PRESENCE Seed Phase

Workshop Outcomes

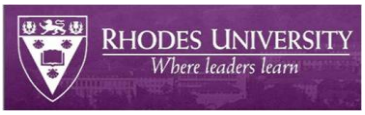
Prepared by
EarthCollective

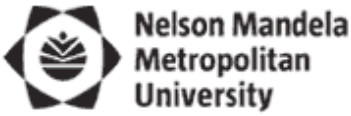
A collaboration between
Wageningen University;
Rhodes University;
Nelson Mandela Metropolitan University;
Rhodes Restoration Research Group;
Department of Water Affairs & Forestry;
Gamtoos Irrigation Board

This report presents key outcomes of the PRESENCE workshop held at Zandvlakte, Baviaanskloof (SA) in November 2007 as part of the PRESENCE Seed Phase.

Facilitated by:

Organizations involved:





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PRESENCE Seed Phase: Workshop Outcomes

Acknowledgements

The EarthCollective network acts as a catalyst in creating, supporting and facilitating initiatives that reinforce links between healthy environments and human well-being. EarthCollective initiated PRESENCE to enable and facilitate restoration 'mainstreaming'.

EarthCollective wishes to acknowledge the valuable contributions made by PRESENCE theme presenters: James Blignaut; Simon Bush; Michelle Cocks; Richard Cowling; Rudolf de Groot; and Michael Schaepman. Special thanks also go to STRP Meeting contributors: Saskia Fourie; Christo Marais; Anthony Mills; Mike Powell; and Ayanda Sigwela. Finally, we are most appreciative for the additional contributions made by Kathy Cassidy, Pierre Joubert, Merwe du Preez and Victoria Willman.

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Executive Summary

The objective of this report *PRESENCE Seed Phase: Workshop Outcomes* is to communicate the outcomes of the PRESENCE workshop held 11 - 13th November 2007 in the Baviaanskloof, South Africa. The information within provides a thorough basis for understanding the key knowledge gaps that exist in our current understanding and which need to be addressed through focused transdisciplinary research in order to catalyze restoration. Background information is provided on each Research Theme nominated as having relevance to the PRESENCE Seed Phase. This is followed by key discussion points and transdisciplinary research questions considered important in furthering our current understanding of restoration.

The *PRESENCE Seed Phase: Workshop Outcomes* will be highly useful in guiding restoration research goals. The information contained herein contributes to an adaptive process of (re-) defining, (re-)formulating and/or (re-)focusing restoration research goals according to ongoing results – from monitoring and evaluating past performances to planning future PRESENCE strategies. This booklet will also be of use in harmonising and optimising existing programme partnerships as well as creating new collaborations under the PRESENCE umbrella.

PRESENCE is proposed as a collaborative 'South-North' effort for building an innovative transdisciplinary learning organisation aimed at mainstreaming landscape restoration. Achieving this means undertaking rigorous transdisciplinary research; developing best management practises and; building capacity through the mainstreaming of restoration processes.

The PRESENCE workshop was financed through South Africa's Department of Water Affairs and Forestry (DWAF) and the Wageningen University & Research Centre's Interdisciplinary Research & Education Fund (WUR-INREF). Since PRESENCE also supports and cooperates with the Subtropical Thicket Restoration Programme (STRP), the PRESENCE workshop was combined with STRP's Annual Review Meeting to develop greater synergies between the programmes.

The purpose of the workshop was to collectively pinpoint the research priorities and capacities needed to guide the broad-scale mainstreaming and implementation of restoration. Attendees to the workshop, from various institutes and active in different disciplines, were invited to brainstorm and discuss key topics during the break-out sessions scheduled after each thematic presentation. Results were written down and formulated as (applied) research questions in order to guide and establish priorities for the long-term restoration of thicket and riparian ecosystems.

The topics dealt with during the workshop were formulated *a priori* in six Research Themes. Each theme was introduced by a presentation, comprising the following: 1) Ecology: Ecosystem Functioning & Biophysical Processes; 2) Ecosystem Goods, Services & Valuation; 3) Stakeholders, Livelihoods & Social Assessment; 4) Policy, Institutions & Governance; 5) Financing, Payments & Reward Mechanisms; and 6) Remote Sensing & Geo-Information Systems. These topics were enhanced by animated break-out group discussion as contributed by workshop participants.

Key achievements to date from the PRESENCE Seed Phase: Workshop Outcomes have included:

- Identification of key questions from a research-implementation perspective – which can be used as basis (post-)graduate research projects or targeted consultancy studies;
- An inventory of knowledge, expertise and partners: what we have and what is needed;
- A comprehensive update on the status of ongoing restoration related activities;
- A review on known challenges and how to approach other bottlenecks which may arise;
- Stimulating new forms of collaboration for supporting multidisciplinary research;
- Introducing new ways of thinking about restoration and its implications at various scales;
- Catalyzing new partnerships across various countries, institutions and disciplines;
- Agreeing on new collaboration arrangements between programme partners;
- Developing an online PRESENCE Portal to facilitate information exchange;
- A commitment to engaging a broad range of stakeholders, improving communication, seeking to disseminate information timely; and to view restoration as a social process;
- Generating renewed momentum for the way forward; highlighting new opportunities.

We would like to sincerely thank all workshop participants, those who were unable to attend but provided valuable input nevertheless and all others who have been actively involved in taking valuable strides towards achieving our collective goal of restoration of ecosystem services, natural capital - and living landscapes.

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1 Introduction to PRESENCE

The Millennium Ecosystem Assessment (MA, 2005) highlighted the fact that the transformation of ecosystems through human activity not only compromises biodiversity and ecological integrity, but also ultimately affects the well-being of people who directly and indirectly depend on the benefits derived from them (i.e. ecosystem services).

1.1 Background

The implications of such a scenario are clearly apparent in South Africa's biologically diverse Eastern Cape where impaired ecosystem functioning is eroding natural capital and the prospect of achieving sustainable livelihoods.

In response, the South African Government and partners are developing national programmes to investigate options for restoring the region's valuable and globally significant biomes and hotspots[1] to meet both socio-economic needs and ecological objectives. However, to achieve these ambitious aims, additional research is required in order to build knowledge and improve understanding of the dynamics of restoration and capacity to communicating and disseminating this understanding and knowledge. Mainstreaming of the improved understanding of ecosystem processes and human dependence on related natural resources, will provide a solid platform for restoring and building resilience in natural (reinstating biodiversity) and socio-cultural systems (securing regional livelihoods). A transdisciplinary restoration research programme was subsequently initiated to facilitate these objectives. This document communicates the outcomes of the Seed Phase of this programme titled:

P articipatory R estoration of E cosystem SE rvices & N atural C apital in the E astern Cape (SA).

(PRESENCE)

PRESENCE's vision is to become a collaborative 'North-South' effort for **building an innovative transdisciplinary learning organisation aimed at mainstreaming landscape restoration.**

PRESENCE Mission Statement

PRESENCE will function as an overarching platform to support existing - and catalyze new programmes for restoring ecosystem services and natural capital in the Eastern Cape. PRESENCE will integrate ecological, cultural, economic and socio-political factors in its applied research to effectively guide implementation management and spatial planning.

[1] A **biodiversity hotspot** is a biogeographic region with a significant reservoir of biodiversity that is threatened with destruction (Wikipedia *accessed on 28 January 2008*.).

1.2 Strategy

Building on the PRESENCE Seed Phase objectives (see § 2.1 and subsequent workshop feedback, a three-pronged mid- to long-term research implementation strategy for achieving the PRESENCE Vision and Mission Statement has been developed as follows:

1. **Undertaking rigorous transdisciplinary research** to address critical knowledge gaps in our current understanding of optimal restoration strategies over time and space. The applied research programme will be a long-term 'North-South' collaborative effort aligned between diverse institutes.

2. **Developing Best Management Practices (BMP)** for natural resource management (NRM) to ensure equitable and effective restoration over geographical and institutional scales.
   The transdisciplinary research underpinning the BMP will guide restoration implementation to become:
   - **stakeholder-driven** and recognises trade-offs in restoring desired ecosystem services;
   - **socio-economically acceptable** in supporting livelihoods and cultural traditions;
   - **ecologically sound** by maximising ecosystem integrity and biodiversity outcomes;
   - **financially sustainable** through the development of innovative financing mechanisms for ecosystem management (e.g. carbon credits, water credits, biodiversity credits);
   - **institutionally feasible** through good governance arrangements, effective learning organisations and behavioural change processes.

3. **Capacity building through the mainstreaming of restoration processes.** This will involve: communicating (the importance of) BMP in restoration across (non) governmental and research institutions; disseminating knowledge and lessons learned to diverse stakeholder groups through tailored strategies (e.g. presentations, workshops, training courses, interactive education modules, community meetings, media releases, etc.).

PRESENCE will only succeed if it is adaptive: responsive to stakeholder preferences, responsive to implementer's needs and constraints; and responsive to improved scientific understanding. Relationships between these groups must be founded on mutual respect and understanding - virtues which will build long-term trust and effective working relationships between partners.

2 PRESENCE Seed Phase

The *PRESENCE Seed Phase: Workshop Outcomes* is the culmination of work commencing late 2006 to identify opportunities for 'up-scaling' restoration through national and international research collaboration; and, for example, in creating opportunities for South African and other international students to undertake their (post-) graduate studies in this field. In early 2007, PRESENCE – as a transdisciplinary research proposal – was prepared by EarthCollective in collaboration with Wageningen University & Research (WUR), Rhodes Restoration Research Group (R3G), Rhodes University, Nelson Mandela Metropolitan University (NMMU) and the Department of Water Affairs and Forestry (DWAF). PRESENCE aims to build upon and integrate the large body of work already undertaken by these organisations and past and present collaborative initiatives (such as Subtropical Thicket Ecosystem Planning (STEP), Subtropical Thicket Restoration Programme (STRP), 'Spearhead' Ecosystem & Landscape Services (SELS)).

2.1 Objectives

The purpose of the Seed Phase was to stimulate North-South interdisciplinary research partnerships intended to support participatory approaches and build capacity for addressing critical scientific questions underpinning ecosystem restoration in the Eastern Cape.

Specifically, from a research perspective, the following objectives were identified:

What needs to be investigated as a matter of priority across the six different Research Themes?
Why is this important for guiding restoration implementation/mainstreaming/up-scaling?
When should this research be carried out (what time frames are possible/optimal/desirable?)?
How can we undertake the identified research in the most effective, efficient and integrated way (what synergies can we develop between disciplines)?
Who needs to be involved to carry out the research, to build long-term capacity and contribute to building mutually beneficial partnerships (desirable institutions and programmes)?

...to make restoration really work.

2.2 Workshop

The first PRESENCE workshop was held at family Kruger's Zandvlakte Accommodation, Zandvlakte, Baviaanskloof 11-13th November 2007 and provided the opportunity for diverse partners – academics, scientists, implementers, expert advisors, consultants and students – to provide input into the strategic direction of PRESENCE and strengthen interpersonal relationships. The final step of the Seed Phase is to communicate feedback of the PRESENCE workshop to the participants (and persons concerned) and continue to build on the outcomes to

generate a stronger PRESENCE in the coming years. The Seed Phase is jointly financed through Wageningen University & Research Centre's Interdisciplinary Research & Education Fund (WUR-INREF) and the South African Government's Department of Water Affairs & Forestry (DWAF).

Since PRESENCE also supports and cooperates closely with STRP and the Kouga Riparian Restoration Project, the PRESENCE workshop was combined with the STRP Annual Review Meeting. The latter's outcomes and presentation summaries are also included in Appendix B of this report.

2.3 Frameworks

This section outlines the research (and implementation) frameworks for guiding the PRESENCE approach and proposed to attendees during the November 2007 PRESENCE workshop.

Frameworks can be either highly useful or terribly tiresome in terms of trying to capture a complex 'reality'. They may enlighten the research context in terms of providing a clear understanding of how all the pieces fit together, or they may become a source of confusion that leads project partners into a downward spiral of discussion! Obviously, our objective here is to arrive at **a conceptual framework that has practical meaning** and relevance for all involved.

As programme facilitator, EarthCollective has taken the opportunity to propose and present three interrelated frameworks that are deemed relevant to the anticipated PRESENCE research and the eventual implementation effort. During the workshop, a consensus was reached that the three frameworks have considerable overlap and can be used complementary to each other.

The three frameworks presented here are:

1. Operational model for mainstreaming ecosystem services (§ 2.3.1)
2. Transdisciplinary Assessment and Implementation Framework (TAIF) (§ 2.3.2)
3. Ecosystem Approach (Principles and Five Steps for Implementation) (§ 2.3.3)

All of the above frameworks deal with research and implementation; therefore it is important for all PRESENCE partners to delineate within this PRESENCE Seed Phase that the current focus is on the research component (of these frameworks); although all partners acknowledge that research must be embedded within the final goals of implementation and capacity building. During the workshop, these frameworks were endorsed with the constructive feedback acknowledged.

2.3.1 Operational model for mainstreaming ecosystem services[2]

The model proposed by Cowling *et al.* (*in press*) (See Appendix A) incorporates four interrelated elements highly relevant to restoration: Project Phase; Spatial Scale; Stakeholder Collaboration; and Status of the Socio-ecological System. Together they illustrate the integrated and interactive relationships between humans and ecosystem services – it paints the 'bigger picture'.

The model is valuable in the sense that it views research assessment as part of a multi-dimensional process with clear goals in mind. It seeks to mainstream ecosystem services research in the context of land-use planning, adaptive management and learning organisations whereby local stakeholders are sufficiently empowered to drive on-ground implementation. Ultimately, this aims to build 'resilient' social-ecological systems which can absorb shocks, surprises and are flexible in adapting to change.

The model's Project Phase trajectory has three phases: Assessment, Planning and Management. Specifically relevant to the initial stages of PRESENCE are the Assessment and, to a lesser extent, the Planning Phase. These phases lay the foundations for Management (and thus Implementation).

The Assessment Phase is a structured process, which builds knowledge useful for policy and anticipated management. Using a transdisciplinary approach, it should answer PRESENCE's key questions and address bottlenecks in planning and implementation. Three phases of Assessment are identified: social, biophysical and their respective valuation whereby social research is considered critical as the first step for identifying the owners and beneficiaries of the ecological functions that actually deliver the services.

The **TAIF** framework below dissects this Operational Model by delineating the Assessment types (social, biophysical and valuation) in terms of outlining the concrete research themes of PRESENCE.

2.3.2 Transdisciplinary Assessment & Implementation Framework (TAIF)

TAIF (See Appendix A) has been developed as a means to provide strategic coordination and integration of the many disciplines and processes involved with understanding the science as well as the practical approaches needed to achieve successful restoration.

[2] A detailed breakdown and discussion of the phases and components of the Operational Model can be found in Cowling *et al.* (in press): *An operational model for mainstreaming ecosystem services for implementation*.

TAIF is a framework that provides a conceptual 'space' for all stakeholders involved (scientists, implementers, etc.) to determine what research, actions and contributions are required to effect restoration. TAIF is intended to support strategic analysis, planning and negotiation to aid effective transdisciplinary research and stakeholder communication. Whilst it is represented as a step-by-step linear framework we recognize that in reality many elements of the framework will need to be considered simultaneously. Flexibility and adaptability are critical. The six research themes identified for the PRESENCE Seed Phase are linked in the TAIF framework as follows:

Research Themes		TAIF Categories
Theme 1	⇔	Ecosystem Functioning & Biophysical Processes
Theme 2	⇔	Ecosystem Goods Services & Valuation
Theme 3	⇔	Stakeholders, Livelihoods & Networks Scoping (& Preferences)
Theme 4	⇔	Policy & Institutional Arrangements (& Measures)
Theme 5	⇔	Financing, Payments & Reward Mechanisms
Theme 6	⇔	Remote Sensing & Geo-Information Systems

TAIF has been developed based on various integrated assessment approaches commonly used in environmental systems analysis and regional management. TAIF has therefore made use of other existing frameworks and models such as those of Cowling et al. (in press), de Groot et al. (2002) and the Millennium Assessment (2005) and combined key components. TAIF should be adaptive to PRESENCE restoration research priorities and overall programme objectives and strategy.

2.3.3 Ecosystem Approach

The Ecosystem Approach is based on the idea that ecosystem health and integrity is central to natural resource management decision-making. It was put forward as a highly appropriate framework for delivering the objectives of the Convention on Biological Diversity (CBD).

Subsequently, the Ecosystem Approach was developed and can be defined as:

A strategy for management of land, water and living resources that promotes conservation and sustainable use in an equitable way (Smith and Maltby, 2003).

Relevance to restoration

The decision to include the Ecosystem Approach as a supporting approach for PRESENCE is both strategic and functional. It is strategic in the sense that the Ecosystem Approach is a guiding principle of the CBD to which South Africa is a signatory; it may therefore enhance PRESENCE's appeal in attracting funding and institutional support. In addition, it seeks to balance the CBD objectives of conservation, sustainable use and equitable benefit of resources. It places people at the centre of biodiversity management by engaging the widest range of sectoral interests (Smith and Maltby, 2003). The Ecosystem Approach is functional in the sense that **it provides a simple operational checklist for guiding research** to support restoration and implementation.

The steps listed in the box below have close linkages to the Operational Model (§ 2.3.1) and the TAIF (§ 2.3.2) above; for example, Step A would have its roots in a social and biophysical research assessments and stakeholder analysis whilst Step D incorporates implementation in advocating adaptive management and organisational learning.

The Ecosystem Approach is based on 12 principles (see Appendix A) and has since been operationalised into five clear steps for realising implementation:

STEP A: Determining the main stakeholders, defining the ecosystem area, and developing the relationship between them (relating to Principles 1, 7, 11, 12);

STEP B: Characterising the structure and function of the ecosystem, and setting in place mechanisms to manage and monitor it (relating to Principles 2, 5, 6, 10);

STEP C: Identifying the important economic issues that will affect the ecosystem and its inhabitants (relating to Principle 4);

STEP D: Determining the likely impact of the ecosystem (management) on adjacent ecosystems (adaptive management over space) (relating to Principles 3, 7);

STEP E: Deciding on long-term goals, and flexible ways of reaching them ecosystems (adaptive management over time) (relating to Principles 7, 8, 9).

The current evolution of the Ecosystem Approach is said to put people and their natural resource use practices squarely at the centre of the decision-making framework (Smith and Maltby, 2003) and to be used in seeking "an appropriate balance between the conservation and use of biological diversity in areas where there are both multiple resources users and important natural values" (Shepherd, 2004).

