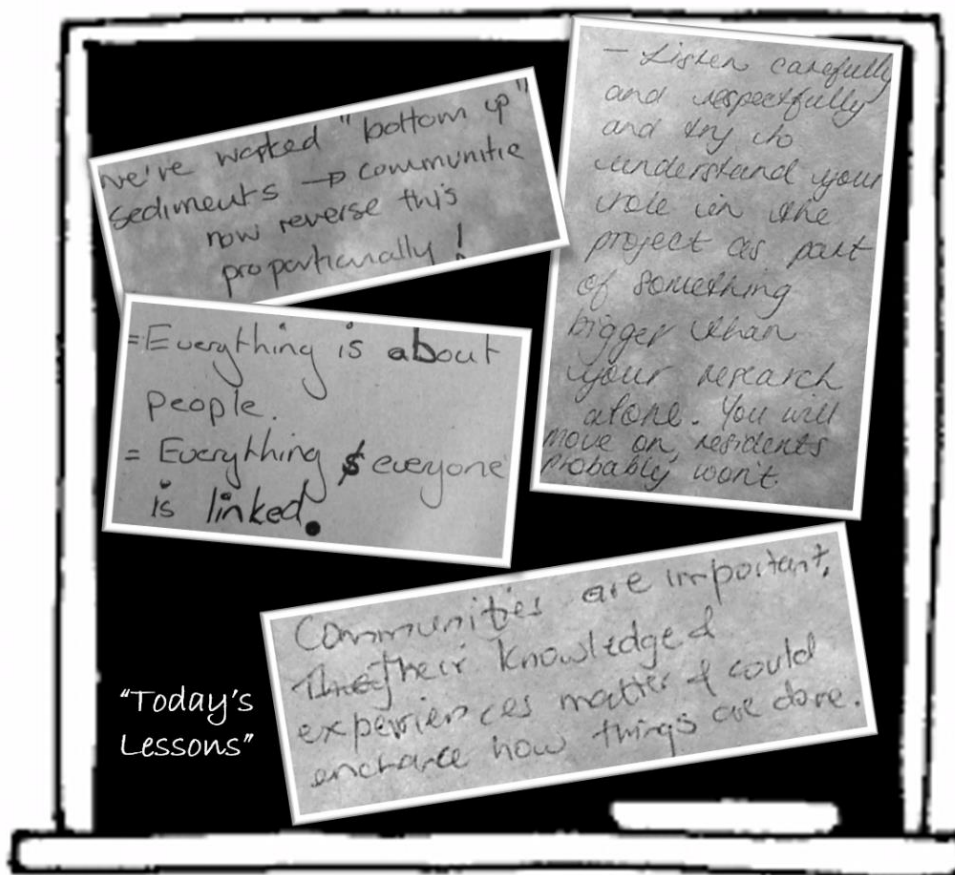


# TSITSA PROJECT\* LEARNING REPORT 2018

## Learning through reflective praxis: Lessons from integrated sustainability research with a governance focus in a complex social-ecological system, Eastern Cape, South Africa



Jessica Cockburn, Harry Biggs, Eureka Rosenberg and Carolyn (Tally) Palmer

Rhodes University, Grahamstown

July 2018

Funded by Department of Environmental Affairs, Chief Directorate: Natural Resource Management

\*Previously known as NLEIP - Ntabelanga and Lalini Ecological Infrastructure Project

## Table of Contents

Preface.....	2
Executive Summary .....	2
1. Introduction.....	10
1.1. Guiding principles for integrated sustainability research and governance in a complex social-ecological system.....	11
1.2. Integrated sustainability research and governance in complex social-ecological systems: contributing to a growing field in South Africa .....	13
2. Methodology .....	14
2.1. Underlying philosophical framework .....	14
2.2. Commitment to reflexivity and learning: A moment to pause .....	14
2.3. Research design and methods.....	14
2.4. Our understanding of learning: a lens to guide reflection and analysis.....	15
3. The case of the Tsitsa Project .....	16
3.1. Tsitsa Project Vision.....	16
3.2. What is the Tsitsa Project and how did it arise? .....	16
3.3. The social-ecological context of the Tsitsa river catchment .....	18
3.4. How the Tsitsa Project works .....	19
3.5. Where we have come from: reflections on antecedent conditions.....	20
4. Findings: Lessons learnt about facilitating integrated sustainability and governance research in complex social-ecological systems.....	21
4.1 Complex Social-ecological systems and resilience thinking is an enabling framing.....	26
4.2 Building new linkages from science outwards is difficult.....	28
4.3 Large, CSES initiatives face particular constraints relating to existing institutional structures, cultures and ways of working.....	33
5. Discussion and recommendations.....	36
6. Conclusion .....	38
7. Acknowledgements .....	39
8. References .....	40

### Recommended citation:

Cockburn, J., Biggs, H., Rosenberg, E. & Palmer, C.G. 2018. *Tsitsa Project Learning Report 2018. Learning through reflective praxis: Lessons from integrated sustainability research with a governance focus in a complex social-ecological system, Eastern Cape, South Africa*. Tsitsa Project Internal Report. Rhodes University, Grahamstown.

### Note on printing:

This document contains colour diagrams and photographs and should ideally be printed in colour.

## Preface

The report is the product of a facilitated learning and reflection process held with the Tsitsa Project (previously known as the NLEIP: Ntabelanga and Lalini Ecological Infrastructure Project) team in early 2018. This process was dual-purpose. Firstly, it was an expression of the Tsitsa Project's commitment to on-going collective reflection and learning, providing a structured opportunity for the team to reflect on their experiences and learning in the project. Secondly, the information collected from the reflection process forms the basis for a peer-reviewed publication in an academic journal (in preparation) to share lessons learnt about the Project with a broader audience.

The authors would like to urge the readers of this report to appreciate it as an on-going work-in-progress, rather than a final, polished product. It is intended to be a conversation-starter and to prompt further reflections and discussions both within the Tsitsa Project, and with the broader community involved in landscape management, ecological restoration, and rural development in South Africa and beyond. We found this guided collective reflection process helpful and enriching and received positive feedback from many participants about it. We therefore recommend that this becomes an annual learning and reflection activity incorporated into implementation of the Tsitsa Project's Participatory Monitoring, Evaluation, Reflection and Learning (PMERL) framework.

## Executive Summary

### Introduction

*How do we manage natural resources sustainably when we recognise that they are embedded in complex social ecological systems?; and then, how do we manage natural resources sustainably in areas with eroded governance systems, a history of disempowered resource users, and high rates of poverty and degradation of natural resources? We propose that lessons learnt in the Tsitsa River catchment, in the Eastern Cape of South Africa, through the work of the Tsitsa Project, may provide novel insights into these two questions.*

The Tsitsa Project (previously known as the NLEIP: Ntabelanga and Lalini Ecological Infrastructure Project) worked with a set of inter-connected and mutually-supporting guiding principles based on a broad commitment to a complex social-ecological systems framework:

- Principle 1: Embed complex social-ecological systems and resilience thinking in praxis<sup>1</sup>
- Principle 2: Encourage polycentric and participatory governance approaches
- Principle 3: Generate transdisciplinary, action-oriented and engaged research
- Principle 4: Work in collaborative, reflexive, adaptive and learning-oriented ways
- Principle 5: Create enabling conditions for equitable participation by multiple stakeholders with a particular commitment to meaningful engagement with local communities.

### The Tsitsa Project Vision

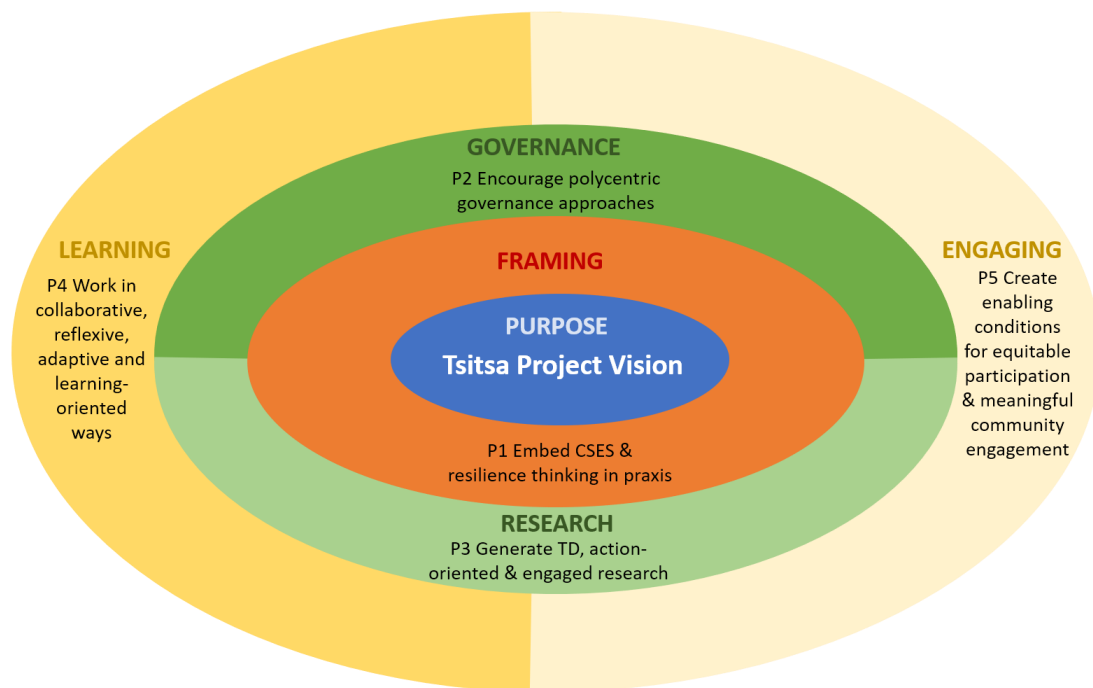
The Tsitsa Project brings together a bundle of concepts that, if realised in practice, could amount to a very different way of working towards landscape sustainability in complex social-ecological systems.

---

<sup>1</sup>By praxis we mean theory-informed practical action. Praxis is purposeful action informed by an intentional practice of reflexivity (Ison, 2018).

**The Tsitsa Project is guided by the following vision: to support sustainable livelihoods for local people through integrated landscape management that strives for resilient social-ecological systems and which fosters equity in access to ecosystem services.**

This vision has four significant pillars, underlined in the text above. The most difficult of these to work towards is ‘fostering equity’. The five principles guide the implementation of the Tsitsa Project towards the vision. Key to implementation are 1) the polycentric nature of internal Project governance which attempts to map and thus adequately handle the ‘outside complexity’ of the catchment itself, and 2) the notion that the principles are all inter-dependent and could fail as a bundle if any are ignored.



Vision: **PURPOSE** - What we are working towards

Layer 1: **FRAMING** - Principle 1: How we understand the system, how we think about the system

Layer 2: **RESEARCH & GOVERNANCE** - Principle 2 & Principle 3: What we are doing

Layer 3: **LEARNING & ENGAGING** - Principle 4 & Principle 5: How we do what we do / how we work

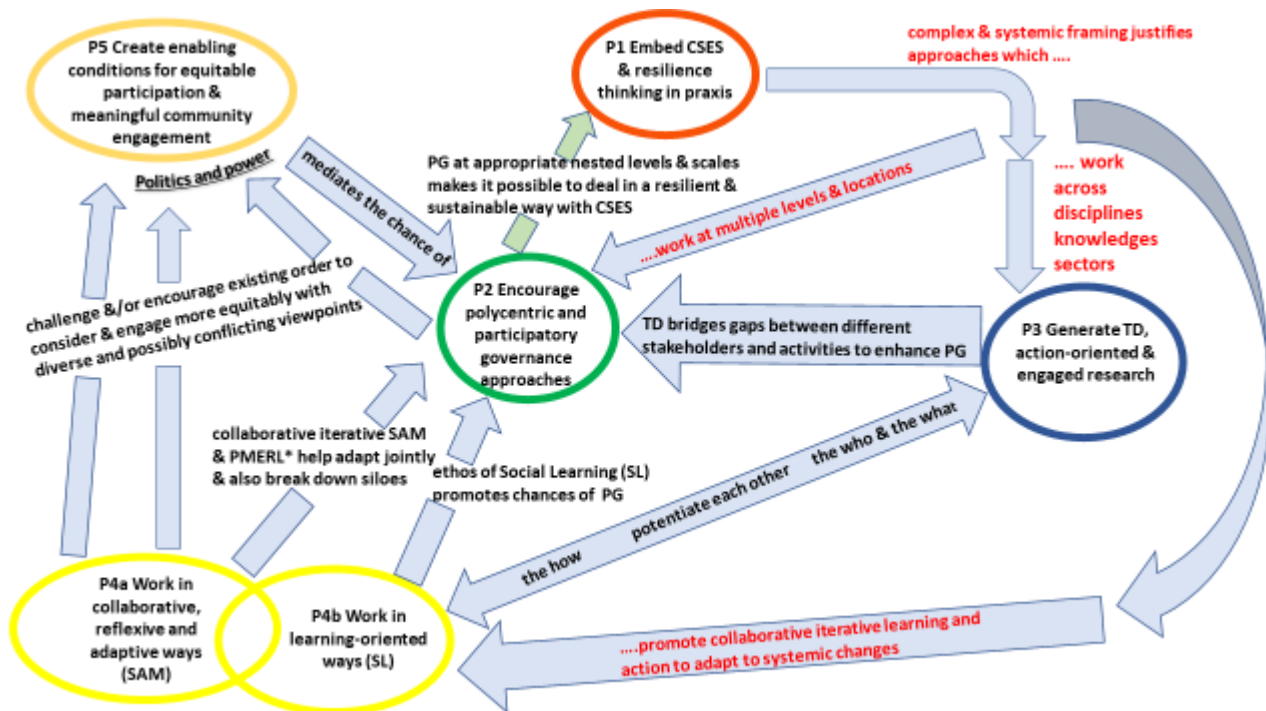
**Layered conceptual diagram illustrating five key principles (P1-5) developed to guide the Tsitsa Project. (CSES – complex social ecological system; TD – transdisciplinary)**

## Findings

Understandably, findings emerged iteratively. After elucidation of the principles,

- A systemic view of the principles was developed.
- Evidence was gathered through a collective reflection and learning process and guided by the principles, from which specific lessons emerged.
- Participant voices were then expressed in two nuanced stages:
  - i) as common narrative threads illustrating participant perceptions of the Tsitsa Project, with lessons learned (Box 1, Table 1);
  - ii) as general lessons learned, each with a cluster of supporting learnings (Box 2)
- Finally, we suggest that three foundational findings emerge
  - i) the social-ecological systems and resilience thinking framing, and recognition of guiding principles is an enabling framing;
  - ii) the challenges of building novel linkages among diverse actors in the CSES, and

- iii) the constraints imposed by existing institutional structures, cultures and ways of working (particularly due to the large scale, complexity, and ambitious vision of the initiative).



Systemic functional linkages between the five principles emphasise necessity for their joint usage. Principles: 1) Embed complex social-ecological systems (CSES) and resilience thinking in praxis; 2) Encourage polycentric and participatory governance approaches; 3) Generate transdisciplinary action-orientated, engaged research; 4) Work in collaborative, reflexive, adaptive (4a) and learning-oriented (4b) ways; 5) Create enabling conditions for equitable participation and meaningful community engagement. The red text indicates the demands posed by assuming the complex social-ecological systems view (Principle 1), and the green arrow, returning to Principle 1 elaborates how these demands are met through systemic, linked application of the other four principles. Principle 5 intentionally reflected as being dependent on the ambient political ecology.

Where: \*SAM stands for Strategic Adaptive Management, the underlying Tsitsa Project framework for practicing collaborative reflexive adaptive mechanisms (Rogers and Luton 2011, Kingsford and Biggs 2011). #PMERL stands for the Participative Monitoring, Evaluation, Reflection and Learning programme planned for the Project which will act as a guardian of SAM feedbacks and hence also assist materially in the breakdown of siloes.

