INVESTING IN SUSTAINABILITY

Restoring degraded thicket, creating jobs, capturing carbon and earning green credit

Lead Contributor: Dr Anthony Mills

Contributors: Prof James Blignaut, Prof Richard Cowling, Andrew Knipe, Dr Christo Marais, Sarshen Marais, Dr Anthony Mills, Mike Powell, Dr Ayanda Sigwela, Andrew Skowno

Editors: Shirley Pierce and Andrew Skowno

September 2009

Lead Contributor Dr Anthony Mills
Contributors Prof James Blignaut, Prof Richard Cowling, Andrew Knipe, Dr Christo Marais, Sarshen Marais, Dr Anthony Mills, Dr Shirley Pierce, Mike Powell, Dr Ayanda Sigwela
Editors Dr Shirley Pierce and Andrew Skowno

Principal funding of document DG Murray Trust administered via the Climate Action Partnership
Project funding and support for document *Working for Woodlands Programme*, Department of Water Affairs (DWA)
Implementation and additional funding for document Wilderness Foundation

Contributors and their affiliations

Prof James Blignaut, Department of Economics, University of Pretoria, Africa's Search for Sound Economic Trajectories (ASSET)
Prof Richard Cowling, Botany Department, Nelson Mandela Metropolitan University, Restoration Research Group (R3G)
Andrew Knipe, Gamtoos Irrigation Board (GIB) and Department of Water and Environment Affairs (DWEA)
Dr Christo Marais, *Working for Woodlands Programme* and *Working for Water Programme,* Department of Water Affairs (DWA)
Sarshen Marais, Climate Action Partnership (CAP)
Dr Anthony Mills, Department of Soil Science, Stellenbosch University, Restoration Research Group (R3G)
Dr Shirley Pierce; Restoration Research Group (R3G)
Mike Powell, Department of Environmental Science, Rhodes University; Restoration Research Group (R3G)
Dr Ayanda Sigwela, Restoration Research Group (R3G)
Andrew Skowno, EcoSol GIS and Wilderness Foundation

Contact Climate Action Partnership: Sarshen Marais: smarais@conservation.org
Contact Subtropical Thicket Restoration Project (STRP):
Andrew Knipe, Gamtoos Irrigation Board (GIB) and Department of Water Affairs: pedunes@isat.co.za
Shirley Pierce, Restoration Research Group (R3G): scowling@kingsley.co.za

Table of Contents

EXECUTIVE SUMMARY

Restoration of degraded vegetation is an opportunity for achieving environmental, economic and social sustainability through government and corporate investment

This document presents the case for restoration of degraded thicket as a means to revive the rural economy in the Eastern Cape. Its purpose is to stimulate investment in the large-scale restoration of degraded thicket, basing its case on sound practical and scientific evidence and economic models built on existing working programmes. It is aimed at corporates seeking green credit, and also at government, given that restoration is aligned with strategies identified in the government's Accelerated and Shared Growth Initiative for South Africa (AsgiSA).

More than one million hectares of vegetation - the spekboom-rich thicket of the Eastern Cape - has been converted from dense forest-like vegetation to an open desert-like state. This degradation is the result of the injudicious farming of livestock, mainly through over-stocking with angora goats. Fortunately this degraded land can be reclaimed by planting cuttings of the Eastern Cape's unique and remarkable plant – spekboom or igwanishe – which is able to re-establish from these cuttings and grow rapidly into tall dense vegetation, without irrigation. The special qualities of this Eastern Cape plant provide a tremendous opportunity for restoring degraded thicket landscapes.

Large-scale restoration of tens of thousands of hectares using spekboom cuttings will create major benefits for South Africa, all of which contribute to the three pillars of sustainability: environment, society and economy.

The environmental benefits include: improved carrying capacity of the landscape for judiciously managed livestock and wildlife; conserved topsoils and consequently less silt deposition in rivers and dams; greater water infiltration into soils and aquifers, thereby replenishing ground water; capture of carbon from the atmosphere; and the return of the thicket's biodiversity i.e. its plants, animals and their natural systems.

The socio-economic benefits include: the creation of thousands of jobs in the restoration industry; improved ecotourism opportunities; improved livelihoods through the generation of income streams from carbon sequestration; training of the rural poor in both business skills and restoration; and financial returns on investments in restoration. Furthermore, by reviving natural capital and ecosystem services, and facilitating rural development, restoration of thicket will build ecosystem resilience and therefore play a role in enabling local communities to adapt to climate change impacts.

These benefits place the restoration of degraded thicket in complete alignment with the government's strategies for the Second Economy. The annual AsgiSA report of March 2009 includes the significant expansion of public employment to the most marginalized, and recognizes potentially significant new opportunities for rural employment, and the potential for

earning carbon credits. Thus, in terms of meeting government objectives, the twinning of environmental and economic development within a single programme offers a great advantage.

One vision of the *Working for Woodlands Programme* is to create a new rural economy in the Eastern Cape, based on the restoration of South Africa's degraded thicket. The realization of this vision will require from government and the corporate sectors, initial investments which will generate considerable green acclaim and social benefits, as well as financial returns. Carbon credits generated could be used for offsetting government and corporate carbon footprints, or for trading on international markets.

Importantly, sustainable livelihoods will underpin the new rural economy. The sheer magnitude of large-scale thicket restoration means that it would create thousands of jobs for previously disadvantaged individuals and greatly assist the government's 2004 AsgiSA target of halving poverty and unemployment by 2014.

To the right of the fence is degraded thicket which is the result of over-stocking with angora goats. On the left is intact spekboom-rich thicket delivering a range of ecosystem services to humans, such as retaining topsoil, supporting judicious livestock farming and storing carbon. (L. Ezzy)

1. Introduction

Spekboom-rich thicket is a type of vegetation unique to the southwestern part of the Eastern Cape. This vegetation formerly covered an area of close to 1,400 000 hectares. Now, after a century of over-exploitation, only about 200 000 hectares of healthy intact bush remains, the rest having been degraded by over-exploitation, mainly through injudicious farming with angora goats (Map 1).

Although only a small part of this unusual vegetation remains in a reasonably healthy or intact state, it continues to deliver a variety of ecosystem services which are invaluable to the region, and indeed, the country. For a start, it sustains the world's biggest mohair crop. It also supports a burgeoning wildlife industry linked to nature-based tourism, numerous plants and animals of medicinal and cultural value, protects the soil from erosion and sustains water supply and quality. It is also the source of a number of plant varieties grown world-wide as ornamentals, with potential for further horticultural development. The total value of this natural capital is immense, and the ecosystem services flowing from it are beyond monetary measure.

There is, however, one ecosystem service that can be accurately quantified and that is the capacity of spekboom-rich thicket to capture and store remarkably large amounts of carbon. Despite growing in a dry part of South Africa, its carbon stores are similar in size to those of forests which receive two to three times the rainfall. While a portion of this carbon is stored in the above-ground plant material, most is in the soil, especially in the mulch layer and dark topsoil.

In this time of impending threats posed by climate change, spekboom-rich thicket has a dual role to play: firstly it can store considerable amounts of carbon, and secondly, because it is drought-resilient, it can potentially maintain flows of ecosystem services in a drier and warmer future. For these reasons, it is a special kind of vegetation – nationally as well as globally.

