Lani van Vuuren

Study proves the economic worth of BIODIVERSITY REHABILITATION PROJECTS

Can we put a price on rehabilitation projects and are some more valuable than others? A recently-completed project, funded by the Water Research Commission (WRC), aimed to answer these and other questions. Article by Petro Kotzé.

Globally, the degradation of ecosystems has reached unprecedented levels. In what seems like a near constant battle of economic development vs. the environment, the latter is paying by far the biggest price. In the process, the capacity and ability of natural resources to supply high quality and quantities of ecosystem goods and services such as fresh water, grazing, soil stabilisation and climate amelioration through the sequestration of carbon dioxide is weakening.

One way to reverse this trend is through the restoration of natural capital – the elements of nature that produce value to people, including rivers, land, minerals and oceans. In South Africa such activities are often enforced by legislation that makes provision for mandatory restoration projects, such as mining rehabilitation.

Another example is government's Natural Resource Management Programmes, which work toward the eradication of alien vegetation. Since 2005, the Working for Water programme, for example, has been responsible for the clearance of more than one million hectares of invasive alien plants. Globally, the programme is recognised as one of the most outstanding environmental conservation initiatives on the continent, and enjoys sustainable political support for its job creation efforts and the fight against poverty.

But, does restoration pay? This is a question that has long begged to be asked, says Prof James Blignaut of ASSET Research and the Department of Economics at the University of Pretoria. And, if it pays, under which circumstances? Furthermore, can the development of markets for ecosystem goods and services aid the development of the restoration industry? If it can, under which conditions would it be applicable?

Blignaut until recently led a study commissioned by the WRC to investigate restoration's economic linkages. The main focus of the project was to determine whether restoration, in fact, yields the desired results and improves the socio-economic value, and particularly the agriculture potential, of restored land. WRC Executive Manager: Water Utilisation in Agriculture, Dr Gerhard Backeberg, reports that the idea for this research topic came about when the late environment and resource economist, Dr Roland Mirrilees, investigated the production potential of degraded landscapes. Mirrilees was particularly interested in what incentives would be necessary to convince people to restore natural capital.

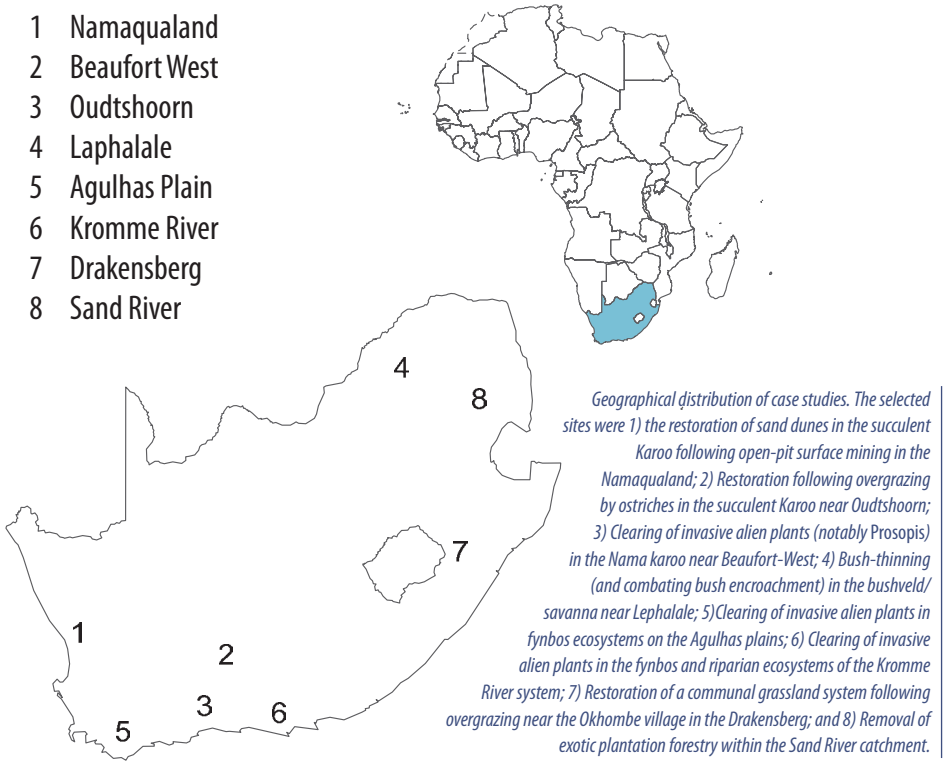
For the current study's purposes, the focus was placed on the relevance of the restoration of natural capital to agriculture, explains Dr Backeberg, and how this restoration can lead to more productive use of the resources available, by providing income to farming households and enterprises. ASSET Research was commissioned to conduct the research over a five-year period, with funding from the WRC and the Natural Resource Management programme of the Department of Environmental Affairs.