Such areas are indeed found all over the world; however, the potential applicability to restoration in South Africa is immediately apparent. [3]

Shepherd (2004) outlines a number of tools that can be used in identifying the characteristics of ecosystem structure and function that are needed to deliver key ecosystem services. As Shepherd (2004) highlights, the most effective move forward is scientists and local community working together. Useful tools include: joint mapping, ground-truthing, transect walks and natural resource-oriented Participatory Resource Assessment (PRA) – and "monitoring exercises that measure change against base-line activities [and] build a two-way flow of knowledge and trust at the same time". Two particular statements of relevance - and something to remind ourselves of repeatedly when referring to our restoration knowledge base - are:

It is important to understand that knowledge will inevitably be incomplete at the beginning but that it will grow over time if harmonious working methods are set in place from the start.
and;
The Ecosystem Approach demands realism: often we must settle for what is possible, not what is theoretically ideal (Shepherd, 2004).

It should be noted that even though the Ecosystem Approach has been increasingly placed as a guiding principle for management approaches and accepted in government discourses, evidence suggests that opportunities to implement the approach are frequently missed. However, there are showcase examples where the approach has worked well and whilst there are various contributing factors, an 'enabling' environment with whole-of-government support is critical.

[3] EarthCollective has proposed **EASTCARE** (**E**cosystem **A**pproach for **S**ubtropical **T**hicket **C**onservation **A**nd **R**estoration in the **E**astern Cape) as a guiding research-implementation programme for ecosystem restoration in the Eastern Cape (with an initial focus on the Baviaanskloof and the Great Fish River Reserve). The EASTCARE proposal will pilot the (research) implementation of agreed PRESENCE priorities in these areas (beginning with the WUR students who were active in Baviaanskloof in late 2007). Outcomes of EASTCARE will feed into PRESENCE approaches and vice versa to ensure the strategy is adaptive in the following programme phases.

3 PRESENCE Research Themes

In this section, the six PRESENCE Research Themes are introduced with a summary prepared by the theme presenter [Introduction]. This is followed by the themes' overarching "Research Objective(s)" and a short statement relating to the "Implementation Relevance". A cross-table indicating how the various Research Themes interact with each other is also included [Thematic Interactions]. This table assists in interdisciplinary thinking and is intended to stimulate integration among the research themes. The next paragraph provides the "Priority Research Areas" as identified by participants of the workshop break-out sessions. . After this, some Research Themes contain a paragraph [Comment and Insights] with remarks made by experts prior to the workshop. Finally, "Points of Discussion" summarize key points and outcomes raised during the workshop and STRP Annual Review Meeting.

The "Priority Research Areas" and "Points of Discussion" will serve as guide for the delineation of the research priorities for the next phase of PRESENCE.

In Appendix D, a preliminary 'brainstorm' list of research questions is listed according to feedback received from various experts (workshop participants) who provided input during 2007.

3.1 Theme 1: Ecology: Ecosystem Functioning & Biophysical Processes

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3.1.1 Introduction

Into the thick of it: new perspectives on the ecology and evolution of subtropical thicket

The ecology and evolution of South Africa's subtropical thicket vegetation, which is concentrated in the south-eastern coastal region of the country, has been poorly studied and understood. The initiation in the early 2000s of the Global Environment Facility-funded Subtropical Thicket Ecosystem Planning (STEP) and Conservation Farming projects, led to a spurt of research that greatly enhanced our knowledge of this system. I summarise some of the new findings in this presentation, especially those relevant for restoration.

We now have an expanded concept of thicket in south-eastern South Africa that encompasses the mosaics that it forms with vegetation associated with other biomes. We also have a hierarchical classification of thicket for this region that recognises four major types (Thicket, Valley Thicket, Xeric Thicket and Dune Thicket), subdivided according to biogeographic locality and grain (solid vs mosaic). We are beginning to appreciate that thicket is part of a global biome of an ancient, early Tertiary formation that preceded fire-prone savannas, grasslands and sclerophyllous shrublands. Thus, the earlier concepts of thicket as a relatively young vegetation type, comprising and admixture of species derived from adjacent biomes, appears to be erroneous. We also now know – as has been hypothesised - that at the ecosystem level, thicket functioning is more similar to that of a rainforest than a semi-arid shrubland.

Much progress has been made in understanding the role of mammalian herbivores, especially mega-herbivores, as drivers of ecological patterns and processes in thicket. More light has been shed on the enigma of plant recruitment in thicket: while ramet recruitment predominates in the Xeric and Valley Thicket types, seedling recruitment may be significant in the Thicket and some Dune Thicket types. We also have a better picture of the extent of degradation of thicket, and have gained important insights on constraints and opportunities for restoring it, at least to a functional state. The STEP Project has provided a rigorous and defensible assessment of conservation priorities as well as a tractable strategy for implementing these.

Finally, some progress has been made with identifying – in addition to fodder for livestock - the services that thicket provides for humans, notably its potential for sustaining rural livelihoods, carbon sequestration, ecotourism, and wildlife ventures. However, much research remains to be done if we are to convince stakeholders of the value of using thicket in a sustainable way, both ecologically and economically. We need to test the notion of thicket as the "mother of all South African vegetation" through comprehensive phylogenetic and phylogeographical analyses of its component plant and animal lineages. This will provide a charisma that is currently lacking for this vegetation type. More research is required on ecosystem processes, especially with regard to nutrient and carbon dynamics. The population and community dynamics of Xeric and Valley Thicket remains an enigma: much more needs to be done. Of great importance is the role of fire in maintaining thicket boundaries and the composition of thicket clumps in mosaic formations. Given that thicket supports hugely more herbivore biomass than vegetation at equivalent latitudes elsewhere in the world, we need to know why this is so and what are the requirements to maintain this biomass. The massive rise in the wildlife industry, often involving extralimital[4] species, challenges us to understand the impacts of these species on biodiversity and ecological processes. While there is some appreciation of stocking rates for both domestic and indigenous livestock, a much finer-scale assessment is required. How do we monitor thicket – what are the benchmarks and indicators of change? We also need a better understanding of the many services, both direct and indirect, that intact thicket provides for the humans who live in its midst.

Finally, and most importantly, we require a much better appreciation of the ways in which humans view thicket and the choices they would make regarding its use or abuse. Without these insights we are unlikely to be in a position to mainstream the sustainable use of thicket into sectors traditionally seen as adversaries of conservation, namely agriculture, subsistence use and infrastructure development.

[4] Species do not historically occur in the area.

3.1.2 Research Objective

Improve understanding of ecology and biophysical processes in relation to (effects and impacts of) restoration strategies, e.g. ecosystem dynamics, plant-herbivore interactions, plant-people **perceptions.**

An important inclusion within this Theme - but not an explicit thematic focus during the workshop - is the sub-section on **horticulture** and propagation of plant species to be used in restoration. A related objective suggested here is: **to improve understanding on (horticultural) propagation techniques and survivorship of species used in restoration implementation.**

3.1.3 Implementation Relevance

Define strategies (how, when, where, why and what) for successful restoration over time/space; Ability to quantify and monitor effects of restoration, e.g. impact assessments perceptions.

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3.1.4 Thematic Interactions

Table 1 below provides an indication of how **Theme 1** can contribute to - and will interact with - the other Research Themes (from a research perspective) (See also Appendix C).

Table 1

Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information System
Establishes link between ecosystem functions and potential services derived; provides understanding for identifying, quantifying, describing and defining ecosystem services (e.g. biodiversity or ecosystem processes needed to maintain a service).	Provides basis for strengthening socio-ecological relationships; ecological characteristics underpin/contribute to stakeholder livelihoods. e.g. relevance of species & species composition for developing options for socially acceptable multi-functional land-use.	Enrich guidance for establishing baselines, indicators and priorities for organisational learning and policy/regulation for land management to maintain ecological integrity, functioning and ecosystem resilience (carrying capacity).	Indirect link: Underpins indicators for monitoring overall effectiveness of (financial) incentives for land management in restoring ecosystem processes & integrity.	Collation of baseline data (e.g. biomass, carbon stock, geomorphology) to test and develop methodologies to derive spatially and temporally explicit information.

3.1.5 Priority Research Areas

The workshop break-out sessions identified the following research project priorities:

Topic	Key Questions
Abiotic characteristics	• What are our needs for understanding abiotic characteristics in restoration? • What are the 'assembly rules' for thicket and riparian vegetation to optimise restoration? • Which are the optimal habitat characteristics (soil, aspect, slope, rainfall, etc; the 'environmental window') to achieve target assemblages? • How can we use surveys to determine the best potential sites are for restoration (based on optimal habitat characteristics)? • How can we build on results of Powell's MSc thesis: "Towards the restoration of Subtropical Thicket in the Baviaanskloof Mega Reserve, Eastern Cape".
Soil Dynamics	• What are the thicket carbon-soil dynamics and nutrient cycling that lead to carbon capture in the soil? • How can soils be manipulated (chemical/structural) to obtain the best rehabilitation results (creating a soil suitable for plant growth) • How do variations in soil nutrient cycling, micro biota and micro-organisms (across the landscape) affect rehabilitation? • What is the soil quality in invaded, cleared and intact areas?
Biodiversity	• When, how and where do we restore biodiversity? What indicators should be used? What happens after we maximize spekboom recovery? • What needs to be restored purely from a biodiversity perspective: desired services/ecological integrity/biophysical processes? • What baseline information do we need on other habitats like aquatic ecosystems?
Ecosystem dynamics	• How do we use succession theory to predict regeneration ecology of thicket and riparian vegetation? • What is the potential for reintroduction of other species especially bird dispersed plants across different states of degradation? • How can restoration be aided by ecosystem processes and symbiotic interactions (pollinators, rhinos, elephants, seeds in bird guano)?
Spekboom: survivorship	• What can we learn from spekboom mortality across different thicket landscapes: relationship between abiotic factors and physiology to spekboom mortality? • What is the population level mortality of spekboom across different thicket landscapes?
Differences between intact, restored & degraded ecosystems	• What is the reproductive biology of key species in thicket and riparian systems: species diversity (fauna & flora) (including sub-terrain/underground)? • What are the differences found in soil across various states (fauna: micro-organisms, earthworms, bacteria, etc, and nutrients)? *Fauna* • What birds and pollinators are using different stages of degraded thicket? • What landscape/vegetative features are attracting birds into the area? *Hydrology* • What is the effect of restoration on hydrology (e.g. base flows of rivers, sedimentation of dams and rivers, soil infiltration, water quality & water security) and watershed services? • What is to be learnt from the quantification of soil loss (as a result of degradation) and water gain (as a result of restoration)? • Does replanting degraded slopes reduce water runoff rates and improve water retention on the landscape and water quality?
Effect of fire	What are the constraints for rehabilitation of (riparian) systems after severe fire events (with a focus on the knowledge gaps from past research on the effect of fire on different soil types)?

3.1.6 Points of Discussion

- **Climate change:** Assess effects of climate change on restoration phenology (in the field).
- **River biodiversity:** Understand the current state of river biodiversity and how it should be considered from the (terrestrial) restoration perspective.
- **Microbiology:** Assess the diversity and abundance of invertebrates and microbiology in the soil as variables influencing spekboom survivorship. Consider the spekboom functions across the range of soil biota. How do micro-organisms influence soil dynamics for carbon storage?
- **Fire:** Which knowledge is available in the literature about the fire impact on soil and restoration? This is a remark to avoid repeating primary studies.
- **Coastal Forests:** Assess the carbon sequestration by coastal forests and consider the potential of including this biome in restoration strategies.
- **Efficiency:** Evaluate the use of machines to increase efficiency of the restoration. Although a need to maintain capacity building at the individual level.
- **Plant competition:** Advocate experiments including competitive plant species in the restoration design in order to evaluate the effect of ecological dynamics.
- **Monocultures:** Sensitive discussion exists about monocultures of spekboom but even if we try to restore 100% with spekboom, it is not possible as it is a highly palatable species and lays the foundation for natural recovery for other vegetation; if we overshoot then it is also reversible as it can be grazed (e.g. with goats) to find the balance we are seeking.
- **Spatial variance in data:** Still a lot of spatial variance in carbon data for spekboom is present and to get into the market the client wants something simple and easy to quantify. One of the challenges is the variability in results across different (test) restoration sites.
- **Challenges and unanswered questions:** A number have been identified for spekboom recovery: allometry; desertification (e.g. dongas[5]); water benefits; incentives; scaling up; and cracking the code of thicket restoration: how can we get other plants to return if spekboom doesn't work?
- **Key challenges to date:** Have not had as much success as seen on Slater's farm[6]; have not really penetrated the carbon market; still exploring innovative cost reduction; and have not really communicated the project well with your average 'Farmer Brown'.
- **Research overlaps with riparian restoration:** After clearing invasive species there are secondary problems with erosion and geomorphological changes, river bank destabilization, siltation of dams, reinvasion after clearing and loss of topsoil. How will these factors affect recovery?

[5] A donga is a gully in the wide open rural spaces of South(ern) Africa.

[6] Slater's farm is considered as the showcase where spekboom re-planting was successful - not only in survival rate and re-establish itself but also in counteracting soil erosion.

- **Riparian rehabilitation objectives:** Cost-benefit analysis, monitoring and evaluation protocols; best management practices; and broader support for the pilot project.
- **Indigenous grasses:** Some exciting results from the work done in Albany using indigenous grasses as has worked very well in suppressing the re-growth of alien seedlings: follow-up cost and time is much less.
- **Knowledge gaps for riparian rehabilitation include understanding:** The planting methods to optimize species survival; the stages of invasion where riparian systems require active rehabilitation and which are most suitable (e.g. in relation to cost-benefits); soil processes, aquatic diversity and social aspects (e.g. incentives needed for farmers and clearing teams).
- **Riparian rehabilitation:** Large issue of cost and what should be sold to the market. Cost of clearing can be up to four times what the land is worth - so need to look at the right to work programme as being the source of capital investment to restore these areas.
- **Sensitive areas:** When we think of restoration, we need to remember we are working in vulnerable areas which are near or beyond their threshold.
- **Marketing:** We need to think about how we market this (ecological) research to make it relevant. Consider aspects like seed production and making them available to the general market as there is a huge demand from farmers for seed to restore their thicket.

Theme 1A: Horticulture

Topic	Key Questions
Seed germination	• What is the viability of seed and the success of seed germination of thicket forest and fynbos species?
Propagation	• How does seed propagation and cutting propagation compare in terms of cost, practicality and field survival? • What are possible alternative methods or better ways of propagation (short cuts) to reduce costs and improve field survival in the field (e.g. direct field planting)? • How can we developing propagation protocols / horticultural rules (in nursery and in the field)? • What are the most frequently encountered plant species in degraded areas and which ones are the most practical species for planting?
Phenology	• When do key thicket species come into flower and produce seed? When is the seed ready for collection? How can this knowledge be best used? • How will climatic changes affect thicket and riparian phenology? Is there a need to establish a long-term monitoring programme on the impacts? • What are the effects of climate change on thicket/riparian distribution and reproduction (regular reporting of phenological observations)?
Techniques	• What is the relative success of different rehabilitation techniques such as stock, absorb, treatments (and use of brush-cutting)?

3.2 Theme 2: Ecosystem Goods, Services & Valuation

Presenter:
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3.2.1 Introduction

The Millennium Ecosystem Assessment (MA, 2005) highlighted the fact that degradation of ecosystems not only compromises biodiversity and ecological integrity, but also diminishes human well-being through the loss of ecosystem services (i.e. natural capital) and the benefits people receive from them (MA, 2005).

Critical ecosystem functions and services provided by subtropical thicket:

Provisioning:
- Supply of material for horticultural activities
- Resource harvest (medicinal plants, fuel, wood)
- Supports commercial & subsistence pastoralism

Cultural:
- Wildlife-based tourism, hunting & recreation
- Cultural & spiritual activities (biocultural diversity)
- Contribution to economic diversification

Regulating:
- Erosion & sedimentation control
- Climate regulation (provision of clean air)
- Sustaining water quality (purification)

Supporting:
- Provision of habitat (biodiversity)
- Maintenance of nutrient, carbon & water cycles
- Soil formation & retention

Source: Adapted from STEP, 2006; De Groot *et al.*, 2006; Wiersum and Shackleton, 2005; following MA, 2005.

The rural poor and others dependent on nature's services are often worst affected by this trend; both the loss of services and the depletion of natural resources intensifies the struggle to fulfil all their requirements (Cocks and Wiersum, 2003). Local communities can be hurt directly in terms of physical hardship (e.g. through the loss of water quantity and quality) or indirectly through higher costs (e.g. services previously provided by ecosystems are replaced with costly infrastructure) and increased vulnerability to adversity (De Groot *et al.*, 2006).

Understanding the value and importance of ecosystem services to livelihoods is critical for defining the role of (landscape) restoration in effective (participatory) natural resource management.

Integrated assessments such as ecosystem service analysis will, in drawing on local knowledge, provide a solid basis for identifying ecosystem benefits, uses, values and perceptions of the

thicket biome across stakeholder groups. It aims to assess the diverse opinions held by various groups regarding the extent and implications of degradation and which land-use features should be rehabilitated as a priority. Results may be coupled with spatial analysis through use of geo-information systems to aid restoration planning, management and monitoring.

The introductory presentation to this session:

- Explained how to link ecosystem structure, process and functioning (= theme 1) with ecosystem goods & services and give a few examples of the main services from (thicket)-ecosystem(s);
- Gave a brief overview of the many values (ecological, social and economic) of (thicket)-ecosystem services;
- Concluded with a reflection on how information on ecosystem services and values can contribute to more awareness about the (economic) benefits of ecosystem restoration (which are usually higher than the costs) and thus how it can contribute to livelihood-improvement (= theme 3) and sustainable financing mechanisms (= theme 5).

References and further information:

The above introductory text is extracted from the PRESENCE Proposal submitted to WUR-INREF in January 2007. Complementary information on ecosystem services and valuation can be found at *naturevaluation.org* & *maweb.org*

3.2.2 Research Objectives

Refine and develop methodology: e.g. identify participatory methods for valuing ecosystem services 'meaningful' to stakeholders; and linking ecosystem services to landscape character;
to
Assess and value ecosystem goods and services (socio-ecological, socio-economic, socio-cultural) in terms of their use, perceived importance and contribution to well-being across different scales (local, regional, national, global).

3.2.3 Implementation Relevance

To build a strong case for mainstreaming thicket restoration and conservation by better understanding the value of services provided by (restored) thicket to livelihoods and well-being;
To identify spatial priorities for restoration and conservation based on perceived importance/value of goods and 'services';
To provide additional justification and basis for developing mechanisms for financing and rewarding ecosystem management.

3.2.4 Thematic Interactions

Table 2 below provides an indication of how **Theme 2** can contribute to - and will interact with - the other Research Themes (from a research perspective) (See also Appendix C).