**Table 1: Lessons learnt in the Tsitsa Project about putting the principles into practice.**

Tsitsa Project Principles	Assessment of progress towards implementing these principles in practice according to participants' perceptions.	Key 'lessons learnt' about each principle
<i>Principle 1: Embed complex social-ecological systems and resilience thinking in praxis</i>	Good progress. This is the one principle which most participants seem to understand, identify with, believe in, and actively try to practice in their work. It sets the scene for the other principles.	<ul style="list-style-type: none"> <li>Using an CSES framing has created an enabling research environment. However, seeing this principle through in governance, management and community and stakeholder engagement has been more of a challenge.</li> <li>The CSES framing creates an imperative for the other principles, and all the principles are interconnected and mutually reinforcing.</li> </ul>

<p><i>Principle 2: Encourage polycentric and participatory governance approaches</i></p>	<p>Limited progress. Some participants were unfamiliar with this concept. The leaders of the initiative, however, are passionate about it and believe it to be the biggest challenge, but also potentially the biggest contribution which the Tsitsa Project can make.</p>	<ul style="list-style-type: none"> <li>• Current structures and processes of governance (especially within government, but also in academia) inhibit or constrain realization of polycentric governance in practice.</li> <li>• In order for the other principles to be realized in practice, polycentric governance must be in place. In this sense, it could be considered the 'container' for the whole initiative to succeed.</li> <li>• Participatory governance is necessary to address power imbalance and to promote equity.</li> </ul>
<p><i>Principle 3: Generate transdisciplinary, action-oriented and engaged research</i></p>	<p>Fair progress. The transdisciplinary research among scientists is considered part of the successful implementation of this principle. However, the move from inter- to transdisciplinarity, and engaged and action-oriented aspects need further attention.</p>	<ul style="list-style-type: none"> <li>• One can consider this principle to be about building two types of bridges: Bridges between researchers from different disciplines (science-science); and bridges between researchers and societal actors (science-society) (Lang et al., 2012). In this case, the Project is doing well building the first type of bridge but building of the second type of bridge i.e. improving the links between science and society, is more challenging.</li> </ul>
<p><i>Principle 4: Work in collaborative, reflexive, adaptive and learning-oriented ways</i></p>	<p>Fair progress. Collaboration between scientists is going well, links between scientists and managers are slowly improving. But links to other catchment stakeholders and community members are still lacking. Similarly, reflection, adaptation and learning are taking place within the core group but need to be extended further.</p>	<ul style="list-style-type: none"> <li>• Putting Principle 4 into practice requires paying attention to conditions that enable good quality communication and the time it takes to reflect and adapt.</li> <li>• Implementing this principle beyond the core Project group is a key challenge and requires additional capacity in the team to facilitate this (e.g. through implementation of the PMERL plan).</li> </ul>
<p><i>Principle 5: Create enabling conditions for equitable participation by multiple stakeholders with a particular commitment to meaningful engagement with local communities</i></p>	<p>Limited progress. Most participants feel we are not doing enough to implement this principle. Community engagement has been ad-hoc and only focused on traditional leaders, thereby marginalizing the less powerful. Lack of engagement with other government stakeholders from different provincial departments and local municipalities is also considered a weakness.</p>	<ul style="list-style-type: none"> <li>• Multiple factors constrain NLEIP in efforts to act according to this principle. These include, amongst others: bureaucracy and funding structure and demands; the right people with the right capacity and skills; the very large scale of the initiative; politics and systemic barriers in the broader governance system.</li> <li>• Without significant financial and capacity investments in community and stakeholder engagement, this principle will not be realized in practice.</li> </ul>

---

**Box 1: Common narrative threads that illustrate some of the most widely-held perceptions about the Tsitsa Project among participants, and illustrate key lessons learnt.**

- Narrative Thread 1:  
*"It takes time...and money....and the right people... to work according to CSES and resilience-thinking principles...to build trust... to build relationships... to reflexively and adaptively.... to build polycentric governance...to put all these principles into practice..."*
- Narrative Thread 2:  
*"The links between research and management have been unclear and confusing, and the "lines of command/responsibility/communication between researchers and managers/implementers has not always been clear, though this is getting better."*
- Narrative Thread 3:  
*"Community engagement and facilitation are a priority and concern. I recognize that some effort is being made in this regard, but it seems that the current effort is insufficient or is not working." ... "Sufficient budget must be put aside to have a community engagement team in the catchment to build trust and long-term relationships with local communities, and the social side of things cannot be an afterthought".*
- Narrative Thread 4:  
*"NLEIP<sup>2</sup>'s focus on polycentric governance is probably the most important work. It is the most challenging but it has the potential to bring about the most significant and sustainable change in the catchment."*
- Narrative Thread 5:  
*"There has recently been a shift in NLEIP: the dominance of 'science' has somewhat decreased (for a long time the science voices were loudest in the room), there is a stronger sense of purpose and understanding of what we are doing, there is better cross-pollination and integration (e.g. among COPs and also between scientists and managers) and there is a clearer focus on tangible local actions."*
- Narrative Thread 6:  
*"There is willingness in NLEIP and 'we/they are trying' to implement the work according to the principles, but it is difficult and, in many cases, constrained by external barriers."*
- Narrative Thread 7:  
*"This is an ambitious and groundbreaking project and I am excited about participating as it appeals to my personal commitment to doing meaningful work that can bring about change."*

---

<sup>2</sup>Note that where participants used the previous name of the initiative i.e. NLEIP (Ntabelanga and Lalini Ecological Infrastructure Project) we have retained this in the quotes. The new name of the initiative is the Tsitsa Project.

---

**Box 2: General lessons learnt through the Tsitsa Project organized into four clusters of lessons. Each statement below the cluster heading is worded as to complete the sentence starting “In the Tsitsa Project we have learnt that ...”**

**Lesson Cluster 1 - Building new relationships and linkages is challenging: Building new working relationships across deep-seated socio-cultural-political divides and in a rapidly changing political landscape is challenging. To put our Tsitsa Project principles into practice we need new connections and enabling spaces for exchange, and to become aware of power differentials among the different actors involved.**

- ... using the integrated SES framework and Tsitsa Project principles to recruit researchers enabled the development of collaborative working relationships among an interdisciplinary team of scientists.
- ... polycentric governance is the biggest challenge, but also potentially the biggest area of learning and novelty within the Project. It is “the container” which we need for NLEIP in order to work effectively towards its vision, and it depends on the development of a myriad of new links between disparate stakeholders operating across multiple scales and levels of power.
- ... developing collaborative ties between the Project and other Eastern Cape universities, with government officials in municipalities and other sectors, and with traditional authorities, is difficult. This requires recognition that building these new relationships means working across deeply entrenched historical power divides. Building of these new relationships will also be influenced by the ever-changing political landscape.
- ... meaningful and effective community engagement in a science-led process driven towards clear biophysical outcomes is a significant challenge. Many Project participants feel the need to contribute to direct, tangible benefits for local communities in the catchment. Effective stakeholder engagement also requires sensitivity to local-level politics. People with the right competencies, language skills, and understanding of the local context need to take the lead in this work.

**Lesson Cluster 2 – The science-action tension is real: Overcoming the tension between theory and practice, research and action, and science and management is particularly challenging in a science-led process. This tension is characterised by relationships among actors operating in different knowledge systems, and by conflicts between incentives and success measures of these different systems.**

- ... bridging the disconnect between scientists and managers takes time, and in the Tsitsa Project the disconnect is still a concern for many participants. This includes a lack of understanding for how decisions are made, lack of clarity about the correct communication channels, and insufficient knowledge-sharing between scientists and managers.
- ... balancing the need for “theory, thinking, conceptualizing (research, science)” on the one hand, and “action, practice, tangible impacts and progress (management)” on the other is difficult. Some participants commented on a recent shift in the Tsitsa Project towards a better balance between these two.
- ... the initial strong focus on research (particularly biophysical research) may have constrained opportunities for action and benefit-oriented interactions with local communities in the catchment, contributing to frustrations about limited community engagement and benefits.
- .... for the principle of polycentric governance to be realized, the links between researchers and managers need to be strengthened. However, building new relationships, communication channels and platforms for knowledge sharing between previously disparate actors (e.g. scientists and managers) is a slow process (links to Lesson Cluster 1).
- ... a commitment to pragmatism, i.e. moving forward despite incomplete knowledge and uncertainties, is key to not letting the science dominate and slow down the process.



### **Lesson Cluster 3 – We need to work with enabling conditions and recognize disabling conditions:**

**Enhancing existing enabling conditions (serendipity) whilst working to create new ones (novelty) are important leverage points in this kind of change-oriented initiative in a complex system. Similarly, there are significant structural and systemic barriers which act as disabling conditions.**

- ... the ambitious and novel approach taken in the initiative has attracted people to participating in it. It inspires people and generates a sense of hope for change.
- ... participants are motivated to participate because the initiative aligns with their research interests and it provides a funded opportunity to conduct research which speaks to their sense of purpose and need to 'make a difference'.
- ... having the right people, with the right skills and capacities is important. Key people have acted as conveners, brokers, and leaders. Having open-minded scientists and like-minded people working together has eased an otherwise potentially difficult process. Conversely, not having sufficient people with certain capacities (e.g. community facilitation, social science research) has also been identified as a constraint.
- ... the importance of leaders working to create enabling conditions or 'room to play' should not be underestimated. This is particularly important considering existing bureaucratic and political constraints in a government-funded initiative. This signals political will and support for the initiative, which inspires participation.
- ... understanding the importance of historical context of the Tsitsa Project, and of the Tsitsa catchment, is critical to identifying leverage points for change.
- ... good will and good intentions (including 'political will') by the Project leaders and participants are constrained by external factors and barriers. These include, for example politics, funding and bureaucracy, lack of the right capacity and people, etc. Linked to this are the challenges the Tsitsa Project has faced in engaging meaningfully with local communities.

**Lesson Cluster 4 - This initiative is a challenge of immense scale and complexity: If this is such an ambitious and complex endeavor intended to have impact at such a large scale, then it needs to be resourced accordingly. It needs the right kind of money and the right kind of people.**

- ... the scale and complexity of the initiative compounds and deepens the other challenges we face. For example, the large scale of the catchment significantly compounds the two biggest challenges identified with the Tsitsa Project: development of polycentric governance approaches, and meaningful and equitable participation by multiple stakeholders including local communities.
- ... this is a big, ambitious, and complex endeavor. We need to be humble about how much we can do, how well we can get to know the context, and how much of an impact we can have on the ecosystems and livelihoods.
- ... it takes a lot of time and money and the right kind of people to do things differently. This raises the question: are we spending money on the right things to leverage the change we want to see?

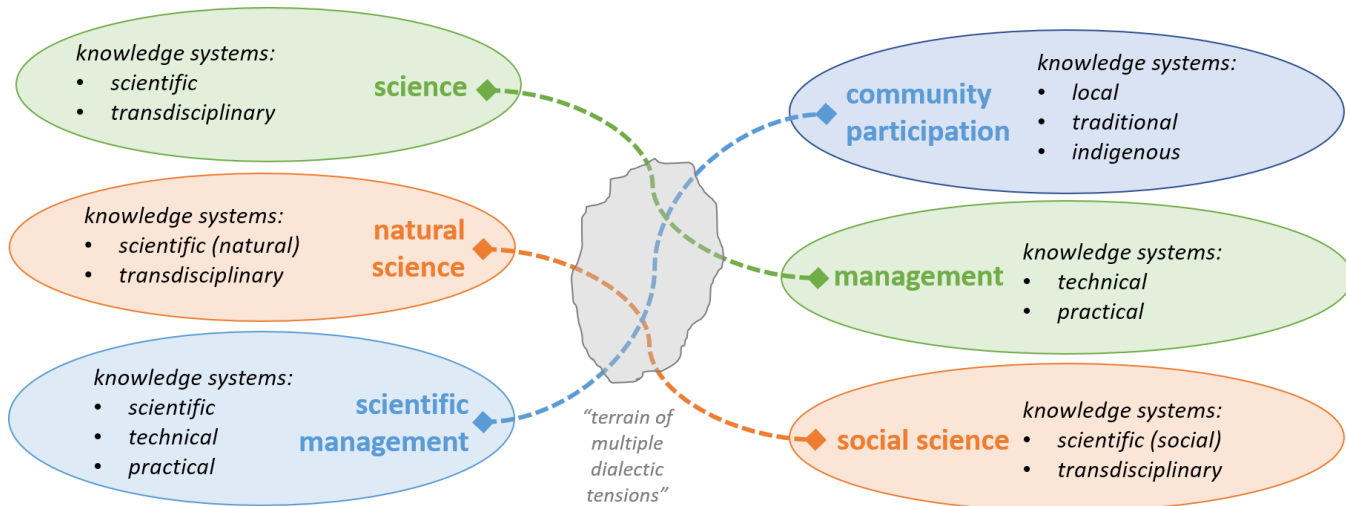
---

## **Discussion**

We focus discussion on linkages between actors from different domains in the Tsitsa Project system which have previously operated somewhat in isolation:

A major recommendation that emerges from this discussion is that attention needs to be paid to recruiting a diversity of participants to deepen and extend the work of the Project. There is a need for enough time and money to do the work we need to do, at the scale at which we need to do it, with the right kind of people. In the positive sense, the convening and leadership roles played by some actors in the Tsitsa Project was hailed by many as a success, as having found 'the right kind of people'. We therefore suggest that the Project should continue to prioritize recruitment of participants who represent the domains of, for example, 'community

participation’, ‘management’ and ‘social science’. Building diversity and redundancy in complex social-ecological systems is considered an important principle for building resilience in CSEs. Building in redundancy in the team is also important, to make sure that if key people leave the initiative they do not leave a big gap. There is also a need for strategically placed and suitably skilled mediators, brokers and system convenors who can directly aid leaders and participants in navigating the complex terrain of multiple ways of understanding.



The terrain of multiple dialectic tensions which the Tsitsa Project is navigating (the grey area in the center of the diagram) is characterized by overlapping linkages between actors operating from different knowledge systems indicated by the colored ovals on the left and right-hand side of the diagram.

----- **END OF EXECUTIVE SUMMARY** -----

# THE REPORT

## 1. Introduction

*How do we manage natural resources sustainably when we recognise that they are embedded in complex social ecological systems?* This question has been posed by researchers, managers, and policy-makers across the world since the notions of complexity and social-ecological systems emerged and began to influence research on natural resource management (Folke, 2006; Berkes et al., 2008). New questions have also emerged, such as: *How do we manage natural resources sustainably in areas with eroded governance systems, a history of disempowered resource users, and high rates of poverty and degradation of natural resources?* This question has been addressed in particular ways in South Africa (Shackleton, 2009; Vetter, 2013; Shackleton & Luckert, 2015), and also in other parts of the Global South (Biggs et al., 2015). In this study, we bring these two questions together, grounding them in an on-going case study of natural resource management in a complex social-ecological system (CSES) in the Eastern Cape of South Africa.

We propose that lessons learnt in the Tsitsa River catchment, in the Eastern Cape of South Africa, through the work of the Tsitsa Project (previously known as the NLEIP: Ntabelanga and Lalini Ecological Infrastructure Project), may provide novel insights into these two questions. Globally, and regionally in many parts of the Global South, there is recognition that the urgent sustainability issues facing society require innovative and pragmatic approaches to managing interconnected and interdependent CSESs (Biggs et al., 2015; Palmer et al., 2015). Such approaches recognise that addressing the challenges of sustainable natural resource management is no longer purely a question of more and better science (Berkes, 2009), but that novel constellations of stakeholders, which bring together diverse knowledge types and perspectives on what it means to manage natural resources sustainably, are needed (Margerum, 2008; Reed et al., 2009; Ison et al., 2011).