The study aimed to develop an evidence base for the use of economic tools and instruments in the decision-making process to restore degraded land, explains Prof Blignaut. "We have neither investigated the need, nor the moral or intrinsic reasons, for restoration.

One of the eight selected case studies was the restoration of a communal grassland system in the Drakensberg.

We applied the conventional return/risk economic decision-making framework to eight existing restoration projects to evaluate whether it could be applied to restoration over a range of environmental conditions and in different contexts."

While it is true that some evidence of the ecological and hydrological implications of restoration for individual projects already exist, the links between these activities and the economy across various spatial scales and biomes have not been established. "There is also no clear understanding of how the benefits before and after restoration might affect agriculture through improved returns from terrestrial ecosystems," says Prof Blignaut. While these



Geographical distribution of case studies. The selected sites were 1) the restoration of sand dunes in the succulent Karoo following open-pit surface mining in the Namaqualand; 2) Restoration following overgrazing by ostriches in the succulent Karoo near Oudtshoorn; 3) Clearing of invasive alien plants (notably Prosopis*) in the Nama karoo near Beaufort-West; 4) Bush-thinning (and combating bush encroachment) in the bushveld/savanna near Lephalale; 5)Clearing of invasive alien plants in fynbos ecosystems on the Agulhas plains; 6) Clearing of invasive alien plants in the fynbos and riparian ecosystems of the Kromme River system; 7) Restoration of a communal grassland system following overgrazing near the Okhombe village in the Drakensberg; and 8) Removal of exotic plantation forestry within the Sand River catchment.*

SANITATION

1.8 billion people gained access to improved sanitation facilities between 1990 and 2010

2.5 billion people still lack improved sanitation. 1.1 billion people still practice open defecation, that's 15% of the world population

If current trends continue, **2.4 billion** people will still lack improved sanitation facilities in 2015

Access to sanitation, the practice of good hygiene, and a safe water supply could save **1.5 million children a year**