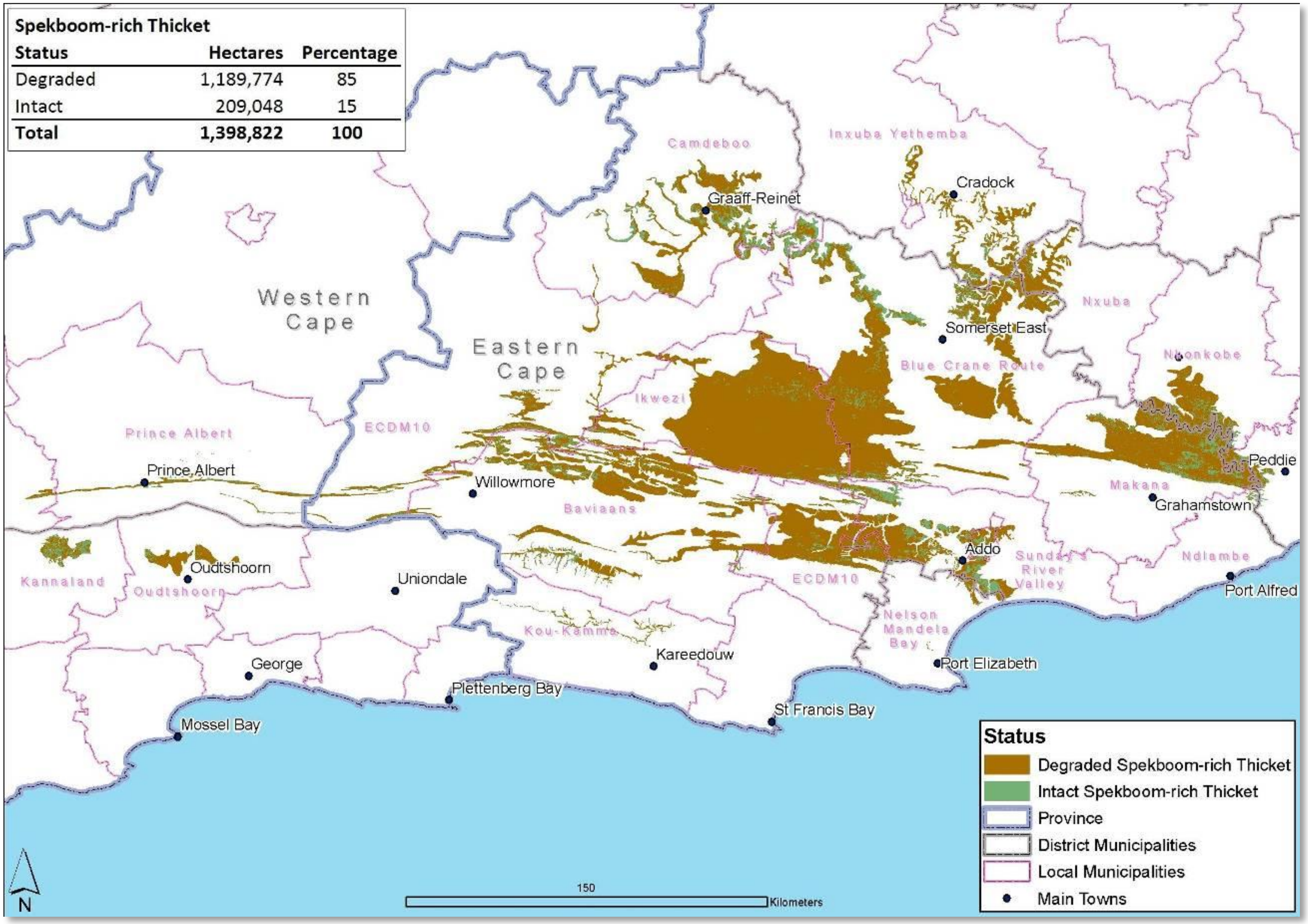
Compared to other semi-arid ecosystems with similar rainfall, spekboom-rich thicket can sustain immense biomass in the form of dense vegetation and high numbers of large animals. Its ability to support elephants and rhinos has made it a major tourism attraction. (C. Marais)

.

While this thicket type can support high numbers of large indigenous animals such as elephant and rhino, it is especially vulnerable to over-stocking by livestock. In just ten years, over-browsing by goats can convert this dense vegetation to a semi-desert state. In the process, thicket's carbon storage is reduced by half. Without active intervention, severely degraded thicket is unable to recover. In other words, even if livestock densities are reduced, the vegetation does not regenerate. The end result is that a whole range of ecosystem services are lost from the system, threatening rural livelihoods and social resilience.

The degradation of thicket vegetation has direct and severe negative effects on socio-economic conditions. With the loss of vegetation cover and erosion, soils become depleted which lowers plant productivity, resulting in reduced livestock yields. Income is lowered and the availability of fire wood, wild fruits and medicinal plants used by rural communities further threaten livelihoods. Socio-economic studies estimate that the degradation of thicket results in a loss of R1500 in annual potential income per household, with serious consequences for rural people living on the breadline.

An aerial view of intact and degraded thicket. Close to 1,2 million hectares of spekboom-rich thicket have been degraded by injudicious livestock farming. (J. Clark)



Map 1. The current extent of intact spekboom-rich thicket and of degraded thicket. Almost all of the 1.2 million hectares of degraded thicket is potentially restorable. Based on STEP 2003. (Map: Andrew Skowno)

BOX 1. A unique type of vegetation: spekboom-rich thicket
Spekboom-rich thicket, confined mainly to the southwestern part of the Eastern Cape (Map 1), is a vegetation type comprising closely growing shrubs and trees, which is remarkably dense and lush given the low rainfall (250-450 millimetres per year). Its mass - 160 tonnes dry mass per hectare - is higher than for certain forests, and 50 to 100 times higher than other semi-desert ecosystems (including karoo). The reasons are: firstly, it produces inordinately large amounts of leaf litter - some 4.6 tonnes of litter per hectare per year which is comparable to wet forest ecosystems and five to 35 times higher than that of other semi-desert ecosystems; secondly, the dense canopy maintains a microclimate of cool and dry conditions, conducive to the slow decomposition of leaf mulch on the thicket floor and in the soil; and thirdly, spekboom-rich thicket is fire-resistant. This allows large amounts of organic carbon to accumulate, dramatically improving the soil's fertility. The topsoil (upper 30 cm) holds about 130 tonnes of carbon per hectare, equivalent to stores in many forest types and 10 to 50 times more than in other semi-arid ecosystems.

BOX 2. Spekboom, igwanishe (*Portulacaria afra*)
This tree-like shrub with its succulent leaves and branches is a key species in thicket vegetation and produces most of the carbon-rich mulch beneath the dense canopy. It is able to switch between its two modes of photosynthesis which capture carbon from the air; one system conserves water during dry periods and the other supports good growth when moisture is available. This makes it remarkably productive for a shrub growing under arid conditions. Some growth is via shoots that spread and take root, forming a dense "skirt" of branches which maintains a cool and dry microclimate resulting in a build up of carbon-rich mulch. Spekboom is highly palatable to animals, and resilient to the pattern of browsing by indigenous animals such as elephant. However, it is vulnerable to browsing by goats, especially if poorly managed. Over-stocking leads to a rapid breakdown of the protective "skirt" of branches, and within a short period, dense thicket degrades to an open vegetation resembling karoo veld.