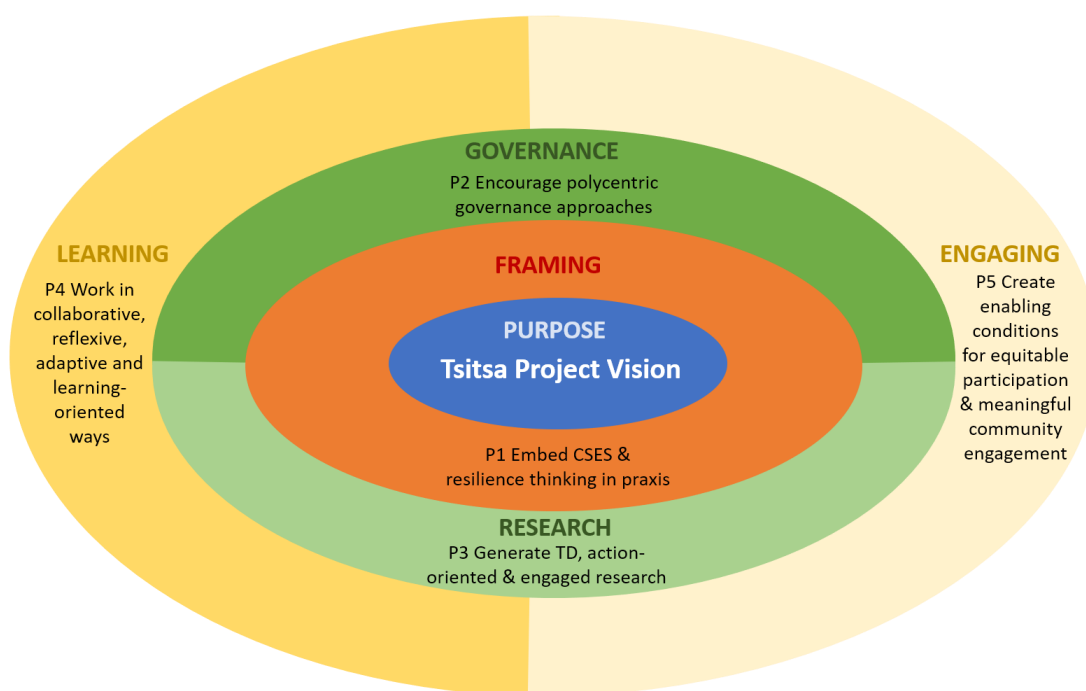
Many strategies and frameworks have been proposed to guide integrative research, governance and management of CSESs (van Kerkhoff, 2014; Biggs et al., 2015). These include, amongst many others, strategic adaptive management (Roux & Foxcroft, 2011), adaptive co-management (Armitage et al., 2007), integrated landscape approaches (Minang et al., 2014; Denier et al., 2015), integrated water resources management (Pahl-Wostl, 2007; Biswas, 2008), ecosystem-based adaptation (Roberts et al., 2012), and ecosystem stewardship (Chapin et al., 2009). Along with a growing set of management-oriented frameworks, there has also been a blossoming of novel research-oriented frameworks and innovations which have sought to support a more integrated and systems-thinking understanding of complex social-ecological systems. Examples of these include transdisciplinary research (Lang et al., 2012; Brandt et al., 2013; Cundill et al., 2015), integrative research (van Kerkhoff, 2014), and the large and growing body of sustainability science (Kates, 2011; Folke et al., 2016). Much of this research focuses on the imperative of science to serve the needs of society (Seidl et al., 2013; Keeler et al., 2017), recognising the need to address the challenges of knowledge co-production and exchange at the science-policy-practice interface (Jacobsson et al., 2014; Görg et al., 2016).

Rather than adopt one of these specific strategies or frameworks, the Tsitsa Project worked with a set of interconnected and mutually-supporting guiding principles based on a broad commitment to a complex social-ecological systems (CSES) framework (Anderies et al., 2004; Ostrom, 2009; Díaz et al., 2015; Fabricius et al., 2016). In this sense, the Project draws on concepts from a variety of frameworks to guide development of its approach, whilst recognizing the need to develop a context-specific and pragmatic set of guiding principles. Below, we briefly review the literature relevant to managing CSESs, making the case for the Tsitsa Project principles, which we have used to guide our reflections and analyse lessons learned. We suggest that the principles and lessons learned during praxis (Ison, 2018) may be of use to others seeking practical

implementation of integrated sustainability research and governance in CSEs. Moreover, we intend for our empirical experiences of putting these theoretical ideals into practice, in a particularly challenging local context, to contribute to the praxis of CSEs.

### 1.1. Guiding principles for integrated sustainability research and governance in a complex social-ecological system

We developed a set of five inter-connected principles to guide our work towards the purpose of achieving the Tsitsa Project Vision (blue oval, Figure 1; and case description (Section 3)). We understand these principles to operate in a layered fashion. The first layer is about ‘framing’: how we understand, think about, and share a mental model of the systems (Biggs et al., 2011) (orange ring). The second layer is about ‘what we are doing’ (green ring). The Tsitsa Project is primarily concerned with conducting applied action-orientated research and supporting the development of effective governance for sustainable management of the Tsitsa River catchment. It acts as a platform and ‘sets the stage’ (Roux et al., 2010) or provides an ‘enabling and flexible institutional setting’ (Pahl-Wostl et al., 2007) for participatory ways of understanding, governing, and acting in the system. The third layer is about ‘how we do what we do’ and captures our commitment to social learning and stakeholder engagement (Reed et al. 2010, (yellow ring). Within each of these layers, the five principles play out, and we describe each of them in turn below, drawing on relevant literature to argue for their significance.



Vision: **PURPOSE** - What we are working towards

Layer 1: **FRAMING** - Principle 1: How we understand the system, how we think about the system

Layer 2: **RESEARCH & GOVERNANCE** - Principle 2 & Principle 3: What we are doing

Layer 3: **LEARNING & ENGAGING** - Principle 4 & Principle 5: How we do what we do / how we work

**Figure 1: Layered conceptual diagram illustrating five key principles (P1-5) developed to guide the Tsitsa Project. (CSES – complex social ecological system; TD – transdisciplinary)**

#### *Principle 1: Embed complex social-ecological systems and resilience thinking in praxis*

The importance of a clear framing, or shared mental model (Biggs et al., 2011) in transdisciplinary research is recognized, and this framing must provide a set of common terms or vocabulary and allow for a broad suite of methods (Brandt et al., 2013). The Project has selected the concepts of CSEs and resilience thinking as a

central framing. The CSES perspective encourages an integrated understanding of humans-in-nature (Berkes & Folke, 1998), suggesting that human systems are embedded in, and entirely dependent, on the biosphere (Folke et al., 2016). CSES are complex adaptive systems (Cilliers et al., 2013). The characteristics of CSESs include nonlinear feedbacks, dynamic interactions, heterogeneity, and they operate over varying spatial, temporal and institutional scales (Levin et al., 2012). Praxis in this context requires specific governance and management purpose, to enhance the resilience of ecosystem services for human well-being (Biggs et al. 2012).

#### *Principle 2: Encourage polycentric and participatory governance approaches*

Collaborative, multi-scale, polycentric governance approaches are needed to manage complex social-ecological systems such as catchments, and these need to be underpinned by a social learning approach (Pahl-Wostl et al., 2008; Newig & Fritsch, 2009). Polycentric governance systems that match the scale of the resource system and are characterised by multiple, nested authorities governing at different scales should be promoted to support resilient CSESs (Biggs et al., 2012) These should be designed in a way that enables and promotes cross-scale collaborative governance and co-constructed action (Biggs et al., 2017) Palmer and Munnik, in press). Yet these kinds of collaborative platforms face significant organisational and financial difficulties (Head et al., 2016), and much can still be learnt about how to design, implement and facilitate these complex social processes. We use “polycentric” to emphasise inter-governance connectivity and “participatory” to denote the development of agency and voice among resident stakeholders.

#### *Principle 3: Generate transdisciplinary, action-oriented and engaged research*

There is growing support for conducting integrated, transdisciplinary (TD) research in response to the increasingly complex social–ecological issues facing society (Macleod et al., 2008; Roux et al., 2010; van Kerkhoff, 2014; Palmer et al., 2015). Transdisciplinary research can help to bridge the research-practice gap in natural resource management and conservation (Reyers et al., 2010; Cockburn et al., 2016). This shift towards more integrated forms of research responds to growing recognition of the need for greater integration between researchers and policy-makers. This requires an evidence base which is transparent, allows for integration of multiple knowledge types, is adaptive and can support management of CSESs (Macleod et al., 2008).

#### *Principle 4: Work in collaborative, reflexive, adaptive and learning-oriented ways*

Complex, messy and dynamic social-ecological systems should be navigated through adaptive approaches that recognize and work with complexity (Biggs et al., 2017). Collaboration is underpins the management and governance of CSESs because of the difficulty of problems, wide range of stakeholders and shared response required (Wondolleck & Yaffee, 2000; Head et al., 2016). Collaborative networks can serve as self-organizing components which somewhat mirror the larger complex adaptive system (Lubell, 2015). The new collaborative ties which are developed in such complex institutional settings are often considered necessary to counter the ‘fractured’ or ‘siloes’ nature of institutions (this is similar to what polycentric governance seeks to do) (Newig & Fritsch, 2009; Lubell, 2015).

Social learning is fundamental to CSES management and governance, enabling co-developed and systemic responses to uncertainty and non-linearity (Collins et al., 2007; Tàbara & Pahl-Wostl, 2007; Pahl-Wostl et al., 2008; Ison et al., 2011; Cundill et al., 2012). While systems and learning-based approaches are encouraged, researchers caution against simplistic understanding of how learning processes unfold and how they are best can be facilitated or supported (Pahl-Wostl et al., 2007; Muro & Jeffrey, 2008; Reed et al., 2010; Cundill & Rodela, 2012a; Lotz-Sisitka et al., 2012; Cundill et al., 2014). In conducting TD research with a mutual learning focus, the following questions should be considered: ‘who to learn with’, ‘what to learn about’ and ‘how to learn’ (Roux et al., 2017), Roux et al., 2010), being attentive to new relational capacities among stakeholders (Pahl-Wostl et al., 2008). Knowledge should be recognised not just as a product, but as a process of relating (Roux et al., 2006). Transdisciplinary research in CSESs challenges conventional impact evaluation. On-going

participatory reflection and evaluation, and other innovative means of tracking change may be better ways of considering the efficacy and impact of TD projects (Roux et al., 2010; Van Ongevalle et al., 2014).

*Principle 5: Create enabling conditions for equitable participation by multiple stakeholders with a particular commitment to meaningful engagement with local communities*

Putting a CSES framing into practice for the management and governance of natural resources requires engagement with the multiple, diverse stakeholders in the system. This enables legitimacy, monitoring and compliance, an understanding of system dynamics, and the capacity of the management sub-system to detect and interpret shocks and disturbances within CSES of interest (Stringer et al., 2006; Biggs et al., 2012). However, the intensity of stakeholder participation in TD research initiatives varies, and very few achieve true empowerment (Brandt et al., 2013).

Politics and power are important mediating factors in the way in which participative processes play out (Krueger et al., 2016). In order to overcome entrenched social injustice (often due to historical and geographical circumstances) in natural resource management, transdisciplinary research that pays attention to outcome and process, should take ethical and political considerations from diverse and possibly conflicting viewpoints into account (Hillman, 2005).

---

## **1.2. Integrated sustainability research and governance in complex social-ecological systems: contributing to a growing field in South Africa**

In South Africa there is a body of research on transdisciplinary research and engaged, learning-oriented management and governance of social-ecological systems in South Africa (Burns & Weaver, 2008; Biggs et al., 2015; Palmer et al., 2015). Such initiatives include, for example, research on strategic adaptive management of protected areas (du Toit et al., 2003; Roux & Foxcroft, 2011), integrated catchment management for resilience (Pollard et al., 2014; Palmer et al., 2015), mainstreaming of ecosystem services into planning for disaster management (Sitas et al., 2016), and supporting urban ecosystem management at the municipal level through implementation-oriented scientific research (Cockburn et al., 2016). There is also growing interest in the concept of ecological infrastructure (SANBI, 2014; Angelstam et al., 2017; Cumming et al., 2017; Sigwela et al., 2017). Ecological infrastructure refers to ecosystems that deliver services to society, functioning as a nature-based equivalent of, and complement to, built infrastructure (Cumming et al., 2017: 253). Through this concept, the South African government is recognizing the contribution of ecosystems to sustainable development and human well-being, for example through implementation of the National Development Plan and working towards the Sustainable Development Goals (Cumming et al., 2017).

A particular challenge faced by these varied initiatives in South Africa is to manage natural resources in a sustainable way keeping in mind the needs of future generations, whilst recognizing the need for more equitable distribution of the benefits of natural resources and ecosystem services in the current generation (Wynberg, 2002; Swilling et al., 2016). Thus a 'just transition' to sustainability is called for (Swilling and Annecke, 2012), which would consist of a "dual commitment to human well-being (with respect to income, education and health) and sustainability (with respect to decarbonization, resource efficiency and ecosystem restoration)" (Swilling et al., 2016: 650). The Tsitsa Project seeks to restore ecological infrastructure contribute to improved human well-being through job opportunities and improved ecosystem-based livelihoods, and to develop participatory governance in the Tsitsa River catchment. Tsitsa Project praxis brings together a growing body of on integrated sustainability research and governance in complex CSESs social-ecological systems to address the specific challenges faced in South Africa, using the five principles.

The aim of our study is therefore to reflect on and share lessons learnt from aspects of Tsitsa Project praxis that have variously enabled and constrained working towards the ambitious vision.

## 2. Methodology

### 2.1. Underlying philosophical framework

The underlying philosophical framework for this study is critical realism. This means we understand the world in the following way: “Reality consists of three domains: our experiences of events in the world, the events as such (of which we only experience a fraction) and the deep dimension where one finds the generative mechanisms producing the events in the world.” (Danermark et al., 2005: 43). A critical realist philosophy is well aligned with a complex systems worldview (Mingers, 2011), and thus with the overall framing of the Tsitsa Project based on CSES theory. Key features of both critical realist philosophy and complex systems theory indicate that they are consistent with one another (Mingers, 2011; Audouin et al., 2013). Firstly, both views recognize the world or reality as open system, and therefore the observer (researcher) is part of the system. Secondly, the concepts of emergence, hierarchies, and boundaries (or framing) are important in both critical realism and complex systems thinking (Preiser and Cilliers, 2010). Thirdly, and most importantly for methodology, in both views, human understanding of reality is recognized as partial and fallible, and therefore we need to be reflexive, humble and learn in an on-going manner from observations and experience. This supports our commitment to a collective, reflexive methods. According to Popa et al. (2015: 11): “knowledge claims arise out of actions, situations, and consequences rather than antecedent conditions”.

### 2.2. Commitment to reflexivity and learning: A moment to pause

This study was undertaken in the spirit of one of the founding principles of the Tsitsa Project i.e. “Principle 4 - Work in collaborative, reflexive, adaptive and learning-oriented ways”; and in the recognition that reflexivity is a fundamental process underpinning transdisciplinary research (Popa et al., 2015): “Principle 3 - Generate transdisciplinary, action-oriented, engaged research”.

The methodological approach was informed by this commitment to collective reflexivity (Popa et al., 2015; Ison, 2018). Therefore, rather than treating the data analysis process as an objective, systematic, and structured task undertaken by one or two individuals, we sought to analyse the data and findings in an on-going, iterative manner with the broader Tsitsa Project team.

### 2.3. Research design and methods

This study was designed as an instrumental case study (Stake, 2005; Yin, 2009). Instrumental case studies are a form of case study used to illuminate a particular question or issue. In our case, we are using the case to illuminate our understanding of implementing integrated research and governance in the context of complex social-ecological systems. We generated data for the case study by drawing on multiple sources of qualitative data (Yin, 2009). In this sense we took a mixed methods approach (Creswell, 2009; Maxwell & Mittapalli, 2010), although we primarily used qualitative data collection and analysis methods.

We generated data about the lessons learnt in the Tsitsa Project from two sources: project documentation, and reflective discussions. Project documents included newsletters and internal reports to funders and were accessed via the project manager’s database (most of the internal reports were confidential). We facilitated reflective discussions with participants in the Project. We recorded data from these as observation notes. We selected participants for the discussions based on the length and intensity of their involvement in the Project. A list of 25 potentially suitable participants was drawn up, and 22 of these participated in the reflections (three Group Reflection sessions, nine Individual Reflection sessions). Where possible, the reflective discussions were conducted collectively as focus group discussions to maximise opportunities for shared reflection and social learning. Where participants were not available to join a collective reflection session, individual one-on-one reflective interviews were held, either in person or via telephone. We captured observation notes directly

after reflection sessions, audio-recorded the discussions as a back-up and to allow partial transcription of relevant sections for quotes. Research ethics clearance was obtained from the Rhodes University Education Faculty Ethics Committee (Code: ED18030202).

We analysed data in an integrated manner across data sources (Bazeley, 2011), conducting manual coding and also using NVivo software as a supporting tool for data management and analysis (QSR International, 2017). We coded the observation notes from reflection sessions, along with project documents, in two coding cycles (Saldaña, 2013). In Coding Cycle 1, we open-coded the data to identify themes according to two main questions: 1. What lessons have been learnt in the Tsitsa Project? (i.e. identifying 'general lessons learnt' beyond the specific Tsitsa Project principles). 2. What lessons have been learnt about implementing Principle X in the Tsitsa Project? (Where 'X' stands for each of the five principles, See Figure 1). In Coding Cycle 1 we followed an inductive approach, whereby we moved from a number of particular instances of a lesson learnt (e.g. as identified in a specific project document or mentioned by participants in a reflection session) to induce a conclusion about a general lesson being learnt across the initiative as a whole. In this way we moved from a larger number of coding themes to a smaller number of over-arching lessons learnt. We then further organised these lessons learnt into over-arching 'Lesson Clusters' within which we grouped similar lessons. Drawing on narrative research approaches (Bold, 2012), we developed 'common narrative threads' (Brand et al., 2014) in order to re-create common verbatim statements from participants which convey the essence of key lessons identified during Coding Cycle 1 in a more personal way.