Table 2

Theme 1 Ecology: Ecosystem Functioning & Biophysical Processes	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information Systems
Prioritises and provides context for ecological research and understanding by providing feedback on the use and perceived importance of specific ecosystem functions/services.	Provides information on the use, value and perceived importance of services to stakeholder livelihoods and identifies competing claims & trade-offs.	Prioritises and provides context for policy research aimed at restoring and safeguarding ecosystem services, values and benefits.	Provides information on ecosystem goods, services and values which can potentially be traded and used for equitable compensation schemes.	Provides information on ecosystem values to be mapped and weighted into GIS layers/analysis.

3.2.5 Comments and Insights

"We do need additional research on valuation, we should focus on those functions that deliver tangible benefits and those for which markets exist – in other words, we need to focus on thicket's ecosystem services. These need to be identified in the social assessment."

3.2.6 Priority Research Areas

The workshop break-out sessions identified the following research project priorities:

Topic	Key Questions
Participatory ecosystem services valuation	• What will a social valuation of ecosystem services tell us about restoration priorities? • What are people's perceptions on 'degradation' (in terms of (lost) ecosystem services)? How do stakeholders perceive and value different goods and services provided by intact and degraded (thicket) ecosystems? • Which are the actual ecosystem services of meaning to stakeholders (as opposed to ecosystem functions only)? • Who values what and to what extent (valuation)? How do these values differ over temporal and spatial scales? • What local ecological knowledge already exists? How can we best use this? • How can the elicited information be disseminated according to the needs of different stakeholders? How can this information be made meaningful? • How can the information be translated into awareness building and behaviour change in relation to conservation and restoration?
Scenarios and trade-offs for the restoration of ecosystem services	• What are the trade-offs when restoring ecosystem services (biodiversity/carbon/livestock grazing/water/freshwater ecology)? • What is the variation across thicket types in terms of which ecosystems services are best produced where? • What are the future scenarios for restoration (from an ecosystem services valuation perspective?) What thresholds can we identify? • Will net benefits of restored land outweigh present benefits? • What are the economic benefits of restored ecosystem services? How does this compare with current economic activities (spatially explicit)? • How can trade-offs be minimised by translating ecosystem service values into financing mechanisms (e.g. Payments for Ecosystem Services) for restoration (see Theme 5)?

3.2.7 Points of Discussion

- **Key Questions:** What are the ecosystem functions, goods and services? How can we quantify them? How can we map them? How do we define and measure values? For whom are they important? How do we use the information to determine where and how to restore and, finally, how to finance?
- **Definitions:** Ecosystem functions are the capacity of ecosystem components and processes to provide goods and services that satisfy human needs (indirectly and directly); Ecosystem services (and goods) are the benefits people derive from ecosystems.
- **Private costs:** What are the (other) ecosystem services for which this can be applied?
- **Fire classification:** Does fire count as an ecosystem function or service - as in some cases used for resource rejuvenation which is a service. There is a risk of fire and damage to infrastructure – can one bring that into the calculation? The impact of fire depends on the system as well – it can be a biological control service but must look at it case by case to see if fire is an integral part of the system
- **Modelling ecosystem services:** This can be a challenging and time-consuming task – it is necessary to prioritize what you want to model and ensure that those doing the modelling are brought in early into the process to ensure that the right data and information is sought from the beginning.

3.3 Theme 3: Stakeholders, Livelihoods & Social Assessment

Presenters:
Dr. Michelle Cocks *(was unable to attend workshop and offered her apologies)*
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Bas Verschuuren *(presented in Michelle Cocks' absence)*
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3.3.1 Introduction

The presentation provided an overview of the importance of understanding how stakeholders' value nature from a livelihood and cultural significance perspective and how these relate to their images of nature. This was followed by highlighting the relevance that such an understanding has for restoration and natural resource management strategies.

Research conducted in the Eastern Cape has revealed that natural resources gathered from the environment fulfil a range of livelihood (Shackleton *et al*. 2002, Hebinck and Lent 2007) and cultural needs (Cocks 2006) among local indigenous communities. The use of natural resources for cultural needs remains important across the wealth and the level of education of the household head. These findings are obviously in contradiction to current thinking, which largely portrays natural resources as only contributing to rural households' subsistence livelihood and 'safety-net' needs (Cavendish 2000; Wunder 2001; Shackleton *et al*. 2002). Thus, the use of natural resources is not solely restricted to representing a poor man's activity but that they also fulfil a very important cultural role in peoples' lives and provide an important sense of well-being. We therefore need to give more attention to the social processes impacting on the use of natural resource products (Cocks 2006) from each identified stakeholders perspective.

Cultural values are attached also to areas or units of vegetation, such as sacred forests, rainmaking sites, land marks (Posey 1999; Goebel *et al*. 2000). Thus cultural values of the natural environment may take on several manifestations which relate not only to the religious roles of forests but also to individual species harvested to fulfil cultural needs (Cocks 2006). The reciprocal relation between cultural diversity and biological diversity has been portrayed as a potential tool to promote biodiversity conservation (Laird 1999; McNeely 2000, Cocks 2006). Cultural diversity has been noted as sustaining a wide variety of use and conservation practices of biodiversity (Dasmann 1991; Posey 1999; McNeely 2000).

It is also necessary to identify and acknowledge the different dominant images of nature that stakeholders perceive. Images of nature have been identified as a powerful tool to formulate and develop appropriate goals and strategies for natural resource management. Empirical research has consistently shown that individuals, beliefs and value orientations are important influences on nature-related perceptions, attitudes and behaviour (Buijs 2007). To date this type of research has largely been conducted in first world countries such as The Netherlands (Buijs 2007, Jacobs 2006) and very little in developing countries, which contain a diverse range of stakeholders differing along race lines, cultural orientations, wealth and levels of education.

Three types of cognitions which have been identified as constituting one's image of nature, a) *beliefs*, b) *norms or values* and 3) *aesthetics valuation criteria* and the relationship between these should be understood (Buijs 2007). The practical value of understanding local peoples' images of nature is that they can be used to show the heterogeneity of values, beliefs and value orientations amongst different groups and this can aid planners, managers and policy makers in understanding the diversity of local people's opinions of natural resource management. Consequently, ensuring more effective strategies for restoration and natural resource management strategies are implemented.

3.3.2 Research Objective

Understanding, assessing and making spatially explicit the importance and influence of livelihoods and stakeholder networks in relation to mainstreaming restoration strategies, e.g. willingness to participate, burnout and cooperative arrangements.
Understanding what different stakeholders' values of nature (thicket) are from a livelihood, cultural significance perspective and how these relate to their images of nature.
Determine the significance of the above for restoration strategies & natural resource management.

3.3.3 Implementation Relevance

To support participatory restoration and create an 'enabling' environment by recognising:

- different stakeholders' images of nature, livelihood and cultural needs;
- trade-offs between restoring desired ecosystem services and sustaining socio-economic activity for restoration strategies and natural resource management.

3.3.4 Thematic Interactions

Table 3 below provides an indication of how **Theme 3** can contribute to - and will interact with - the other Research Themes (from a research perspective) (See also Appendix C).

Table 3

Theme 1 Ecology: Ecosystem Functioning & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information Systems
Indicates which species and ecosystem processes are of importance for setting research priorities in terms of their relevance to stakeholder livelihoods and social preferences.	Signals most important use and non-use values in order to determine which ecosystem goods and services are linked closest to - and supported by - restoration activity from a social perspective.	Identifies opportunities and impediments within current processes in terms of the potential for creating an enabling, environment for stakeholders' to effectively engage in restoration.	Identifies stakeholder preferred incentives for maintaining or improving livelihoods and networks whilst participating in restoration.	Provides information for visualising stakeholder relationships, interactions, networks and social preferences in terms of their spatial relevance.

3.3.5 Comments and Insights

"How do stakeholders perceive and value the different goods and services provided by thicket and degraded landscapes, and what they consider their future relationship with these ought to be?

- This must be done systematically so as to assess how values are distributed over different categories of local people;
- Determine what the features of an thicket and degraded landscapes are, in terms of species richness and abundance;
- Determine trends in the change of floristic composition of agro ecosystems landscapes in relation to land transformation.

Furthermore, strategies for disseminating the information learnt according to the needs of different stakeholders needs to be explored, i.e. policy makers, managers, planners, and researchers in the field of nature conservation, as so often this not taken into consideration.

These two approaches we believe are needed to determine the significance of culturally-valued landscape elements for biodiversity conservation both, from an ecological perspective and a local use /conservation perspective, so as to determine if these values can contribute towards biodiversity conservation/improve management in the area. If found to exist, one needs to develop socially responsive and ecologically appropriate policies for the conservation and restoration of natural landscapes in the area."

"The Xhosas like having their cattle and goats. By entering the carbon market the potential for grazing will effectively decrease while the livelihood options/potential will increase if our results are correct. How do we marry stock farming and the culture around it with the restoration of thicket and accessing the carbon market? We will never convince them to get rid of their cattle. What is the middle road that will work for both parties?**"**

3.3.6 Priority Research Area

The workshop break-out sessions identified the following research project priorities:

Topic	Key Questions
Access to natural resources	• What are the existing (cultural) rules and regulations for accessing resources? How are people restricted or enabled to use their natural environment? How will restoration affect current access arrangements?
Cultural values of nature	• How can we link culture and biodiversity through stakeholder images of nature? • How do we restore cultural values? How do we monitor changes in cultural values? How do we determine what is desirable over the long-run? • How do we assess the values people have in relation to nature that underpin the ways they view, use and relate to thicket? • How do communities perceive degradation? How does this (spatially) link to people's values, ethnicity and historic realities?
Perceptions of restoration, degradation and indicators	• What are different stakeholders' perceptions of the thicket rehabilitation project: what are perceived costs-benefits/trade-offs? • What indicators do various stakeholder groups use to determine ecosystem health, different states, alien species, value systems? • What comparisons can be made between social issues in communal and commercial areas and their reaction to rehabilitation (SWOT)? • How do we ensure use and non-use values are sustained (e.g. composition of species of perceived importance)?

3.3.7 Points of Discussion

- **Restoration costs:** Assess the impact of restoration costs into the market prices of natural capital. How can the restoration costs be aggregated to the prices in a way that the ecosystem can be used in a sustainable way by local communities?
- **Natural resource use:** Restoration should also be recognized as a development strategy once the natural capital restored brings back "eco**s**ystem products" into the market.
- **Medicinal plants:** Look at ways to transfer/apply existing evidence around medicinal plant use in forests to thicket.
- **Variables:** How can we enable and ensure successful restoration considering the social variables and cultural differences over space and time?
- **Social landscape:** Integrate the social landscape into the context of the restoration up-scaling with due consideration given to the perceptions of landscape use by people.
- **Short-term benefits:** What are the short-term benefits restoration could provide to local stakeholders in order to secure financial sustainability during the initial stages of the restoration?
- **Behavioural change:** How can the perception of nature protection be enhanced and embedded in the consciousness of the people? We need community-based people who are agents of behavioural change and make use of a multifaceted approach.
- **Rotational grazing systems:** Previously collapsed – do we have the capacity to revitalize?
- **Contractors' expectations:** Which mechanisms need to be put in practice to improve the expectations of the former workers and contractors of the Working for Water programme? How can these workers be supported and motivated to put their acquired training to use?
- **Up-scaling:** A big challenge may exist here – it is very important that we account for the diversity of those stakeholders involved and that this variability doesn't override whether the overall project is a success. Environmental sociologists need to be involved from the beginning and we need to assess the social landscape using true social scientists.
- **Perceptions:** Very important to assess the perceptions of landscape use by people; to look at and understand the motives as to why people behave in the ways they do – and then to capture this information visually and spatially.

3.4 Theme 4: Policy, Institutions & Governance

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3.4.1 Introduction

This presentation gave an overview of policy and governance research related to environment, development and climate change. To encourage discussion the main focus was on the interplay between centralised government control and networked governance arrangements that: 1) are inclusive of a wide group of actors to ensure more timely and inclusive decision making; 2) introduce mechanisms that efficiently and equitably facilitate payments for ecosystems services; and 3) require novel institutional arrangements to ensure trust and compliance.

The shift to more inclusive conservation techniques, recognising existing land and resource patterns brings with it the need for more inclusive techniques for representing the interests and values of a diverse set of actors beyond government authorities and departments. Experience tells that these arrangements should be flexible and adaptive enough to respond to incorporate the capability of resource users to cope with external economic and political pressures and internal social, ecological and cultural change. These mechanisms reorient the authoritative role of the state to compliment the consensus based rules and norms of resource users. However, key questions remain as to what mechanisms can steer the empowerment of resources users, thereby ensuring greater compliance with conservation measures in the Eastern Cape.

Carbon funding mechanisms, such as Clean Development Mechanism (CDM) and voluntary carbon offset projects, provide new opportunities for financing conservation. The global nature of these mechanisms requires new institutional arrangements to ensure that 'carbon for conservation and livelihoods' is a trusted and therefore legitimised policy programme. A range of questions remain. How can trust be built over carbon 'additionality' measurements? How can conservation ensure both the security of local livelihoods and sequestered carbon? How can national and provincial government institutions provide support to local actors to secure carbon and conservation while also fostering their capacity to diversify livelihoods?

Given the novelty of combining conservation and global funding mechanisms, questions also remain over how government can most efficiently and effectively organise and manage

resources. Attention is often given to the role of government in ensuring efficient acquisition of funding from sources such as the CDM, but before this can happen, the responsibilities of different Ministries, departments and agencies for carbon and conservation need to defined and allocated. In the case of the Eastern Cape, this may be of particular concern given the incorporation of a land based resource under the various jurisdictions of conservation, agriculture, livestock and forestry. Who is responsible for these resources? Are responsibilities well-defined? And is there coherence between policy and legislation from various departments and Ministries and authorities?

Evaluate existing arrangements and potential options for policy, institutions and governance at global and regional levels which support or limit restoration strategies (e.g. CDM, poverty reduction).

3.4.2 Research Objective

3.4.3 Implementation Relevance

To understand what policy and institutional (learning/change) processes are needed to provide an enabling environment and enhance the potential success of restoration strategies.

3.4.4 Thematic Interactions

Table 4 below provides an indication of how **Theme 4** can contribute to - and will interact with - the other Research Themes (from a research perspective) (See also Appendix B).

Table 4

Theme 1 Ecology: Ecosystem Functioning & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information Systems
Identifies policy and institutional boundaries which may be instrumental in driving restoration and thereby helping to define and prioritise related ecological research. Provides impetus to reassess present arrangements.	Identifies opportunities for integrating ecosystem services assessment and valuation in policy and decision-making processes – and giving outcomes greater policy relevance.	Provides information for understanding the institutional arrangements and circumstances under which the social assessment can be carried out (e.g. opportunities and constraints for collective stakeholder agreements).	Uses an understanding of governance arrangements to identify opportunities for financial instruments and arrangements for restoring natural capital. Indicates bottlenecks in current policy and institutional frameworks for financing long-term restoration.	Provides additional layers to spatial understanding of the complex systems by providing information on socio-political constraints affecting restoration.

3.4.5 Comments and Insights

"How should policy change within organizations to ensure that restoration projects are funded via the carbon industry? A number of institutions are keen but they do not seem to have the policies or institutional frameworks in place to take advantage of the situation."

"We need to envisage the restoration project as a social process. Seeing our project as a process will enable us to identify priority actions in a more strategic way. The big gaps lie in the social assessment, "Stakeholders, Livelihoods, etc" and "Policy, Institutions and Governance". Without understanding our socio-economic and governance contexts, we are bound to make mistakes. [There is a] need to establish an effective learning organisation that can respond to feedback from the field (social and ecological), ensure that interventions are designed as action research, and make sure that lessons are disseminated."

3.4.6 Priority Research Areas

The workshop break-out sessions identified the following research project priorities:

Topic	Key Questions
Institutional networks (Who's who in the zoo & what do they do?)	• How can we develop an organogram of the decision-making structures and people/organizations involved in restoration? • What organisational responsibilities do we need to be aware of to help ensure institutional/organisational buy-in (as opposed to just individual buy-in)? • How can we use institutional networks to galvanize government at different scales to reduce degradation (ensuring monitoring and accountability)? • What are the future scenarios for these institutions with impending change? • What do we need to know in order to deal and adapt to such change?
Institutional design and arrangements (Adaptive co-management)	• What institutional arrangements promote trust by and between stakeholders? • How do we mainstream restoration at an institutional level (in regional development, municipal planning, Integrated Development Planning (IDP) etc) • What do we need to know in order to design institutions (and arrangements) for communal lands that are effective and equitable? • How can we devise incentives/structures that are responsive and adaptive? • What novel forms of governance are required to ensure that restoration (and carbon benefits) can flourish (over the long-term) on communal lands? • How can we guarantee adaptive institutions that ensure the equitable distribution of (e.g. carbon/payments for ecosystem services) benefits? • What institutional capacity is needed to deal with the CDM and how to integrate CDM across different governance levels? • What is the role of the state in supporting stakeholder groups? e.g. leverage • What are the implications of CDM for title deeds and land tenure arrangements? • How easily can farmers and communities enter the carbon market (gap analysis)? • What sort of adaptive co-management arrangements need to be realized at local/regional scales to successfully implement CDM? • What is the capacity of local institutions to support, engage and promote ecosystem management and restoration? • How do we mainstream restoration priorities in land and water use planning at municipal and regional level? How can restoration be integrated into IDP? • How can the above be demonstrated/analysed spatially? How can social variables be mapped onto biophysical mapping/data? • What opportunities are there for different stakeholder groups to organise (their structure and function) to conserve thicket, create and market carbon? • What is the adaptive capacity of market-based governance mechanisms such as CER and VER's?
Environmental education, training and advocacy	• In what ways can we best employ environmental education: towards which stakeholder groups? Will it make a difference (in terms of mainstreaming)? • How can we create an enabling environment for education and training in ecosystem management and restoration? • How can environmental education ensure organizational behaviour change? • How can we develop relevant and engaging education and training programmes for different sectors and stakeholder groups (schools, communities etc)? • How do we employ social marketing in understanding people's views, needs and constraints: how do we market restoration to ensure societal 'buy-in'?
Land reform policy and restoration	• What approaches should we use to investigate land reform policy and restoration programmes in the Eastern Cape? How can this information inform governance and decision-making processes? • How do we effectively capitalise on the opportunity to 'buy up' degraded lands and set up community cooperatives to restore it? (co-governance) • How does land (thicket) use, access, support and funding differ between different tenure arrangements?

3.4.7 Points of Discussion

- **Novel forms of governance:** Are needed to deal with fast moving global processes while still attending to existing local ownership, access and management. The global carbon challenge is made up of fast moving variables which require fast moving institutions.

