ocean, an estuary, or a dam. A catchment consists of mountains, the lowlands/flood plains and all the rivers running through this area. South Africa is divided up broadly into 19 primary catchments, as shown in the picture, above. Each of these 19 catchments is further divided up into quaternary catchments, which is the scale at which water management, in terms of urban water use, should take place.

New York Municipality: The municipality invested US$1.5 billion in maintaining and restoring its Catskill Catchment and saved $6 billion in the cost of a filtration plant plus operating costs (Cosman et al, 2012). New York City is supplied with water from the Catskill Catchment via the Catskill Aqueduct.

Kampala, Uganda: The Nakivubo Swamp provides wastewater purification services and nutrient retention services, valued at US$1-US$1.75 million a year. Using the existing swamp is far cheaper than the expansion and maintenance of new wastewater facilities. Despite these findings, policymakers have neglected to protect the area and the wetlands' ability to remove nutrients and pollutants has been greatly reduced – costing the country millions of dollars each year. However, after 2008 a new plan was proposed to reverse this (Kozak, 2012).

A CASE STUDY OF THE KROMME RIVER

The Kromme River in the Eastern Cape provides 40% of the water (Raymer, 2010), and it provides the cheapest* and best quality water in the Western System to the Nelson Mandela Bay Municipality (NMBM). However, the catchment that supplies the Kromme with water is in An extremely bad condition at present.

**The average operational cost of water from the Churchill Water Treatment Works is R0.54/m^3 compared to R0.83/m^3 in Elandsjacht and R0.93/m^3 at Loerie.*

The upper Kromme River valley is divided up into relatively small farms, with the main activities being dairy, livestock and fruit farming. Agriculture in this arid environment has low profit margins. The land has been poorly managed, resulting in erosion of arable soil and about 85% of the once extensive wetlands have been destroyed (ASSET Research, 2012). Loss of wetlands is serious as these provide services such as the maintenance of water quality, silt retention, flood protection, low flow augmentation and a place of refuge for animals. Since the wetlands in the Kromme have been destroyed, the flood damage is reported to have become more severe.

These services, invisible to the economy when the system is healthy, require expensive engineering solutions to replace them. This is a case where the cost of uninformed decisions by a few private landowners is carried by the citizens of Port Elizabeth over a long-time horizon.

Other factors contributing to the loss of services from the Kromme are the alien black wattles, which first appeared in the catchment in the 1940s. Currently 41ha of this area are invaded, mostly in the river itself, which equates to more than 11% of the catchment (ASSET Research. 2012). These trees use more water than indigenous vegetation (Dye and Jarmain, 2004) and landowners have reported that smaller rivers have ceased flowing as a result of these trees using the water. The river itself has also been

HEADCUTS – DONGAS AND GULLIES

A headcut is caused by an activity which disturbs a rivers path. Examples are building a road or railway line through a wetland, river or floodplain, allowing animals to graze in these areas, or ploughing these areas up. These activities cause damage called a 'nick-point' to the path that water flows along, and as more and more water flows past the point of damage, it will start to wash the loose sand and gravel downstream. This causes the nick-point to start moving backwards and become bigger with time. This process happens much faster during big floods. Headcuts are bad because they drain the water from the surrounding land, so it can no longer be as productive for agriculture or grazing. It also destroys wetlands – which provide many services.

Source image: Image: http://deq.mt.gov/statesuperfund/ubmc/images/virtour/full/22b_full.jpg

structurally damaged. Many parts have been canalised and poor road construction and illegal farming in the river have taken their toll. The Conservation of Agricultural Resources Act (Republic of South Africa, 1984) prohibits certain practises and yet is not being enforced in the Kromme. These activities cause headcuts, which steadily erode their way upstream impairing the land's ability to hold water and causing loss of top soil. This is detrimental to both agriculture and water users downstream.

All of this damage has a direct impact on NMBM's water supply. Resource abuse has negatively affected the quantity and quality of water the city receives, requiring costly engineering interventions and alternative water sources being developed sooner than would otherwise be necessary. The attempts by landowners in the Kromme to increase their short-term financial gain has had adverse implications in the long-term for the public water resources and has at the same time reduced the capacity of the agricultural land to support the farmers' livelihoods.

WHAT IS RESTORATION?

When humans get ill, they go to a doctor who fixes them so their bodies can function properly again. When land, rivers and mountains are damaged or "ill", they also need to be fixed so that they can function properly again. South Africa and all its people rely on the ability of the land to function properly. They need its fresh, clean water, its healthy soil for agriculture, and especially need its ability to protect the population from extreme events, particularly in the face of climate change.

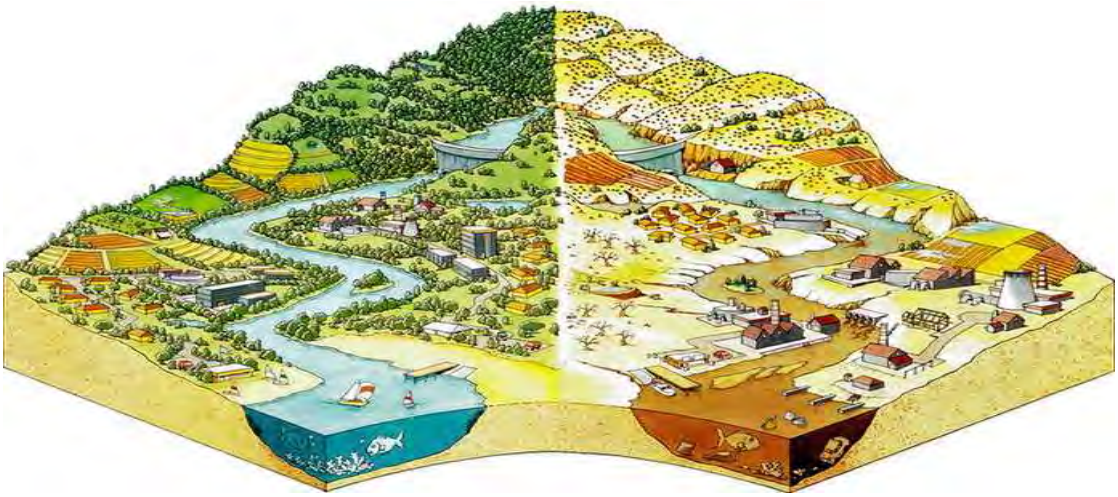
There are many ways to "fix" or "restore" the environment. Some ways include cutting down alien (from another country) trees and plants that use up all the water. Other types of restoration include fixing up damaged wetlands by building concrete structures to stop the soil being washed away. It could also be re-growing plants in areas where animals have been allowed to overgraze and all that remains is bare soil.

