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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Water and environment

Restoration of natural capital: A systems dynamics approach

A completed WRC-funded project has developed an evidence base for the use of economic tools/instruments in the decision-making process about ecological restoration.

Background

The WRC funded a study focused on developing an evidence base for the use of economic tools/instruments in the decision-making process about restoration. Neither the need, nor the moral and/or intrinsic reasons for restoration were investigated.

By making both the cost and the benefits of restoration explicit, the project aimed to illustrate the potential for the development of markets for ecosystem goods and services (offered by restoration). The underlying assumption was that by changing market signals, market participations will adjust their behaviour.

The specific objectives of the study were to conduct ecological, hydrological and socio-economic assessments to determine the impact of restoration at eight existing ecologically and socio-economically different restoration sites by comparing them with degraded or un-restored areas in close proximity.

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.

Approach

The research team identified eight existing restoration sites that were well established, and that had significant/sufficient supporting data. Methods were standardised across the different studies as far as possible so that all the hydrological function indices and vegetation measurements were collected on all the sites. The actual measurements of infiltration-related variables varied from site to site, depending on the conditions, but a minimum set was collected by all the site-based studies.

1 Namaqualand
2 Beaufort West
3 Oudtshoorn
4 Lephalale
5 Agulhas Plain
6 Kromme river
7 Drakensberg
8 Sand river

Geographical distribution of case studies

Each hydrological study was run in close conjunction with an ecological study and contribute to and used, the historical and ecological information collected for each site.

Each ecology study used a combination of line transects and/or plots to assess the following variables where applicable:

- Cover of alien and indigenous plant species
- Species richness of alien and indigenous plant species
- Vegetation structure
- Resilience (changes in cover between seasons)
- Grazing capacity
- Soil structure
- Assess the change in ecosystem function before and after restoration.

This information was used to determine the impact restoration has had on the flow and generation of ecosystem goods and services, with a particular reference to its value for agriculture.

The economic studies focused on the same eight sites and used the information generated by the ecological and hydrological studies, in combination with local level surveys/questionnaires and/or group sessions, to determine the socio-economic value of restoration of natural capital (RNC) in each case. This was done to determine the economic value of the site before and after restoration, or in comparison with a control site/area.

The study outcomes were synthesised and analysed through the use of a System Dynamic model using VENSIM software.

Results

This study considered economic return and project risk as its main determinants of economic success. The results with respect to economic returns are provided in the final report. Most net present values (NPVs) are positive, and range between R300-million and R620-million after 50 years, once all ecosystem benefits are taken into consideration (cultivated, replenishable and renewable).

The size of the restoration project, however, is very important. When the results are expressed per unit area, the more arid areas typically generate relatively low values compared with the higher values for more humid areas. This assessment, however, ignores risk and uncertainty.

With regards to evaluating the economic risk inherent to a restoration project, 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. Restoration projects yielding grazing and crop services are mostly 'bread and butter' projects, ones which are likely to succeed but yield low (negative?) rewards.

There is one 'white elephant', the Namaqualand mining project, with large resources committed to it, proportionally little reward and low probability of success in terms of restoration outcomes. However, 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 is, however a legal requirement placed on the mining company as part of its licence to operate and which changes the context and, therefore, requires a different type of evaluation. In this case the project team evaluated the project in terms of benefits and costs of ecological restoration to make it comparable across sites.

Lephalale (grazing) is a potential oyster, on the other hand, with untested and therefore uncertain long-term benefits from restoration. Fairly low levels of resources are committed to this activity.

There is, however, no individual measure of risk (e.g. success probability, standard deviation, CV) that is sufficient for selecting and classifying projects. A combination of measures provides an improved means of selection.

This is then used to inform a portfolio mapping exercise in order to classify and select restoration projects. A summary of the classification of projects suggests that those with the highest potential payoffs are the water projects, in other words, those projects where downstream water consumers benefit from the restoration project. The Agulhas, Beaufort West, Kromme and Sand study sites are all examples of this.

The analysis of projects using portfolio mapping suggests that this approach, coupled with risk analysis and system dynamics modelling, is able to provide a means of selecting and prioritising restoration projects based on economic parameters.

Further reading:
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.