Only after good rains in summer does spekboom produce its large crop of flowers. Millions of vulnerable short-lived seeds are dispersed, but very few germinate and even fewer survive as seedlings (A. Mills)

In spekboom-rich thicket, the dense canopy and the "skirt" of branches create a cool dry microclimate underneath. These conditions, together with the sizeable leaf litter produced by spekboom, are conducive to the accumulation of extraordinarily high amounts of carbon-rich mulch. (A. Mills)

Many rural people of the thicket region depend on thicket for fuelwood, medicinal plants and cultural rituals. (T. Dold)

2. Restoration

Fortunately, thicket and the services it delivers can be re-established by the relatively simple practice of planting cuttings harvested from spekboom shrubs. Planted cuttings readily take root and in suitable areas at the appropriate densities, a healthy stand of spekboom can be established within several years. Farmers and agricultural scientists have been experimenting with small-scale trials over decades, providing good evidence for restoring degraded thicket by planting spekboom cuttings. As the re-established spekboom plants grow and begin to restore the vegetation structure, other shrubs and trees are able to establish and thicket recovers with time.

The restoration procedure is very labour intensive, requiring workers to harvest stems from intact thicket, excavate the holes and then to plant the cuttings then planted in the degraded landscapes. This makes it exceptionally cost effective relative to most other restoration initiatives, since infrastructure such as greenhouses or tunnels are not required for plant propagation. Furthermore, shrubs are able to grow without irrigation – a major advantage in a region with low rainfall.

To evaluate methods of spekboom restoration, a partnership has been forged among scientists, government and an implementing agency. The South African government's *Working for Woodlands Programme* (a sister programme to the *Working for Water Programme* of the Department of Water and Environment Affairs - see Boxes 3 and 4) has engaged a group of scientists to assist in evaluating effective ways of

using spekboom cuttings for restoration under different conditions (see Boxes 5 and 6). The programme is being managed by an implementing agency, the Gamtoos Irrigation Board (GIB), rated as one of the best agencies used by *Working for Water.*

Using the opportunities provided by small-scale experimental plantings of spekboom cuttings, scientists have discovered the remarkable ability of this plant to restore carbon stocks both above ground and in the soil. It is this capacity for carbon capture which provides the foundation for soil recovery, a first step towards the rehabilitation of thicket to its former richness and ecosystem service delivery. Importantly, degraded sites restored with spekboom can, over a thirty-year period, capture some 15.4 tonnes of carbon dioxide per hectare per year. As explained later in this document, this figure indicates that the market for carbon credits is likely to provide an important incentive for thicket restoration. There is also evidence that some fifty years after restoration, the full complement of thicket shrub and tree species is able to establish – an important consideration with regard to earning biodiversity credits (i.e. credit earned for safeguarding or restoring plants, animals and their natural systems - see BOX 8).

Research on spekboom restoration was pioneered by the Department of Agriculture and landowners who conducted small-scale plantings like this one. (A. Mills)

Restored spekboom, 27 years after cuttings were planted (A. Mills)

BOX 3. *Working for Woodlands Programme* of the Department of Water Affairs (DWA)

This Programme is administered by the Natural Resource Management Programmes (NRMP) of the Department of the Water (DWA) (formerly the Department of Water Affairs and Forestry - DWAF). The NRMP forms part of DWEA's contribution to the South African government's Expanded Public Works Programmes (EPWP) aimed at alleviating poverty by providing additional work opportunities coupled with skills training. The *Working for Woodlands Programme* relies on a partnership between communities, government, ecologists, soil scientists, botanists and economists. Restoration of thicket is just one of the initiatives of the *Working for Woodlands Programme*. Known formally as the Subtropical Thicket Restoration Project (STRP), it is concerned with the implementation, monitoring and evaluation of restoring degraded ecosystems, using cost-effective methods and ensuring social upliftment through employment and skills training. The implementing agent for thicket restoration within the *Working for Woodlands Programme* is the Gamtoos Irrigation Board based in Patensie.

BOX 4. *Working for Water Programme* of the Department of Water Affairs (DWA)

Regarded as one of the world's best restoration and social upliftment programmes, South Africa's *Working for Water Programme* has been responsible for the clearing of 1.8 million hectares of invasive alien plants, a process which includes on average two subsequent follow-up clearing treatments. Since 1995, the programme created more than 22,000 employment opportunities per year. The water benefits are significant: in the period 1998 to 2006, even where removal of invasive alien trees was restricted to areas alongside riverbanks, stream flow was increased by a massive 46 million cubic metres. Of this, more than 34 million cubic metres became available for human consumptive use, with the remainder providing for the healthy functioning of downstream ecosystems. By clearing invaded areas the programme also significantly reduces the hazard of uncontrollable fires, and enables the recovery of biodiversity - plants, animals and their natural systems. The *Working for Water Programme* makes use of implementing agencies who not only oversee contracts to small-scale entrepreneurs to employ teams of individuals from the poorest of the poor, but who also administer skills training.

BOX 5. Experimental trials in spekboom restoration

The various sites where farmers have successfully planted spekboom cuttings have demonstrated that this method of restoration is indeed feasible. But several key questions remain unanswered. These include: 1) Where in the Eastern Cape is restoration feasible? 2) How do soil properties and climatic conditions influence survivorship of cuttings and rates of carbon capture? and 3) What is the best technique of planting spekboom cuttings? Should they be treated with rooting hormone before planting, watered after planting, planted horizontally or vertically? And how do these planting techniques affect survivorship and growth? Without these answers, the *Working for Woodlands Programme* cannot develop a thicket-wide restoration strategy, and cannot advise farmers on where to plant and how to plant.

Therefore, an extremely ambitious and challenging experiment has been established across the extent of thicket to directly tackle these key questions. Three hundred plots have been set up across the 550 km east-west span of spekboom-rich thicket on farms with degraded vegetation. Each plot is fenced to exclude livestock and is a quarter hectare in size. In each plot, thirteen different treatments have been implemented using a range of different sized cuttings. This trial, referred to as the 'Thicket-wide plots' experiment, is arguably the largest ecological restoration experiment in the world. While the results of survivorship and growth rates will only be available in several years' time, the results to date are most promising. Spekboom cuttings in the larger size classes have shown remarkable survival despite one of the region's worst droughts in living memory.