- **Adaptive transitions:** To adaptive co-management and to adaptive governance: - link to global regimes when you bring in carbon emissions: balance conservation, livelihoods and carbon aims.

- **Building trust in markets:** In a (carbon) market if the buyers don't have the trust then it brings risk to the restoration programme.

- **Building trust through institutions:** Especially for those planting (spekboom). There needs to be a level of trust that people feel they can acquire the capacity to access the market. Need to be aware that the value of carbon may exclude locals from the land they own.

- **Governance coherence:** What is the coherence between Government departments? Can state institutions remain adaptive enough to secure carbon storage while ensuring local benefits? Can market mechanisms be adaptive to ensure local benefits? (e.g. Kyoto protocol has a 15 year lag time – is this good enough for restoration purposes?) What new capacities are needed by different stakeholders?

- **Recognize existing rules in the communities:** May need to promote an internal organization within communities to empower them to trade and actively engage in the carbon market.

- **Farming co-ops:** Will need to form co-ops to get money to farmers unless it is a large farming operation. A larger operation could go the CDM route but it is a long and costly process to get carbon credits certified. In South Africa, co-ops were developed around sourcing material such as fertilizers at reasonable price. For restoration, we need a collective form of governing related to ecosystem services. There is a transition with the majority of commercial farmers belonging to co-ops which are financially strong; therefore it could be relatively easy to add another 'arm' to support carbon/restoration activities. Co-op structures could be more of an issue with communal lands; the challenge is to engage and secure the buy-in of the traditional leaders of the communities who have related knowledge which we can tap into.

- **Voluntary market:** An innovative farmer may be able to tap into voluntary market through airline companies or supermarket chains but there is no such mechanism currently in place.

- **Income distribution:** With poverty alleviation, income distribution mechanisms can often be an issue. Need to be aware of how to deal with this.

- **Land redistribution:** An opportunity lies in land redistribution; 30% of current thicket biome (farmland) is subject to redistribution. Suggestion has been put forward to look at three land tenure types: state land, freehold and communal land and that the 30% redistribution would probably not go directly to communal land as it effectively state land but managed under a different regime. So the 30% will mainly go to freehold land. However, the point was made that a lot of land is actually redistributed through communal property associations.

- **CDM certification:** Expensive and difficult – co-operative structures offer a promising way forward. Need to understand how the trading of carbon works as it is a lengthy process. Should be transparent to those involved to minimise risk from dubious outside investors.

- **Project Design Document (PDD):** The pivotal importance of the CDM PDD and finding the capacity required to handle the document and get it through the process. The PDD is an extremely 'heavy' document requiring lots of time and a full-time skilled person available to work on it. It needs to be submitted in order to get funding? How? A key barrier to entry.

- **Need for CDM approval:** Suggested that CDM approval - and following project design methodology - is needed in order to acquire highest price from the voluntary market. But do the financial benefits reach the people on the ground? Suggested that a cost-benefit analysis is needed between CDM and voluntary market markets. How do they both work in practice? Also critical to address issues revolving around trust.

- **CDM and institutional arrangements on the ground:** Key questions remain particularly regarding communal land or private tenure – might be very important for long-term sustainability, e.g. changing title deeds. Often seems simpler at the higher level but on the ground can be a different story. Challenge will be in solving institutional issues with land tenure – private will be difficult enough; state and communal even more so.

- **Buyer-seller chain:** The shorter the chain from buyer to seller the better and that's where North-South relationships are critical. How can one shorten this chain through which finances are flowing? For example, using carbon developer companies as they take on the costs themselves and transaction costs nil for project developers. How to short circuit the whole long chain so money goes to the trees and people and not with the middle-men.

- **Seeking a triple windfall**: creating jobs, restoring thicket and capturing carbon. Should also investigate other potential land uses such as tourism, game farming, medicinal plants and goat farming at sustainable stocking rates.

- **Governmental implementation:** Restoration may find greater success in Government with Land Affairs than with Agriculture.

- **Marketing challenges:** The hurdles are political and financial but also the willingness of partners: it is much easier to sell cows than to promote and sell biodiversity. People will wonder whether you can harvest or sell spekboom once you have grown it – many do not grasp the concept of a carbon market and how it works. Will need information strategy.

- **Example of Costa Rica:** Costa Rica provides a good example of institutional arrangements. We need to accept that we will not get rid of all the goats but that it is better to try and reduce the numbers and increase the number of woodlands. In Costa Rica, the market was built on cooperatives and there may be avenues for South Africa to explore the potential with their traditional leaders to fence areas and hope that people will see the difference – after these areas have been rehabilitated, they can be grazed in a sustainably managed way.

- **Community agents of change:** We need to find community based people who are agents of change; insiders within the community who have enough influence and motivation. We need to continue to develop our (community) forums so they can achieve this.

- **Environmental literacy:** We will face a battle if we do not include environmental literacy in planning environmental projects – we are waving the job trump card but do not appear to really understand the dynamics. The jobs end and the people involved still do not really understand the biological/environmental side of things.

- **Capacity:** Do we have the capacity to achieve our objectives? Some of the points listed are the foundation for the success of the programme: the perception of nature protection needs to be enhanced and embedded in the consciousness of the people involved.

- **Partners:** Two types we need to involve: the NGOs to provides contact with the relevant people (funders) and inform whether we are on track or not; and academics institutions – need to justify why (poverty relief) money should be devoted toward research and why relevant to management.

3.5 Theme 5: Financing, Payments & Reward Mechanisms

Presenter:
Prof. James Blignaut
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james@jabenzi.co.za

3.5.1 Introduction

This presentation had four sections starting with the question what is the Restoration of Natural Capital (RNC), followed by sections covering valuing restoration, mechanisms for financing restoration and then, lastly, a conclusion. The lion's share of the presentation dealt with ways of valuing restoration on what is elaborated here.

The common way to estimate the value of natural capital is to either use market prices, or to estimate the discounted net present value of the sum of the future income stream derived from such a stock (United Nations 2003). Both market values - because they are not available - nor the net present value method is appropriate to value the restoration of natural capital since natural capital and its restoration has completely different properties than that of manufactured capital. Various studies have therefore resorted to use replacement cost as a direct proxy, this is a method endorsed by the Systems of Natural Resource Accounting fraternity as documented by the UN (United Nations 2003:272):

If there are no market prices and it is not possible to calculate the net present value of an asset, then the cost of producing it may be used as a lower bound on its value.

This statement deserves our full attention for a while. First, by focussing on the replacement cost of natural capital in the context of restoration, natural capital will have to be valued so as to reflect its increasing scarcity value over time. Also, one will have to consider the increasing difficulty to restore a system that is undergoing continual degradation over time. Simply put, restoration today costs less than restoration tomorrow, and in some event we simply cannot afford not to restore today!

Second, by valuing the asset based on its replacement cost one couples the act of restoration to the value of the resource and thereby one is not commodifying the asset by linking the asset's

value to the flows, but rather indicating that natural capital has value, that restoration costs money, and that it is likely to cost increasingly more over time, rather than less.

One is also focussing on the system as a whole and not on individual processes or functions that are either impossible or very hard to measure and quantify, let alone value. Further, should one only focus on maximising the sum of the flows of individual processes one could come to perverse conclusions such as which to maximise carbon sequestration in an area what used to be a wetland or grassland by planting an exotic species with a high carbon sequestering capacity, or to maximise water runoff by removing all riparian vegetation.

Third, valuing the asset this way is also in line with the method prescribed when determining the value of the consumption of fixed capital stock. Which, in effect, is what we're dealing with when considering the restoration of natural capital. Degradation is the consumption of natural capital, but to make provision for its replacement, i.e. restoration, the asset to be restored should be valued at its appropriate replacement cost.

Fourth, the System of Environmental and Economic Accounting (SEEA) make the statement that replacement cost is likely to underestimate the value of the asset by rendering a lower bound value. This might be true for most assets, but in the case of natural capital restoration, it is not necessarily the case since restoration could take a long time, cost a large sum of money, and renders services whose values are not easily quantifiable. The replacement costs of either species or system, natural capital, is also likely to increase exponentially as the natural capital approaches its limit function, i.e. approaching thresholds of critical natural capital. The value will be infinite at the limit, and zero beyond the limit, i.e. at extinction of species. This relationship is indicated here in Figure 1 below.

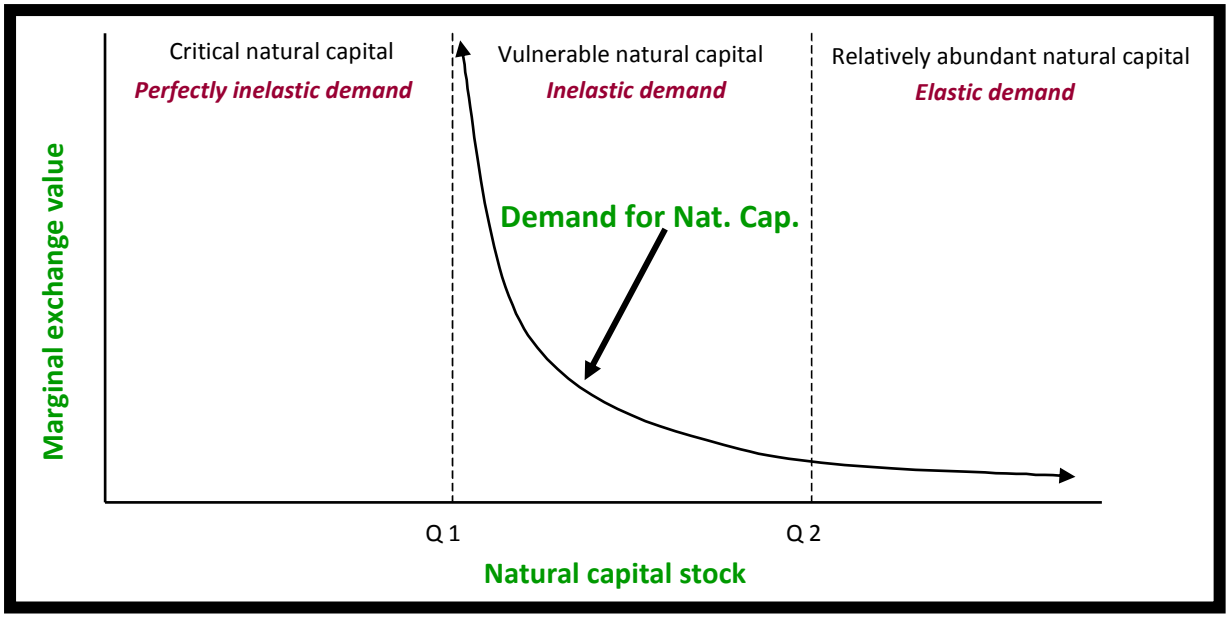

Figure 1: ***The inverse relationship between the level of the natural capital stock and its marginal exchange value.*** *When natural capital is relatively abundant its value is low and the unitary change in such is low (demand elasticity <1), once natural capital becomes more vulnerable its value rises and the unitary changes is high (>1) and approaches infinity (at levels of critical natural capital).*
Modified from Farley & Gaddis 2007.

The United Nations document cited above (United Nations 2003:272) states that the benefits of reproducing the asset should at least be equal the costs of producing it. In other words; the cost of replacing or restoring the natural capital should not exceed the benefits derived from it. A few qualifications to this statement are, however, required. First, this qualification can only be deemed appropriate when one do not consider critical natural capital. When systems do approach such threshold levels one has to apply the precautionary principle and restore the system. That is the price society is paying today for living beyond its means yesterday.

Only a few studies have tried to calculate the economic benefits of restoration and all of them did so by calculating the beneficiaries' willingness-to-pay through contingent valuation studies, which is a method to capture the use value of the resource or natural capital. These studies indicated, among others, the exponential rise in the demand for ecosystem goods and services as provided by restoration as the natural system becomes more intact. In others words; the more a system is being restored, the more people benefit from it and the more they are demanding services from the restored natural capital. This inverse demand function is Jevons' paradox applied to natural capital and restoration. The technology, restoration, is improving the efficiency of the capital stock so that the capital stock produces more goods and services and more efficiently so than before restoration.

The demand for both natural capital and its goods and services increases exponentially as restoration increases, i.e. the use or application of the new technology. It should be noted that by applying positive discount rates to estimate the net present value of ecosystem goods and services assumes a reduced future value of such ecosystem goods and services, further proof that such a measure is inappropriate.

A more complete way of dealing with the matter is to consider the benefit of restoring natural capital as the opportunity cost of not restoring. This implies that the benefit of restoration is equal to:

- the sum of the future flows provided by the restored system using a discount rate that would reflect the increasing cost of replacement if such restoration was not done, plus
- the cost avoided by the restoration activity, which includes both the mitigation and adaptation cost that will be required if the system is not restored, plus
- any other additional benefit such as training, job creation (the value of which could approach the total wage bill in conditions of high unemployment) and cultural and other intrinsic values.

3.5.2 Research Objectives

Investigate (the economics behind) equitable financing, payment and compensation mechanisms that mainstream restoration, support dynamic rural livelihoods and reward sustainable land management.

3.5.3 Implementation Relevance

To develop restoration as a financially viable alternative land-use over time (long-term) and space;
To mainstream restoration strategies through equitable incentive and reward arrangements.

3.5.4 Thematic Relevance

Table 5 below provides an indication of how **Theme 5** can contribute to - and will interact with - the other Research Themes (from a research perspective) (See also Appendix B).

Table 5

Theme 1 Ecosystem Structure & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 6 Remote Sensing & Geo-information Systems
Identifies key ecological indicators and benchmarks for restoration against which financing schemes will need to be monitored and measured. Establishes ecological research criteria needed to guide financing schemes for rewarding restoration.	Prioritizes ecosystem services research by linking values to financing schemes which offer the greatest potential uptake. Harmonises ecosystem services valuation research with actual willingness to buy, sell, reward or compensate services delivered/preserved through restoration.	Financing schemes may influence livelihood analysis, options and scenarios and the networks or arrangement within which stakeholders operate. Recognises the complex and highly dynamic stakeholder relationships that set the context for any system of compensation or rewards.	Identifies opportunities and constraints in current policies and institutional frameworks for establishing incentives relevant to restoration financing whilst ensuring equity and benefit-sharing.	Provides information for spatial analysis, assessment and scenario-building of how financing schemes may influence – or affected by- biophysical processes, stakeholder preferences and interactions, socio-economic factors and governance arrangements over time and space. Provides linkages between 'buyers and sellers' of ecosystem services.

3.5.5 Comments and Insights

"I'd also caution against too much focus on carbon credits. The restoration initiative needs to be based on more than just carbon sequestration. Basic back of the envelope calculations tell us that biological carbon sequestration alone cannot reduce carbon emissions by much. Apparently if all ecosystems in the world were at climax (i.e. max carbon storage) we'd only sequester less than 10% of our expected emissions over the next 30 years.

Economists have run with the idea of carbon credits and turned it into a profitable market and we should take advantage of that, BUT as with all markets it will only last so long and when it collapses the restoration initiative needs to have something else it can stand on, i.e.: take advantage of carbon credit initiatives now, but don't bet on them in the long term!"

"It is important for us to get a handle on how the dividends of carbon sequestration (the cash) will be distributed among the communities in the communal areas without causing problems (some people losing out and others gaining)."

3.5.6 Priority Research Areas

The workshop break-out sessions identified the following research project priorities:

Topic	Key Questions
Build on ecosystem services valuation to establish related markets	• How can we economically identify and value (thicket) services and establish effective markets/buyer-seller arrangements (esp. non-carbon services)? • How can the 'value' of the (subtropical thicket) biome be established and translated into incentives for ecosystem restoration and conservation? • How can we use economic values to build the case for the restoration of natural capital? How will this resonate across various stakeholder groups? • Which incentives work best and at what scale? How can we develop an optimization model in relation to changes in market prices and values? • To what extent do selected ecosystem services need to be 'bundled'? • What other arrangements exist and are socially desirable/acceptable (biodiversity banking, subsidies, tax breaks, communal payments)? • To what extent can the voluntary market be a viable option for Payments or Compensation & Rewards for Ecosystem Services (PES/CRES) in ecosystem and landscape restoration? • What is the willingness to pay for conservation/restoration? And to what state? What happens when the 'threat' or driver has gone? • What is the regulatory environment in which a water market can be developed? • What are the spatial dynamics of ecosystem services in terms of supply and demand? Who benefits? Where and how?
Opportunities for financing through existing arrangements	• Through which ways it is possible to unlock financing for restoration through the municipal IDP and how can these plans be best assessed? • How can restoration be made part of regional business and economic development plans (by aligning with current objectives)? • What other integral financing and land-use options are available to facilitate restoration through viable livelihood alternatives? (biogas, tourism)
Rewarding good practice	• How to provide (avoided deforestation) incentives/rewards to those who have shown sustainable land management practices (and who don't have degraded land which needs to be restored: avoiding favour to those who reaped from overgrazing and have the opportunity to do so again through restoration)? • How can rewards from carbon benefits from restored lands be shared equitably in favour of good practice?

3.5.7 Points of Discussion

- **Payment for Ecosystem Services (PES):** Is another option instead of social security grants and can become a part of the Right to Work programme: DWAF is investigating how the Government can invest in natural resource restoration and then have the users continue to pay for them.
- **Timeline:** People need to see benefits in the short-term to remain engaged.
- **Management data:** The science needs to be plugged into the management data to develop economic models. Proper databases are needed so management data can be captured on a spreadsheet. Will allow variables to be monitored to determine the progress of the project.
- **Valuation:** When valuing restoration do we focus on local/international or formal/informal markets? What is the Total Economic Value (TEV) of spekboomveld? Will the monetary value of services be bigger than carbon value? Need to optimize the suite of ecosystem services.
- **Markets:** If you want to stimulate trade you must have a quid pro quo: poverty doesn't sell but restoration does – restoration is therefore an economic development strategy. Need to be innovative to access existing markets and find new ways of doing things – restoration is the only way of augmenting our dwindling supply of natural capital.
- **Institutional issue**: Finding the right client for the right product; find the one common denominator and link that service deliverer to the producer and beneficiary. One must fix the institutions – as the markets are real – to bridge the two and therefore need institutions and good governance to do this. Also need to bring the buyers and sellers together.
- **Commodification of nature:** What happens if you can't find any buyers for water but lots for carbon – is there a danger of shifting system to monoculture and leave out other 'commodities'? Can never be a monoculture if the end goal is restoration – but may be a process of going through monoculture to diversification. Trading schemes: Look at options for trading schemes (emission permits) and private sector behaviour change.
- **Identify drivers:** In the Limpopo province the loss of vegetation and woodlands was due to fuel wood consumption; necessary to address the drivers of deforestation (e.g. energy).
- **Institutional fixing:** EarthCollective/PRESENCE has currently filled a gap through 'institutional fixing' i.e. providing facilitation and support to overcome market and government failure.
- **Long-term alternatives:** Need to keep in mind that carbon credits may eventually run out so we need to find long-term alternatives. Need to look at developing other markets as well – e.g. tourism and biodiversity markets – and investigate how these can also be up-scaled but not at the cost of other markets. Different markets must be developed to work in synch.
- **Holistic restoration:** There is a need to collate the different streams into one - such as the consideration of alternative fuels. People also need to feel part of the solution so they do not feel alienated in the process. Remember the feel-good factor involved when marketing offset investments. We must work towards a planet in repair but in the end it must not just be about carbon but about changing land use and attitudes.