WHAT IS BEING DONE?

Working for Water: In the 1990s scientists recognised the widespread damage to the land and the urgent need for restoration. In 1996, the government's Working for Water (WfWater) programme began clearing the invasive alien trees in the Kromme.

WfWater aims to make more water available by clearing invasive alien plants that use high amounts of water. It is run through the Department of Water Affairs. Since WfWater started in 1995, more than one million hectares of invasive alien plants have been cleared throughout the country. WfWater has also provided jobs and training to about 20 000 people a year. These people are drawn from the most marginalised areas, and of the total, 52% are women. Currently there are 300 projects in all nine provinces.

INTEGRATED CATCHMENT MANAGEMENT



Integrated catchment management is a form of management and planning where a catchment as a whole is looked after instead of the more traditional piecemeal approach. This is based on the fact that all aspects of nature are intimately connected. It is not possible to separate land management from water management and successfully look after natural resources. *Image from: Waterwatch Queensland (http:// www.georgesriver.org.au/IgnitionSuite/uploads/images/poster_healthycatchment%20qld%20waterwatch%20sml.jpg)*

Working for Wetlands: The Working for Wetlands (WfWetlands) project was started in 2000 by the South African National Biodiversity Institute (SANBI) on behalf of the Departments of Environmental Affairs, Department of Agriculture, Forestry and Fisheries and Department of Water Affairs (DWA). It aims to fix up the wetlands of South Africa as well as draw unemployed people into the productive sector of the economy. There are 40 projects running and in 2009, 95 wetlands were rehabilitated in all nine provinces, jobs were created for 1500 people and 250 small businesses were supported. In 2000, Working for Wetlands began to physically rehabilitate the Kromme, building cement structures to stop the headcuts moving further up the river, preventing the loss of more arable land.

Biodiversity Stewardship Initiatives: The Biodiversity Stewardship Initiative (BSI) is an initiative of Environmental Affairs and Tourism (DEAT) as well as key conservation organisations such as Eastern Cape Parks. The BSI allows landowners with land that has rich biodiversity to enter into an agreement to secure legal protection for their land. The initiative offers support and advice from nature conservation agencies and funding from government to protect valuable resources. It employs landowners to look after their land in a way that will protect these resources in perpetuity. An estimated R22 million has been spent on the restoration of the wetlands (WfWetlands) and over R12 million devoted to the removal of invasive trees (WfWater). Restoration in the Kromme catchment is regarded as an investment, it will improve the ecosystem and preserve services for posterity.

Integrated Catchment Management: This integrated catchment management is currently not well integrated due to poor communication. Landowners should be included in the process and agricultural practices need to change to provide a lasting legacy. In addition, integrated catchment management needs to be made financially viable and appealing to landowners if the benefits of restoration are to be sustained. Because restoration and integrated catchment management will benefit the end-users, a suggestion is that landowners should be paid to manage their land in such a way that the ecosystem services their land provides are optimised for downstream users in the long term. Essentially they would be paid for providing good quality water, or "farming water".

ANALYSIS

A cost-benefit analysis, as performed in Kromme River Catchment to assess the economic viability of restoration activities should be undertaken in each case to determine the viability of any planned intervention. The additional yield resulting from clearing one hectare of alien invasive plants in the Kromme amounts to 3207m^3 of water per year. On average, about 140ha of invasive woody trees are removed each year. Thus the NMBM can expect an additional 440 000m^3 flowing into the Churchill Dam each year. The economic value or NMBM's willingness to pay for this additional water amounts to around R540 000 per annum. However, private landowners also benefit from the restoration in terms of increased land productivity and on-farm increased water availability.


The government's Water for Work programme (left) and Working for Wetlands programme (right)

CONCLUSIONS

An important finding of this study was that the benefits of the restoration are not economically viable over a 25 year period *for water production alone*. Other services that are also provided by restoration such as improvements in water quality, the security of the water source, increased agricultural productivity and increased flood protection contribute to the viability. Restoration programmes protect the catchments and provide employment and capacity building opportunities. The restoration in the Kromme area provides around 500 jobs per annum and spends R4 000 on wages for every hectare cleared.

WfWetlands provides an additional 100 jobs per annum. Government's New Growth Plan aims to create five-million new jobs by 2020 (National Planning Commission, 2011). Restoration of catchments could therefore help meet these targets while addressing other issues such as securing long-term sustainable water supply for cities.

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ABOUT THIS POLICY BRIEF

This Policy Brief was prepared by Alanna Rebelo, University of Stellenbosch and ASSET Research (arebelo@sun.ac.za), and Katie Gull, University of Cape Town and ASSET Research (katie_gull@hotmail.com)

The South African Water Research Commission provided financial support for this study, under contract K5/1803, *The impact of re-establishing indigenous plants and restoring the natural landscape on sustainable rural employment and land productivity through payment for environmental services*, (Water Research Commission 2009, Water Research Commission Knowledge Review 2008/09. Water Research Commission, Pretoria, South Africa. ISBN: 978-1-77005-894-1), awarded to ASSET Research. ASSET Research is an economy/ecology think-tank that seeks to internalise the importance of natural assets – such as water, energy, biodiversity and fertile land – in the search for alternative development paths.

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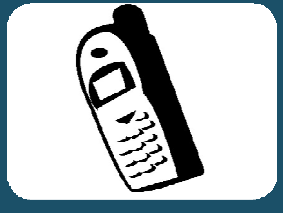
POLICY BRIEF

Market challenges for the restoration of the natural environment



INTRODUCTION

Over the past century South Africa has become increasingly reliant on the manufacturing and services industries for its economic development and growth. However, the natural environment continues to play an important role in the livelihoods of particularly the poor, those in rural areas and the agriculture sector – the latter being essential for urban living.

The productivity of land and the availability of water can help the poor overcome some of the critical constraints they face in meeting their basic needs, and they are essential for productive farming.

Restoration of the natural environment involves the replenishment of the natural environment through both active and passive means. Passive restoration undertakes the removal of those things that damage the environment such as invasive alien plants. The natural environment is then left to re-establish itself without further intervention.