A scientific approach to restoration : a) different treatments to spekboom cuttings are applied in a replicated experiment (M.Powell); (b) excavating a soil pit to determine carbon stocks. (M. Powell)

Workers erecting a stock proof fence around one of the three hundred 50x50 m plots established across the extent of the spekboom-rich thicket. Different planting treatments were applied to each plot to enable scientists to estimate the return on investment of different restoration techniques in different areas. (Y.Vermaak)

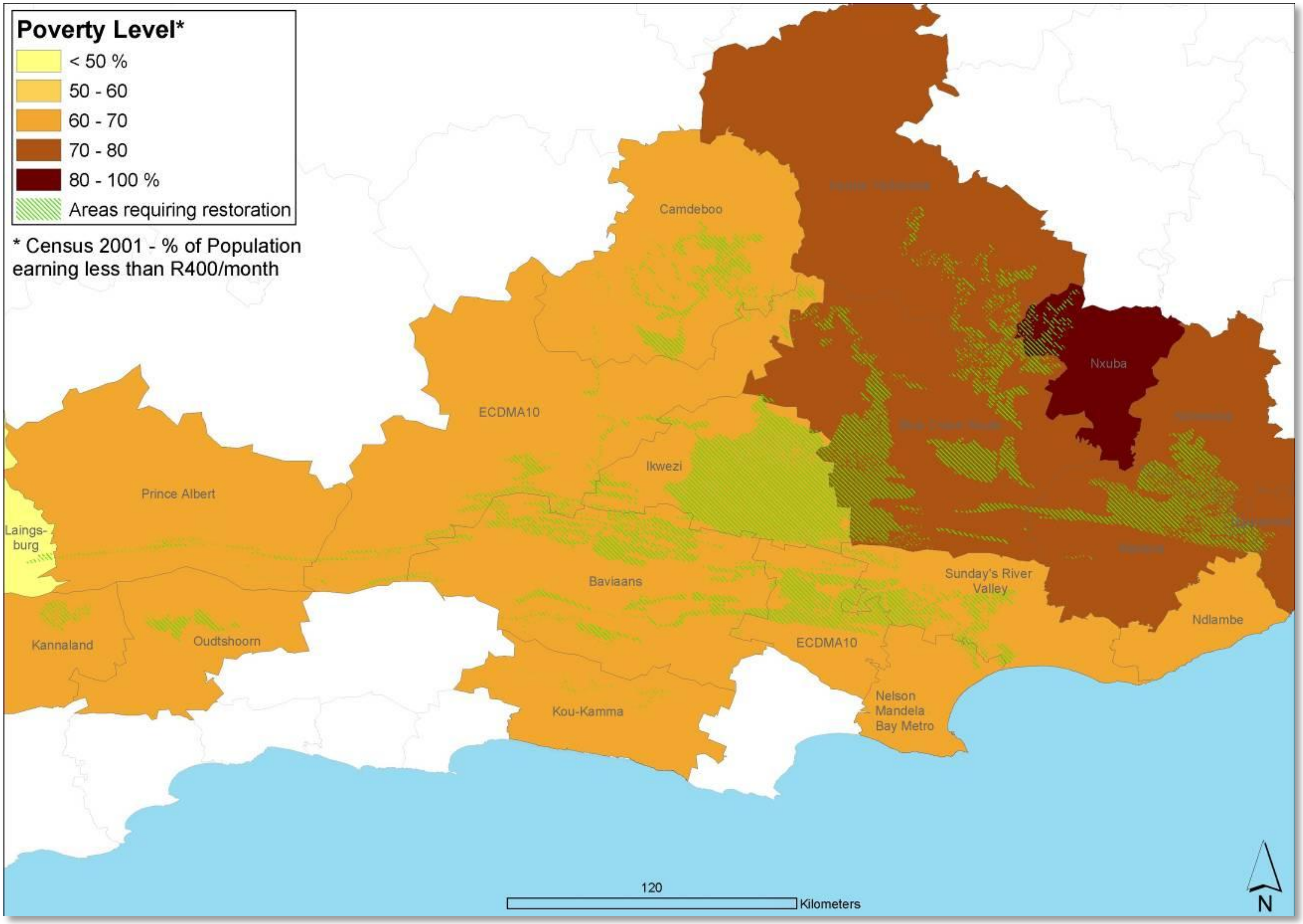
BOX 6. Large-scale spekboom restoration
Three large protected areas in the Eastern Cape, the Baviaanskloof Nature Reserve, Addo Elephant National Park and the Fish River Reserve all have thousands of hectares of degraded spekboom-rich thicket. Restoration of these areas was identified as a conservation priority by the relevant conservation agencies but they lack funding for this intervention.

The emergence of the international carbon market has created a great opportunity for funding large-scale restoration, and the South African government has been quick to capitalize on this. In 2003, the then Department of Water Affairs and Forestry decided to invest in the research and development of large-scale restoration projects that focus on carbon sequestration and generation of carbon credits. The rationale behind this investment was that carbon credits would be generated and ultimately provide a financial return on the project. As a result of this investment decision, the *Working for Woodlands Programme* is today undertaking large-scale planting operations in all of the above-mentioned protected areas. To date, a total of 430 hectares has been planted in these reserves. Baseline carbon stocks are being determined and a project design document has been written to generate the carbon credits on the voluntary carbon market as well as the Clean Development Mechanism (CDM) otherwise known as the compliance market (see BOX 8).


Large-scale restoration being undertaken in the Baviaanskloof Nature Reserve. Here and in two other protected areas, a total of 430 hectares has been restored to date. (M. Powell)

Where restoration can meet human needs

Degraded spekboom-rich thicket occurs over much of the southwestern Eastern Cape (Map 1) and rural communities over large parts of this area are poverty stricken (Map 2). Investments in large-scale restoration provide a possible pathway out of the poverty trap, by generating new income streams, reviving flows of ecosystem goods and services and creating thousands of jobs. The vision is to ultimately create a new rural economy with sustainable livelihoods for people involved in the restoration industry.



Map 2. Opportunities for restoration programmes: the areas requiring restoration and areas with high levels of poverty. (Poverty levels for selected local municipalities as the percentage of population earning less than R400/month – source: Census 2001. Distribution of land which needs restoration back to spekboom-rich thicket – source - see Map 1.) (Map: Andrew Skowno)

Practicalities of thicket restoration

Restoration using spekboom is suitable only in areas where spekboom-thicket formerly occurred, namely in its original natural habitat (see Map 1).The first step in selecting a degraded site suitable for restoration is to ensure that it was previously covered in spekboom-rich thicket. This requires an ecological and soils assessment of the site. The restoration sites should preferably be near an abundant source of spekboom for the harvesting of cuttings – not only to reduce transport costs, but also to ensure that the appropriate plant variety or genotype for the area is re-planted. The cuttings must be 25-30 millimetres in diameter at the base. Once harvested, the stems must be stored in the shade for two days before planting. It is critical at this stage that soil carbon is measured and a plant survey is carried out. This information serves as a baseline against which the process of restoration will be measured, and is crucial if the ultimate aim is to earn credit – either for green acclaim or for trading in carbon credits.

Based on the experience of the *Working for Woodlands Programme*, two methods of planting are applicable depending on the nature of the ground. On steeply sloping, rocky slopes, holes are dug using a *koevoet (*crowbar*)*, while on gentle, relatively non-rocky slopes, the introduction of power drills has been shown to greatly increase productivity. In both methods, the cuttings are carefully planted by hand to a depth of approximately 15 cm. Planting density of cuttings is on average 2000 to 2500 stems per hectare.