EVERY

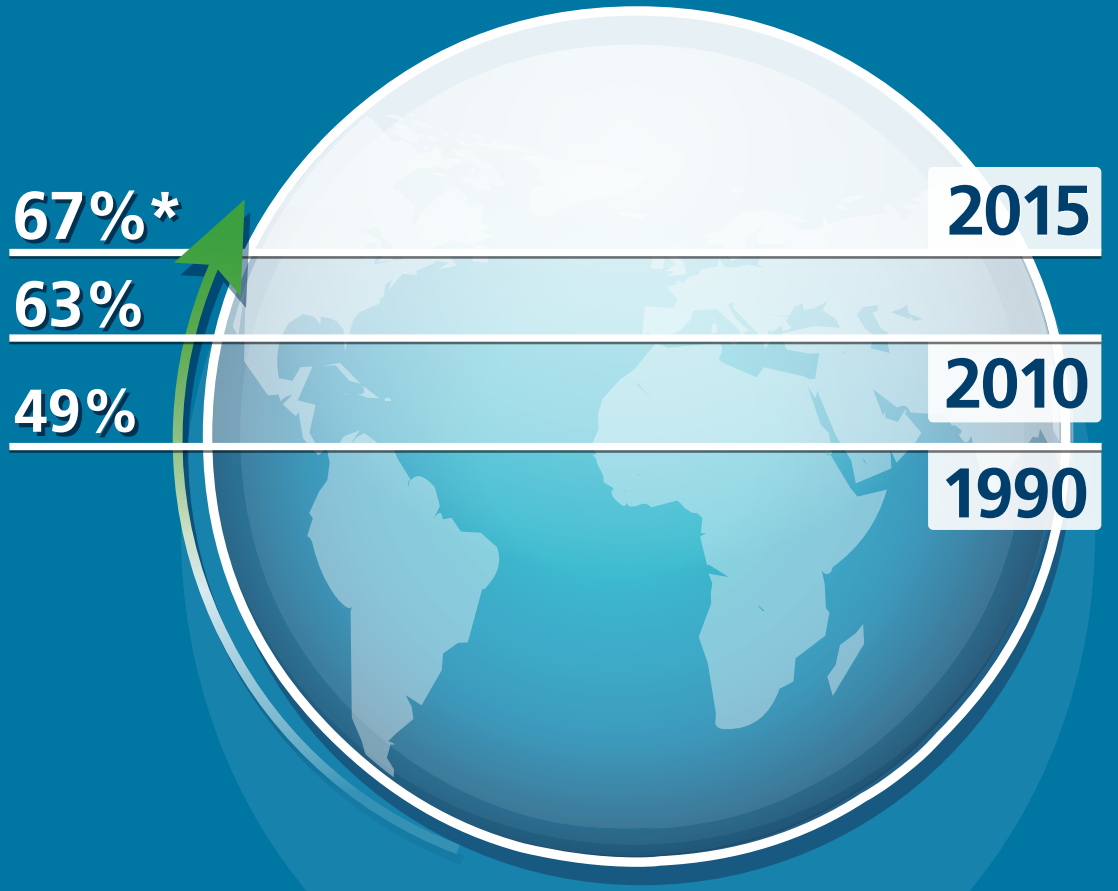
ACCESS TO SANITATION

EVERY

20

SECONDS,
A CHILD DIES
AS A RESULT
OF POOR
SANITATION

ACCESS TO SANITATION AS A PERCENTAGE OF WORLD POPULATION



* Projected total
(Millennium Development Goals' target is 75%)

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The outputs from these studies were used to develop an integrated system dynamics model on the likely impact of restoration on the ecology, hydrology and economy of notably agriculture.

HOW THE STUDY RESULTS CAN BE APPLIED: THE CASE OF THE KROMME VALLEY FARMERS

The Kromme River is a high energy river system in a long narrow catchment of the Eastern Cape and supplies roughly 40% of Port Elizabeth's drinking water. Once, there were pristine palmiet wetlands along the entire length of the valley, which provided many crucial ecosystem goods and services such as water infiltration, filtration and decreasing the impacts of floods. Poor farming and management practises have led to the formation of headcuts, or dongas, which resulted in erosion, loss of soil and a drop in the water table. These headcuts and the invasion of alien trees have destroyed the wetlands. As a result, less water is available. Unless this land management is changed in the Kromme immediately, the damage will become irreversible.

MSc student Jane Rebelo's thesis (which formed part of the project) investigated the hydrological impact of the land-cover changes in the Kromme River Catchment over the last 50 years. Modelling results predict that over the past 50 years, the transformation of the floodplain wetlands in the Kromme River has shifted the flow regime, reducing baseflows and increasing the responsiveness of the catchment to extreme rainfall events. The invasion of *A. mearnsii* has also caused a reduction in river flow. Various restoration scenarios were considered. If the Kromme were to be restored back to a land-cover state comparable to the 1950s, 26.9 km^2 (65.1%) of *A. mearnsii* would have to be cleared, and 5.2 km^2 (34.2%) of the wetlands would have to be restored. The hydrological benefits would include a predicted increase in riverflow (42 mm/a), baseflow (2.9 mm/a), an increase in flood protection and improved water quality. This restoration strategy could be regarded as a type of insurance plan, and the benefits gained in terms of increased ecosystem service delivery would be the insurance premium. Rebelo concluded that it appears that restoration, insuring natural capital in the Kromme River, would provide significant economic returns on investment.

To try and facilitate behavioural change following these findings, researchers facilitated articles in popular magazines, met with municipal decision-makers and held a workshop for all farmers and landowners in the Kromme catchment.

The latter was seen to be 'extremely successful' and resulted in three key outcomes: Firstly, the farmers recognised that communication needed to be improved in the area. Secondly, the need to form a committee which would provide a platform for communication among landowners and between landowners and organisations that apply restoration was identified. Most importantly, farmers acknowledged the importance of protecting water supplies, using water more sustainably and the importance of working together towards this goal.

benefits are generally believed to be very real and significant, they are not well understood.