In Coding Cycle 2 we shifted to a more analytical mode, moving beyond the initial themes of lessons learnt (Bazeley, 2009). Here we worked with the thematic codes identified in cycle one by applying two strategies. Firstly, we applied the 'describe-compare-relate' scheme to work in an integrative way with the themes to develop rich descriptions of themes, identify relationships between the themes, and to compare them to one another. Secondly, we asked 'realist questions' of the data. Realist questions are based on a mode of inference used in critical realism called abduction (Danermark et al., 2005; Mingers, 2011). Abduction moves from a particular occurrence or observation (in our case the thematic 'lessons learnt' and lesson clusters identified in Coding Cycle 1) through an imaginative or creative leap by the researcher to think of an explanation which might account for that observation (Mingers, 2011). These are the kind of realist questions we posed (Danermark et al., 2005; Mingers, 2011): *'What qualities or conditions must exist for this lesson to have emerged as important?'* or: *'What kind of underlying condition or mechanism can explain the significance of this lesson within the Tsitsa Project?'* or: *'What does this lesson reveal about the underlying processes and structures which influence outcomes in the Tsitsa Project?'* or: *'What kinds of lessons might have emerged if we had applied a different methodology, for example gathering reflections informally rather than through a facilitated process, or not using the five Tsitsa Project principles to frame the reflections?'*

We used these questions to propose explanatory mechanisms, which allowed us to probe more deeply into the underlying causes of the observable lessons learnt about the Tsitsa Project as a means of empirically learning about the system (Cumming et al., 2005).

---

#### **2.4. Our understanding of learning: a lens to guide reflection and analysis**

It is important to define our understanding of learning so that when we look for and share 'lessons learnt', it is clear what we mean by this. Rather than clearly or narrowly defining learning, therefore, we rather draw together features of learning, based on a range of definitions of social learning (Keen et al., 2005; Muro & Jeffrey, 2008; Reed et al., 2010; Cundill & Rodela, 2012a) which align with the Tsitsa Project principles. Therefore, we understand learning as:

An on-going individual and collective process in which people inter-subjectively construct a change in understanding of a social-ecological context. They do this through an iterative process of acting,



reflecting, and adjusting their understanding and their practices. This builds collective capacity to improve management of social-ecological systems.

Since we recognize learning as an on-going, situated, collective process, rather than an object or outcome in itself (Lotz-Sisitka et al., 2012), it is important to ask: “Who learns? (Learning by...)”, ‘How do they learn? (Learning through...)’ and “What do they learn? (Learning about...)” (Cundill & Rodela, 2012b). In this study, we are focusing on learning characterised as follows:

- Learning by: participants within the Project (internal participants who have been closely involved, in an on-going and almost daily basis, with the Tsitsa Project)
- Learning through: conducting own research or research in collaboration with others, conducting own management tasks or management in collaboration with others, collective reflection and sharing of understandings
- Learning about: the Tsitsa River catchment, the Tsitsa Project, and our individual and collective practices within the Project and the catchment as a whole.

When we speak about ‘lessons learnt’, we are talking about instances within an on-going process where individuals directly involved in the Project have co-constructed a change in understanding of the Tsitsa River catchment CSES. This has come about through collective action, reflection and adjustment of the Project participants’ understanding and practices.

### 3. The case of the Tsitsa Project

Ntabelanga and Lalini are the suggested names for the two large dams which have been proposed on the Tsitsa River under the Mzimvubu Water Project (van Tol et al., 2016). The term ‘ecological infrastructure’ has gained traction amongst government decision-makers in South Africa as equally deserving of funding as other forms of infrastructure (SANBI, 2014; Sigwela et al., 2017).

---

#### 3.1. Tsitsa Project Vision

The Tsitsa Project brings together a bundle of concepts that, if realised in practice, could amount to a very different way of working towards landscape sustainability in complex social-ecological systems.

**The Tsitsa Project is guided by the following vision: to support sustainable livelihoods for local people through integrated landscape management that strives for resilient social-ecological systems and which fosters equity in access to ecosystem services.**

This vision has four significant pillars, underlined in the text above. The most difficult of these to work towards is ‘fostering equity’. Five principles guide the implementation of the Project towards the vision. Key to implementation are 1) the polycentric nature of internal governance which attempts to map and thus adequately handle the ‘outside complexity’ of the catchment itself, and 2) the notion that the principles are all inter-dependent and could fail as a bundle if any are ignored.

---

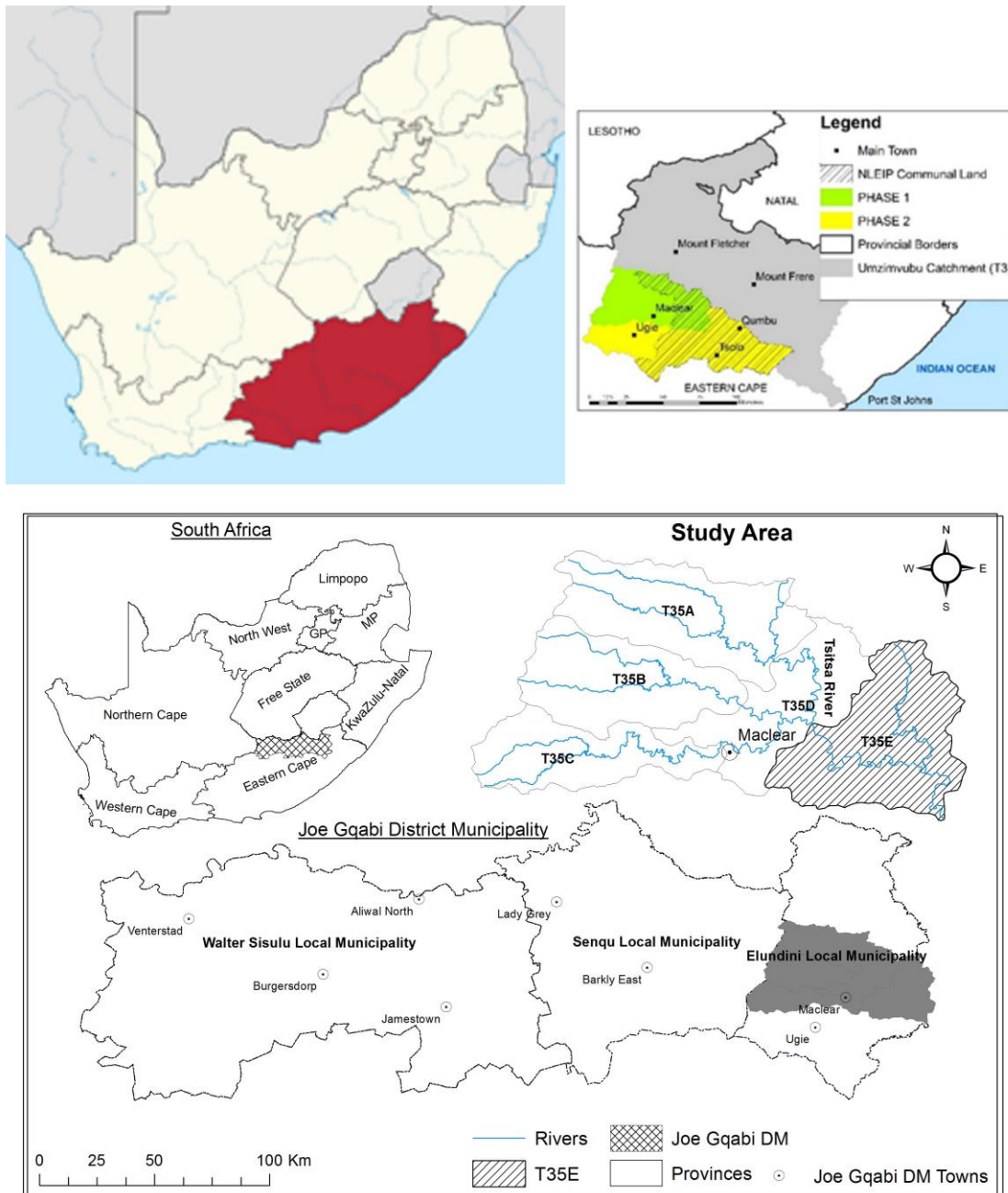
#### 3.2. What is the Tsitsa Project and how did it arise?

South Africa’s Department of Environmental Affairs: Chief Directorate Natural Resource Management (DEA: NRM) is responsible for 2 billion ZAR annually in employment benefits for poverty relief, all related to environmental rehabilitation, restoration<sup>3</sup> or care. Colloquially these various programmes (Working for Water, Working for Wetlands, Working for Ecosystems, Working on Fire etc.) are seen as the ‘Working for’ suite, and

---

<sup>3</sup>Although the initiative aims for ecological restoration, we recognise that the term rehabilitation may be more realistic.

are considered a key mechanism for achieving sustainable development in South Africa (van Wilgen & Wannenburg, 2016; Cumming et al., 2017). Over the past 22 years, it has become clear that although there are indeed employment and human capacity building benefits, the environmental outcomes are not always sustainable, and will not likely be sustainable beyond the era of the ‘Working for’ programmes, unless the ways of working can change and also diversify (van Wilgen & Wannenburg, 2016; Bek et al., 2017). For instance, from being state-controlled and organized, some programmes have started semi-privatizing, and critics have questioned the neoliberal underpinnings of the initiative which conflict with long-term environmental sustainability goals (Bek et al., 2017).



**Figure 2: Maps showing the location of the Tsitsa River catchment in the Eastern Cape Province of South Africa.**

The large Mzimvubu Water Project (MWP) which includes two large dams, was announced in one of the poorest areas in South Africa with high soil erosion rates (Parwada & Van Tol, 2016). The proposed dam falls under the mandate of the Department of Water and Sanitation. The first dam is intended for water supply downstream and to a large urban area outside the catchment (Mthatha) as well as an irrigation scheme near Tsolo. The second dam is intended to generate hydro-electricity largely for the irrigation scheme and to power water pumping. Sedimentation was seen as a major threat to the dam investment, and any lengthening of the dams' functional lifespans through controlling sediment was considered desirable (Parwada & Van Tol, 2016; Roux, 2018). Recognizing the opportunity offered by the proposed development, DEA: NRM secured longer-term funding to prevent or arrest sediment, but from the outset realized that if this was not effectively linked to livelihood benefits of local residents (beyond just jobs in 'Working for' programmes and dam construction) that any benefits for people and the environment would be short-lived. Equally clear was the realisation that unless this initiative could increasingly be planned and done with meaningful local involvement, that ongoing adaptation and sustainability would be just a dream (Sigwela et al., 2017). Quickly the ambit widened from just sedimentation to fuller sets of ecosystem services which could better support livelihood options especially through stewardship and repair of landscape functionality. This is the beginning of our story.

---

### 3.3. The social-ecological context of the Tsitsa river catchment

The Mzimvubu River catchment flows into the Indian Ocean and covers almost 20 000 km<sup>2</sup>, the size of South Africa's Kruger National Park or the country of Wales (Figure 2, Figure 3). The underlying geology comprises various sedimentary strata with Karoo dolerite intrusions, differentially forming the various features from escarpment to coast. Importantly, there are large areas of highly erodible duplex soils, only some of which are not yet eroded, posing serious sedimentation, landscape and livelihood consequences (Parwada & Van Tol, 2016; Roux, 2018). The Mzimvubu's southern sub-catchment, the Tsitsa River catchment (the Tsitsa Project focus), occupies 5 000 km<sup>2</sup>, a quarter of the whole Mzimvubu. The vegetation is mainly grassland, with riparian and other areas heavily infested with alien plants. There are approximately 84 villages in the easternmost part of the Tsitsa, which was previously part of a so-called black homeland (the "Transkei") in the Apartheid era (Sigwela et al., 2017). Traditional councils, comprising chiefs, headman and sub-headman are the dominant means of governing this communal land area. At best, councils co-operate with municipalities and democratically elected ward councillors. Further west in the Tsitsa River catchment lies a commercial farming area with freehold tenure. The communally owned area lies in scenic moderate to steep-sloped, and often erodible, areas with a sub-humid climate and variable annual rainfall, which ranges from 625 mm in the lower plains to 1 327 mm in the mountains (Roux, 2018) (Figure 3). De-agrarianisation (abandonment of crop lands) and an outflux of young to middle-aged residents are key features of the CSES, with resident communities dependent on multiple livelihoods including at least a partial dependence on natural products, home gardens and some cropping and livestock (Sigwela et al., 2017).

Natural resources are significant to local people for both livelihoods and socio-cultural activities, with rivers, grasslands and forest plantations being the most important land covers (Sigwela et al., 2017). Although there is good potential, ecotourism has not yet taken off. The freehold zone (generally higher altitude) has mainly maize, cattle and sheep farming, but also has large swaths of commercial plantation forestry. It is considered to be ecologically more intact and seen as economically productive. There is currently also some land re-allocation for emergent black farmers. This western part of the catchment falls within the Eastern Cape Drakensberg strategic water source area (Nel et al., 2017). Few sustainability-oriented NGOs have been active recently in the Tsitsa River catchment, in contrast to the Upper Mzimvubu River, where the (U)Mzimvubu Catchment Partnership Programme (UCPP, 2016) is active. This means that there is a large community trust-building task ahead for the Tsitsa Project. The Project has endeavoured to hold the tension between the top-down initiation, and a commitment to facilitating meaningful engagements with stakeholders (Principle 5). Trust-building is jeopardized by uncertainty as to whether the dams will actually be built, and concerns have

been raised about the way in which local communities were consulted and informed about the dam-building plans (van Tol et al., 2016). This contentious socio-political context is a challenge to the ambitious Project vision.



**Figure 3: View over the Shukunxa village, one of the villages in the Tsitsa Project, in the Tsitsa catchment (Photograph credit: Dylan Weyer).**

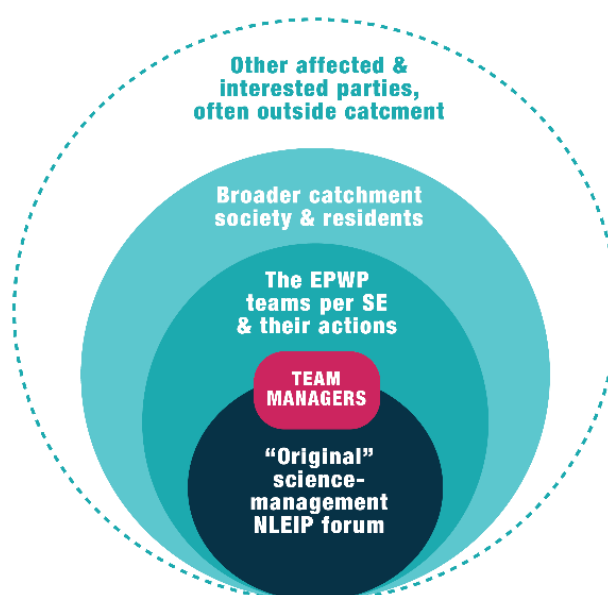
---

### 3.4. How the Tsitsa Project works

The Tsitsa Project is a loosely-convened network of researchers, natural resource managers, decision-makers and related stakeholders. Currently, the Project is co-ordinated by a core leadership group based at Rhodes University in Grahamstown, Eastern Cape, South Africa (illustrated in Figure 4 as the ‘Original’ science management Project forum, outside the catchment). The managers are DEA: NRM employees and are based in the catchment itself where they manage restoration teams under the banner of various ‘Working for...’ programmes (also referred to as ‘EPWP’ teams through their affiliation with the Expanded Public Works Programme, Figure 4). DEA: NRM has appointed implementing agencies who support the managers with on-the-ground implementation of restoration and natural resource management activities (‘Team Managers’ in Figure 4). Senior managers and decision-makers are based in East London or Cape Town where DEA has regional and national offices respectively. DEA: NRM are the primary funder of the Tsitsa Project, although co-funding is leveraged where possible. The funding was initially focused on research, but there is recently a shift to funding more stakeholder engagement and learning processes including implementing the Participatory Monitoring, Evaluation, Reflection and Learning (PMERL) framework (Botha et al., 2017). To implement this, a proposal has been made to employ a catchment coordinator, along with a team of community liaison officers, who will be based in the catchment and will enable better communication and interactions between the core Project network of researchers and managers with residents and other stakeholders in the catchment, thus expanding the influence of the Project in a more meaningful and effective way within the catchment (Figure 4).