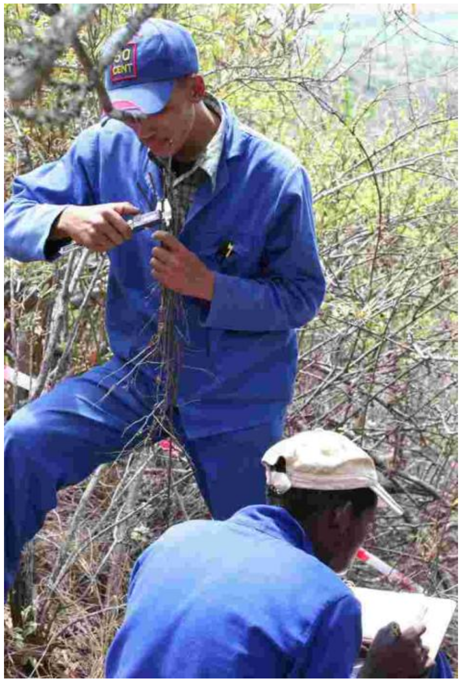
The productivity recorded on steep slopes using *koevoets* is 37 person-days per hectare (0.02 hectare per day per person or 200 square meters per day). By contrast the productivity recorded on gently sloping land using drills is considerably better, namely 8.6 person-days per hectare (0.11 hectare per day per person or 1100 square meters per day).

Browsing effects by wild game and livestock could seriously retard rates of restoration; therefore, landowners and managers need to exclude livestock from restored sites for a period of 3-5 years.

Planting spekboom cuttings is labour intensive, in places requiring the use of a koevoet to prepare the ground. (M.Powell).

Job creation and skills development

The *Working for Woodlands Programme* makes use of a tender-based system in which a contractor with a team of workers receives payment only on completion of planting a designated block and according to standard specifications. This system ensures efficiencies of scale and implementation. Furthermore, as part of its responsibility for the development of previously disadvantaged individuals, the *Working for Woodlands Programme* tailors its skills training to serve the needs of developing contractors in managing their own businesses, including tendering, bookkeeping and financial management, as well as technical skills. Training for the teams of workers includes technical skills as well as life development skills such as personal finance, HIV training and primary health care. This preparation affords disadvantaged individuals the opportunity to develop themselves in a personal capacity, which in turn equips them with more skills and the ability to improve their circumstances. Such individuals are potentially the entrepreneurs of a new rural sustainable economy where thicket restoration catalyses new income streams via carbon credits and payments for other ecosystem services.



Estimating carbon stocks requires careful analytic techniques including the measurement of plant mass in order to determine above-ground carbon content. (M.Powell)

Spekboom restoration provides employment and training opportunities for the poorest of the poor. (V.Wilman)

3. Credit for Carbon

Tens of thousands of tonnes of carbon dioxide will be captured from the atmosphere by large-scale restoration. This will generate credit either as green acclaim for restoring natural capital and biodiversity, or as fungible carbon credits which can be traded on the carbon market. Both credits – green and carbon - can deliver attractive financial returns on investments and both will enhance income streams in rural areas.

Carbon credits earned via restoration are best suited for trade in the voluntary carbon market where buyers place high value on the sustainability of a project, often paying a premium for carbon capture which provides benefits for rural livelihoods and biodiversity. These buyers include companies which are not necessarily legally bound to reduce their emissions, but which include mitigation of climate change within their strategy for corporate social responsibility.

BOX 8. Carbon Credits

Carbon credits are the unit of trade used in the carbon market, where one carbon credit represents one tonne of carbon dioxide that has been captured from the atmosphere or has been prevented from entering the atmosphere. The carbon market aims to decrease emissions of greenhouse gases (GHGs) which scientific evidence shows in all likelihood to be contributing to global warming and climate change. Broadly based on the earlier, highly successful programme to reduce acid rain, the carbon market developed from the Kyoto Protocol which emerged under the United Nations Framework Convention on Climate Change (UNFCCC).

The Protocol sets targets for GHG emissions by developed countries. Each government then sets annual size limits on emissions by its major industries or emitters. If an industry exceeds its target or cap, it must make up for this surplus by trading, for example, with another industry which has successfully reduced its emissions to a level below its target. This system of "cap and trade" is the basis of the compliance market. Carbon credits can also be traded between countries, while those countries unable to reduce their emissions and stay within their targets can invest in developing countries through the Clean Development Mechanism (CDM). In this way they can "offset" their emissions, e.g. support a carbon sequestration project in a developing country and buy the carbon credits thus created. The CDM trade is strictly regulated according to rigorous standards, verification and certification.

In contrast to the legally-enforced compliance market, the voluntary market is driven mainly by public concern about climate change and corporate social responsibility. The Voluntary Carbon Standard (VCS) follows the format of CDM but does not require authorization by the host country which greatly reduces transaction costs. Another is the Community, Climate and Biodiversity Standard (CCBS) which ensures benefits to communities and the consideration of biodiversity over and above the carbon stored and can be linked with the CDM and VCS standards and verified accordingly. (For more information see www.carbon-standards.org)

In order to meet these standards, a baseline measure of the carbon stock is required, followed by *validation* of the proposed method of reforestation/restoration by an auditor with appropriate qualifications. After several years, when the area is starting to re-establish, the auditor must return to *verify* the actual amount of carbon stored in the land. Once the amount is verified, a credit certificate is issued which can then be traded. Carbon captured in projects without this accreditation cannot be considered as offsets. In order to ensure verifiable offsets, the CCBS and VCS/CDM standards will be used in all of the restoration work proposed in this project. Although this requires substantial upfront funding, this accreditation is crucial for offset trading. While application of the CCBS will ensure that benefits accrue to communities and biodiversity, a further advantage is that credits of this standard attract premium prices.

Reduced Emissions from Deforestation and Degradation (REDD)

There are proposals by the UNFCCC under the auspices of the VCS for the inclusion of Reduced Emissions from Deforestation and Degradation (REDD), as well as the REDD+ mechanism which would encompass sustainable forest management, afforestation and reforestation. This is a mechanism whereby carbon credits are gained primarily for the reduction of deforestation or degradation in an area. REDD+ will also include reforestation of areas which had previously been deforested. There may also be future expansion of REDD+ to include ecosystems other than forest (such as thicket). It is noteworthy that standards are currently being developed for REDD+ to ensure that, as with CCBS, multiple benefits are enhanced and that the rights of local communities and indigenous peoples are recognized, and that biodiversity is conserved.

The loss of approximately 100 tonnes of carbon per hectare could be prevented by avoiding degradation of this vegetation. Incentive schemes such as those promised by REDD+ are needed to safeguard intact thicket. (A. Mills)

Jobs, carbon and green acclaim

One of the primary benefits of restoring degraded thicket, especially attractive to government, is job creation. Thousands of jobs could be created in a large-scale thicket restoration project. For corporations, in turn, thicket restoration offers, at very low cost, the generation of carbon credits, where one carbon credit represents one tonne of carbon dioxide that has been captured from the atmosphere or has been prevented from entering the atmosphere. Such credits can be used for offsetting carbon emissions, or for trading on

international markets. Such credits are used by corporations or individuals to offset their carbon emissions (see Box 8).

This type of restoration has a host of secondary benefits, or, positive externalities as they are termed in economic jargon. These include the numerous ecosystem services provided by intact thicket described earlier, ranging from opportunities for judicious livestock farming to increased life spans of dams as a result of reduced silt loads. Essentially thicket restoration will give rise to multiple benefit streams.

The green acclaim of a restoration project, extending over one million hectares, would echo across Africa and the world, earning respect for both government and business, locally and internationally. With regard to climate change, such large-scale restoration would provide an effective mitigation and adaptation strategy for rural communities. In addition to acting as carbon sinks, the restored landscapes would yield greater productivity during drought years.