This study thus also endeavoured to provide these links. "In effect, restoration is no different from the capital expenditure on any project and the return to the land," notes Prof Blignaut. The value of environmental services emanating from the ensuing flows (as a result of the capital expenditure) is the annual stream of benefits delivered at an annual maintenance and operation cost. "This is not unlike any other investment that does have an upfront capital component with regular or annual operational and managerial cost, but that yields an ongoing stream of benefits in the form of products or services being sold."

"By making both the cost and the benefits of restoration explicit, we aimed to illustrate the potential for the development of markets for ecosystem goods and services offered by restoration. Our underlying assumption was that by changing market signals, market participants will adjust their behaviour."

WHAT DID THE RESULTS SHOW?

Ecological, hydrological, and socio-economic assessments were undertaken to determine the impact of restoration at the chosen eight existing restoration sites. These were compared with degraded or unrestored areas in close proximity.

The study sites that were chosen reflect a broad range of biophysical parameters, such as ecosystems (fynbos, desert, riparian, grassland and savanna), soil types and precipitation. The sites also varied with respect to socio-economic parameters, such as the types of beneficiaries (e.g. farmers, rural and urban water users, tourists and recreationists), and the value they would be willing to pay for an increased flow of higher quality ecosystem goods and services.

The outputs from these studies were used to develop an integrated system dynamics model on the likely impact of restoration on the ecology, hydrology and economy of notably agriculture. This model was specifically focused on internalising the economic (societal) costs and benefits of restoration and to apply an economic decision-making rationale to the results in an effort to make the societal benefit of restoration explicit.

According to Prof Blignaut, results indicate that in semi-arid South Africa, restoration projects yielding water services are the 'pearl' projects, with high likelihoods of success and high payoffs. As a general rule, downstream water consumers benefit from these restoration projects. The Agulhas, Beaufort West, Kromme and Sand study sites are all examples of this.

Restoration projects yielding grazing and crop services are mostly the 'bread and butter' projects, ones which are likely to succeed but yield low rewards.

The Lephalale project, again, is a potential oyster, with untested and therefore uncertain long-term benefits from restoration. Fairly low levels of resources are committed to this activity.

ASSET Research

Top right: *Decomposing* prosopsis *in cleared veld at Brandwagt Farm, one of the study sites.*

Bottom right: *Prof James Blignaut and Dr Christo Marais during a site visit to the Oudtshoorn study area.*

Summary of projects classified by type

	Oyster	Pearl	Bread and Butter	White elephant
Description	High risk projects with uncertain merits	Projects with high likelihood of success	Essential projects that enterprises cannot do without	Projects which are preferable to avoid
Water projects	Drakensberg; Kromme (no agriculture)	Agulhas, Beaufort West, Kromme (with agriculture), Sabie Sand		
Crop projects		Sabie Sand	Agulhas, Kromme (with agriculture)	
Grazing projects	Lephalale	Oudtshoorn (passive only)	Beaufort West, Drakensberg, Kromme (with agriculture)	Namaqua Sands

PROJECT SCOOPS WRC KNOWLEDGE TREE AWARD

Prof James Blignaut scooped an Award in the 'Human Capital Development' category of the inaugural WRC Knowledge Tree Awards held earlier this year. The award was particularly made for the project on the restoration on natural capital. According to Backeberg, the strong capacity building factor, and the way in which regular colloquiums were used to streamline study results, was some of the project's biggest benefits. The project saw the training of no less than 11 post-graduate students in various disciplines. The students conducted the bulk of the research, and their theses were the backbone of the study. They were supported by numerous supervisors. "It was a huge honour to be able to help put this project together," says Prof Blignaut.

The eleven students were Helanya Vlok, Marco Pauw, Megan Nowell, Thabisisani Ndhlovu, Petra de Abreu, Worship Mugido, Alanna Rebelo, Katie Gull, Jacques Cloete, Dane Marx and Douglas Crookes.

Elske Kritzinger

Economic tools and instruments can indeed assist the restoration industry to be more effective and efficient.