3.6 Theme 6: Remote Sensing & Geo-Information Systems

Presenter:
Prof. Michael Schaepman
Geo-information & Remote Sensing Group, Wageningen University & Research (WUR)
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Michael Schaepman was unable to attend the workshop and offered his sincere apologies. Subsequently, no presentation was delivered on Remote Sensing and Geo-Information Systems. However, the following section summarizes this Research Theme with due consideration given to the relevance and applicability of geo-information systems to multi-scale restoration.

3.6.1 Introduction

Assessing biodiversity and the plant pigment system from space

Introduction

Various definitions of biodiversity exist, but a common denominator of these is always a certain scale dependency. The United Nations (UN) Convention on Biological Diversity defines biodiversity as "the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems". Scales in biodiversity are relevant and need to be addressed individually. Biodiversity is often plotted as taxonomic richness of a geographic area, occasionally referenced to a temporal scale. This, along with the uneven distribution of biodiversity on Earth, renders biodiversity measurements using spatially explicit methods particularly complex. Lately, biodiversity is being assessed increasingly using air- and space-borne Earth Observation instruments. However, ecologists mainly value biodiversity in terms of species richness amongst other metrics as well as using various indices (Simpson, Shannon, etc.), whereas Earth Observation based instruments usually measure the spatial distribution of radiance fields, backscattering, as well as polarization state changes. It is the main challenge of Earth Observation and Ecology to establish semantic interoperability between these two fields, then establish common sampling schemes, and consequently bridge scaling gaps finally allowing a spatio-temporal continuous sampling of biodiversity with limited discontinuities. In combination with solid and continuous ground observations, long term perspectives of various scale biodiversity assessments are emerging and strongly supported by efforts such as the GEOSS Biodiversity Observation Network, the United States (US) National Ecological Observatory Network (NEON), AlterNet (a network of excellence aiming to build lasting integration of biodiversity research), amongst many other noteworthy initiatives.

Necessity to observe biodiversity changes

The latest trends of the global World climate are, unfortunately, weakening the biodiversity-ecosystem bound. Ecosystem biodiversity is strongly related to actual ecosystem services and goods delivered, affected by environmental, i.e., natural and human induced processes. Increasing temperatures are relocating ecosystems on the Earth, and further re-emphasizing the uneven biodiversity spatial distribution. Consequently animal as well as plant species are forced to either adapt to these new climatic regimes, running the risk to be extinct, or migrate into more suitable environments. An average temperature change of 1°C can trigger a shift of certain ecological zones by up to 160 km. Given the predicted warming effect of 4°C over next the century may therefore cause migration of certain Northern Hemisphere species of up to 500 km. However, such fast, intense and even extreme changes in environmental conditions combined with physical-geographical barriers may overwhelm the ability of species to modify their physiological-seasonal strategies or to follow shifting climate via colonizing new territories, and lower their survival rate. Alternatively, extreme events or shifting climate could also trigger invasion by opportunistic species, which may to some extent cause a biodiversity increase.

Apart from ecosystem disruption due to climatic change, biodiversity is also facing a direct negative impact of anthropogenic and global human activities motivated by rapid, often economical, benefits. A frequently raised anthropogenic impact is the large scale wood logging in the tropical rain forest resulting in many negative effects, such as soil degradation and biodiversity loss. Land-use change in the year 2100 forced by climate change alone will be the influential key player of biodiversity decline. The strongest negative impact of biodiversity loss is currently to be expected in Arctic, Alpine and Boreal ecosystems. Steadily growing long-distance transportation and trade globalization is further fostering the dispersal of exotic invasive species. Due to their progressive life strategies, these invaders manage to occupy niches of originally conservative species, resulting in biodiversity homogenisation and/or loss. Moreover, such colonization initiates unpredictable ecological interactions between new organisms and surrounding environment, emerging new ecosystems and potentially reducing original variability of natural habitats.

Bridging scaling gaps

Limitations in terms of generalization are inherent to experiments carried out under scale limited laboratory or field conditions. Such small-scale experimental design is unable to reveal the complex spatial and temporal character of larger scale ecosystems and their biodiversity response to accelerated climate change. Figure 2 depicts on how Nature's complexity is successively scaling various structures, states, and processes over time and space. The chain of

scales starts at the ultra-cellular structure of plant membranes, accommodating instantaneous biochemical processes (occurring in fractions of seconds), that are scaled through cellular tissues, leaves, shoot/branches, crown canopies, habitats, and ecosystems up to biomes, ending with the global bio-geochemical cycles (having response times of several years). The latest state-of-art science in Earth Observation related remote sensing (RS) enables bridging of these scales and processes using radiative transfer based models, data assimilation, and evidential reasoning

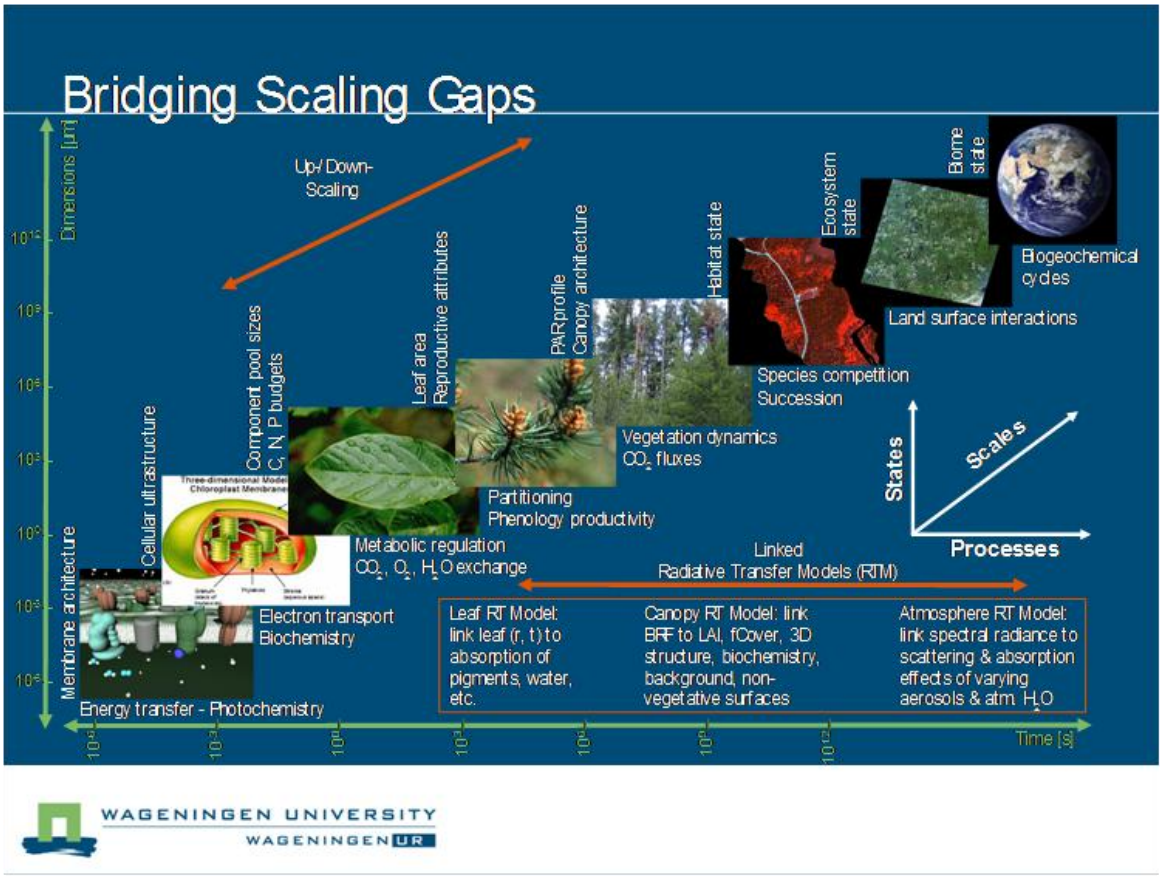


Figure 2. Bridging scaling gaps using Earth Observation

Various air- and space-borne Earth Observation instruments are currently in use for regular large-scale and long-term monitoring as well as regional, high spatial and spectral resolution mapping of biodiversity related activities. However, even systematic satellite-based biodiversity monitoring alone is not able to reveal changes in biodiversity (past data records are partially incomplete, discontinuous, or simply not long enough to monitor relevant changes). On the predictive side, Earth Observation is well suited for now-casting applications, but can not predict future evolution of ecosystems.

Continental – or even global – scale Earth Observation at larger spatial resolution (typically 0.25 – 1 km), using instruments such as MERIS on ENVISAT, MODIS on Aqua/Terra, NOAA/AVHRR, may not directly be used for (individual and indicator) species identification. However, these data are well suited to derive dominant species composition or depict abundances of plant functional

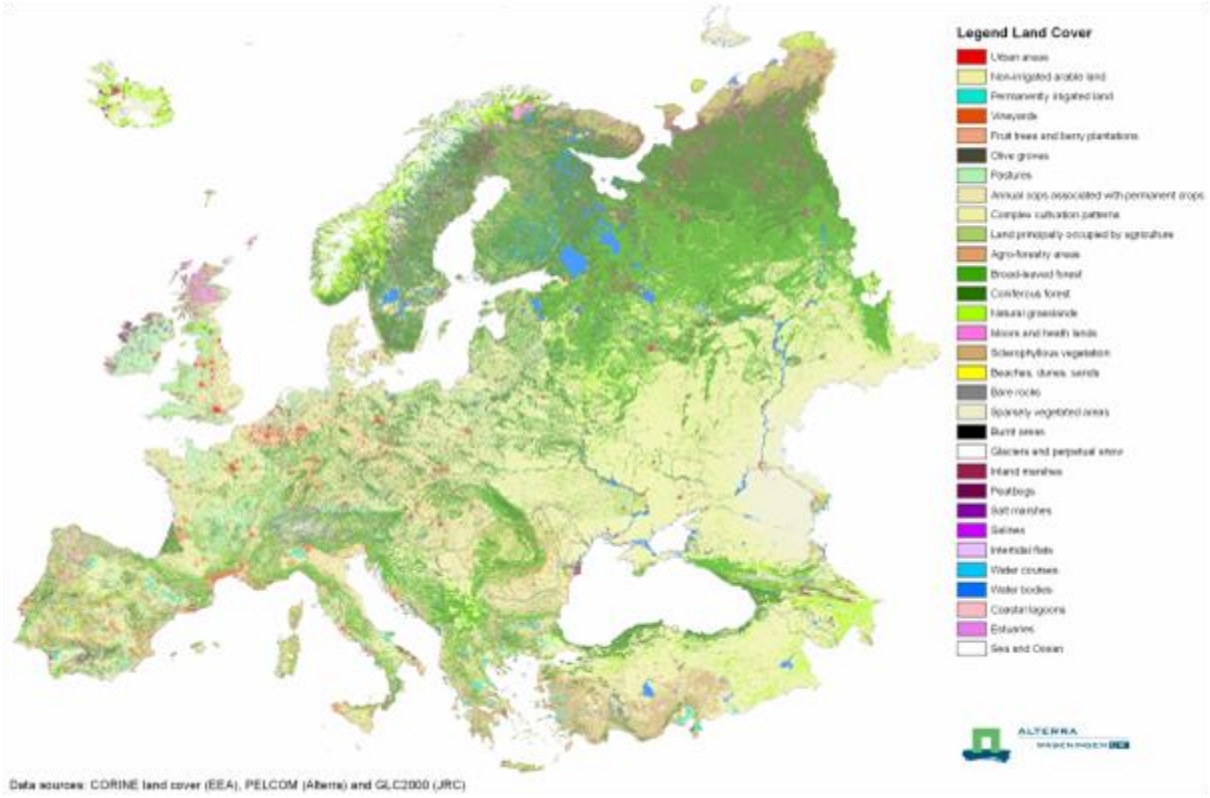
types (PFTs). Spatio-temporal disaggregation schemes, evidential reasoning and data assimilation are often part of such applications. In addition, given sufficient temporal resolution data are available, products such as vegetative change cover and species specific phenological indicators may be further derived. These products are very well suited to initialize and parameterize ecological models predicting vegetation development or dynamics (e.g., LPJ, CASA, etc.). However, not many of the current existing vegetation models are ready to directly accept Earth Observation data.

Regional scale biodiversity assessment (having a typical spatial resolution between 0.5 – 30 m) has certainly been pioneered by Landsat sensors. In this category, instruments such as Landsat ETM+, CHRIS on PROBA, EO-1 Hyperion, HyMap, and NASA JPL AVIRIS are named most frequently. Semantic interoperability and proper interfacing sampling design and schemes between Ecological and Earth Observation activities are the most important factors driving the success of this bottom up scaling based approach. Indicator species mapping is still only possible if the spatial resolution is at a fraction of the species size, otherwise only dominant species mapping can be performed. Recent imaging spectrometers have, in particular, contributed to the mapping of quantitative vegetation biochemical and structural parameters (e.g., concentrations of leaf biochemistry, assessment of foliar pigments), disturbance occurrence, and invasive species. These applications have the potential to contribute to the vegetation modelling, but again many of these models (e.g., SMART/SUMO/NTM model suite to predict floristic diversity) have been developed without having Earth Observation input in mind.

Combined disaggregation/aggregation scheme: towards habitat abundance mapping

Large scale characterization of ecosystems, landscape diversity and functions is an increasing demand, in particular at finer spatial resolution and temporal scales than have been in the past. While the large scale stratification using climatic data may be sufficient to define broad eco-regions, combination with the landscape spatial information allows a variety of subclasses to be identified at a finer scale. The landscapes consist of a multitude of habitats and plant communities of coexisting biological species. A method combining disaggregation of remotely sensed data with evidential reasoning can produce probability maps of dominant plant species habitats. Such maps can be re-aggregated to produce fractional abundances of plant functional types (PFT). The PFTs represent an important input into dynamic vegetation models, having the capacity to forecast floristic diversity under various scenarios. The PFT maps allow to evaluate results of scenarios initiated in the past (e.g., using a historical pollen distribution database) and to assess confidence of future projections.

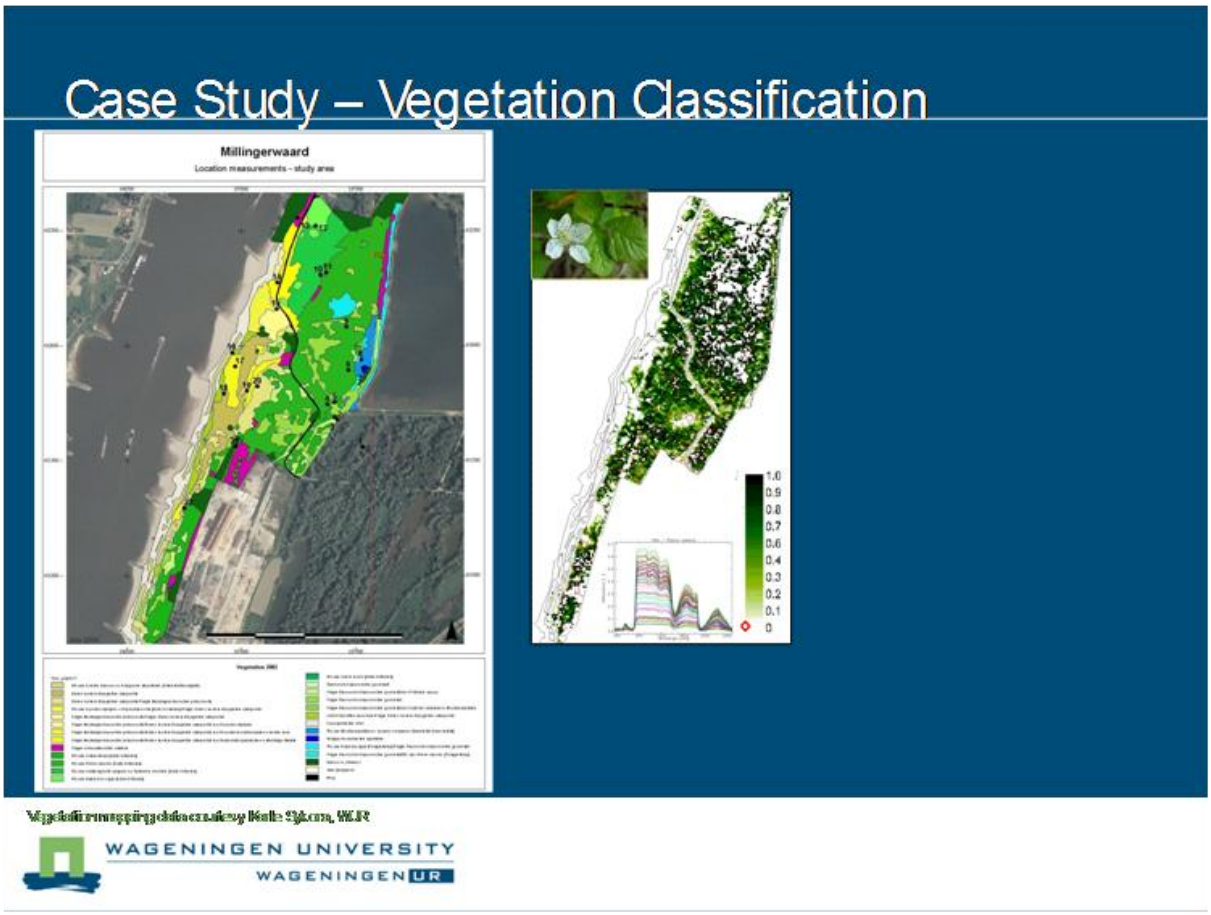
A currently developed disaggregation scheme is based on a pan-European dataset. The approach relies on identifying all major habitats in Europe defined in accordance with the Annex I of the Habitat Directive (198 habitats). The data set is compiled using current state of the art land cover databases (namely CORINE, PELCOM and GCL2000). Harmonisation of the data sets is implemented as much as possible according to the CORINE land cover nomenclature to avoid loss of information. Additional stratification and evidential reasoning is used by integrating datasets such as biogeographic regions, digital elevation, soil information and other geographic and topographic data to finally arrive at a probabilistic species distribution of a particular habitat (e.g., 'Calcareous Beech Forest'). These maps can support better management of protected areas, allowing the monitoring of the long term stability of ecosystems, identification of potential species reintroduction sites, and finally protection of the original ecosystem species against invasive species by predicting their potential colonization areas.