Both primary and secondary benefits will be greatest if restoration occurs at a large-scale. Figure 1 shows that as a restoration project increases in size from 500 to 64,000 hectares, the number of person-days generated - reflected in the size of the bubbles on the graph – increases from 20 thousand to 4.5 million, depending on the terrain of the landscape. A focus on economic benefits in the same graph shows that the cost of sequestering one tonne of carbon dioxide decreases from approximately R85 in a 500 hectare project in a steeply sloping landscape to R30 in a 64,000 hectare project in a gently sloping landscape (modelled on spekboom growth rates in dry thicket). These latter costs are, in particular, highly competitive in an international context, with recent research showing that restoration of degraded forests around the world is likely to cost investors more than R100 per tonne of carbon dioxide sequestered http://www.mckinsey.com/clientservice/ccsi/pathways_low_carbon_economy.asp

Restoration is attractive for investors (given that it is likely to yield attractive internal rates of return) (Figure 2), but importantly, from a land management perspective, it is essential in order to ensure sustainability. The returns are largely dependent on a few key variables including the cost of restoration, the rate of spekboom growth and the price of carbon. These variables are in turn related to the slope of the restoration site, the soil type and rainfall, and the supply and demand for carbon credits on international markets.

The internal rates of returns are predicted to increase with the size of the restoration project due to economies of scale involving management and transaction costs of generating the carbon credits. A scenario of a gently sloping landscape, with nutrient-rich soils, a dry climate and a selling price of carbon of US$15, yields an internal rate of return ranging from 11% (500 hectares) to 14% (64,000 hectares) (blue dashed line in Figure 2). Included is a fifth scenario based on a recently trialled, highly efficient restoration method using large power drills which increases the rate of hole excavation, and which yields internal rates of returns of greater than 20%. This is the most practical, cost-effective method for future large-scale restoration initiatives.

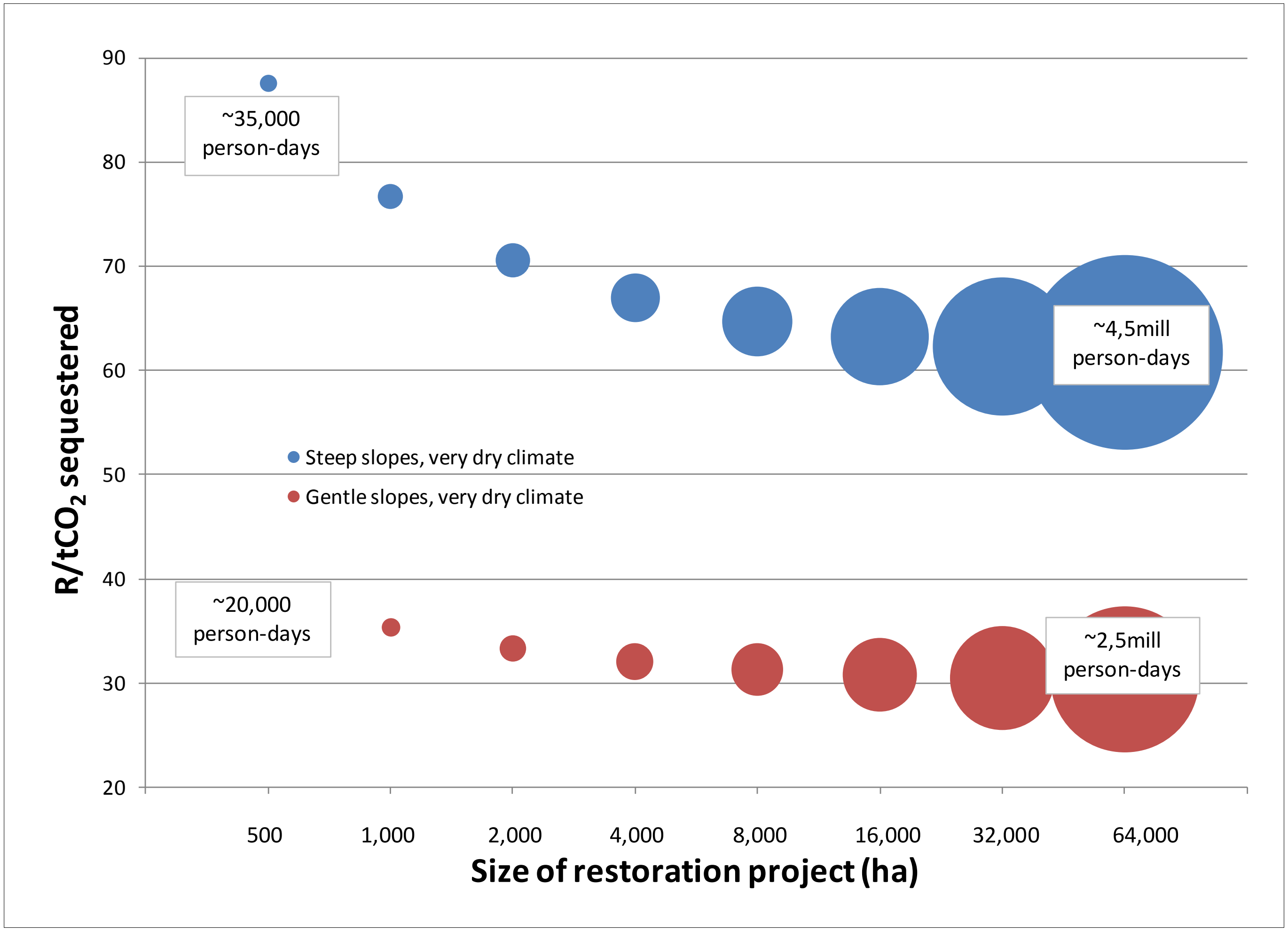


Figure 1. The cost of sequestering one tonne of carbon dioxide through restoring degraded spekboom-rich thicket vegetation. The larger the area restored, the lower the unit cost (reflected on the y-axis), and the more the person-days in employment created (indicated by the increasing size in the balloon). Two scenarios are presented, depicted by the red balloons (gently sloping landscape, nutrient-rich soils, and a very dry climate - rainfall less than 300 millimetres per year - and the blue balloon (steeply sloping landscape, nutrient-rich soils and a very dry climate). The results presented are modelled from data generated by the *Working for Woodland Programme* over the period 2004 to 2009 in which over 500 hectares of land were restored across the Baviaanskloof Nature Reserve, Addo Elephant National Park and the Fish River Reserve. Rates of carbon sequestration (350t/CO_2/hectare over 30 years) were based on research undertaken by Mills and Cowling (2006) at a 27 year old restoration site. In areas with higher rainfall the sequestration level are likely to exceed 450tCO_2/hectare over 30 years, resulting in an even lower unit cost. Source: Own analysis.