The Tsitsa Project network meets 2-3 times per year at a ‘Science-Management Forum’ which is an opportunity to share research, for managers to share their experiences on the ground, for new ideas and suggestions to be deliberated, and for network participants to reflect and learn together. There are also regular planning and strategy meetings with smaller groups of high-level leaders and decision-makers which guide implementation of the Project. A recent internal governance innovation has been the development of three distinct but interconnected ‘Communities of Practice’ (COP) (it is envisaged that more of these thematic working groups may develop over time). The COPs work on thematic areas and are composed of scientists, managers and decision-

makers. They are intended to strengthen the links across these different actors, and to create a platform for more action-oriented projects on the ground. The COPs are currently organised according to the following three themes: 1. Sediment and rehabilitation, 2. Governance, 3. Livelihoods and ecosystem services.



**Figure 4: The multi-scale nature of the Tsitsa Project showing different stakeholders involved, and concentric zones of the project’s influence (Botha et al., 2017).**

### 3.5. Where we have come from: reflections on antecedent conditions

From on-going reflection on the history and future of the Tsitsa Project we recognise there are several antecedent conditions which strongly influence the pathway towards the vision:

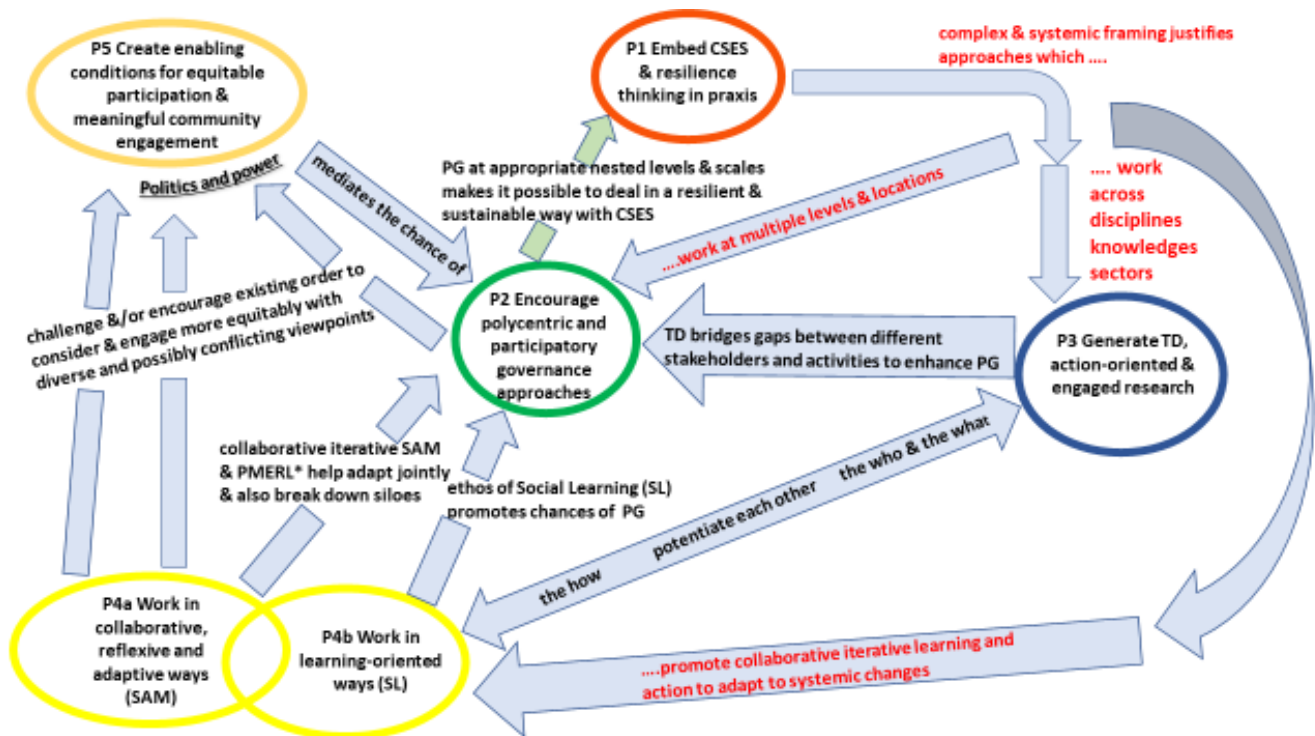
- **Creating ‘room to play’ for the Tsitsa Project as a flagship:** DEA: NRM has treated the Project from early on as a flagship initiative or “experiment” and given it the requisite partial freedom and space to attempt innovations in research, management, governance and practical interventions.
- **Widening learning linked to parallel processes:** Prior to the Tsitsa Project, and parallel to its development, DEA: NRM have conducted their own science and management planning meetings on a regular basis. Senior officials have reflected honestly and openly about constraints to their progress. From these meetings came a request to learn more about several key topics such as value-based adaptive planning (Keeney, 2009; Roux & Foxcroft, 2011). These discussions laid a foundation for consideration, not only in the Tsitsa Project, but possibly more widely, of leading officials transitioning from project managers to social and institutional entrepreneurs who mediate multi-party initiatives in and across whole sectors in the regions where they are active.
- **Multi-scale and expanding nature of the initiative and its impact:** The geographical extent of the Tsitsa Project, though vast, still fitted into the regional context where some such multi-party adaptive processes have already become established. In that regional context multiple connected scales and levels of operation and governance influenced focused Project activities (Figure 4).
- **Political will at senior government levels:** There is significant political and high-level administrative will to support and give the Tsitsa Project a fair chance. This seems partly linked to its value-heavy agenda (Keeney, 2009) for instance regarding people-centeredness and livelihoods especially in relation to rural poverty. Similarly, the ability of its leadership to convene fora that attract interested people with

experience in splicing novel ideas in during suitable windows of opportunity (Olsson et al., 2006), and to place learning at the forefront of monitoring and evaluation have set the scene for advancing the Tsitsa Project vision. For instance, well-respected scientists working on social-ecological systems research were invited and played a key role in setting up the first Research Investment Strategy (Fabricius et al., 2016) through facilitated meetings of scientists and managers working (many of them for the first time) through a social-ecological lens.

- **Appreciation for systems features such as novelty and serendipity:** There is a sense of novelty and serendipity arising from enabling leaders (including many experienced practitioners, scientists, administrators, and now wise community elders) to share ideas and co-construct potential ways forward. This often-organic process engenders trust, and itself open new windows of opportunity.
- **Openness to collective learning:** Much of the evolution and progress in the Project is based on learning from inter-personal and especially inter-group interactions and shared experiences, rather than being ideologically rooted in some “external” idea or recipe. This requires pragmatism based on lively ongoing reflection and a commitment to adaptive practice.

#### **4. Findings: Lessons learnt about facilitating integrated sustainability and governance research in complex social-ecological systems**

Understandably, findings emerged iteratively. After elucidation of the principles (Figure 1) a systemic view of the principles was developed (Figure 5). Evidence gathered through the collective reflection process guided the principles being linked to specific lessons learned (Table 1). Participant voices then are expressed in two nuanced stages. Firstly, as common narrative threads illustrating participant perceptions of the Tsitsa Project, with lessons learned (Box 1); and secondly as general lessons learned, each with a cluster of supporting learnings (Box 2). Finally, we suggest that three foundational findings emerge and are presented drawing on additional reflections: 1) the social-ecological systems and resilience thinking framing, and recognition of guiding principles (Figure 1), 2) the challenges of building novel linkages among diverse actors in the CSES, and 3) the constraints imposed by existing institutional structures, cultures and ways of working (particularly due to the large scale, complexity, and ambitious vision of the initiative).



**Figure 5: Systemic functional linkages between the five principles emphasise necessity for their joint usage: Principles: 1) Embed CSES and resilience thinking in praxis; 2) Encourage polycentric and participatory governance approaches; 3) Generate transdisciplinary action-orientated, engaged research; 4) Work in collaborative, reflexive, adaptive (4a) and learning-oriented (4b) ways; 5) Create enabling conditions for equitable participation and meaningful community engagement. The red text indicates the demands posed by assuming the complex social-ecological systems view (Principle 1), and the green arrow, returning to Principle 1 elaborates how these demands are met through systemic, linked application of the other four principles. Principle 5 intentionally reflected as being dependent on the ambient political ecology.**

\*SAM stands for Strategic Adaptive Management, the underlying Tsitsa Project framework for practicing collaborative reflexive adaptive mechanisms (Rogers and Luton, 2011, Kingsford and Biggs, 2011). #PMERL stands for the Participatory Monitoring, Evaluation, Reflection and Learning programme planned for the Tsitsa Project which will act as a guardian of SAM feedbacks and hence also assist materially in the breakdown of siloes.

**Table 1: Lessons learnt in the Tsitsa Project about putting the principles into practice.**

Tsitsa Project Principles (See Figure 1)	Assessment of progress towards implementing these principles in practice according to participants' perceptions.	Key 'lessons learnt' about each principle
<i>Principle 1: Embed complex social-ecological systems and resilience thinking in praxis</i>	Good progress. This is the one principle which most participants seem to understand, identify with, believe in, and actively try to practice in their work. It sets the scene for the other principles.	<ul style="list-style-type: none"> <li>Using an CSES framing has created an enabling research environment. However, seeing this principle through in governance, management and community and stakeholder engagement has been more of a challenge.</li> <li>The CSES framing creates an imperative for the other principles, and all the principles are interconnected and mutually reinforcing.</li> </ul>
<i>Principle 2: Encourage polycentric and participatory governance approaches</i>	Limited progress. Some participants were unfamiliar with this concept. The leaders of the initiative, however, passionate about it and believe it to be the biggest challenge, but also potentially the biggest contribution which the Tsitsa Project can make.	<ul style="list-style-type: none"> <li>Current structures and processes of governance (especially within government, but also in academia) inhibit or constrain realization of polycentric governance in practice.</li> <li>In order for the other principles to be realized in practice. Polycentric governance must be in place. In this sense, it could be considered the 'container' for the whole initiative to succeed.</li> <li>Participatory governance is necessary to address power imbalance and to promote equity.</li> </ul>
<i>Principle 3: Generate transdisciplinary, action-oriented and engaged research</i>	Fair progress. The transdisciplinary research among scientists is considered part of the successful implementation of this principle. However, the move from inter- to transdisciplinarity, and engaged and action-oriented aspects need further attention.	<ul style="list-style-type: none"> <li>One can consider this principle to be about building two types of bridges: Bridges between researchers from different disciplines (science-science); and bridges between researchers and societal actors (science-society) (Lang et al., 2012). In this case, the Tsitsa Project is doing well building the first type of bridge but building of the second type of bridge i.e. improving the links between science and society, is more challenging.</li> </ul>
<i>Principle 4: Work in collaborative, reflexive, adaptive and learning-oriented ways</i>	Fair progress. Collaboration between scientists is going well, links between scientists and managers are slowly improving. But links to other catchment stakeholders and community members are still lacking. Similarly, reflection, adaptation and learning are taking place within the core group but need to be extended further.	<ul style="list-style-type: none"> <li>Putting Principle 4 into practice requires paying attention to conditions that enable good quality communication and the time it takes to reflect and adapt.</li> <li>Implementing this principle beyond the core Tsitsa Project group is a key challenge and requires additional capacity in the team to facilitate this (e.g. through implementation of the PMERL plan).</li> </ul>
<i>Principle 5: Create enabling conditions for equitable participation by multiple stakeholders with a particular commitment to meaningful engagement with local communities</i>	Limited progress. Most participants feel we are not doing enough to implement this principle. Community engagement has been ad-hoc and only focused on traditional leaders, thereby marginalizing the less powerful. Lack of engagement with other government stakeholders from different provincial departments and local municipalities is also considered a weakness.	<ul style="list-style-type: none"> <li>Multiple factors constrain the Tsitsa Project in efforts to act according to this principle. These include, amongst others: bureaucracy and funding structure and demands; the right people with the right capacity and skills; the very large scale of the initiatives; politics and systemic barriers in the broader governance system.</li> <li>Without significant financial and capacity investments in community and stakeholder engagement, this principle will not be realized in practice.</li> </ul>



---

**Box 1: Common narrative threads that illustrate some of the most widely-held perceptions about the Tsitsa Project among participants, and illustrate key lessons learnt.**

- Narrative Thread 1:  
*"It takes time...and money....and the right people... to work according to CSES and resilience-thinking principles...to build trust... to build relationships... to reflexively and adaptively.... to build polycentric governance...to put all these principles into practice..."*
- Narrative Thread 2:  
*"The links between research and management have been unclear and confusing, and the "lines of command/responsibility/communication between researchers and managers/implementers has not always been clear, though this is getting better."*
- Narrative Thread 3:  
*"Community engagement and facilitation are a priority and concern. I recognize that some effort is being made in this regard, but it seems that the current effort is insufficient or is not working." ... "Sufficient budget must be put aside to have a community engagement team in the catchment to build trust and long-term relationships with local communities, and the social side of things cannot be an afterthought".*
- Narrative Thread 4:  
*"NLEIP<sup>4</sup>'s focus on polycentric governance is probably the most important work. It is the most challenging but it has the potential to bring about the most significant and sustainable change in the catchment."*
- Narrative Thread 5:  
*"There has recently been a shift in NLEIP: the dominance of 'science' has somewhat decreased (for a long time the science voices were loudest in the room), there is a stronger sense of purpose and understanding of what we are doing, there is better cross-pollination and integration (e.g. among COPs and also between scientists and managers) and there is a clearer focus on tangible local actions."*
- Narrative Thread 6:  
*"There is willingness in NLEIP and 'we/they are trying' to implement the work according to the principles, but it is difficult and, in many cases, constrained by external barriers."*
- Narrative Thread 7:  
*"This is an ambitious and groundbreaking project and I am excited about participating as it appeals to my personal commitment to doing meaningful work that can bring about change."*

---

<sup>4</sup>Note that where participants used the previous name of the initiative i.e. NLEIP (Ntabelanga and Lalini Ecological Infrastructure Project) we have retained this in the quotes. The new name of the initiative is the Tsitsa Project.

---

**Box 2: General lessons learnt through the Tsitsa Project organized into four clusters of lessons. Each statement below the cluster heading is worded as to complete the sentence starting “In the Tsitsa Project we have learnt that ...”**

**Lesson Cluster 1 - Building new relationships and linkages is challenging: Building new working relationships across deep-seated socio-cultural-political divides and in a rapidly changing political landscape is challenging. To put our Tsitsa Project principles into practice we need new connections and enabling spaces for exchange, and to become aware of power differentials among the different actors involved.**

- ... using the integrated SES framework and the Tsitsa Project principles to recruit researchers enabled the development of collaborative working relationships among an interdisciplinary team of scientists.
- ... polycentric governance is the biggest challenge, but also potentially the biggest area of learning and novelty within the Project. It is “the container” which we need for the Project in order to work effectively towards its vision, and it depends on the development of a myriad of new links between disparate stakeholders operating across multiple scales and levels of power.
- ... developing collaborative ties between the Tsitsa Project and other Eastern Cape universities, with government officials in municipalities and other sectors, and with traditional authorities, is difficult. This requires recognition that building these new relationships means working across deeply entrenched historical power divides. Building of these new relationships will also be influenced by the ever-changing political landscape.
- ... meaningful and effective community engagement in a science-led process driven towards clear biophysical outcomes is a significant challenge. Many Project participants feel the need to contribute to direct, tangible benefits for local communities in the catchment. Effective stakeholder engagement also requires sensitivity to local-level politics. People with the right competencies, language skills, and understanding of the local context need to take the lead in this work.