Active restoration, on the other hand, involves active intervention such as the control of alien invasive plant species and the re-establishing of natural (indigenous) vegetation, for example by re-seeding, re-planting and soil preparation treatments.

Restoring the natural environment in South Africa is not new. The Working for Water programme, a government programme to eradicate invasive alien plants, has been in operation since 1995, and spawned a number of other initiatives such as the Working for Wetlands and Working for Fire programmes.

Only recently, however, have the proponents of these programmes begun to consider the market implications of restoring the natural environment. The marketability of the natural environment is influenced by different forms of restoration activities, which in turn has cost implications depending on the different types of ecosystems and the extent of the damage. Furthermore, different sites will have different vectors of benefits. These different

KEY ASPECTS

Location: The selection of the restoration site is crucial, as this affects the supply of environmental goods and services to the market. Features to consider include the extent of degradation, distance from the market, the existence of an appropriate distribution channel, and the nature of the land tenure. Other factors include the climatic conditions, and also the vegetation type, as this will affect the range of environmental goods and services supplied. There is a need to start in areas where there is a greater chance of success.

Functionality: Restoration has the aim of restoring the functionality of an ecosystem. This in turn affects the flow of goods and services onto the market. However, this can only happen if markets themselves are well functioning, where possible free from restrictions and characterised by many buyers and sellers. Where markets are not well functioning, some monitoring is required to ensure that dominant players do not manipulate the system to the detriment of other participants.

Process: Many environmental commodities are traded as free goods, or at a price that does not reflect their true value. One example in South Africa is water. A key market challenge for restoration is to determine an appropriate price for environmental goods and services. A number of techniques are available in order to achieve this.

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Examples of active restoration of the natural environment include repairing dongas in the Drakensberg. The reduction of soil loss through erosion has downstream benefits since water from this catchment flows into the Woodstock dam, which in turn supplies water to communities throughout South Africa. Reduced erosion from the communal areas reduces siltation of dams such as Woodstock, and therefore reduces the management costs of these dams.

factors suggest that there is no one-size-fits-all solution but each is site specific and context specific. There is also a need to start in areas where there is a better likelihood of success.

It is important to note that an economic approach to the environment is being applied in this brief. One of the major market challenges is therefore simply to accept that different role players – scientists, ecologists, managers – have different ways of expressing value. Not everyone is comfortable with the concept of the environment as a source of economic value. The market challenges of restoration are essentially twofold: first, to stimulate the production of environmental commodities; and second, to create market demand for those commodities.

SUPPLY CHALLENGES FOR RESTORATION

A number of issues are relevant in stimulating the production of environmental commodities – or supply side market challenges. First, it is important to take note of the site location, and site characteristics, such as extent of degradation. Restoration can also take place on different land ownership patterns, including private land, mixed land use, public land or communal areas. A further example of site characteristics is the location of the restoration site. For example, if the restoration site is located a long distance from potential markets, this will have an adverse effect on market access and will also increase transportation and transaction costs. Another factor that influences location is the availability of distribution networks. In some cases, good distribution networks can mitigate the supply costs where natural resources are situated far from markets, for example the case of water supply in South Africa.

As noted, one of the market challenge of restoration is to stimulate the production of environmental commodities. This in turn restores the functionality of ecosystems that have been damaged. Examples include the restoration of wetlands, natural forests, grasslands and other ecosystems.

Restoring the functionality of an ecosystem has a direct impact on the types of goods and services that an ecosystem can provide. On the negative side, a degraded ecosystem can have adverse health impacts, for example the link between poor water quality and cholera. On the positive side, a well-functioning ecosystem provides a stream of positive goods and services, directly, for example wild flowers, carbon water and pollination services, and indirectly through enhanced agricultural production. These and other market challenges affect the supply of environmental goods and services.

SITE CHARACTERISTICS

Site characteristics are one of the key features that affect the supply of ecosystem goods and services. South Africa represents a highly diverse landscape, with different ecosystem features. For example, the natural landscape falls within a range of vegetation types, from Nama Karoo and Succulent Karoo, through fynbos, savannah, grassland and forest. The natural landscape also falls within different climatic zones, which in turn have different ecosystem features. Some landscapes are in arid or semi-arid

Restoration of ostrich farmland, Little Karoo with degraded land (left) and restoration in progress (right)

climatic zones, with mean annual precipitation of less and 700mm per year, while others are in temperate areas with higher rainfall. Another important site characteristic is the nature of property ownership. Some sites may be communal, others private property, others state owned. These different ownership structures have different implications for market access, and who is entitles to the revenues from sales of natural resource products. It is therefore important to consider a range of site characteristics when considering restoration.

Some restoration sites have low connectivity to the origin (leading to fragmentation), which occurs when only a small parcel of the total degraded area is restored. In other cases, restoration occurs across entire landscapes.

The extent of degradation also varies quite significantly across sites. Different types of activity also affect the extent of degradation, for example mining activity (strip mining) would have much worse landscape consequences compared with commercial farming as well as the communal grazing activities, although there would also be considerable variation within each of these categories of activities.

SUPPLY CHALLENGES FOR RESTORATION

Supply challenges for restoration involve how to get environmental goods and services (EGS) on the market. The major market challenge of restoration is stimulating demand for environmental commodities. This can be achieved in a number of ways.

First, *a well-functioning market is crucial* to provide the conditions in which market participants can trade. For the financial benefits of carbon sequestration to be realised, for example, a well-functioning carbon market needs to exist. This involves the promotion of healthy levels of competition, as well as creating an enabling regulatory framework for the free functioning of markets without restrictions. These latter two objectives are sometimes in conflict with each other. For example, when the carbon markets were introduced many of the biggest emitters stockpiled emission permits, benefiting from low prices as a result of a flooded market.