Regional vegetation productivity estimates: towards dominant species mapping

Using a remote sensing based approach of vegetation sampling in the field may lead to significantly differing results compared to a more traditional vegetation mapping scheme such as the method of Braun-Blanquet. Remote sensing approaches will always spatially integrate information over the instantaneous field of view (IFOV), resulting in spectrally mixed radiometric quantities affected by the most dominant species and the fraction of non-photosynthetic vegetation and soil in vertical projection. Ecological sampling schemes, however, frequently

focus on indicator species sampling, where these indicator species may have no significant spatial abundance in the sampled area. Recent advances in measurement of leaf optical properties combined with advanced radiative transfer (RT) modelling (e.g., PROSPECT/SAIL) allow in forward mode to scale leaf biochemistry and structural parameters up to higher scales and in inverted mode to retrieve vegetation biochemical and structural properties from reflectance signal measured within the sensor IFOV. Spectral libraries of leaf optical properties can be used to spectrally unmix large areas and derive abundances of dominant species, given all dominant species are represented well in the library. Figure 2 shows results of two methods, classical vegetation sampling as well as the spectral unmixing approach. The unmixed abundance of *Rubus sp.* corresponds much more to the actual average impression of the test site, rather than the effective floristic diversity, due to sparse spatial distribution of these species.



Further analysis of dominant species abundance results in solid estimates of vegetation Net Primary Productivity (NPP) , approximated from remotely sensed Light Use Efficiency (proxied by the Photochemical Reflectance Index (PRI)), photosynthetically active radiation (PAR), and the fraction of PAR absorbed by photosynthetic tissues. The latter, being basically a function of Leaf Area Index (LAI), is again retrievable from spectrometric data by inversion of RT models.

These advanced remote sensing product combinations can serve as an input to dynamic vegetation models, such as the SMART (soil processes), SUMO (vegetation processes and succession), and NTM (potential floristic diversity) model combination, supporting the assessment of biodiversity at regional scales.

Conclusions

Increasingly, Earth Observation data and products are used to assess biodiversity and the palnt pigment system from space. In particular, since large scale spectral, spatial and temporal high resolution instruments have become available, significant advances were made in contributing to the structured monitoring of biodiversity from space. However, due to inherent observational limitations, scaling gaps need to be bridged in all of the above domains. The two approaches presented here are able to bridge several scaling gaps and provide input for ecological modelling at required accuracy. Disaggregation and re-aggregation combined with evidential reasoning at biome scale and radiative transfer based inversion methods at regional scale are just two examples indicating the increasing applicability of remote sensing in the structural assessment and monitoring of biodiversity, plant structure and biochemistry. Sound forecasting methods of biodiversity trends in the future will not only rely on the above methods, but they will increasingly include temporal information and data assimilation based methods. The discussed methods will be able to deliver a significant contribution to qualitatively map ecosystem restoration related issues with unprecedented accuracy.

3.6.2 Research Objective

To stimulate acquisition of data, development of methodologies and approaches to support spatial understanding and integration of the transdisciplinary research required to guide restoration.

3.6.3 Implementation Relevance

To provide spatially explicit information and scenarios for improving effectiveness of restoration strategies.
To support monitoring, planning and tracking of socio-ecological changes over space and time.
To visualise spatial data, information and restoration scenarios for diverse stakeholders.

3.6.4 Thematic Interactions

Table 6 below provides an indication of how **Theme 6** can contribute to - and will interact with - the other Research Themes (from a research perspective) (See also Appendix C).

Table 6

Theme 1 ecosystem Structure & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms
Identifies spatial and temporal patterns and processes which can be validated with on-ground baseline data to feed into the testing and development of methodologies to derive spatially and temporally explicit information. Characterises the inter-relationships between biophysical processes over time and space.	Enables research on ecosystem services and values to be modelled over time and space and linked to landscape character. Assists in standardising accurate methodology for identifying and valuing ecosystem services to derive spatially and temporally explicit information in relation to stakeholders, conservation and restoration efforts.	Provides information for visualising stakeholder relationships, interactions, networks and social preferences relevant to conservation and restoration issues in an interdisciplinary, multi-functional spatial representation. Maps and evaluates spatial interaction of human activities and natural resource use.	Visualises interrelated and complex processes at diverse spatial and temporal scales in order to support decision-making processes at policy, institutional and governance levels. Enhances communication between stakeholders based on different scenarios and options. Monitors the impact of policies in the ecosystem and provides insights on cost-benefits analysis of different strategies.	Assesses and presents opportunities for stakeholders to engage in innovative financing schemes in relation to spatially expressed restoration options. Represents and models the flux of natural capital.

3.6.5 Comments and Insights

> "[We could] use remotely-sensed data for rapid assessments of carbon stocks. This component will need to be tamed by realism. We will also need to figure out how to monitor and evaluate the social impacts of the research."

3.6.6 Priority Research Areas

The research areas listed below were outsourced from the discussion originating from the Research Themes and reinforces the underlying role spatial analysis will play in PRESENCE. No specific break-up session was held for Remote Sensing & Geo-information Systems during the workshop – and explicit questions were not formulated - so the research areas listed below should become a basis for further exploration of this key research theme.

Theme 1: Ecology: Ecosystem Functioning & Biophysical Processes

1. Stimulate spatial ecological research and build a GIS database for multivariate analysis of ecosystems;
2. Testing rapid assessment techniques for carbon using remote sensing and their value as proxies based on field data (valuation).

Theme 2: Ecosystem Goods, Services & Valuation

3. Testing rapid assessment techniques for ecosystem services using remote sensing and their value as proxies based on field data (valuation). Develop long-term spatial visions (of thicket) based on projected biodiversity and ecosystem service gains.
4. Scenario building: spatial analysis supporting understanding of the trade-offs in ecosystem services valuation perspective of the restoration.

Theme 3: Stakeholders, Livelihoods & Social Assessment

5. Capture spatial indicators of social landscapes. Combine people's use of the ecosystem and its conservation priorities to understand areas likely to benefit.
6. Provide maps as visual material for assessing peoples' spatial perception of the landscape.
7. Analysis of existing and future drivers of land use practice and change at local, regional and global scale (land distribution vs. game farming vs. carbon farming).

Theme 4: Policy, Institutions & Governance

8. How can the institutional design and its implications in the restoration management be demonstrated spatially?
9. How can social variables be mapped onto biophysical mapping/data?
10. Support the understanding of drivers for land use change over space: analysis of existing and future drivers of land use practice and change at local, regional and global scale (land distribution vs. game farming vs. carbon farming).

Theme 5: Financing, Payments & Rewards Mechanisms

11. What are the spatial dynamics of ecosystem services in terms of supply and demand (to establish markets)? Who benefits? Where and how?

4 CONCLUSIONS

At the conclusion of the PRESENCE Seed Phase, it is necessary to reflect on achievements and progress made. To date, the PRESENCE Seed Phase has been successful in:

- Developing the PRESENCE Workshop Booklet with a focus on integrated restoration approaches for Subtropical Thicket and Riparian Zones which included six PRESENCE research themes, proposed frameworks, objectives, implementation relevance, thematic interactions, a 'pool' of research questions and lessons learned in restoration from cases around the world;
- Holding the successful 3-day workshop with near full attendance and active participation from attendees. The workshop exceeded expectations and received positive feedback;
- Identifying key questions and focus areas from a research-implementation perspective;
- Inventory knowledge, expertise and partners: what we have and what is needed;
- Stimulating collaboration for supporting multidisciplinary research and capacity building;
- Catalyzing new ways of approaching the mainstreaming of restoration at various scales;
- Building long-term partnerships across various countries, institutions and disciplines;
- Engaging a broad range of stakeholders and seeking to timely disseminate information;
- Involving five students from Wageningen University within the PRESENCE Programme;
- Initiating a pilot project utilizing the PRESENCE approach in the western Baviaanskloof. The case study (EASTCARE) engaged four WUR MSc students whose thesis fieldwork results provided PRESENCE and the Subtropical Thicket Restoration Programme (STRP) with a better understanding of the stakeholders' views, perceptions and needs. The students were able to give positive exposure to the programme and build healthy relationships with the farmers and communities as a basis for follow-up cooperation.

Summary achievements: stimulating knowledge sharing and transfer; assisting in market and institutional 'fixing'; establishing an innovative facilitating and enabling role in restoration research; strengthening partnerships and networks; coordinating research integration; realising new opportunities; encouraging stakeholder 'buy-in'; and aiding capacity building.

The results of the Seed Phase will be used to formulate an expanded strategic research implementation plan as a springboard for launching the subsequent 'growth' phase during 2008. This plan will include key partner roles and responsibilities, activities and actions and research trajectories. As with the Seed Phase, project partner involvement and a coordinated approach for managing research expertise is critical for successful programme execution.

From seed to seedling: the PRESENCE Growth Phase

With the completion of this Seed Phase, numerous activities and initiatives are underway to up-scale PRESENCE to its Growth Phase:

- Raising the quota of students involved within the PRESENCE Programme to address the priority knowledge gaps identified during the Seed Phase;
- Engaging new WUR Chair Groups to source MSc students for interdisciplinary research;
- Expanding partnerships with South African universities and research institutes to develop Honours, Masters and (sandwich) PhD trajectories for South African students;
- Strengthening public-private relationships (with both South African and Dutch Governments) and discussing avenues for furthering collaboration;
- Proposing a PRESENCE Reference Group (PRG) comprised predominantly of programme researchers and implementers. The PRG will advise, steer and define the PRESENCE programme and monitor and evaluate the progress, activities and achievements/ milestones made by the diverse organisations involved;
- Actively seeking co-financing possibilities to ensure PRESENCE maintains momentum and is in a position to capitalise opportunities for restoration across Southern Africa.
- Developing a proposal for an Ecosystem Management And Restoration Knowledge Centre at the Kouga Dam to integrate expansion of the horticultural nursery, a proposed cultural heritage botanical gardens and research village for visiting scientists and implementers (with a vision to become a key training centre and tourist attraction).
- Fast-tracking mainstreaming by capitalising on opportunities for institutionalising restoration through broad stakeholder engagement and (participatory) action research.
- Establishing a facilitation, integration and enabling role guided by EarthCollective (with the intention to build long-term local capacity and eventual 'handover') and will:
    - Integrate the different elements of PRESENCE research programs;
    - Link various restoration programs (new and existing) falling under PRESENCE;
    - Facilitate (student) research and related PRESENCE logistics;
    - Advertise requests for proposals and research opportunities (primarily students);
    - Involve interested universities and research institutions to collaborate and build mutually beneficial partnerships to stimulate transdisciplinary research;
    - Ensure open and continuous dialog between implementers and researchers;
    - Encourage 'North-South' collaboration to build scientific and technical expertise;
    - Communicate and disseminate the knowledge and experience gained to the programme; managers, implementers and other stakeholders involved in restoration implementation through diverse channels.

If sufficient funding and capacity is available, programme facilitators may further:

- **Establish** and manage PRESENCE Research Villages which will create an enabling environment for research, education, training and related capacity building;
- **Engage** governmental institutions in the restoration process through existing policy and planning arrangements and new forms of governance arrangements;
- **Engender** pro-restoration/conservation behaviour across stakeholder groups;
- **Empower** local stakeholders and communities in restoration implementation;
- **Extension:** aid implementers with stakeholder extension activities as required.

In the lead-up to the 2010 World Cup, when interest in South Africa's natural and cultural heritage will be extraordinary, there has never been a better chance to showcase the advances made in developing new paradigms for integrated natural resource management. This PRESENCE Seed Phase report lays the basis for realising state-of-the-art approaches and presents a prime opportunity to build a true restoration presence in Southern Africa.

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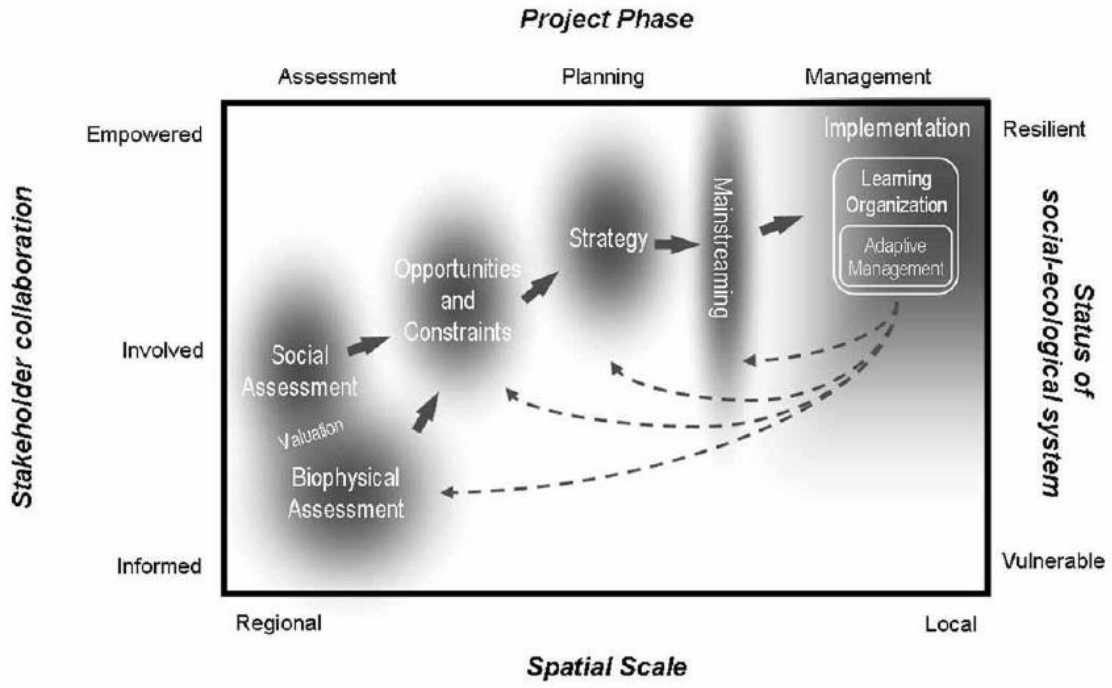
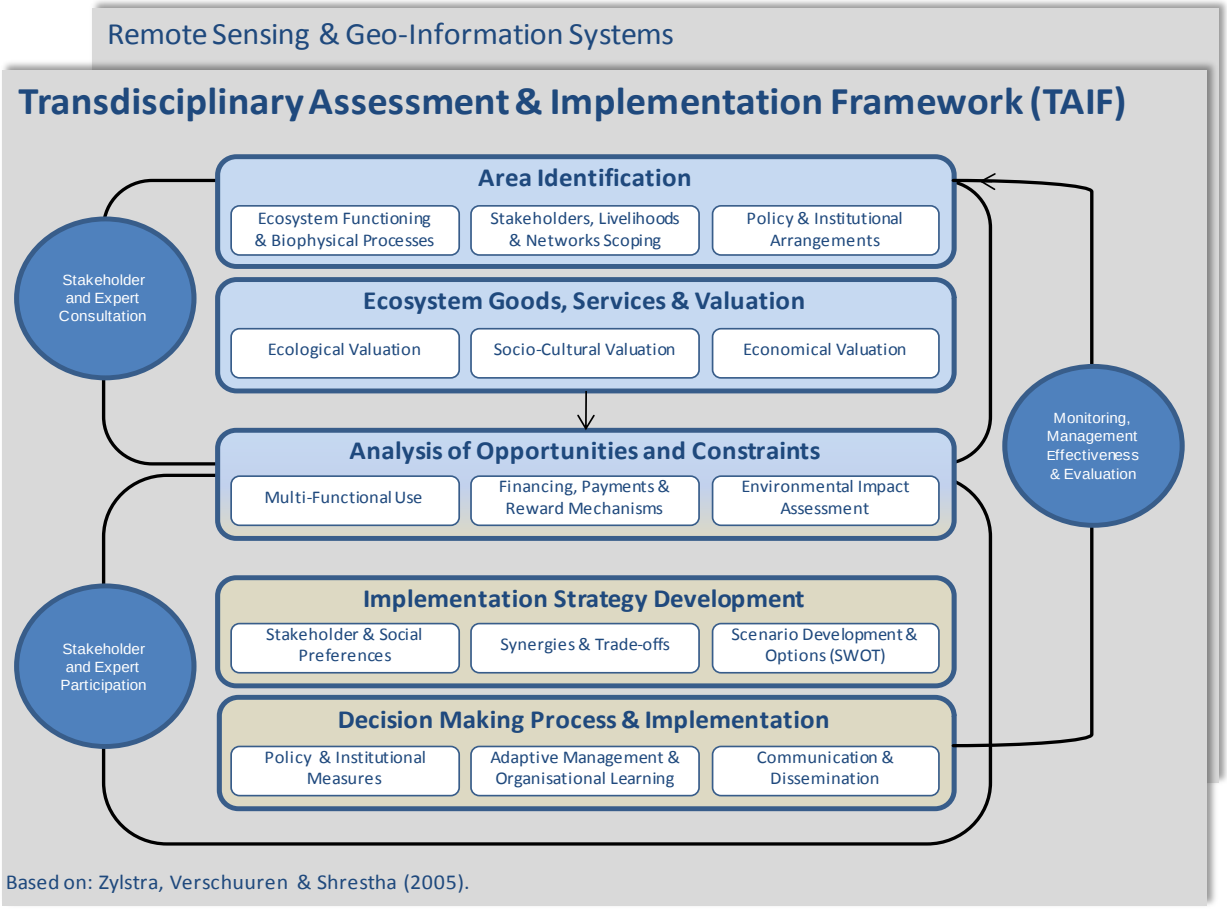
Appendix A: Proposed Frameworks

1. **OPERATIONAL MODEL FOR MAINSTREAMING ECOSYSTEM SERVICES** (Cowling *et al.*(in press))



2. **TRANSDISCIPLINARY ASSESSMENT & IMPLEMENTATION FRAMEWORK** (EarthCollective *unpub.*, 2007)



3. THE 12 PRINCIPLES OF THE ECOSYSTEM APPROACH*

Principle	Description
Principle 1:	The objectives of management of land, water and living resources are a matter of societal choices.
Principle 2:	Management should be decentralized to the lowest appropriate level.
Principle 3:	Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
Principle 4:	Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: a) Reduce those market distortions that adversely affect biological diversity; b) Align incentives to promote biodiversity conservation and sustainable use; c) Internalize costs and benefits in the given ecosystem to the extent feasible.
Principle 5:	Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
Principle 6:	Ecosystem must be managed within the limits of their functioning.
Principle 7:	The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
Principle 8:	Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
Principle 9:	Management must recognize that change is inevitable.
Principle 10:	The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
Principle 11:	The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
Principle 12:	The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

*Source: Convention on Biological Diversity. CBD Guidelines: The Ecosystem Approach.

http://www.biodiv.org/

Appendix B: Collaborations

The PRESENCE Workshop was preceded by the 2007 STRP Annual Review Meeting. This provided an opportunity for participants to become thoroughly acquainted with ongoing restoration efforts. During the meeting, participants were informed about STRP's progress to date, strategy and restoration challenges. The information presented was highly relevant to the six PRESENCE Research Themes and has therefore been summarized here. Furthermore, considerable overlap in research questions – and thus potential collaboration – is present with the Kouga Riparian Restoration Project and the Matiwane Coastal Forest Project. Therefore, Saskia Fourie and Ayanda Sigwela respectively outlined the ongoing research described below.