**Lesson Cluster 2 – The science-action tension is real: Overcoming the tension between theory and practice, research and action, and science and management is particularly challenging in a science-led process. This tension is characterised by relationships among actors operating in different knowledge systems, and by conflicts between incentives and success measures of these different systems.**

- ... bridging the disconnect between scientists and managers takes time, and in the Tsitsa Project the disconnect is still a concern for many participants. This includes a lack of understanding for how decisions are made, lack of clarity about the correct communication channels, and insufficient knowledge-sharing between scientists and managers.
- ... balancing the need for “theory, thinking, conceptualizing (research, science)” on the one hand, and “action, practice, tangible impacts and progress (management)” on the other is difficult. Some participants commented on a recent shift in the Tsitsa Project towards a better balance between these two.
- ... the initial strong focus on research (particularly biophysical research) may have constrained opportunities for action and benefit-oriented interactions with local communities in the catchment, contributing to frustrations about limited community engagement and benefits.
- .... for the principle of polycentric governance to be realized, the links between researchers and managers need to be strengthened. However, building new relationships, communication channels and platforms for knowledge sharing between previously disparate actors (e.g. scientists and managers) is a slow process (links to Lesson Cluster 1).
- ... a commitment to pragmatism, i.e. moving forward despite incomplete knowledge and uncertainties, is key to not letting the science dominate and slow down the process.

### **Lesson Cluster 3 – We need to work with enabling conditions and recognize disabling conditions:**

**Enhancing existing enabling conditions (serendipity) whilst working to create new ones (novelty) are important leverage points in this kind of change-oriented initiative in a complex system. Similarly, there are significant structural and systemic barriers which act as disabling conditions.**

- ... the ambitious and novel approach taken in the initiative has attracted people to participating in it. It inspires people and generates a sense of hope for change.
- ... participants are motivated to participate because the initiative aligns with their research interests and it provides a funded opportunity to conduct research which speaks to their sense of purpose and need to 'make a difference'.
- ... having the right people, with the right skills and capacities is important. Key people have acted as conveners, brokers, and leaders. Having open-minded scientists and like-minded people working together has eased an otherwise potentially difficult process. Conversely, not having sufficient people with certain capacities (e.g. community facilitation, social science research) has also been identified as a constraint.
- ... the importance of leaders working to create enabling conditions or 'room to play' should not be underestimated. This is particularly important considering existing bureaucratic and political constraints in a government-funded initiative. This signals political will and support for the initiative, which inspires participation.
- ... understanding the importance of historical context of the Tsitsa Project, and of the Tsitsa catchment, is critical to identifying leverage points for change.
- ... good will and good intentions (including 'political will') by Project leaders and participants are constrained by external factors and barriers. These include, for example politics, funding and bureaucracy, lack of the right capacity and people, etc. Linked to this are the challenges the Tsitsa Project has faced in engaging meaningfully with local communities.

**Lesson Cluster 4 - This initiative is a challenge of immense scale and complexity: If this is such an ambitious and complex endeavor intended to have impact at such a large scale, then it needs to be resourced accordingly. It needs the right kind of money and the right kind of people.**

- ... the scale and complexity of the initiative compounds and deepens the other challenges we face. For example, the large scale of the catchment significantly compounds the two biggest challenges identified with the Project: development of polycentric governance approaches, and meaningful and equitable participation by multiple stakeholders including local communities.
- ... this is a big, ambitious, and complex endeavor. We need to be humble about how much we can do, how well we can get to know the context, and how much of an impact we can have on the ecosystems and livelihoods.
- ... it takes a lot of time and money and the right kind of people to do things differently. This raises the question: are we spending money on the right things to leverage the change we want to see?

---

Using the principles (Figure 1), Table 1, and Boxes 1 and 2, we elaborate on the three overarching findings:

#### **4.1 Complex Social-ecological systems and resilience thinking is an enabling framing**

The complex social-ecological systems and resilience-thinking framing (P1, Figure 5) has created enabling conditions for integrative research and project governance, and for making new connections across multiple social-institutional divides - supporting a recognition of, and limited transitions towards polycentric governance (Ostrom, 2010). The transdisciplinary research approach was hailed by many participants as one of the early successes, yet the limited evidence of effective polycentric governance (P2, Figure 5) and equitable participation by local communities and other relevant catchment stakeholders (P5, Figure 5) indicate that realising CSES and resilience thinking in practice **takes time** (Box 1, Narrative Thread 1).

Seeking to embed complex social-ecological systems and resilience thinking in praxis was realised through explicit and agreed conceptual framing of the Tsitsa Project (Fabricius et al., 2016), which attracted particular researchers with an affinity to the approach.

Study participants agree most progress has been made in implementing Principle 1, as evidenced by the shift from an early focus on sediments, hard engineering and restoration science, towards a more integrated understanding of the system in which livelihoods, community engagement and governance have become core focus areas:

*(Commenting on Principle 1) "... we probably spent a year and a half to get engineering out of people's heads ...most of the guys said listen, we just need to build physical structures ... and we were like no, there are guys who must benefit from this, how do they benefit from the structure that is sitting full of sediment. And it took a long time and some guys were really pushing that agenda ... so we've come a very long way." (Group Reflection #1)*

Similarly, many participants commented on the fact that it is because of our commitment to Principle 1, that the project has a strong focus on community involvement:

*"I think with Principle 1, we are getting there. Like the fact that this plan will only be accepted once the community has signed off on it... well different parts of the community... is key." (Group Reflection #3).*

*"Resilience thinking involves the people on the ground. Communication, trust and action is important." (Group Reflection #1).*

However, there is recognition that this perception about the successful implementation of this principle may be more from the research perspective than from the management perspective, and that putting CSES and resilience thinking into practice may be 'easier' for researchers than managers (where research practice means ensuring graduations and publications as well as situated changes). This extends to putting CSES and resilience thinking into practice for governance (P2) and community and stakeholder participation (P5) as well. Many participants commented on the fact that it takes significant financial resources, a long time, and people with the right skills and interests to implement a project according to CSES and resilience-thinking principles (Box 1, Narrative Thread 1).

Some participants also pointed out the importance of deepening our understanding of the Tsitsa River catchment as a CSES by paying closer attention to emergent features, and paying attention to the constantly changing nature of the systems, as for example shown in this quote:

*"Thinking about Principle 1... and asking the kind of questions around what constitutes a complex adaptive system. So, thinking about things like emergence, like what are the gaps that have emerged, what are the unintended consequences that have emerged. What do we need to emerge? You kind of have to let it run for a while to see some of these things sprout up, and then kind of step back and ask, well, what are these things that are emerging, how is the system changing as we are going along... and that that process is difficult." (Group Reflection #3)*

What we have learnt about putting CSES and resilience-thinking into practice is that using an explicit framing creates an enabling environment for conducting integrated, transdisciplinary research. Participants noted that the CSES aspect has been stronger than the resilience thinking aspect, and this may well relate to the constant use of the term 'complex social-ecological systems' which was apparent both in the reflection sessions and in the documents analysed. Importantly, the CSES framing has not only set the scene for research within the Tsitsa Project but it has also set the scene for the other principles (Table 1). Participants mentioned that the principles are all interconnected, and that they mutually reinforce one another (Figure 5).

---

## 4.2 Building new linkages from science outwards is difficult

A pervasive challenge in the Tsitsa Project has been to build new linkages between the research community and other important actors in the CSES. The Project research is fundamentally a science-driven process (taking science in the broadest sense). Funds are held at the university, and the majority of participants are academic staff or students. For the Project to move towards its vision, academic outcomes need to be matched by practice outcomes of restoration supporting livelihoods. Concurrently, new linkages need to include inter-personal working relationships and relationships of trust, channels of communication and decision-making, and platforms and channels for knowledge-sharing across knowledge systems. The Tsitsa Project principles require linkages to be made ‘outwards’ from scientists towards managers, implementers, catchment community members, and other relevant stakeholders in the catchment (Figure 5). Many of the reflections in this study articulated concerns about the disconnect between scientists and managers (Box 1, Narrative Thread 2), and the widely held concerns about insufficient engagement with local communities and other catchment stakeholders (Box 1, Narrative Thread 3; Table 1, Principle 5).

*Principles 1 and 2:* The science-led basis of the Tsitsa Project research is a system precondition with consequences, both positive and negative (Box 2, Lesson Cluster 3). It has resulted in tensions and difficulties in overcoming the divide between science and action (Box 2, Lesson Cluster 2), and it has contributed to a slow community engagement process (Box 2 Lesson Cluster 1, Box 1, Narrative Thread 3), and in fragmentary evidence of emerging polycentric governance (Box 1, Narrative Thread 2). On the other hand, the strong emphasis on co-development of conceptual frameworks around the notion of resilience CSEs has set the scene for a systems-thinking initiative which has attracted mostly open-minded people with similar interests and shared personal motivations for participating in the Project (Table 1, Principle 1).

Lesson Cluster 1 (Box 2) captures the multiple lessons related to building the new linkages required for working in an CSES manner. Building new working relationships across deep-seated socio-cultural-political divides in a rapidly changing political landscape is challenging. We acknowledge it has been ‘easier’ to build the relationships between scientists-and-scientists, than between scientists-and-managers, and between government officials across departments. Barriers include geographic distance, power imbalances, and the tension between different knowledge domains.

To put our Tsitsa Project principles P2 (extensive, meaningful engagement) and P5 (polycentric and participatory governance – (Box 1, Narrative Thread 4)) into practice we need new connections and enabling spaces for exchange, and to become aware of power differentials among the different actors involved. Participants captured the essence of polycentric governance, and its value, as follows:

*“...polycentric governance is about mimicking in governance the linkages of the real world, the complex system at hand...its’s about creating adaptive linkages... putting people in contact with one another” (Individual Reflection #3)*

*“This one (the principle, P2) is brilliant... they are encouraging linkages between different government platforms. And that is very effective... and in actual fact ... that’s one area that NLEIP in my view have a greatest value in the Ntabelanga catchment... you (NLEIP) should not view yourselves as coming to set up governance platforms but rather to facilitate existing governance platforms... when you are saying that you are linking the community with COGTA, with Environment, with Agriculture, with different institutions for better management of the catchment, then that’s a better way.” (Individual Reflection #8) (Note: COGTA: Department of Cooperative Governance and Traditional Affairs).*

Many participants commented on how P2 was ‘great in theory’ but difficult to implement:

*“Polycentric governance... we are trying to do that and I think it’s fairly new for all of us ... and it can be very frustrating because not everybody is cooperating in the same way. Look. I think it’s very important, but how do we do it correctly, how do we pull in all these different role players, especially agriculture - that is the most*

*important role player that is part of the scene. They don't have transport to get there, there is so much issues, it's so problematic. It's a nice thing to put up here (as a principle)... but to implement it we still have serious challenges I think.” (Individual Reflection #9).*

A reason for this could be that realizing polycentric and participatory governance in practice depends on the development of relationships between disparate stakeholders operating across multiple scales and levels of power:

*“So, I think polycentric governance... even if you take it at a national departmental or provincial departmental level, there are so many cross-cutting mandates. This project is in the middle of what's really a murky kind of space. At one level there is clarity about who is responsible for what but each of those responsibilities impacts so directly on another. So, it's with agriculture, rural development, water and sanitation, environmental affairs, all of those...I think that's hugely challenging... not just thinking about our institutional structures, or bureaucratic hierarchy, but also, where power sits. The role of the traditional authorities in those communities. And the sort of interplay between those forces. I fear that's deeply problematic. And as an aspiration it's something to work towards. But if we want to... if that was to become a condition of which everything else happens, I don't think we'd go very far.” (Individual Reflection #6).*

Similarly, despite the imperative of relationality and developing trusted working relationships, these processes takes time (Box 1, Narrative Thread 1 and 3).

Lesson Cluster 2 (Box 2) addresses the tension between theory and practice, research and action, and science and management (Box 1, Narrative Thread 2 and 5). This tension is characterized by disjunct knowledge systems and incentives. For example, most managers described one-way knowledge exchange in which they passively ‘received’ knowledge, advice, or recommendations from scientists:

*“I am very happy working with NLEIP ... to make sure that what I am doing is complying with all requirements, not just doing my thing... so for me it's very important ... all these points, I collect them from NLEIP and then I apply them in my practical work on the ground.” (Group Reflection #2)*

*“Operationally there's a lot of mistakes that's happened, because there is this research unit ... that we need to listen to... but there's not always clear guidance on what you should do, and those decisions might change from one to the next meeting. And that is difficult.” (Group Reflection #1)*

*“I was actually confused. I do not know, what is the relationship between NLEIP and the restoration teams... because NLEIP researchers, they don't seem to know. I mean, this is just my own observation, but they don't seem to know what rehabilitation activities are going on. It seems as if GIB (one of the implementation agents) they are just doing their thing, and then NLEIP researchers are just doing their thing. And yet, my understanding was that NLEIP is involved in restoration.” (Individual Reflection #2).*

This quote is from one of the researchers:

*“...there's never been a clear structure as to who we should be working through. When I first went into the field I was severely wrapped over the knuckles because I hadn't talked to the right manager... and I kept finding that I was doing something, and I shouldn't be doing that, and I hadn't talked to the right person ... but nobody ever said this is who you should talk to. So, I think we were very much, as an NLEIP project, trying to work out who was doing what...” (Group Reflection #1)*

These seem to indicate that the relationship between scientists and managers in the Tsitsa Project is based on an assumption that scientific knowledge is superior to local practical knowledge held by managers. Furthermore, there is a lack of understanding among scientists about how decisions are made by managers; there is a lack of clarity about the correct communication channels between scientists and managers; and

there is insufficient knowledge-sharing between scientists and managers (Box 1, Narrative Thread 2). These multiple tensions point to the benefit of skilled people who can act as brokers and conveners, bringing together actors across knowledge divides, or to act as translators between different knowledge systems:

*“So that's one thing about this process, I think what we can learn from this is that it's not quick... these things are not quick and dirty.... if you want to change land use in the Ntabelanga area, you probably need to give us 10 years to start really showing good results...and you need to get the right people, people who can sit and talk to people for hours and hours and don't get gatvol...” (Individual Reflection #9) (Note: gatvol is an Afrikaans word meaning annoyed or fed up).*

The fact that several participants identified a recent shift in the Tsitsa Project from a science-dominated process, to a more practice and action-oriented one, also shows that participants are aware of the tension between science and action (Box 1, Narrative Thread 5; Box 2, Lesson Cluster 2):

*“In quite a few of the first big NLEIP meetings, there was a very big stress on this whole idea of [complex] social-ecological systems and resilience thinking and lots of people were giving very theoretical talks, and I think that probably distanced some managers, because it seemed so nebulous - and some researchers. They just want to get on with it and do it... ‘I can do it in a different way, but I just want to do it’. So, I think that did create some tensions.” (Group Reflection 1).*

Pragmatism provided a balancing perspective (Box 2, Lesson Cluster 2).

*“So, I don't think it's a bad thing that we started with some stuff (actions on the ground), sometimes we are criticised for it, but if we hadn't done anything, none of the people would have been employed, there would not be any good will. We are giving over 90 people work in that area, so some of the chiefs are very positive... so at some stage you have to start getting your hands dirty. You will never have all the answers.” (Individual Reflection #9).*

**Principle 3:** The thematic COPs (Communities of Practice) which have emerged as a feature of the Tsitsa Project's internal polycentric governance are a space in which multiple divides can be bridged: the divide between researchers from disciplinary backgrounds, and the divides between researchers and managers. The recent interest in increasing cross-pollination and integration across the COPs is encouraging and seems to indicate that the TD practice is maturing in the Project (Box 1, Narrative Thread 5).

Bringing together researchers from different disciplines was not without its difficulties, and in the early stages of the Project there was often tension in the Science-Management meetings as people found their feet in this collaborative research process. Principle 3 is considered by many participants to be one of the principles with which most progress has been made (Table 1), particularly with reference to the involvement of a team of transdisciplinary scientists, as these two quotes from participants illustrate:

*“...that's part of this whole thing: the more you pull in people from different disciplines to come up with complex systems, it really, really helps a great deal. We can't be it all... we can't be a soil scientist, a geologist, a restoration ecologist, all that in one go... so ja, I completely believe in this and I think it's a good way of doing things ... but again, it takes money and time.” (Individual Reflection #9).*

*“Because academics involve an element of research in restoration... involvement of academia is guiding the projects towards measurable outcomes that are scientifically based.” (Individual Reflection #8)*

Interestingly, and unsurprisingly, researchers had more to say about Principle 3 than managers. This seems to show that researchers are themselves reflecting on how they can do their research more in line with this principle, but it also shows that maybe there is less interest in this form of research from managers within the Project. Maybe they are comfortable with a more conventional research approach in which they are passive recipients and implementers of knowledge generated by disciplinary experts? This needs to be explored further but indicates that the conventional roles played by scientists and managers and therefore existing organisational cultures may constrain the ability of the Project to work according to these 'business unusual' principles.