A second aspect of demand is *marketing of products*. The market for EGS comprises individuals needing a product, having the ability to purchase, wanting to

Restoration of grassland ecosystem in the communal areas of the Drakensberg with eroded grassland (left) and restoration in progress (right)

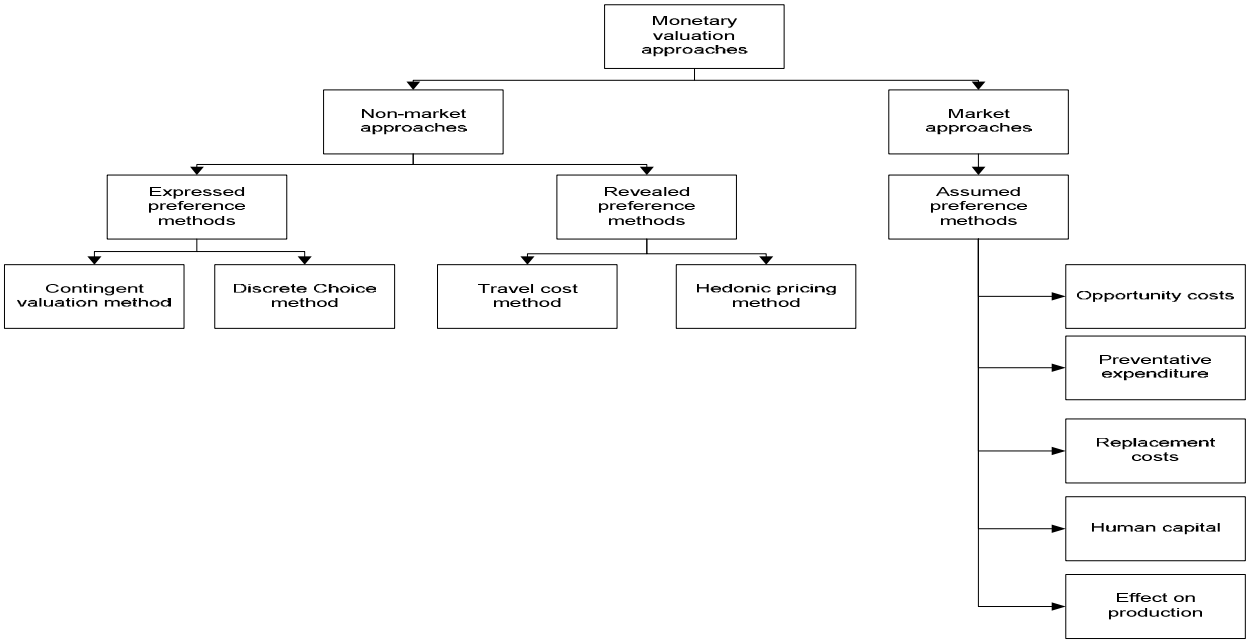

Figure 1: Techniques for valuing ecosystem goods and services

purchase the product and having the authority to purchase the product. The environmental goods and service market ranges from essential items (such as water) to luxury items (such as organic ostrich meat). It is important when marketing EGS to have a good understanding of the market participants, their socioeconomic status and specific needs and desires. Not everyone will be interested in all environmental commodities. A major challenge for marketing EGS is determining an *appropriate market price* that reflects the worth or value of the good or service provided.

An appropriate measure needs to be found to express environmental commodities. This can pose a problem. Most markets trade in financial currency, whereas many environmental goods are expressed in ecological units, and this can cause controversy. For example, what is the appropriate measure for 'water quality' or 'wildlife habitat'? Some form of proxy measure is required.

PUTTING A PRICE ON ENVIRONMENTAL GOODS AND SERVICES

One of the main market challenges of restoration is the value or price placed on EGS. In many cases EGS are not traded on traditional markets, or when they are, they are often traded at prices below their true worth. How can the true value of an ecosystem good or service be estimated? A range of different valuation techniques are available to economists.

It is, however, important to stress a number of points. First, most valuation exercises provide only an approximate value of ecosystem goods and services. Second, it is important to know exactly what ecosystem good or service is valued. Some techniques might value a range of EGS, while others may only value one or two. Third, these are not all stand-alone techniques and some may be used in conjunction with others to determine the total economic value of a good or service. Finally, it is not appropriate, due to cost and time constraints, or even desirable to conduct an in-depth valuation study of all ecosystem goods and services for all land use changes. Certain ecosystem values fall out the domain of economic valuation (e.g. ecosystem primary values).

Valuing EGS falls into two categories: those that use a market-based approach and those use a non-market approach (See Figure 1 above). Market-based approaches use actual market prices to estimate the value of EGS. Examples of valuation techniques that use this method include the opportunity cost approach, replacement cost method and preventative expenditure approach.

Many EGS, however, are not traded on an actual market, and this makes it much harder to estimate their true worth. Two categories of valuation techniques are used in this case. The first is known as *stated (or expressed) preference method*, in which value is expressed by respondents in an interview. Examples include the contingent valuation method, in which respondents are asked to state willingness to pay for an EGS, or willingness to accept compensation for the loss of that good or service. Another example is the discrete choice method, in which respondents are given a range of choices with associated costs, and asked to choose their preferred option.

The second category of non-market approaches is the so-called *revealed preference techniques*, where value

Successful rehabilitation on a coastal mineral sands mine in Namaqualand

is revealed through a directly related, or surrogate, market. Examples include the travel cost method, in which respondents are asked the costs associated with visiting a particular site, and the hedonic pricing method, which uses property prices to estimate the value of an environmental benefit. The revealed preference techniques are mostly used for recreational benefits of EGS, while the stated preference techniques may be used for a much broader range of benefits.

CONCLUSION

Market challenges of restoration are twofold: first to stimulate the production of environmental commodities; and second, to create market demand for those commodities. Stimulating the production of environmental commodities is a supply-side challenge, and a number of challenges affect the supply of environmental commodities onto the market, including distance to the market, patterns of land ownership, and climatic variability. Furthermore, there are potential adverse impacts of ecosystem degradation, and a functioning ecosystem in the supply of ecosystem goods and services is important.

Demand-side challenges include establishing a well-functioning market with stable and effective distribution channels, and marketing of the environmental commodities with due cognisance of socioeconomic profiles (including purchasing power) of participants, nature of environmental good traded (luxury or necessity), and the extent and strength of competitors. Marketability of environmental goods and services may be increased by the presence of local institutions such as the Ostrich Business Chamber. The South African Ostrich Business Chamber, for example, has been active in promoting sustainable practices among farmers in the Oudtshoorn basin of the Little Karoo.

Local conditions play an important role in determining the marketability of restoring the environment, and starting in areas where there is a better likelihood of success is important. Appropriate financing models are also important as in many instances restoration is limited by a lack of funds. Many of the benefits realised are social benefits, and there is a need to further expand public works programmes such as the Working for Water programme into other areas, although some of this work is already underway.