Summary 2007 STRP Annual Review Meeting

Introduction:	**Dr. Christo Marais**
Title:	**Working for Woodlands – Where and Why?**
Email:	**chris@dwaf.gov.za**

DWAF began relating land degradation to invasive alien plants with the so-called Working for Woodlands project. About two years ago, the focus was on the Limpopo area and the Eastern Cape with thicket vegetation as its core. Although it was not thought that carbon sequestration could hold potential in a semi- arid zone, Working for Water money was made available to investigate this. It was decided to contain alien vegetation in the Eastern Cape by restoring subtropical thicket to instigate the Working for Woodlands programme. Besides thicket, we need to look at how contributions can be made in the broader context of South Africa.

Presenter:	**Dr. Anthony Mills**
Title:	**Restoring degraded landscapes for ecosystem service delivery: Prospects for a semi-arid African ecosystem**
Email:	**mills@sun.ac.za**

The degradation of subtropical thicket vegetation – about 600 000ha moderately degraded by goat farming and about 800 000ha severely degraded – results in considerable loss of carbon from plants and soils (approximately 100 t C ha-1). Restoring degraded thicket would result in rapid return of carbon to the ecosystem (approximately 4 t C ha-1 yr-1). This 'captured' carbon can then be sold on international markets. These markets are growing rapidly and have emerged as a result of efforts to reduce concentrations of carbon dioxide in the atmosphere and thereby

combat global warming and climate change. The opportunity therefore exists to restore thicket and generate a new source of income for rural communities whilst restoration would also improve the conservation status of the land and result in a return of biodiversity. Eventually, the sale of carbon credits could fund restoration of an entire biome.

The income from 'carbon farming' is likely to be substantially greater than present income streams from livestock farming. The internal rates of return (at present carbon prices) make the investment in restoration attractive. There are hundreds of thousands of hectares of degraded subtropical thicket, and there is consequently no shortage of land. In addition to income generation, the opportunity exists to create tens of thousands of jobs because the restoration process is labour intensive. New landowners that emerge from the land redistribution process in the Eastern Cape could benefit greatly from this new land-use of carbon farming.
Traditional clan structures may be used as an access-point towards organizing carbon farming in the communities in order to ensure it will be cognizant of the communities' socio-cultural values.

To capitalise on the above opportunities, the Subtropical Thicket Restoration Project was launched by the Department of Water Affairs and Forestry (DWAF) in January 2004. The aims of the project were to:

- determine the most effective way of maximising carbon return in degraded landscapes;
- promote return of biodiversity;
- develop strategies for sustainable use of restored thicket by rural communities;
- to facilitate the private sector's involvement in large scale restoration.

To date, approximately 250 hectares of degraded thicket in the Baviaanskloof Mega Reserve have been restored. The project has gone into a second phase (2007-2010) in which an additional 400 hectares of land will be restored across the entire thicket biome, including Addo Elephant National Park and the Fish River Nature Reserve. Approximately 300 plots will also be established across the thicket biome to ascertain how abiotic factors affect spekboom cutting survivorship and growth.

Barriers to entry are, however, considerable. There are transaction costs to cover and complex project design documents to write. There is also a threat of international investors farming carbon and taking money overseas. The Subtropical Thicket Restoration Project aims to overcome these barriers and catalyze the up-scaling of restoration in the private sector. This project has the potential to create a new rural economy in the Eastern Cape.

Once the first carbon credit has been sold, and government has demonstrated that carbon farming in degraded thicket is a reality, it is anticipated that large-scale restoration initiatives will rapidly develop from public and private funding.

Presenter: Dr. Ayanda Sigwela
Title: Networking and challenges of the restoration programme
Email: nyathi@ecol.co.za

The scope of Rhodes Restoration Research Group (R3G) interventions is present throughout the Eastern Cape. The thicket scope (the western section of the Eastern Cape) spreads inland while in the forest scope is in the eastern section of the Eastern Cape and spreads along the coast. In both thicket and forest transformed areas reflect vegetation replacement where above-ground vegetation has been replaced by grasses and ephemeral plant species. The major reasons for transformation are pastoral operations, but in the coastal forests there's forest clearing for human habitation.

In the Matiwane forest area there is restoration intervention in the Mtakatye river basin undertaken by DEAT. This intervention has been compromised by lack of follow-up and by allowing access of herbivores in rehabilitated areas.

R3G is interacting with various departments to solicit buy-in and support for rehabilitation projects in Matiwane. The departments that have shown interest are Department of Economic, Development and Environment Affairs and Department of Agriculture and Land Affairs and Department of Water Affairs and Forestry, whose national department is the main pioneer for the proposed project. There are municipalities who have shown interest in the project. The involvement of private sector is also explored. The level of success with these stakeholders varies. What we want to achieve from the networking operation is:

- co-operation between various departments
- facilitation of up-scaling
- fundraising for transaction costs (short term)
- fundraising for implementing restoration (long term) – especially on land acquired by Land Affairs for emerging farmers

The major constraints are partner willingness and understanding of the proposed interventions. Although there is fair understanding of global warming there is very little understanding on issues such as carbon sequestration.

There is a grave danger of advertising the proposed project on employment opportunities. Due to poverty levels of the rural people there are very high hopes that this project will alleviate their poverty state. The rural people will become despondent if it takes a long time before the project start. Major challenges for government departments are:

- the amount of work load and different pressures that officials face are enormous for them to incorporate our requests in their schedules
- it is difficult for the officials to honour appointments
- this proposal needs to be presented at an appropriate level, time might be wasted if it presented to a junior official.

Presenter: Mike Powell
Title: History and progress of the STRP pilot project
Email: m.powell@ru.ac.za

The Subtropical Thicket Restoration Programme (STRP) was initiated in January 2004 by the Department of Water Affairs and Forestry (DWAF). The project was originally called the "Baviaanskloof Rehabilitation Pilot Project", and had the explicit purpose of testing the feasibility of conducting landscape restoration under the banner of Payment for Ecosystem Services (PES). The pilot project has expanded considerably and is now a fully fledged Restoration Programme, within the greater Working-for-Water portfolio and an anchor project in the Working-for-Woodlands Programme.

Mixed results have been obtained in the Baviaanskloof with the planting of spekboom (*Portulacaria afra*) in both experimental trials as well as large contract plantings undertaken by poverty relief teams. The factors affecting mortality are varied and interacting making conclusive findings difficult. Truncheon size, soil characteristics, frost, fire, herbivory, planting depth, quality control and climate are some of the key factors involved.

Significant gains in knowledge have been made in assessing the carbon stocks in the Baviaanskloof. Valuable allometric relationships have been formulated for key guilds and species that will assist further assessments in subtropical thicket. Furthermore, a favourable differential has been established between the above ground carbon found in degraded sites versus intact sites. The below ground carbon results are still pending but similar patterns are expected.

This bodes well for the carbon trading plans under the CDM, whereby restoring degraded subtropical thicket will qualify for carbon credits.

The nursery facility has flourished following the appointment of a professional horticulturalist and the volumes and numbers of species for biodiversity planting (following spekboom establishment) has increased significantly. Unfortunately the first attempts to implant pioneer species like *Lycium ferocissimum*, were spectacularly unsuccessful and more work is required in ameliorating the microclimate and soil moisture regimes, to allow successful establishment.

Plant species diversity has been assessed for all the areas where restoration has been undertaken. Preliminary results corroborate other work done whereby species diversity drops significantly following degradation.

The drive to reduce costs of restoration has investigated a number of techniques and tools. No major breakthrough in this regard has yet been achieved.

Kouga Riparian Restoration Project

Presenter: Saskia Fourie
Title: Kouga Riparian Rehabilitation Project Keystone Initiative
Email: saskia.fourie@ru.ac.za

Working for Water (WfW) has initiated a natural resource restoration programme, the Eastern Cape Restoration Programme (ECRP), to restore natural resources/capital, as well as to restore both social and financial capital of rural communities. The programme is aimed at enhancing the efforts of WfW in improving the recovery of degraded land after alien plant invasions and unsustainable land management practices. One of the keystone projects of the ECRP is the Kouga Riparian Restoration Project.

Riparian - Fynbos Restoration - Kouga Catchment

WfW in partnership with WWF-South Africa has initiated a natural resource restoration programme in the Eastern Cape. The programme is aimed at enhancing the efforts of WfW in improving the recovery of degraded land after the clearing of alien plant invasions. The programme aims to establish pilot restoration projects in priority catchments, which will contribute towards restoring ecological functionality to degraded systems on private land in the Eastern Cape.

The goals of the programme are as follows:

1. To demonstrate successful riparian restoration in pilot projects at an operational scale
2. To develop Best Management Practices at an operational scale for restoration after the clearing of alien invasive vegetation by WfW.
3. To develop and implement a defensible monitoring and evaluation protocol for restoration projects.
4. To undertake a cost-benefit analysis of restoration activities.
5. To communicate and build support for the outcomes of the pilot projects.
6. To develop restoration protocols to be applied and tested in other South African river eco-regions.
7. To build capacity in the field of natural resource restoration.

The Riparian Fynbos Restoration Project has identified a number research gaps and research opportunities are available in the following fields:

- Assemblage rules and protocols for riparian restoration
- Horticultural & field restoration trials
- Changes in soil due to invasion and the effect on restoration
- Impact of woody alien invasive plants on geomorphology of riparian systems.

Appendix C: Cross Tabular Thematic Interactions

	Theme 1 Ecology: Ecosystem Functioning & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information Systems
Theme 1		Establishes link between ecosystem functions and potential services derived; provides understanding for identifying, quantifying, describing and defining ecosystem services (e.g. biodiversity or ecosystem processes needed to maintain a service).	Provides basis for strengthening socio-ecological relationships; ecological characteristics underpin/contribute to stakeholder livelihoods. e.g. relevance of species & species composition for developing options for socially acceptable multi-functional land-use.	Enrich guidance for establishing baselines, indicators and priorities for organisational learning and policy/regulation for land management to maintain ecological integrity, functioning and ecosystem resilience (carrying capacity).	Indirect link: Underpins indicators for monitoring overall effectiveness of (financial) incentives for land management in restoring ecosystem processes & integrity.	Collation of baseline data (e.g. biomass, carbon stock, geomorphology) to test and develop methodologies to derive spatially and temporally explicit information.
Theme 2	Prioritises and provides context for ecological research and understanding by providing feedback on the use and perceived importance of specific ecosystem functions/services.		Provides information on the use, value and perceived importance of services to stakeholder livelihoods and identifies competing claims & trade-offs.	Prioritises and provides context for policy research aimed at restoring and safeguarding ecosystem services, values and benefits.	Provides information on ecosystem goods, services and values which can potentially be traded and used for equitable compensation schemes.	Provides information on ecosystem values to be mapped and weighted into GIS layers/analysis.

	Theme 1 Ecology: Ecosystem Functioning & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information Systems
Theme 3	Indicates which species and ecosystem processes are of importance for setting research priorities in terms of their relevance to stakeholder livelihoods and social preferences.	Signals most important use and non-use values in order to determine which ecosystem goods and services are linked closest to - and supported by - restoration activity from a social perspective.		Identifies opportunities and impediments within current processes in terms of the potential for creating an enabling, environment for stakeholders' to effectively engage in restoration.	Identifies stakeholder preferred incentives for maintaining or improving livelihoods and networks whilst participating in restoration.	Provides information for visualising stakeholder relationships, interactions, networks and social preferences in terms of their spatial relevance.

	Theme 1 Ecology: Ecosystem Functioning & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information Systems
Theme 4	Identifies policy and institutional boundaries which may be instrumental in driving restoration and thereby helping to define and prioritise related ecological research. Provides impetus to reassess present arrangements.	Identifies opportunities for integrating ecosystem services assessment and valuation in policy and decision-making processes – and giving outcomes greater policy relevance.	Provides information for understanding the institutional arrangements and circumstances under which the social assessment can be carried out (e.g. opportunities and constraints for collective stakeholder agreements).		Uses an understanding of governance arrangements to identify opportunities for financial instruments and arrangements for restoring natural capital. Indicates bottlenecks in current policy and institutional frameworks for financing long-term restoration.	Provides additional layers to spatial understanding of the complex systems by providing information on socio-political constraints affecting restoration.
Theme 5	Identifies key ecological indicators and benchmarks for restoration against which financing schemes will need to be monitored and measured. Establishes ecological research criteria needed to guide financing schemes for rewarding restoration.	Prioritizes ecosystem services research by linking values to financing schemes which offer the greatest potential uptake. Harmonises ecosystem services valuation research with willingness to buy, sell, reward or compensate services secured through restoration.	Financing schemes may influence livelihood analysis, options and scenarios and the networks within which stakeholders operate. Recognises the complex and highly dynamic stakeholder relationships that set the context for any system of compensation or rewards.	Identifies opportunities and constraints in current policies and institutional frameworks for establishing incentives relevant to restoration financing whilst ensuring equity and benefit-sharing.		Provides information for spatial analysis, assessment and scenario-building of how financing schemes may influence biophysical processes, stakeholder preferences /interactions, socio-economic factors and governance arrangements over time and space.

	Theme 1 Ecology: Ecosystem Functioning & Biophysical Processes	Theme 2 Ecosystem Goods, Services & Valuation	Theme 3 Stakeholders, Livelihoods & Social Assessment	Theme 4 Policy, Institutions & Governance	Theme 5 Financing, Payments & Reward Mechanisms	Theme 6 Remote Sensing & Geo-information Systems
Theme 6	Identifies spatial and temporal patterns and processes which can be validated with on-ground baseline data to feed into the testing and development of methodologies to derive spatially and temporally explicit information. Characterises the inter-relationships between biophysical processes over time and space.	Enables research on ecosystem services and values to be modelled over time and space and linked to landscape character. Assists in standardising accurate methodology for identifying and valuing ecosystem services to derive spatially and temporally explicit information in relation to stakeholders, conservation and restoration efforts.	Provides information for visualising stakeholder relationships, interactions, networks and social preferences relevant to conservation and restoration issues in an interdisciplinary, multi-functional spatial representation. Maps and evaluates spatial interaction of human activities and natural resource use.	Visualises interrelated and complex processes at diverse spatial and temporal scales in order to support decision-making processes at policy, institutional and governance levels. Enhances communication between stakeholders based on different scenarios and options. Monitors the impact of policies in the ecosystem and provides insights on cost-benefits analysis of different strategies.	Assesses and presents opportunities for stakeholders to engage in innovative financing schemes in relation to spatially expressed restoration options. Represents and models the flux of natural capital.	

Appendix D: PRESENCE Research Questions: Brainstorm Pool

Research Questions
Theme 1 - Ecology: Ecosystem Functioning and Biophysical Processes
Restoration ecology: ❖ What are the target thicket assemblages in different environmental conditions and land-uses? ❖ How can restoration effort be optimised to achieve the target thicket assemblages? ▪ What more can be learnt about the key species' physiology (e.g. growth and recovery rates) and distribution characteristics (e.g. geographic range, biomass and density distribution) to enhance restoration effort? ▪ Which restoration methods enhance germination and seedling/cutting survival (in the field and the nursery)? ▪ (How) Should soil be treated (e.g. using wood pulp, fire) to optimise restoration efforts? ▪ Can (re-)introduction of animals (e.g. insects) optimize restoration efforts? ▪ Why is arid thicket unable to recover from a degraded state on its own accord? ▪ Why has human intervention to stimulate restoration not yet proven to be entirely effective despite the promise of spekboom cuttings? **Ecology:** ❖ What are the assemblages in intact thicket in different environmental conditions (e.g. slope, aspect, soil, rainfall, etc.)? ▪ Developing a fine-scale predication map of past vegetation cover with remote sensing ▪ What successional processes are at play in the thicket ecosystem? ❖ What ecological processes/structures are at play in the thicket ecosystem? ▪ Which plant/animal species are key in maintaining the ecological processes within thicket? ▪ What are the key producers & consumers in the thicket ecosystem and what is their role? ▪ What is the role of animal species (e.g. insects) in seed germination and seed distribution? ▪ What are the influences of mycorrhizae in intact thicket? ▪ What is the optimal clumb size and species composition to restore micro-climate? ❖ Baseline data: biodiversity inventory of all restored sites (before and after restoration) i.e. plants, birds, mammals, reptiles, insects, nematodes, etc. ❖ What was the vegetation at a site before it became degraded? [history/paleoecology]What vegetation could it support now? ❖ Was the initial vegetation stable or was it in a flux state (i.e. does it undergo major changes naturally)? **Soil Science:** ❖ What is the optimal soil structure for the thicket ecosystem (also in relation to soil biota, soil aeration, nutrient exchange, etc.)? ❖ What are the key (trace) elements within the thicket ecosystem? ❖ Baseline data: detailed soil maps of all restored sites are required.

Botany:

- What are key species physiology (e.g. growth and recovery rates) and distribution characteristics (e.g. geographic range, biomass and density distribution)?
    - What are the vegetative and generative reproduction strategies of thicket species?
    - What differences are present in key species' ability to fix carbon across various scales?
    - Which environmental conditions influence the growth rate of different thicket species?
    - What are the optimal environmental conditions for key species (e.g. rain fall, frost, soil characteristics, etc.)
    - Which key species decrease soil erosion and increase water infiltration, retention and quality?

Hydrology:

- What is the effect of thicket restoration on hydrology (e.g. base flows of rivers, sedimentation of dams and rivers, soil infiltration)?
- Does replanting degraded slopes reduce water runoff rates, improve water retention on the landscape and ultimately water quality?