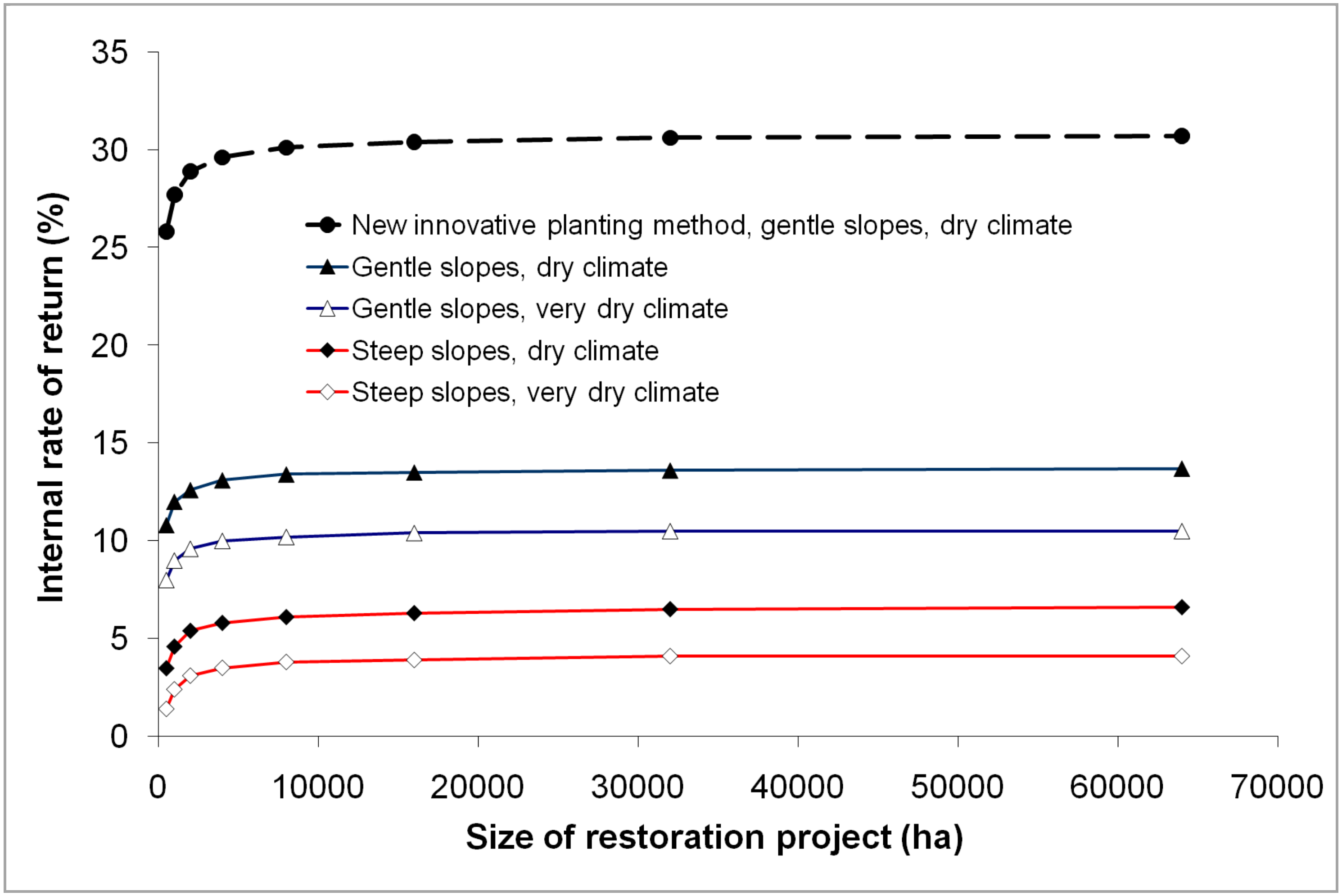


Figure 2. The effect of increasing the size of the restoration project on internal rates of return over a 30 year cash flow. Five scenarios are presented. The red solid line with open diamonds – steeply sloping landscapes, very dry climate (see the red balloons in Figure 1); the red solid line with closed diamonds – steep slopes in a dry climate; blue solid line with open triangles – gently sloping landscapes, very dry climate (see blue balloons in Figure 1); blue solid line with closed triangles – gently sloping landscapes in dry climate; black line with solid circles - gently sloping landscape, dry climate, and an efficient new planting methodology recently trailed by the Working for Woodlands programme. The results presented are based on research undertaken by Mills and Cowling (2006) at a 27 year old restoration site. The model includes the introduction of livestock at judicious stocking levels ten years into the project.

4. Where to from here?

Restoration of natural capital for the delivery of ecosystem services (Box 9) is entirely in alignment with the government's Accelerated and Shared Growth Initiative for South Africa (AsgiSA). In its coverage of rural economic development, the annual report of March 2009 acknowledged the role of payments for ecosystem goods and services (PES) such as carbon sequestration. PES involves a contractual arrangement where the external beneficiaries of an ecosystem service make a direct compensatory payment to land owners or managers for ensuring the safeguarding and restoration of that ecosystem. PES has the potential to provide employment in poverty stricken rural areas (Box 9), and thus greatly assist the government in achieving its target of creating half a million jobs in the next few years

However, getting there will require the involvement of both the public and private sectors. They will need to collaborate in order to create the new institutions 1) to convert environmental and climate-change challenges into opportunities for development and 2) that are necessary for the implementation of the large-scale projects required for sustainable restoration and job creation. Here is what they should do.

What needs to be done

By the public sector:

1. Build on the excellent progress made by the *Working for Woodlands/Working for Water* alliance in developing the scientifically proven practice of thicket restoration.

2. Institutionalise co-operative governance among relevant spheres of government in order to effectively implement a region-wide programme (see also Box 9).

3. Continue to invest in developing the scientific basis required to inform the development of the market for ecosystem services in order to ensure fair trade.

4. Continue to invest in the building of capacity, not only for participation in the market for payment of ecosystem services (PES) but also to regulate and facilitate the development of the market.

By the private sector:

1. Invest in South Africa's thicket-based carbon mitigation and adaptation options, while acknowledging that there are rigorously developed norms and standards that guide investment in carbon offsets based on restoration.

2. For organized and emerging agriculture to investigate appropriate business models to ensure a competitive and optimum economy of scale, taking into account the high transaction costs typical of markets for ecosystem services.

By both the private and public sector:

1. Develop a working relationship to stimulate, in a systematic way, sustainable rural economic development, thereby enhancing the quality of life of the people of the Eastern Cape, while reducing South Africa's carbon footprint.

2. Engage and collaborate in order to ensure fair trade and the development of sustainable markets for ecosystem services

Key to making restoration work for people, companies and the environment, is the need to consolidate ongoing efforts and initiatives. In this context a number of NGO's have joined forces to form the Climate Action Partnership (see Box 10) which can be contacted for more information or investment in thicket restoration.

At present, possible models for public-private-partnerships are being investigated that will enable individual farmers to participate in the carbon farming exercise together with the protected area conservation authorities and NGOs. This partnership will include a management company that 1) designs the planting protocols for each site taking into account soil types and local ecological processes, 2) monitors the plant and soil carbon stocks through time, 3) facilitates the validation and verification process for generating carbon credits, and 4) trades the carbon credits on behalf of the land owners. The 2003 vision of the *Working for Woodlands Programme* was for the private sector to join the government's initiatives and catalyse the up-scaling of the restoration of hundreds of thousands of hectares of degraded thicket. This vision is on track.