ABOUT THIS POLICY BRIEF

This Policy Brief was prepared by Douglas J Crookes, University of Stellenbosch and ASSET Research, (d_crookes@hotmail.com), and James N Blignaut, Pretoria University, Beatus and ASSET Research (jnblignaut@gmail.com)

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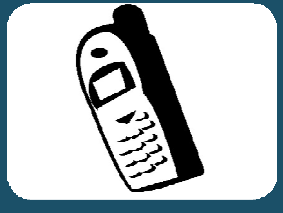
POLICY BRIEF

Bush thickening and indigenous woody plants as a source of renewable energy



INTRODUCTION

Indigenous woody plants are natural and essential components of savannah ecosystems. They benefit the ecosystem through nutrient cycling, soil enrichment and by providing food and shelter to many vertebrates and invertebrates. An increase in tree density, or bush thickening, beyond a certain threshold may be detrimental for the ecosystem and reduce the productivity of such rangeland for agriculture and conservation.

These surplus woody plants in areas where there is bush thickening present an opportunity to harvest the wood as bio-fuel. The health of the ecosystem and rangeland restoration must, however, always be prioritised during any tree harvesting for bio-fuel. The highest wood yields are in large trees, presenting a potential conflict of interest. From an ecological point of view, the larger trees should be retained during the thinning operations. It is, thus, a matter of weighing short-term benefits against long-term benefits (ecological stability and rangeland restoration).

Several recommendations can be made in the interests of ecological sustainability and for maintaining long-term stability (see box below). These are of value to landowners affected by bush thickening, as well as government decision-makers and non-governmental organisations (NGOs) involved in solving the problems associated with the bush thickening.

In South Africa, indigenous woody plants are a prominent feature of the savannah, the largest of the vegetation biomes in South Africa and the Southern African sub-continent. Woody plants are traditionally used for firewood, construction timber, the production of charcoal and wood carving. For half-a-billion people in Africa, wood is the main source of fuel

RECOMMENDATIONS

- Objectives of tree-thinning operations must be clearly identified prior to the harvesting operation.
- The threshold value in terms of tree density that can be supported in a specific rainfall region without adversely affecting the grass layer must be determined prior to the harvesting operation. Harvesting of woody plants should be done only in areas exceeding this threshold value.
- Emphasis should be on selective harvesting, during which larger trees are retained and smaller trees and shrubs are harvested, preferably of the problem tree species.
- Most woody plants will regrow again after cutting. While this may be seen as beneficial in the sense of a renewable resource, it is generally considered undesirable from a restoration point of view. It is recommended than an appropriate and ecologically safe arboricide be used to treat cut stumps after harvesting.
- As new seedlings might re-establish in thinned savannah areas, a state worse than the original thickened area may develop if left unattended. Post-treatment management such as a fire or a limited treatment with an appropriate arboricide may be required.
- The bush thickening problem cannot be solved if its causes are not addressed. The most important aspect here is stocking rates of livestock and game. Landowners must comply with prescribed stocking rates and adequate rest of the herbaceous layer.

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Bush thickening is arguably the most serious environmental problem associated with the savannah biome. Due to the water-limited nature of many savannah ecosystems, bush thickening is considered a major factor contributing towards the low occurrence or even total absence of herbaceous plants in severe cases (left). Large trees at low tree densities benefit the environment through soil enrichment under their canopies thus having positive effects on grass growth (right).

and the wood of several savannah woody species is known for their excellent fuel properties, especially species with dense heartwood. In addition, woody plants are an important source of food for browsing herbivores, which include both domestic stock and game. The recent expansion of the game ranching industry in southern Africa makes this latter aspect increasingly important to game ranchers.

An excess of woody plants, however, creates the problem of bush thickening. Many savannah ecosystems are water-limited and bush thickening negatively effects herbaceous plants, in severe cases eliminating them completely. As a result of bush thickening, the grazing capacity of large areas of the southern African savannah has declined to a level that many previously economic livestock properties are no longer economically viable. Bush thickening is a serious environmental problem in the Southern African savannah biome and an estimated 20 million hectares of the 96 million hectares is affected.

The growing energy crisis in South Africa and the world has created a growing interest in wood as an alternative energy source. The rationale is that wood is a renewable bio-fuel and it can help finance bush control measures on farmland through the selective harvesting of surplus woody plants. Although the removal of the woody plants will normally result in an increase in grass production and thus also in the grazing capacity, the results of woody plant removal may differ between vegetation types, and there are both negative and positive responses to removing trees: *There is a potential conflict of interest, depending on what is being prioritised*: the product (i.e. wood), or rangeland restoration from bush thickening. In the latter case the true advantage of tree harvesting will be increased animal production because of the increased grazing capacity, and the tree harvesting then primarily serves as a way to cover the costs of the operation. It is thus important that priorities be clearly identified *prior to the harvesting operation*.

BACKGROUND

Restoration of savannah areas with bush thickening should comply with two important requirements before it can be considered successful: it should be ecologically responsible and economically justifiable. In Southern Africa, judged on these two basic requirements, few attempts at restoring bush thickened areas can be considered successful. This is either because the costs are too high or because the wrong approach was followed. This resulted in the loss of beneficial woody plants, with the subsequent re-establishment of woody plants leaving the savannah in a worse state than before the interventions.

Biological activity is important in enhancing soil fertility, often on base-poor substrates. Trees act as such biological agents, creating islands that differ from those in the open. Ample evidence in support of soil-mineral enrichment under tree canopies exists, notably with nitrogen, organic carbon and various other important elements such as calcium, potassium, magnesium and sodium. This soil enrichment under tree canopies has positive effects on grass growth. Beyond a threshold tree density, however, this positive effect may change to a negative effect as a result of competition for resources such as soil water. The effect of bush thickening on herbaceous plants differs between wet and arid savannahs. In wet savannahs herbaceous plants are able to co-exist with relatively high tree densities, while in arid savannahs the herbaceous layer mainly disappears under high tree densities, leaving bare ground.

Woody plants are an important source of food for browser herbivore species, which include both domestic stock and game. (left). For many rural communities, wood is still the only source of fuel for cooking and heating and the wood of several savannah woody species is known for its excellent fuel properties (right).