Despite these optimistic reflections on our implementation of Principle 3, there is still work to be done towards the Tsitsa Project becoming a truly transdisciplinary initiative. Since we take our understanding of TD from Lang et al. (2012), then there are two distinct types of integration which are fundamental to TD practice. These are integration across disciplines (i.e. an advanced, integrative form of interdisciplinarity called ‘strong transdisciplinarity’ (Max-Neef, 2005)), and integration between knowledge types across academia and society (i.e. better linkages between academic and societal actors in knowledge co-production processes). The Project appears to have set in place the foundation for strong transdisciplinarity among academic actors and knowledge types but has made limited progress in integrating both academic and societal actors into an engaged knowledge co-production process. The lesson learnt here is that in a science or research-driven process, conducting TD research which is truly action-oriented and engaged requires paying particular attention to the role of non-academic actors in the knowledge co-production process. More targeted, and carefully facilitated, opportunities for two-way knowledge-sharing across the science-society interface may need to be put in place.

Another lesson learnt is that it takes people with a certain kind of personality and set of competencies to be able to work in transdisciplinary, engaged research processes. It requires people who are open-minded and able to see things from other people’s perspectives, and it takes people who are willing to learn and adjust their own disciplinary view and approach (Box 1, Narrative Thread 1; Box 2, Lesson Cluster 3). This often comes about through a ‘self-selection’ process whereby certain people are attracted to TD initiatives like the Tsitsa Project, but the Project could also actively work to creating learning opportunities for people to learn the skills and competencies required for TD research. This could, for example, be focused on developing integrative and transdisciplinary skills amongst postgraduate students conducting research within the Project.

*Principle 4: Working in collaborative, reflexive, adaptive and learning-oriented ways, has been put into practice in a number of different ways in the Project (Table 1), and the challenges of putting this into practice have also related to building new linkages in the system from science outwards. Firstly, the way in which the initiative was set up from the start, drawing in diverse stakeholders from research and management, reflects the commitment to a collaborative process. Science-Management meetings are facilitated in a way that encourages contributions and participation from these various stakeholders and encourages reflection and on-going learning, though they may be favouring science. The process of gathering lessons learnt through reflection sessions for development of this paper is another example of how this principle has been put into practice.*

Participants reflected on good progress toward collaborative, adaptive, learning oriented practice, although this seems to be primarily focused on collaborative research between a transdisciplinary team of scientists, rather than collaborative governance or decision-making with other stakeholders, as shown in this quote:

*“An advantage that NLEIP has had... is the formulation of a collaborative forum, whereby you have different departmental people involved, various people that are involved, and that sort of assisted the NLEIP programme to jump start the problems that other restoration programmes have had. It's natural: two brains are better than one. if an implementer is just working on their own - it's better if there are a couple of people around the table are coming up with guidance, such a collaborative platform provides an enriched context in which projects are implementer.” (Individual Reflection #8).*

Participants recognize that senior leadership in the initiative embody and explicitly facilitate and encourage a reflective, adaptive and learning-oriented approach. The fact that the Tsitsa Project has spent funding on the development of a Participatory Monitoring, Evaluation, Reflection and Learning (PMERL) plan (even though it has not yet been implemented) is considered by many participants to be an indication of the Project’s commitment to this principle, as shown by these quotes:

*“The PMERL is a tangible expression of Principle 4 and demonstrates the commitment to this principle... now we just need to implement it.” (Individual Reflection #1).*



However, beyond implementation of the PMERL plan, the Project needs to continuously work towards embedding a culture, and everyday practices, to realize these principles in practice across a diverse range of stakeholders. There is a risk that once a PMERL co-ordinator has been appointed, that participants become complacent about their responsibilities towards reflection, learning and adaptation. A number of participants commented on the value of the reflection sessions which were facilitated in the development of this paper, saying that it was good to set aside specific time for reflection and to make our learning explicit.

*Principle 5:* The most tangible ways in which the Tsitsa Project has sought to put Principle 5 into practice have been: 1) an early research project on developing participatory governance through the facilitated co-development of a draft catchment management strategy; 2) the commissioning of stakeholder analyses in the Ntabelanga and Lalini dam catchment areas; and 3) a series of participatory land use mapping workshops, held with selected villages, to provide an opportunity for local residents to share their knowledge and understanding of natural resources, and for their plans and wishes to be incorporated in the Project's restoration and management plan. One participant was very happy about the fact that the Project has given communities these opportunities (though later in the conversation this same participant pointed out that we have not returned soon enough for feedback on the participatory land use maps):

*"...what I like, mainly, about NLEIP... people are given opportunity to actually say, we want to do this here, we want to do that there. And that is actually very powerful." (Individual reflection #2)*

The researchers who conducted the stakeholder analyses were critical of the way in which the Project has gone about engaging (or not engaging) with catchment stakeholders, and since the presentation of these findings, concerns about including the 'community voice' within the Project have been raised and discussed in many meetings and fora, as shown by this extract from a project Newsletter following a Science-Management meeting:

*"Maintenance of interventions and good communication and community engagement is critical over the long term for achieving the NLEIP vision." (NLEIP Newsletter #2)*

Other participant reflections that align with Box 1, (Narrative Thread 6) and Box 2 (Lesson Cluster 3) included:

*"The majority of community members that I spoke to, they don't trust external institutions. And then when we get into the village, when we introduce the project, we ensure community members that we are different. And then we tell them, look, if there's a problem, we will come back to you, we will let you know. We'll never keep you waiting forever. If we come and do research, we collect data, we will give feedback. That hasn't happened. And that is a core thing in building community relationship, in building a reputation... If you don't go back soon, you lose trust." (Individual Reflection #2)*

*"Although there's a lot of goodwill around equitable participation and involving stakeholders, local governance... at the moment that's still a little bit on paper... the project is still a little bit outside the catchment, it's still not inside the catchment." (Group Reflection #3)*

*"We have to treat people in the catchment well. The social side of things cannot be an afterthought." (Individual Reflection #7).*

*"NLEIP have a good heart, they want to do good, but it seems as if there's lots of red tape, and discussion... This is the 3rd or 4th year, and still, it's only papers, things that are being produced are papers... I know it is an 8 or 10-year project... there's a lot of planning, but, you can't in the 4th year of the project still be planning." (Individual Reflection #2)*

In response to these sentiments, a catchment liaison officer was appointed to improve Tsitsa Project communication and engagement activities within the catchment, and to facilitate interaction between researchers and local catchment residents. Despite these activities, a strong view remains among most Project participants that Principle 5 is the principle on which we have made the least progress and in which we face the most challenges (Box 1, Narrative Thread 3, Table 1). This is unsurprising in the science-led domination of

the first phase of the Project and is balanced by a commitment to building on the progress made in the next phase.

There are multiple perspectives, some of them divergent, about how the Tsitsa Project should be engaging with local communities and other relevant stakeholders. For example, some participants feel strongly that traditional authority leaders should be invited to Science-Management meetings as a way of bringing the 'community voice' into the central discussion forum of the Project, whilst others believe this could be disempowering, for example because of language barriers and the prevalence of technical scientific jargon in this forum.

A serious community engagement constraint relates to the political tension around development of the dams and the ongoing uncertainty as to whether the dam building is going ahead. The government stakeholder engagement processes in terms of the dam are widely considered to have been flawed, particularly in terms of informing local residents about possible consequences of the dams for their livelihoods and homes. This resulted in significant mistrust in the local catchment communities of outsiders, particularly of anyone coming in to discuss land, water or related natural resource issues, since they were often automatically associated with the dam. During the CMS development process, the Project manager was disappointed by the focus on the dams over-shadowing a focus on landscape restoration.

In respect of the Tsitsa Project funding - the early research investment strategy did not make sufficient allowance for governance development and engagement related to restoration practice. More recently there is a recognition of 'business unusual':

*"this implementation plan will only be accepted once the community has signed off on it... well different parts of the community... this is DEA's commitment to doing 'business unusual'" (Group Reflection #3)*

Other interacting factors which constrain the Tsitsa Project's ability to improve its community engagement activities include a lack of suitable capacity and skills within the existing Project team, the large scale of the initiative (meaningful engagement across the entire catchment would require significant investment in local community engagement facilitators or liaison officers), the long-term nature of potential benefits to local communities from restoration activities, and the ever-changing political landscape. This needs to be negotiated sensitively which requires local knowledge and good relationships with community leaders. Finally, some participants pointed out the need to define more carefully and more realistically, what we mean by 'participation', 'equitable' and 'meaningful engagement'.

All the principles inter-relate (Figure 5) and depend on the development of relational competencies among Tsitsa Project participants and require funding which recognises the time it takes to build new working relationships amongst previously disparate social actors relevant to the catchment (Box 1, Narrative Thread 1). This will likely require investment in development of leadership and facilitation skills among senior Project managers and decision-makers. Furthermore, a clearer focus on local actions is needed. These could be, for example, pilot projects to test novel restoration approaches coupled to livelihood benefits for local people, which can provide opportunities for building relationships with local resource users and with other stakeholders such as local municipalities, and government officials from other sectors. In this way, multiple stakeholders can get to know each other, collaborate, learn, and share the benefits of pilot projects.

---

### **4.3 Large, CSES initiatives face particular constraints relating to existing institutional structures, cultures and ways of working**

Existing structures and institutions are a significant constraint to the Tsitsa Project realising its theoretical principles in practice, particularly since this is such a large-scale and ambitious endeavour (Box 2, Lesson Cluster 4). Deep institutional change is needed to bring these principles to life. This explains why polycentric

and participatory governance development is considered by many to be the most difficult of the principles to implement (Box 1, Narrative Thread 4), yet 'getting it right' has potential to bring about the most significant change on the ground. In this sense it is considered to be a 'deep leverage' point related to design of the system (Abson et al., 2017).

There are significant disabling preconditions or barriers which the initiative faces. These include for example the uncertain and volatile political context (both at the local catchment level and at senior decision-making levels), funding which has certain 'strings attached' (i.e. pre-determined mandates which direct funding towards certain activities and do not allow flexibility), and pressure to deliver tangible deliverables to satisfy the bureaucracy (Box 2, Lesson Cluster 3). Lesson Cluster 4 (Box 2) captures lessons learnt about the challenges faced in the Project due to the immense scale and complexity of the initiative. This quote captures one participants' perception about the complexity of the initiative:

*"It is so complex. That if you had to be told at the beginning how complex it was, you wouldn't be involved. But because you just jump in, and you swim, and I guess you kind of make it up as you go, that the complexity gives you a massive learning curve and a lot of reward ... So that probably would be my lesson, that the level of complexity is way beyond anything, just because it is the monster wicked problem." (Individual Reflection #4).*

The scale and complexity of the endeavour compounds and deepens the other challenges faced in the Tsitsa Project and requires us to act with humility and work patiently. However, it is precisely the large and complex nature of the endeavour, and the potential for significant system-wide change, that seems to attract people to getting involved, and in this sense the large scale and ambitious nature of the initiative is a significant enabler (Box 1, Narrative Thread 7). It gives people hope and inspires them to continue participating despite the significant challenges, and often negative critique, levelled at the Project.

If the Project is intended to have impact at a large scale, then it needs to be resourced accordingly (Box 1, Narrative Thread 1). This does not only mean putting in place large financial resources, but also spending money on the right kind of activities and employing people with the right skills and competencies to leverage systemic change. This also supports our findings that actively work to create enabling conditions at deeper system levels (Box 2, lesson Cluster 3) is critically important.

Lessons learnt about encouraging polycentric and participatory governance approaches reveal important insights about the systemic barriers to implementing this at scale. Relevant aspects of governance transformation include both support for increasing polycentric governance among institutions, and the development of participatory governance with an emphasis on developing catchment resident agency and voice. In addition, attention is paid to the internal governance of the Tsitsa Project, which is regularly communicated at 'Science-Management Meetings' which take place 2-3 times per year and are open to all researchers and managers involved in the Project. They are also open to visitors and new people possibly interested in participating in the Project. Over time, it was decided to form three 'Communities of Practice' which include scientists and managers working on distinct topics and issues within the Project. These are: 'Sediment and Restoration', 'Governance', and 'Livelihoods and Ecosystem Services'. However, several study participants commented on the fact that 'it takes time' to put in place polycentric and participatory governance approaches, and so an assessment of progress on this principle at this point may be premature (Box 1, Narrative Thread 1 and 4). Within the Tsitsa Project, there are two senior oversight groups: 1) research and managements leaders ("B-Team"), and decision-makers across many government departments at all levels, local to national ("A-team")

A concern about the provincial scale of polycentric governance (Box 2, Lesson Cluster 1), is reflected:

*"There's no problem internally. But immediately you now seek this integration departmentally, then you would have some problems. Because that's the part that we are still grappling with. To have other departments coming in... and there was a forum for the Mzimvubu catchment driven at the departmental level... Driven at the*

*provincial government officers where most of the departments come in. But it seemed to me those discussions at the boardroom level only. And that's the part that seems to be impacting negatively on NLEIP. It wants those partners, but they are moving at a very slow pace.” (Individual Reflection 5).*

The flipside of these deep-seated institutional challenges and constraints, is that supportive enabling conditions at deeper system levels also exist in the system (i.e. deep leverage points such as underpinning goals, values and worldviews of actors who have leverage in the system and seek to change the goals of the system) and have been actively leveraged to support the process (Box 2, Lesson Cluster 3). The lessons captured in Lesson Cluster 3 (Box 2) illustrate that enhancing existing enabling conditions (for example by working with serendipity and enhancing preconditions), whilst working to create new ones (i.e. seeking novelty and creating hope), are important leverage points in this kind of change-oriented initiative in a complex system. The case study description (See Section 3 ‘The Case of the Tsitsa Project’), further illustrates the importance of some of the historical preconditions which have set the Project up to potentially bring about change in the Tsitsa catchment. These include for example political will to ‘do things differently’ which has resulted in senior government officials creating ‘room to play’ in an otherwise constrained, hierarchical bureaucracy, as shown in these two quotes:

*“Because of the hierarchical way government comes from...that historical trajectory, there's no way we will succeed unless a person in that historical hierarchy is actually busy trying to turn boats around. So, he is such a person.” (Individual Reflection #3)*

*“I think for us it's a kind of departure from how we have traditionally and historically approached our work, the way we think about our work. The community-centeredness, even though that's an area that we are obviously still struggling with. There are so many complexities and tensions that are embedded in each of these principles that are really challenging for government to practice. So, I think that what's interesting and exciting is the opportunity and the slightly longer-term commitment to this project over a longer period of time than we can typically to commit to, we are normally tied to 3-year cycles, but because of the presidential and ministerial commitment to this project we were able to look at a 10-year horizon. So that is also exciting and a new departure... there is a huge amount of goodwill from the department, particularly in wanting to see this work, and wanting to see this work, and trying to accommodate as best as we are able to the needs of the project within what we can and can't do.” (Individual Reflection #6)*

Similarly, senior researchers have worked under sometimes difficult circumstances (motivated by the ambitious and change-oriented vision of the initiative, Box 1, Narrative Thread 7) to create enabling conditions for other actors in the system. The fact that so many scientists and managers have become involved in the Project is considered a success by many. This is partly due to the ambitious and challenging nature of the endeavor which appeals to participants (Box 1, Narrative Thread 7; Box 2, Lesson Cluster 3), as shown in this quote:

*“There is an opportunity to turn government machinery around.... I wouldn't be involved if it wasn't for the fact that they have radical aims...” (Individual Reflection #3)*

*“It's appealing...I feel I am investing my time in work that has meaning and is worthwhile. Because of my personal interest, or faith and belief and hope, that this can work, and this can be how we operate in the future...” (Individual Reflection #6).*

Some participant's perception of the relative success of the initiative to date is also attributed to the charisma, convening skills, and leadership shown by senior leaders in the initiative to attract. These have emerged as important preconditions.