Climate change:

- How are weather patterns and subsequently thicket influenced by climate change?
- What are the potential threats of climate change to the restoration efforts?

Theme 1a: Horticultural Research Questions

- What information is already available about the propagation of sub tropical thicket species? (Literature review)
- Which species are difficult to propagate or have not been worked on before and therefore need special attention? (Literature review)
- What are the optimal propagation methods for Subtropical Thicket species? (Developing propagation protocols)
- How do we restore areas to the desired state?
- What actually needs to be done? [horticulture, and ecology (understanding ecological processes etc.)]
- What are the optimal and most cost effective propagation methods for individual species?
- What is the optimal and most cost effective propagation medium and growing medium for thicket species?
- What are the effects of various fertiliser types, at different stages in the growing cycle, on thicket species?
- What are the effects of various fungicides and insecticides, at different stages in the growing cycle, on thicket species?
- Seed propagation vs. cutting propagation: Which is the optimal propagation method in terms of long term survival and growth in the field?
- Would coated seed improve propagation/production of thicket species in the nursery?
- Phenology – When do key thicket species come into flower and produce seed? When is the seed ready for collection?

- How are seeds in thicket dispersed and what processes do they undergo before germinating in a natural system? (e.g. seed dispersal by birds may result in the seed coat being broken down by stomach acid. This may need to be simulated in the nursery in order to break seed dormancy).
- Would the use of hormone treatments improve the rooting success of cuttings planted in the field (thicket)?
- Would the use of products such as Stockosorb or other water retention methods, improve the survival rate of field plantings (thicket)?
- What agronomy related research is necessary in helping to improve vegetation cultivation, planting methods, resilience and recovery?
- Why are a large percentage of spekboom cuttings dying in some plots in the Baviaanskloof?
    - Is it lack of soil moisture, and is this related to poor water infiltration?
    - Is it fungal attack, or some other disease?
    - Do the cuttings require a mycorrhizal symbiosis that is not establishing in certain soil types?
    - Does mortality vary with soil type i.e. is mortality associated with a specific soil texture or nutrient content?
- Which cultivation techniques and spatial restoration planning result in the highest number of cutting survival?
    - At what (st)age should cuttings be replanted from nursery to open soil?
    - How does planting depth affect spekboom cutting survival?
    - (How) Should plant cuttings be treated after planting?
    - Is there a spatial dimension to the performance of the spekboom in the area?

Riparian:

- What are the optimal propagation methods for riparian species? (Developing propagation protocols)
- What information is already available about the propagation of riparian species? (Literature review)
- Which species are difficult to propagate or have not been worked on before and therefore need special attention? (Literature review)
- What are the optimal and most cost effective propagation methods for individual species?
- What is the optimal and most cost effective propagation and growing medium for riparian species?
- What are the effects of various fertilizer types at different stages in the growing cycle on riparian species?
- What are the effects of various fungicides and insecticides, at different stages in the growing cycle, on riparian species?
- Would coated seed improve propagation/production of riparian species in the nursery?
- Seed propagation vs. cutting propagation: Which is the optimal propagation method in terms of long term survival and growth in the field?
- Phenology – When do key riparian species come into flower and produce seed? When is the seed ready for collection?

- Would the use of enhanced/coated seed improve the success of seeding in the field? (riparian)
- Would the use of products such as Stockosorb or other water retention methods, improve the survival rate of field plantings (riparian).

Theme 2 - Ecosystem Goods, Services & Valuation

Ecosystem functions:

- What key ecosystem functions are present in thicket? How do they interact?
- What are the main ecosystem functions threatened through thicket degradation?
- How should the key ecosystem functions be identified and quantified?
- How can information about ecosystem functioning be used to develop scenarios for multi-functional use?

Ecosystem goods and services:

- What are the ecological, economical and cultural/spiritual goods and services provided by thicket for different stakeholders?
- What are the main ecosystem goods and services lost through thicket degradation/transformation?
- Undertaking a benefit-cost analysis of the ecosystem service(s) in a specific site (comparing autonomous developments to various scenarios). Comparing business-as-usual to various multiple-use scenarios.
- Over what scales do the benefits of ecosystem services flow (local to international)?
- Studying interactions among ecosystem services and land-use options.
- What direct and indirect use values and option values (such as water filtration, flood control, maintenance of soil fertility, natural pest control, etc.) and non-use values (e.g. existence, intrinsic, cultural and biodiversity values) can be identified? (use/non-use values are also termed market/non-market values).
    - Can these ecosystem services be quantified?
    - Can these ecosystem services be monetarised?
- What quantification/value method is most appropriate (e.g., travel cost method, hedonic pricing method, contingent valuation method, production function approach, damage cost avoided, replacement costs, factor income, market price, etc.)?
- Are the values site-specific? Should they be determined locally? Can they be estimated form literature?
- How do stakeholders perceive and value the different goods and services provided by thicket and degraded landscapes?
- What socio-cultural values underpin people's preferences in thicket restoration?
- What is the socio-economic value of restored and degraded thicket (across various spatial scales)?

Theme 3 - Stakeholders, Livelihoods & Social Assessment

What are the economical, socio-cultural and ecological costs and benefits for the different stakeholders involved in restoration?

Who are and/or will be the major actors/stakeholders in restoration of the ecosystem?

- What is the mutual relationship between the stakeholders?
- What are the social, economic and cultural factors driving stakeholders' decisions regarding to restoration?
- What are the needs and views of stakeholders (regarding to large-scale restoration)?
- Do stakeholders have (traditional) knowledge helpful to restoration?
- Would it be useful to group stakeholders according to how they interpret the thicket biome in order to come to suitable and successful restoration strategies, planning, *management* & *policy?*

❖ Which are the relevant groups to pay for the ecosystem service?

❖ What type of rural livelihood processes are taking place?

- How do local livelihood strategies relate to biodiversity conservation and restoration and how does this understanding contribute to poverty alleviation?
- What are stakeholders' minimum required incomes in order to sustain livelihoods?
- What is the contribution of thicket to rural livelihoods and poverty alleviation in terms of wild plant and animal resources as well as potential options for income and *livelihood diversification?*

❖ Poverty alleviation can be interpreted as relating to an increase in income and employment as well as an increase in human capital and dignity. How can restoration of thicket contribute to economically attractive use of biodiversity when focusing on local concerns?

❖ Can restoration efforts based on biodiversity, water, combating desertification and carbon markets meet the needs of farmers and communal land owners? Farmers, especially communal farmers will be under pressure to restock as soon as possible whilst carbon investors will want no herbivory for as long as possible?

❖ How can restoration (in terms of ecosystem functions and integrity) can be reconciled with socio-economic demands, policy processes, livelihood strategies, stakeholder needs and various land uses (e.g. private lands for agriculture and pastoralism, communal areas, governmental and private game reserves)?

❖ What vegetation do we want to restore it to? [socio-economic/human use value and conservation (rarity of vegetation type and species of which it is composed)]

❖ In including diverse interest groups on multi-stakeholder platforms, what trade-offs exist between engagement and consultation burnout?

❖ What are the main economic activities in the study area that can be related to ecosystem goods and services?

❖ Who are the main stakeholders involved and how do they depend on these activities?

- What are the current economic (& monetary) benefits of the selected economic activities?
- What would be the potential economic benefits of sustainable use/restoration of the ecosystem goods and services?

Communities:

- How is the ecosystem of the restoration area socially and culturally valued by the local communities?
  - How is the land used by these local communities?
  - How are those land-uses valued by the locals (e.g. for the sake of survival traditions)?
  - To what extent are the land-uses important for sustaining the local culture?
- How are the local communities influenced by the current plans for restoration and PES (carbon credits)?
  - What is the best road towards sustaining the livelihoods of local communities when in terms of carbon sequestration?
  - If local plans for carbon sequestration already exist, how are they structured in terms of land use, policies and dividend division?
  - If there are current plans for carbon sequestration, how will the necessary land-use changes influence the local communities?
- How willing are local communities to change their daily activities in return for PES (carbon credits)?
  - If plans for carbon sequestration do not exist yet within local communities, what are the different ways it could be implemented?
- In the field of sustainable management; are evident alternatives for carbon sequestration existing?
- If yes, what will be their implications for sustainability of local livelihoods?

Theme 4 - Policy, Institutions & Governance

- What is the effect of existing policy, governance and institutional arrangements on current and planned restoration and conservation efforts?
  - What are the key policy questions linked to the social practices and institutional arrangements that allow different stakeholders to access or conserve natural resources?
  - How are relevant policies formed and who are the winners and losers?
  - What is the relationship between institutional arrangements and PES?
- Which rules and regulations can be used to enhance thicket restoration?
- Which policy mechanisms can ensure that benefits of payments for ecosystem services actually reach those responsible for supplying the services?
  - What are the key bottlenecks in such policy mechanism and how can these be overcome?
- How to translate research into policy?
- How should Ecosystem Goods, Services & Values contribute to policy and management processes?
- Which institutions are involved and can be involved in thicket restoration?
  - (How) Should policy change within government and institutes (ECPB and SANParks) to ensure successful restoration projects?

- How to integrate the needs of STRP/PRESENCE with the needs of the different governmental departments and other institutes?
- From a policy and institutional perspective, what scope is there for investigating various change processes and planning models in terms of empowering individuals and institutions (enabling) and securing conservation and restoration action (implementation)?

❖ What type of methodologies can be applied to ensure democratic and transparent decision making on restoration efforts and planning?

❖ Can relevant agencies or benefactors be lobbied to finance such restoration?

❖ What is relation between land tenure and restoration strategies?

- What are the different land tenure possibilities for restoration?
- What are the stakeholders' interests according the land tenure possibilities?
- Who are the different stakeholders involved in land tenure? What is their status? What are their roles?
- What are the links/conflicts between the different stakeholders involved in land tenure?
- What are their views on the conservation project, concerning land tenure?
- What are the threats of land tenure to restoration efforts?

❖ What are the different trade-offs concerning land tenure?

❖ How can we get desired restoration done? [politics, funding, stakeholder buy in, and management]

Theme 5 - Financing, Payments & Reward Mechanisms

❖ (How) Can knowledge on ecological, economical and cultural values and livelihood benefits provide scope for financing/reward instruments to support biodiversity conservation and restoration efforts?

❖ How can/what basis is there for financing/reward instruments be combined with a mix of participatory, institutional and non-financial instruments to assist restoration of natural capital?

❖ Is qualifying for carbon, biodiversity, water and desertification credits financially and technically feasible (e.g. in terms of establishing baselines/meeting transaction costs)?

❖ What other incomes from the restoration can be generated besides carbon credits?

❖ How can demand for PES (across various scales) be stimulated and implemented?

❖ What knowledge is needed to better explore and implement financing possibilities within the scope of PES and/or biodiversity and carbon offsets across regional, national and international scales?

❖ How can benefits from restoration be supported through innovative financing mechanisms for ecosystem management?

❖ How can an institutional environment be facilitated at local (e.g. cultivation and commercialisation of medicinal plants), national (e.g. PES and water credits) and international (e.g. Clean Development Mechanism and spekboom carbon sequestration) scales to enable (access to) PES?

❖ What are the possible PES mechanisms (like pricing (direct payments), tax incentives (to enable private investments), creating funds (combining public and private finance)?

❖ What combinations of PES are possible to promote restoration and alleviate poverty?

- Do payments for ecosystem services lend themselves to include small landowners and communities?
- How can the requirements for CDM approval be fulfilled? What needs to be proven? What role does economics play?
- What are the economic returns from public investment in restoration under current institutional arrangements (compared with possible improvements like development of markets for some ecosystem services)?
- What framework can be established for PES (like watershed services) taking into account the 'receiver' and the 'payer' (example elephant tax in RSA)?

Carbon Market:

- How much income can be generated from the carbon market to provide sustainable livelihoods?
- An expert review of the PDD document is required.
- Continual assessment of the state of the voluntary market is required.
- Documents need to be written to get CCB certification in order to sell credits on the voluntary market.
- How can it be mathematically demonstrated to carbon auditors that the plant aerial and root carbon can be accurately assessed?
- Can we accommodate communal farming and/or mega-herbivores and successfully generate carbon credits?
- Given that the potential for carbon sequestration within landscape restoration is likely to resonate with the growing interest in carbon trading and the CDM, how can equitable access, benefit-sharing and use of resources be assured?
- How - or in what ways - can this knowledge on key species feed into potential carbon trading schemes

Theme 6: Remote Sensing & Geo-information Systems

- Developing a predication map of past vegetation cover.
- The spectral versus spatial resolution trade-off: identifying the appropriate data for monitoring carbon stocks in thicket-wide experimental plots versus large-scale restoration plots.
- Using carbon stock data from the 30 year old restoration site (Krompoort) for calibrating remote sensing data.
- Monitoring spekboom cutting survival in the Baviaanskloof restoration sites using remote sensing data.
- Using carbon stock data from Mike Powell's 180 vegetation plots in the Baviaanskloof for calibrating remote sensing data.
- Disparity or challenge between fine spatial level data for biophysical and spatial resolution for socio-economic data.
- How can RS & GIS potential be explored for tracking changes in ecosystem services and developing rigorous methodology for carbon accounting in semi-arid ecosystems (e.g. tracking soil carbon leakage, soil moisture correlations, canopy cover comparisons and herbivore impact monitoring (game and livestock)).

- How can remote sensing methodology in a semi-arid environment be approved under the Clean Development Mechanism (CDM)?
- How can remote sensing be proven to be useful and acceptable for CDM accreditation?
- To what extent can such tools be valuable in participatory resource monitoring and policy decision-making?
- Can spatial analysis methodology ensure local capacity building and promote time and cost effectiveness and 'inclusiveness' in focusing the restoration effort?

Geo-Information Systems:

- Mapping of ecosystems functions, goods, services and values.
- Mapping of stakeholder networks, land tenure and perspectives.
- Mapping of relevant ecological, socio-economic, socio-cultural knowledge as relevant to management, policy & planning.

Appendix E: A Snapshot of Relevant Lessons Learned

EXAMPLE 1 - From Cowling *et al.* (*in press*):

Cowling *et al.* (2002) analysed twelve projects from various production sectors in South Africa and designed a simple model for understanding the mainstreaming process. In essence, the structure comprises four elements:

1. *Prerequisites* – elements without which mainstreaming cannot happen;
2. *Stimuli* (or windows of opportunity) – elements external and internal to the sector that catalyse awareness of the need for mainstreaming;
3. *Mechanisms* – the actual activities that seek to effect mainstreaming; and
4. *Outcomes* – the measurable indicators of mainstreaming effectiveness.

The most frequently cited prerequisites in these projects were democratic and accountable governance, awareness and knowledge, and organisational and institutional capacity. Mainstreaming is primarily achieved through behaviour change.

EXAMPLE 2 - From Adekola & Zylstra (2007, *unpublished*)[7]:

Whilst it can be ordinarily assumed that reasons for perceived failure of (restoration) implementation will be simply the opposite of the listed reasons for success enumerated in Table 7 (below), additional shortcomings were also identified in selected studies assessed. The most important shortcoming mentioned in these restoration studies was typically found in an African context and involved **uncertainty over tenure issues (ownership)**. For example, who owns – or has access to - the lands containing the 'restored' forest.

Such issues were not adequately addressed at the commencement of these projects and thus tended to cause bottlenecks in the latter stages. In particular, **no arrangements were made for benefit sharing** (how rewards are to be distributed and shared). Thus it is important that the issues relating to the security of tenure and land ownership be addressed from the outset of any restoration project.

[7] Olalekan Adekola is a recently graduated MSc student within the Environmental Systems Analysis Group, Wageningen University. His internship report assessed lessons learned from restoration cases listed in the Nature Valuation & Financing Case Study Database [http://eyes4earth.org/casebase] and other published literature.

Another critical issue often cited is the **failure to ensure long-term capacity building of local people and organisations**. This should be paramount as often projects have "died" with the end of the current project life span - not necessarily only because of a lack of financing, but because the locals do not have the capacity or capability to manage the project as previously or know where to seek new funding opportunities. Together, this has the potential of eroding most of the gains of the project. For example, in the Gwari Banso project, the inability of the project to provide the farmers with the capacity to manage the established plantations as well as ensuring sustainability of the programme was said to have the eroded most of the gains of the project.

Table 7 below lists factors for success in restoration projects as identified in the case study review undertaken by Adekola and Zylstra (2007, *unpublished*).

Table 7: Reasons for success in restoration

Factors contributing to 'success'	Case Study Examples
Initial broad consultation with partners and their decision to cooperate	**Gwari Banso Project**: The initial stakeholder consultations with local landowners, regional District Assembly and the Ministry of Food and Agriculture and the Forest Service to elicit views and suggestions were deemed critical in ensuring the project initial success.
Public involvement throughout all stages of the project	**Mowitch Estuary Project:** public was involved from site selection to project design; ensured public acceptance.
Stimulating/Creating public education and awareness	**Shinyanga Region Project**: education and awareness stimulated local interest and prevented misunderstandings. **Illinois Prairie Project:** initiators sponsored/organised popular free tours, activities and monthly programmes which were popular in raising awareness about the project.
Use of local knowledge and traditions to support restoration	**Lake Chad Basin:** use of farmers' practices and experiences was reported to be a strong reason for achievements. **Shinyanga Region Project**: availability and utilization of a past history of *Ngitili* (traditional management) which had not been forgotten by the people aided in creating a sense of project ownership and belonging in the local community.
Strong will of local people to participate in the face of possible opposition from other sectors of society	**COPRANAT Restoration**: initiated and implemented by local women, despite discouragement from the men. With determination, the project succeeded; men also joined in.
Addresses livelihoods and needs of the local people and land owners	All 'successful' cases addressed the benefits derived by people to support their livelihoods; and ensured that the 'flow of benefits' was not severely diminished.

Factors contributing to 'success'	Case Study Examples
Restoration strategies used (technical)	**French Polynesian Reef Restoration:** installed protective barriers to prevent shoreline erosion during restoration.
Appropriate utilization and 'uptake' of scientific expertise and information	Although not all restoration projects are preceded by scientific research, the most successful cases are where prior research (primary and secondary) was found to be essential. **Lake Chad Basin:** Past research on farmers' preferences on tree species and on tree planting distance were utilized in project implementation and assisted good decision-making.
Scientific vision, dogged determination and good communication skills on the part of the project initiators	**Working for Water:** Owed much of its initial success to the likes of Guy Preston and other scientists, who managed to convince politicians of the importance of the issue. This combined with the political vision of Kader Asmal (former Minister of Water Affairs and Forestry), who saw the opportunity to link environmental, social and economic concerns in one programme, was a critical factor.

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