An increase in woody plant abundance is primarily brought about by two processes (vegetative growth) and the second is by an increase in tree density, mainly from the establishment of seedlings (reproduction). The reasons for an increase in the abundance of woody plants in any vegetation type are diverse and complex. In most situations the drivers of savannah systems were modified by man, either directly or indirectly. Examples are the exclusion of occasional hot fires, the replacement of most of the indigenous browsers and grazers by domestic (largely grazing) livestock often at extremely high stocking rates, the restriction of movement of herbivores by the erection of fences, poor grazing management practice, and the provision of artificial watering points.

Fire is widely used to control woody plants, although fire alone is not effective in killing woody plants in the savannahs of Southern Africa. Veld fires may, however, be used to modify the structure of the woody layer. The total exclusion of fire or, conversely, the frequent occurrence of fire under conditions of low herbaceous biomass may benefit the establishment of woody plants.

Climate change and increased atmospheric CO_2 concentrations may also have an effect on the different floristic components of savannah ecosystems. Increases in atmospheric CO_2 improve water-use efficiency and increased carbon uptake under certain circumstances.

An important determinant of woody seedling establishment is competition from other plants. Tree-on-tree competition appears to be species specific or related to the shade tolerance of the seedlings. Significant positive correlations between the size of a tree and the distance to its nearest neighbour have been reported for several woody species. The presence of large trees, representing a structured savannah, may result in a more stable ecosystem. Such a structured ecosystem can be considered the most productive since all the benefits of woody plants are represented.

The loss of large trees from savannah ecosystems through indiscriminate, non-selective bush control measures and/or tree harvesting is a major reason for sustained long-term solutions in the restoration of bush thickened areas not being achieved. Restoring savannah structure in cases where it is lost is a slow

An example of an open savannah dominated by large trees, which is considered the most productive and also less prone to bush thickening (left) Hot, brush killing fires can be used to control newly established woody plants and to assist in the prevention of bush thickening. (right)

process. This will entail a highly selective approach where woody plants are thinned in such a way that the remaining trees will benefit from the reduced competition from other woody plants, resulting in increased growth and thus an increasing sphere of influence on newly established seedlings and the wider ecosystem.

Estimations from various South African savannahs indicate that the total wood dry mass can be as high as 450 000 kg/ha, but is more often in the region of 40 000 kg/ha per harvest cycle, which could be several years.

On average the wood greater than 20 cm in diameter made up 80% of the total wood mass, while the stems greater than 0.5-20 cm and shoots less than 0.5 cm made up 13% and 7% of the total wood mass respectively. Should the trees be harvested during the summer months when the trees have their full leaf carriage the leaves would add another 2%-5 % to the total tree dry mass.

It can, however, be expected that most of the leaves will probably be lost during the harvest and chipping process as they dry and fall from the branches. It is important to note that not all this wood biomass can be used as bio-fuel and in most cases a yield of not more than 10 000 kg/ha is realistic. In general the average long-term rainfall will determine how many should be left. (A general rule of thumb stipulates that the average number of Evapotranspiration Tree Equivalents (ETTE)/ha that can be supported in a specific rainfall region without adversely affecting the grass layer, should not exceed 10 times the mean annual rainfall. An ETTE is defined as the leaf volume equivalent of a 1.5 m single-stemmed tree. Anything more that this figure presents a possible problem density and surplus trees and shrubs can be used.)

CONCLUSIONS

Research done in African savannahs has shown that the presence of woody plants in savannah ecosystems is associated with both positive and negative aspects, which are closely related to tree density. Therefore any restoration programme should focus on tree thinning rather than clearing of all woody plants to retain some of these positive influences. Each should consider the importance of a balance between the effect of surplus trees and the positive influences of trees. There is no single optimum tree density. The optimum density will fall within a range rather than being a single value.

It is important to identify priorities prior to the thinning/harvesting operation. Is it the product (wood as energy source) or rangeland restoration that is the desired outcome?

The rapid establishing of tree seedlings after the removal of some or all of the mature woody plants is likely to negate restoration measures unless post thinning/harvesting management is carried out. It is important for any land manager to realise that there is no quick solution to the problem of bush thickening, and ongoing management is essential. Sound grazing management practices, especially during wet seasons, is one way through which a landowner may ensure a vigorous and competitive herbaceous layer is established.

ABOUT THIS POLICY BRIEF

This Policy Brief was prepared by Jacques Cloete, University of the Free State and Asset Research (jaccloete@gmail.com), and Nico Smit, University of the Free State (SmitGN@Ufs.ac.za)

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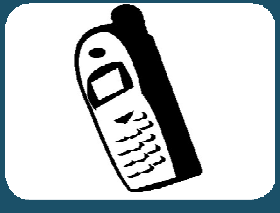
POLICY BRIEF

Supporting livelihoods through the protection of natural capital: A case study of the Agulhas Plain



INTRODUCTION

Ecosystems are a form of natural capital. Invasions by introduced alien plant species alter ecosystems, often reducing supplies of valuable ecosystem goods and services and imposing substantial costs on South Africa's economy. Reversing these losses by removing alien plants imposes further costs because clearing and control operations are expensive. However, the high costs can be offset by the benefits of creating employment opportunities through such operations and the livelihood benefits that can be derived from the cleared land.

Using the Agulhas Plain as an example, this policy brief compares two different post-clearing land-use options that can be used to support livelihoods in the area, namely: restoring natural capital to allow wildflower harvesting, or using the land for bioenergy production. The different costs and benefits associated with each option are illustrated, together with guidelines about how to deal with selecting post-clearing land-use options.

The nature and value of livelihood benefits that can be derived from cleared land vary between different areas and call for a careful understanding of the ecosystem goods and services that are provided. Ecosystem goods can be defined as tangible products that ecosystems provide, whereas ecosystem services are benefits that result from ecosystem functioning (Turpie, 2004).

Ecosystem goods and services can have direct or indirect value. Direct value is derived if the good or service is captured in a market, i.e. traded between people or organisations. Indirect value is inferred from goods and services that are not traded and to which it is more difficult to attach a monetary value, such as placing a value on the air that we breathe. When comparing different land-use options, it is necessary to weigh the associated costs and benefits against each other.

The public and private sectors are both showing increasing interest in bioenergy as a way of reducing South Africa's greenhouse gas emissions and contributing towards a sustainable energy supply. It has often been suggested that the potential threat to food security could be reduced by using marginal land, including land invaded by alien trees, for bioenergy production. In contrast, strong arguments can also be made for the protection of South Africa's biodiversity and ecosystem services through restoring natural vegetation in many invaded areas. Although many areas are arguably marginal for agriculture, they provide critical ecosystem services, a characteristic that should not be overlooked.