Restoration empowers by providing opportunities for sustainable livelihoods in rural areas. (M. Powell)

BOX 9. Restoration in the context of sustainable rural economic development

From this document, it is clear that the twinning of restoration and economic development objectives within a single program could and should, become a reality. This twinning is crucial to overall success. Restoration should be seen as an indispensable element of a broader economic development strategy, rather than an initiative supporting conservation or biodiversity – plants, animals and their natural systems. This development strategy is based on the recognition of natural capital as a form of capital which yields an invaluable stream of benefits which are almost impossible or too costly to create artificially. These benefits, termed ecosystem services, deliver productive veld for livestock and wildlife, improved water quality and flow, carbon sequestration, tourism and recreational opportunities, and so on. Furthermore, restoration of natural capital can act as a catalyst for sustainable economic development that addresses people's needs.

True economic development enables people to participate - increasingly and meaningfully - in the economy in such a way that it improves their quality of life. Research shows that approximately 60% of poor households' expenditure is directed towards food, water and energy (only about 20% is used for transport, communication, and household appliances/furniture). Therefore, for restoration to contribute meaningfully to sustainable rural economic development, it should be linked with activities that enhance food, water and energy security. For example, the introduction of systems that harvest rain water in tandem with biogas digesters will enable (with multiple rotations) high yielding food gardens, supplied with nutrient rich water from the biogas digesters, which in turn, receive water from the rain water harvesting systems, and organic feedstock from household wastes and garden residuals. Many such opportunities exist for integrating restoration with economic objectives, reinforcing both, and ensuring overall viability.

BOX 10. Climate Action Partnership (CAP)

The key to making restoration work for people, business and the environment is the need to consolidate ongoing efforts and initiatives. In this context, eight of the larger conservation NGO's, namely Wildlife and Environmental Society of South Africa, Conservation South Africa, Botanical Society, Endangered Wildlife Trust, Wildlands Conservation Trust, Wilderness Foundation, and recent members World Wildlife Fund and Birdlife SA have formed a partnership. Their aim is to promote and assist in the implementation of restoration and conservation of intact healthy ecosystems as part of the mitigation and adaptation solution to climate change. To stimulate investment in restoration in the Eastern Cape, CAP has assisted in funding this assessment report through their primary funder, the DG Murray Trust, and in partnership with Department of Water and Environmental Affairs. CAP would like to assist the ongoing restoration of the Eastern Cape by facilitating public private partnerships and providing support with fundraising activities. CAP can also assist with knowledge exchanges and support the integration of CCBS standards within the process. For more information on the partnership please visit www.cap.org.za or contact, Sarshen Marais smarais@conservation.org.

5. Further Reading

CAP website www.cap.org.za
Carbon Standards: CCBS: www.climate-standards.org VCS www.v-c-s.org

Department of Water and Environmental Affairs (DWEA) (formerly Department of Water and Forestry (DWAF) website - www.dwaf.gov.za

R3G Restoration Research Group website - www.r3g.co.za

STEP Map available on SANBI's BGIS website - http://bgis.sanbi.org/STEP/project.asp for more information on the Suptropical Thicket Ecosystem Project 2003, which provided the information on restorable areas of spekboom-rich thicket.

AfriCarbon (Pty) Ltd – a private company that plays the role of catalyser, facilitator, advisor, investor and participant in the restoration of degraded thicket and the generation of carbon credits - www.africarbon.co.za

6. References

Cocks, M.L. and Wiersum, K.F. 2003. The significance of plant diversity to rural households in eastern Cape Province. *Forests, Trees and Livelihoods* 13: 39-58

Hobson, F.O., Stuart-Hill, G.C. and Swart, M.L. 1993. Establishment of spekboom: unpublished preliminary results. Dohne Research Station, Stutterheim.

Lechmere-Oertel, R.G., Kerley, G.I.H. and Cowling, R.M. 2005a. Patterns and implications of transformation in semi-arid succulent thicket, *South African Journal of Arid Environments* 62: 459–474

Lechmere-Oertel, R.G., Kerley, G.I.H. and Cowling, R.M. 2005b. Landscape dysfunction and reduced spatial heterogeneity in soil resources and fertility in semi-arid succulent thicket, South Africa. *Austral Ecology* 30: 615–624

Lechmere-Oertel, R.G., Kerley, G.I.H., Mills, A.J. and Cowling, R.M. 2008. Litter dynamics across browsing-induced fence line contrasts in succulent thicket, South Africa. *South African Journal of Botany* 74 (4): 651–659

Lloyd, J.W., van den Berg, E. and Palmer, A.R. 2002. Patterns of transformation and degradation in the thicket biome, South Africa. TERU report no: 39. University of Port Elizabeth, Port Elizabeth, South Africa.

Mills, A.J. and Fey, M.V. 2003. Declining soil quality in South Africa: effects of land use on soil organic matter and surface crusting. *South African Journal of Science* 99: 429-436

Mills, A.J. and Fey, M.V.2004. Soil carbon and nitrogen in five contrasting biomes of South Africa exposed to different land uses. *South African Journal of Soil Science* 21(2):94-103

Mills, A.J. and Fey, M.V. 2004. Transformation of thicket to savanna reduces soil quality in the Eastern Cape, South Africa. *Plant and Soil* 265:153-163

Mills, A.J., Cowling, R.M., Fey, M.V., Kerley, G.I.H., Lechmere-Oertel, R.G., Sigwela, A., Skowno, A. and Rundel, P.W. 2005. Effects of goat pastoralism on ecosystem

carbon storage in semi-arid thicket, Eastern Cape, South Africa. *Austral Ecology* 30: 807-813

Mills, A.J. and Cowling, R.M. 2006. Rate of carbon sequestration at two thicket restoration sites in the Eastern Cape, South Africa. *Restoration Ecology* 14: 38-49

Mills, A.J., Turpie, J., Cowling, R.M., Marais, C., Kerley, G.I.H., Lechmere-Oertel, R.G., Sigwela, A.M. and Powell, M. 2007. Assessing costs, benefits and feasibility of subtropical thicket restoration in the Eastern Cape, South Africa. In: J.Aronson, S.J. Milton and J. Blignaut (eds), *Restoring natural capital. Science, business and practice*. Island Press, Washington DC.

Mills, A.J. and Cowling, R.M. (2009) Below-ground carbon stocks in intact and transformed subtropical thicket landscapes in semi-arid South Africa. *Journal of Arid Environments*. **doi:10.1016/j.jaridenv.2009.07.002**

Powell, M.J. 2009. Restoration of degraded subtropical thickets in the Baviaanskloof Megareserve, South Africa. MSc. thesis, Rhodes University, South Africa.

Siqwela, A.M. 2004. The impacts of land use on vertebrate diversity and vertebrate mediated processes in the thicket biome, Eastern Cape. Ph.D. thesis. University of Port Elizabeth, South Africa.

Sigwela, A.M., Kerley, G.I.H., Mills, A.J. and Cowling, R.M. 2009. The impact of browsing-induced degradation on the reproduction of subtropical thicket canopy shrubs and trees. *South African Journal of Botany* 75: 262-267

STEP Map – see details in Further Reading

7. Acknowledgements

Thanks are due to the Gamtoos Irrigation Board and Wilderness Foundation for arranging the workshop. Julian le Roux provided valuable input at the workshop.