Under certain extreme conditions it is also possible to have 'white elephants'. These are projects where large amounts of resources are committed to the restoration project, but with proportionally little reward and low probability of success in terms of restoration outcomes. The rehabilitation of sand dune mining in arid areas, such as the west coast of South Africa is one such project where large resources committed to it and proportionally little reward and low probability of success in terms of restoration outcomes. Despite the cost the restored area's level of ecosystem function is still below that of the undamaged area, indicating an unmitigated loss despite restoration. The project, however, is a legal requirement placed on the mining company as part of its licence to operate and therefore, requires a different type of evaluation.

"Clearly, the economic outcome of restoration projects is highly context dependent and definitely not uniform," notes Prof Blignaut. While the development of markets for ecosystem goods and services might be appropriate in some cases, in others it might not.

The need for and urgency of investing in restoration, however, does not depend on the development of markets for ecosystem services, he cautions. "Restoration of natural capital remains a moral obligation towards both the current and future generations if an activity has caused degradation, and the reduction in the potential flow of future streams of ecosystem goods and services."

The Oudtshoorn study site is an example of a 'pearl' project – one with a high likelihood of success.

ASSET Research

HOW CAN WE USE THIS KNOWLEDGE?

It is important to note that this study did not seek to provide a motivation for restoration per se, but only sought to identify under which conditions markets could contribute to restoration. "We do not suggest that only monetary values are of importance within the larger restoration decision-making picture," says Prof Blignaut. While those restoration options that have high risk/low reward outcomes over time should not necessarily be abandoned, the

study results suggest that markets are ill-equipped to assist in restoration under such conditions.

"We acknowledge that there may be a suite of other drivers for doing restoration, such as legislation on mining, where restoration needs to be conducted according to legal requirements and also socio-economic considerations like job creation."

However, he adds that when considering economic development that will cause environmental degradation, where the most plausible restoration outcome is likely to be one of high risk and low reward, extreme caution should be taken before embarking on such a project. Also, it then becomes particularly important that legal checks and balances are in place to safeguard the residents and the environment from undue exploitation.

In essence, says Prof Blignaut, the team has proved that, under particular conditions, economic tools and instruments can indeed assist the restoration industry to be more effective and efficient.

Chief Director of the Natural Resource Management Programmes at the Department of Environmental Affairs, Dr Christo Marais, adds that one of the biggest values of the WRC project was that primary ecological and field studies served as input for the economic studies. Two previous substantial, multi-disciplinary (ecological, hydrological and economic) studies that were done on the value or cost advantages of natural resource restoration were largely based on existing literature. In comparison, the WRC project rendered new primary, in-field research instead of historical research that was used as assumptions in economic analysis. The ecological and hydrological studies' research questions were asked in in such a way that the results can be used in the economic studies. "It is probably the first of its kind in South Africa," says Dr Marais.

He adds that the results can definitely be used in the so-called mainstreaming of watershed services in water resource management decision making processes. "Closer to home, we will use it to prioritise where and how much resources must be invested across South Africa."

- To order the report, *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 1: Main Report* (**Report No. 1803/1/13**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy. ❑

ASSEF Research

The rehabilitation of sand dune mining is an example of a large volumes of resource committed with proportionally little reward and low probability of success in terms of restoration outcomes.

Description of restoration study/project sites

Site	Biomes	Climatic zone	MAP	Ownership	Size (km²)	Extent of degradation
1	Succulent Karoo	Arid	160	Private	26	Severely degraded: Restoration following open-pit surface mining
2	Nama Karoo	Arid	239	Public/Private	8	Degraded: Clearing of invasive alien plants
3	Succulent Karoo	Arid	242	Private	1 762	Severely degraded: Restoration following overgrazing ostriches
4	Savanna	Semi-arid	400	Private	9 249	Degraded: Bush-thinning (and combating bush encroachment)
5	Fynbos	Semi-arid	478	Public/Private	548	Degraded: Clearing of invasive alien plants
6	Fynbos	Semi-arid	650	Private	46	Degraded: Clearing of invasive alien plants in the riparian ecosystem
7	Grassland	Temperate	900	Communal	1	Severely degraded: Restoration of a communal grassland system following overgrazing
8	Forest/Savanna	Temperate	1 275	Public/Private	32	Degraded: Removal of exotic plantation forestry

MAP = Mean annual precipitation; size refers to the size of the study site from an economic perspective