ASPECTS TO CONSIDER

- All direct and indirect costs and benefits associated with different land-use options must be identified and compared. If the cost or benefit is not included in an explicit market, or if a monetary value for the attribute does not exist, it must be included in a qualitative manner.
- It is necessary to understand how the demand and supply of ecosystem services varies within an area as well to account for downstream (off-site) benefits.
- Different scenarios of how ecosystem services can be expected to change over time must be envisaged, and livelihood options selected accordingly.
- Infrastructure constraints and loss of economies of scale when dealing with fragmented land-use must also be considered.

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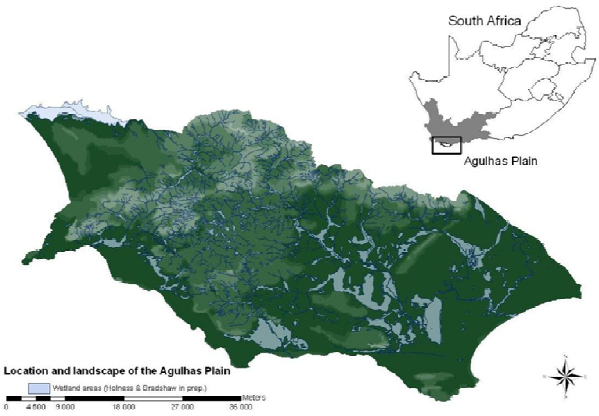

Figure 1: Location of the Agulhas Plain
Source: Nowell (2011)

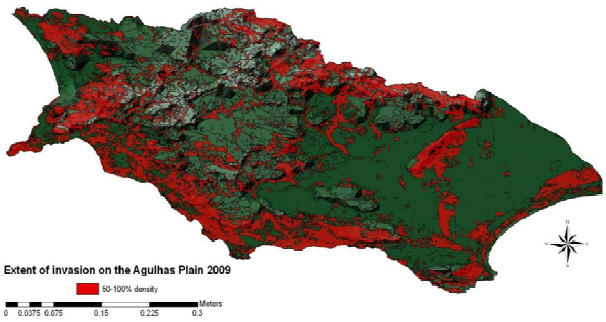

Figure 2: Extent of invasion on the Agulhas Plain
Source: Nowell (2011)

THE AGULHAS PLAIN

The Agulhas Plain is a low-lying coastal region at the southern-most point of the African continent (See Figure 1). It falls within the world renowned Cape Floristic Region, known for its diverse flora and the variety of the landscapes and tourist attractions. There are more than 1 500 species of plants within the 2 160 square kilometres of the Agulhas Plain. About 100 of these are found nowhere else and about 110 species are listed as threatened. There are more than 230 bird species and bird watching on the wetlands is one of the prime attractions. The combination of rocky and sandy coastlines supports a diverse marine and intertidal life and provides nesting sites for rare coastal birds like the African black oystercatcher.

The Agulhas Plain traditionally specialised in dairy and grain farming but the economy has recently begun to diversify. The area has also become an important wine producing area, specialising in white wines which do well in the cool conditions. There is an indigenous flower harvesting industry which provides employment for more than 25 000 people (Heydenrych, 1999). Tourism is increasing in importance, especially shark and whale viewing from boats and underwater.

The plains, particularly the wetlands, have been invaded by a variety of introduced plant species that often form dense stands. These include Australian Acacia species, pines, myrtle and eucalypts, which use more water than the natural fynbos vegetation. There are several different vegetation types on the Agulhas Plain which have been invaded to varying degrees, as detailed in Figure 3. About 23% of the Agulhas Plain is invaded by alien species when expressed as the equivalent area of dense stands (See Figure 2).*

**If 25% of an area of 100 ha has been invaded, the equivalent dense stand is 25 ha.*

POST-CLEARING LIVELIHOOD OPTIONS

The government's Working for Water programme was initiated in 1995 with the dual purpose of clearing invasive vegetation and facilitating poverty alleviation through creating employment. Milton et al. (2003) estimated that the programme employed 24 000 people in 2000. The extent of invasion on the Agulhas Plain suggests that the total employment benefits of alien clearing in the area could be more than one million person days. The table below shows the total person days per hectare for initial and follow-up clearing.

Density of invasion	**Acacia species**	**Eucalyptus species**
75-100% density	33.89	30.91
1-5% density	2.45	11.51

Source: Marais and Wannenburgh (2008)

The Working for Water programme has historically not paid much attention to *post-clearing land-use*. The post-clearing land-use options that are considered in this policy paper are: (1) restoring cleared areas using natural fynbos species; and (2) planting biomass crops for energy.

The land-use options yield divergent benefits. Restoring the invaded areas with natural fynbos species will allow for income generation from wildflower harvesting, and will create opportunities for employing the local community. Fynbos vegetation uses less water than alien tree species. Using remote sensing, Nowell (2011) estimated that 82 million kilolitres of water can be made available per year by clearing all the invaded areas on the Agulhas Plain, and restoring them to fynbos. Although the Agulhas Plain is on the coast and the water that would be released would hold limited marketable value, it will provide indirect benefits such

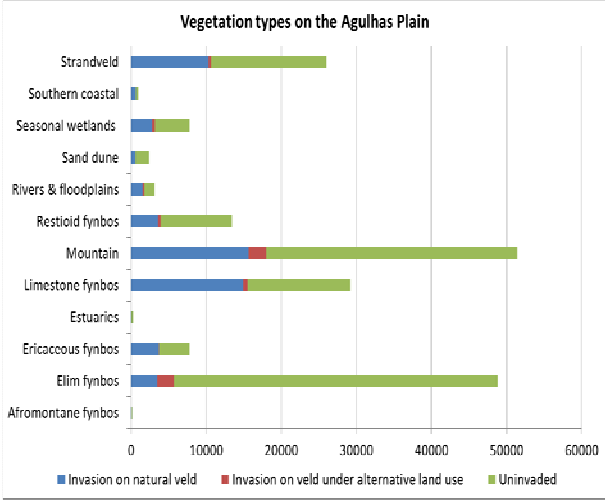

Figure 3: Hectares invaded on the Agulhas Plain per vegetation type and land-use. *Source: Nowell (2011)*

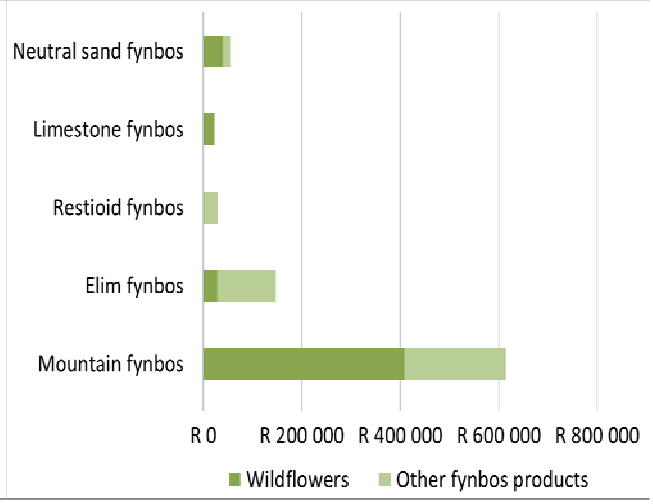

Figure 4: Potential net income per year from fynbos products. *Source: Fourie, De Wit, Van der Merwe (2011)*

as increased dilution of run-off and waste water from dairy farms, or improved estuary conditions and fish habitat by increasing flows through the estuary. Improved fish habitat would increase fish stocks and, potentially, the income of fishermen in the area. Recreational fishing would also benefit.

Finally, restoring the natural vegetation would assist in sustaining the valuable biodiversity of the area. By allowing sustainable wildflower harvesting from the restored areas, a direct use value is attached to the fynbos. This not only encourages the local communities to protect it, but also allows them to generate income from harvesting products from the restored veld. Products provided by fynbos vegetation include wildflowers, honey bush used for brewing tea, and thatching reed. Strandveld fynbos provides non-landowners with an opportunity to derive income from drying and selling sourfigs, but they are often harvested illegally from privately owned land.

If all invaded areas on the Agulhas Plain were restored to their natural state, additional net income of R870 000 could potentially be derived from wildflowers and other fynbos products (excluding sourfig harvesting. (See Figure 4). An experimental study has shown that active restoration through mulching and sowing native fynbos species can significantly increase the income that can be derived from restored areas (Gaertner et al, 2012). Restoration of mountain fynbos provides the largest share of benefits from wildflower harvesting, suggesting that restoration of these areas should be prioritised. In addition, wetland restoration would enhance bird habitats and draw more bird watchers to the area. Bird watchers are typically wealthy and stay for more than one day in the area, providing an additional source of income to local communities.

In contrast to fynbos restoration, planting biomass for energy would yield benefits such as energy production, carbon offsets, and job creation. Bioenergy production could take the form of planting crops for biofuels, planting trees for gasification, or using the invasive trees for wood chip and bio-char production. By providing a financial incentive for alien plant removal, woodchip production from invasive biomass could add value. If the project can (a) demonstrate carbon saving through a reduced use of fossil fuel for energy, and (b) adhere to sustainable development criteria as stipulated by the economic, social and environmental standards of the Clean Development Mechanism (CDM), it can enter the carbon market and in doing so create additional livelihood opportunities. The CDM allows emission reduction projects in developing countries, such as South Africa, to earn certified emission reduction credits (equivalent to one tonne of carbon dioxide) that can be used by industrialised countries to meet their emission reduction criteria as set out by the Kyoto Protocol (United Nations Framework Convention on Climate Change*).*

A number of risks need to be considered when planting biomass for energy in an area with high biodiversity value. When planting crops for biofuel, the question arises as to how energy crops can remain restricted to marginal land. A rational landowner would select the land-use activity that provides the highest return. There is thus a risk for productive land to be directed towards energy crop production if bioenergy proves more profitable than food production. There is an additional risk to biodiversity if landowners opt for bioenergy production on land currently covered by natural fynbos.

Eucalyptus invasion on the Agulhas Plain (left). Preparing flowers for packaging (right).

The threat to biodiversity and food security that is associated with introducing crop species for bioenergy can be minimised if project areas are selected discerningly. Aspects to consider include the cost of restoring an invaded or transformed site to its natural state, the conservation value of the natural biodiversity (in this case fynbos and the associated ecosystem), and the opportunity cost of the ecosystem goods and services that will be foregone if bioenergy crops are planted. Policymakers, for instance must establish the alternative use of water in the absence of bioenergy crops. In addition, resources will have to be set aside to ensure that invasions beyond the demarcated crop lands are kept in check.

Climate change is expected to reduce water supply on the Agulhas Plain and to encourage the spread of invasive vegetation, placing additional pressure on the natural fynbos. The impending threat of climate change paradoxically suggests that it will become increasingly important to reduce greenhouse gas emissions through using renewable sources such as bioenergy. By carefully selecting areas for biomass production, bioenergy benefits can be realised at minimal cost to biodiversity. Some income could even be used to finance fynbos restoration in other areas.

CONCLUSION

A number of lessons can be drawn from the Agulhas Plain. First, it is important to note that ecosystem services vary across an area and these variations need to be taken into account when land-use decisions are made. By planting bioenergy crops on areas where water has few other benefits, the opportunity cost of the water that is lost can be minimised. Second, when comparing ecosystem services across an area, it is important to also consider the services that may be excluded from the market but which still provide benefits. One example is the increased dilution of waste water. In cases where these benefits are difficult to value they should be accounted for qualitatively in the decision-making process.

Finally, policymakers must be aware that the land-use option selected has future implications. As the supply of certain ecosystem services become scarcer, their value may increase. Decision-makers should compare livelihood options with foresight and under varying scenarios of how the supply of ecosystem services can be expected to change. The impact of climate change on water supply is one of the key aspects that decision-makers across South Africa must consider.

Using the Agulhas Plain as an example, this policy paper has illustrated the potential livelihood benefits that can be derived from alien clearing and from post-clearing land-use activities. This includes the livelihood benefits from alien clearing, the importance of the supply of ecosystem goods and services when selecting post-clearing land-use options, and how site specific characteristics should guide decision-making.

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ABOUT THIS POLICY BRIEF

This Policy Brief was prepared by Helanya Fourie , Western Cape Department of Agriculture and ASSET Research (HelanyaF@elsenburg.com), and David le Maitre, CSIR (DlMaitre@csir.co.za)

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