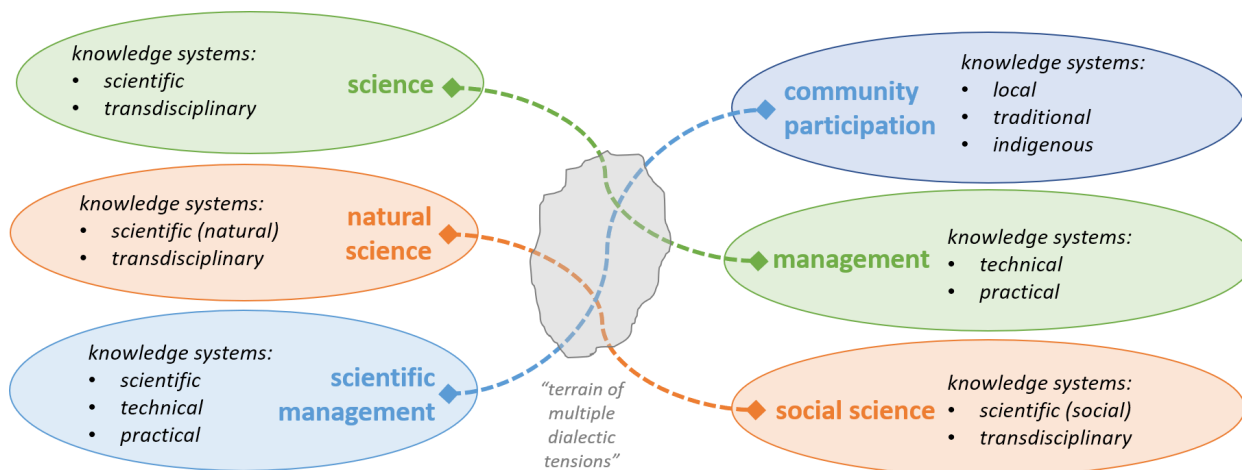
## 5. Discussion and recommendations

The findings reveal an array of lessons learnt so far in the Tsitsa Project. The overarching lessons revolved around the enabling conditions created by an CSES framing, the challenge of building diverse new linkages from science outwards, and the constraints imposed by existing institutional structures, cultures and ways of working. These constraints emerge from the large scale, complexity, and ambitious nature of the initiative. In contrast, there are also deep-seated enabling conditions in place which set the initiative on a hopeful trajectory.

Our realist understanding of the world prompts us to seek explanatory mechanisms to explain the empirically-observed findings of our research (Danermark et al., 2005). The kinds of lessons learnt within this reflective process in the Project reveal that there are, indeed, underlying structures of society or ‘antecedents’ at work which help us to explain these findings. Taken together, these findings can be explained to some extent by recognizing that the Project is navigating a terrain of multiple, interconnected dialectic tensions, characterized by actors operating from different knowledge systems (Bartunek & Rynes, 2014) (Figure 6). These dialectic tensions are linkages between actors from different domains in the system which have previously operated somewhat in isolation. These linkages are not always easy to put into place, as the different domains pull in different directions, and have different priorities. The actors operate in domains with “differing logics, time dimensions, communication styles, rigor and relevance, and interests and incentives” (Bartunek & Rynes, 2014: 1181).

For example, the linkage between science (left) and management (right) is a tension between the knowledge systems which scientists operate in (scientific and transdisciplinary knowledge systems) and the knowledge systems in which managers operate in (technical and practical knowledge systems). Another example is the dialectic tension between scientific management (left), and community participation (right). The current discourse and practice of natural resource management in South Africa prioritizes scientific management system (scientific, technical and practical knowledge systems) and this makes it difficult to create linkages between such management systems and community participation, which operates in a knowledge system characterized by local, traditional, and indigenous knowledge systems (Figure 5).

This diagram shows three examples of such dialectic tensions at play in the Project, but there are many more and the relationship-building challenge is heightened by the Project striving for a new mode of practice in an existing – possibly outmoded – institutional context. This is the motivation for the Project’s work towards encouraging polycentric and participatory governance in a context where underlying institutional change is needed. Holm (1995: 398, cited in Seo and Creed (Seo & Creed, 2002)) asks the difficult question "How can actors change institutions if their actions, intentions, and rationality are all conditioned by the very institution they wish to change?" The existing hierarchical governance structures, bureaucratic systems, and the ever-changing and unpredictable political landscape further exacerbate the challenge of institutional change. What is needed is an intentional process of ‘absencing the absences’, which is fundamentally a process of change (Bhaskar, 2016). In this case, it is primarily an institutional change, but also a change in the kinds of relationships (or a change in the nature or quality of these relationships) which actors in the system have with one another.



**Figure 6: The terrain of multiple, interconnected dialectic tensions which the Tsitsa Project is navigating (the grey area in the center of the diagram). This terrain is characterized by overlapping linkages between actors operating from different knowledge systems (the colored ovals on the left and right-hand side of the diagram).**

Another feature of the Tsitsa Project which exacerbates the tension experienced in the terrain between the multiple dialectic relationships, is starting condition of the Project as a science-driven process, with inherent power-dynamic at play between the actors from the different knowledge systems. This can be ascribed to the ‘ascendancy of science’ (Adas, 1990), whereby science (i.e. the scientific knowledge system) is seen as the primary holder or provider of solutions. Although most strategies and approaches working towards management and governance of complex social-ecological systems recognise the need for diverse knowledge types and seek to create space for knowledge sharing and co-production among diverse actors (van Kerkhoff & Lebel, 2006; Tengö et al., 2014; Biggs et al., 2015), science is still (implicitly and explicitly) considered the superior knowledge holder (Bäckstrand, 2004). This is also the case in the Project, where the links between scientists and managers are primarily perceived as a means of transferring knowledge and expertise in a one-way direction. The fact that DEA: NRM approached researchers at Rhodes University to co-ordinate the Project illustrates that the government has put their faith (and funding) in academic researchers to help them address the significant challenges facing landscape management in the Tsitsa catchment. The researchers control the research praxis funding and are therefore powerful players in the Tsitsa Project system.

In the past science has often left society behind in its quest for new knowledge, understanding and solutions (Bäckstrand, 2004). We have an opportunity in the Tsitsa Project, through a process committed to reflexivity, to adjust this assumed-role of science as the ultimate solution-provider, and to take society along on this journey. The Project can contribute to finding ways of truly democratizing environmental governance, to better integrate civic expertise (i.e. local, indigenous, experiential and other non-science knowledge systems) into natural resource management and decision-making. Popa et al. (2015) suggest that there is a “need to combine conventional consensus-oriented deliberative approaches to reflexivity with more open-ended, action-oriented transformative approaches.” This aligns with the Project’s commitments to action-oriented science that engages meaningfully with local stakeholders. One might consider the Project to have been ‘saved from the ascendancy of science by the bell of reflexivity’. However, the challenge remains as to how we can bring about the social-relational and institutional change required to enable better linkages between the diverse actors in the complex social-ecological system.

A major recommendation that emerges from this discussion to assist the Project, and initiatives facing similar challenges, is that attention needs to be paid to recruiting a diversity of participants to deepen and extend the work of the Project. In the same way that polycentric and participatory governance seek to mirror the

complexity of the CSES, we suggest that the participants within the Project should be somewhat a mirror of the diversity and complexity of the system of interest. The findings on lessons learnt indicate frustrations with not having enough time and money to do the work we need to do, at the scale at which we need to do it – this speaks to a sense of deficit, of insufficiency in resources. A less-often identified deficit is that of people – the right kind of people. In the positive sense, the convening and leadership roles played by some actors in the Project was hailed by many as a success, as having found ‘the right kind of people’. But maybe we still do not have enough of the right kind of people, to help us spend our precious time and money in the right kinds of ways. Currently the Project is dominated by scientists with a biophysical training, and managers and decision-makers with a scientific management underpinning. They represent the three left-hand ovals in the diagram above illustrating the terrain of multiple dialectic tensions, and there are very few participants representing any other the ovals on the right-hand side of the diagram (Figure 6). We therefore suggest that the Tsitsa Project should prioritize recruitment of participants who represent the domains of, for example, ‘community participation’, ‘management’ and ‘social science’. Building diversity and redundancy in complex social-ecological systems is considered an important principle for building resilience in CSESs (Biggs et al., 2012). This applies as much to the ecological systems (e.g. promoting protection of biodiversity) as it does to the social system. And thus, implementing the Project’s Principle 1 also requires paying attention to the development of a diverse team of participants. Building in redundancy in the team is also important, to make sure that if key people leave the initiative they do not leave a big gap.

Not only is a diversity of participants needed, but there is also a need for strategically placed and suitably skilled mediators, brokers and system convenors who can directly aid leaders and participants in navigating the complex terrain of multiple dialectic tensions (Figure 6). This work requires an explicit and active process of building new relationships within the bounds of ‘old institutional structures’. Eventually, this may lead to a transformative process of institutional change. From this it becomes apparent that Tsitsa Project participants are in fact acting as transformative change agents. We recommend that it might be useful for project participants to actively and explicitly re-imagine themselves as transformative change agents in the process. This re-imagining could have a number of benefits. Firstly, it could provide a shared sense of identity and purpose and assist people who are traversing the complex terrain of dialectic tensions to appreciate that they are, despite their different vantage points, involved in a shared change process. People could thus move beyond just thinking of themselves as ‘a scientists’ or as ‘a manager’, which brings with it the historic legacies and work cultures associated with those roles. Through a shared identity as change agents, they can see that they are part of an institutional change process in which their own roles will also be changing. Secondly, identifying themselves as change agents may assist participants in recognizing that they have agency in the system. In a context where external constraints are perceived by many as significant barrier, a reminder that they are institutional entrepreneurs and potentially have ‘transformative agency’ and can in fact bring about change (Westley et al., 2013), could help to inspire people engaged in this deeply challenging work.

## 6. Conclusion

The purpose of this study was to reflect on and share lessons learnt from implementing an integrated sustainability research and governance initiative in the Tsitsa River catchment. The work of the Tsitsa Project in the Tsitsa River catchment is guided by five principles drawn from global literature on natural resource management and governance in CSESs (Figure 1). We have reflected on the lessons learnt from seeking to put these five principles into practice and have sought to critically reflect on the case-specific contextual conditions which have enabled and/or constrained us in working towards our ambitious vision.

From our reflections we identified four clusters of lessons: 1. Building new relationships and linkages is challenging; 2. The science-action tension is real; 3. We need to work with enabling conditions and recognize disabling conditions; 4. This initiative is a challenge of immense scale and complexity. Out of the many lessons

within these clusters, we drew out three over-arching findings. Firstly, complex social-ecological systems and resilience thinking is an enabling framing. Secondly, building new linkages from science outwards is difficult. Thirdly, large, CSES initiatives face particular constraints relating to existing institutional structures, cultures and ways of working.

To explain these findings, we developed a realist understanding of the Tsitsa Project as an initiative which is navigating a terrain of multiple, interconnected dialectics (Figure 6). This complex terrain is characterised by overlapping linkages between actors operating from domains characterised by different knowledge systems. Because the Project is a science-driven process, the power dynamics between these different actors make it difficult to develop new linkages across this dialectical terrain. The fundamental challenge facing the Project is one of bringing about institutional change. Existing institutional structures and cultures make it difficult for actors to build new relationships, and shift existing institutional norms and practices, which is needed to realise the project vision in practice.

Based on this understanding of the underlying features of the knowledge landscape which the Project is navigating, we recommend that a diversity of participants or social actors should be recruited to mirror the social and institutional features of the complex social-ecological system of interest. Attention should also be paid to identifying skilled participants who can act as mediators, brokers and systems convenors to support participants in navigating the challenging multi-scaled, multi-actor terrain in which they are expected to work and bring about positive change towards more sustainable and equitable management of complex social-ecological systems. Participants in this process could be encouraged to re-imagine themselves as transformative change agents, which could assist them in finding a shared identity and purpose, and a sense of agency in an otherwise constrained and challenging work environment.

## **7. Acknowledgements**

As authors of the report we have merely played a convening role in this reflection and learning process. We acknowledge all Tsitsa Project/NLEIP participants who have contributed to this process as important holders of this collective knowledge and learning. We thank the following project participants for joining us in individual and collective reflection sessions, and for openly sharing their insights and reflections with us: A. Michael Braack, Japie Buckle, Rienette Colesky, Laura Conde, Alta De Vos, Michael Kawa, Kyra Lunderstedt, Karen Milne, Nosiseko Mtati, Justice Ngcengane, Sarah Polonsky, Nina Rivers, Kate Rowntree, Ayanda Sigwela, Bennie van der Waal, and four participants who wished to remain anonymous. Thank you to Mike Powell for providing guidance and oversight for the process, to Karen Milne and Kyra Lunderstedt for assisting with communication and meeting arrangements, and to Margaret Wolff for editorial support.



## 8. References

- Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., Ives, C. D., Jager, N. W., & Lang, D. J. (2017). Leverage points for sustainability transformation. *AMBIO*, 46(1), 30-39.
- Adas, M. (1990). *Machines as the measure of men: Science, technology, and ideologies of western dominance*. Ithaca, NY: Cornell University Press.
- Anderies, J. M., Janssen, M. A., & Ostrom, E. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society*, 9(1), 18.
- Angelstam, P., Barnes, G., Elbakidze, M., Marais, C., Marsh, A., Polonsky, S., Richardson, D. M., Rivers, N., Shackleton, R. T., & Stafford, W. (2017). Collaborative learning to unlock investments for functional ecological infrastructure: Bridging barriers in social-ecological systems in South Africa. *Ecosystem Services*, 27, 291-304.
- Armitage, D., Berkes, F., & Doubleday, N. (Eds.). (2007). *Adaptive co-management: Collaboration, learning, and multi-level governance*. Vancouver, Canada: UBC Press.
- Audouin, M., Preiser, R., Nienaber, S., Downsborough, L., Lanz, J., & Mavengahama, S. (2013). Exploring the implications of critical complexity for the study of social-ecological systems. *Ecology and Society*, 18(3), 12.
- Bäckstrand, K. (2004). Scientisation vs. Civic expertise in environmental governance: Eco-feminist, eco-modern and post-modern responses. *Environmental Politics*, 13(4), 695-714.
- Bartunek, J. M., & Rynes, S. L. (2014). Academics and practitioners are alike and unlike: The paradoxes of academic-practitioner relationships. *Journal of Management*, 40(5), 1181-1201.
- Bazeley, P. (2009). Analysing qualitative data: More than 'identifying themes'. *Malaysian Journal of Qualitative Research*, 2(2), 6-22.
- Bazeley, P. (2011). Integrative analysis strategies for mixed data sources. *American Behavioral Scientist*, 56(6), 814-828.
- Bek, D., Nel, E., & Binns, T. (2017). Jobs, water or conservation? Deconstructing the green economy in South Africa's Working for Water programme. *Environmental Development*, 24, 136-145.
- Berkes, F. (2009). Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management*, 90(5), 1692-1702.
- Berkes, F., Colding, J., & Folke, C. (2008). *Navigating social-ecological systems: Building resilience for complexity and change*. Cambridge, United Kingdom: Cambridge University Press.
- Berkes, F., & Folke, C. (1998). *Linking social and ecological systems: Management practices and social mechanisms for building resilience*. Cambridge, United Kingdom: Cambridge University Press.
- Bhaskar, R. (2016). *Enlightened common sense: The philosophy of critical realism*. Oxon, United Kingdom: Routledge.
- Biggs, D., Abel, N., Knight, A. T., Leitch, A., Langston, A., & Ban, N. C. (2011). The implementation crisis in conservation planning: Could "mental models" help? *Conservation Letters*, 4(3), 169-183.
- Biggs, H. C., Clifford-Holmes, J. K., Freitag, S., Venter, F. J., & Venter, J. (2017). Cross-scale governance and ecosystem service delivery: A case narrative from the olifants river in north-eastern South Africa. *Ecosystem Services*, 28(Part B), 173-184.
- Biggs, R., Rhode, C., Archibald, S., Kunene, L. M., Mutanga, S. S., Nkuna, N., Ocholla, P. O., & Phadima, L. J. (2015). Strategies for managing complex social-ecological systems in the face of uncertainty: Examples from South Africa and beyond. *Ecology and Society*, 20(1).

- Biggs, R., Schlüter, M., Biggs, D., Bohensky, E. L., Burnsilver, S., Cundill, G., Dakos, V., Daw, T. M., Evans, L. S., Kotschy, K., Leitch, A. M., Meek, C., Quinlan, A., Raudsepp-Hearne, C., Robards, M. D., Schoon, M. L., Schultz, L., & West, P. C. (2012). Toward principles for enhancing the resilience of ecosystem services. *Annual Review of Environment and Resources*, 37, 421-448.
- Biswas, A. K. (2008). Integrated water resources management: Is it working? *International Journal of Water Resources Development*, 24(1), 5-22.
- Bold, C. (2012). *Using narrative in research*. London, United Kingdom: SAGE Publications Ltd.
- Botha, L., Rosenberg, E., Biggs, H., Kotschy, K., & Conde-Aller, L. (2017). *Ntabelanga-Lalini ecological infrastructure project (NLEIP): Participatory monitoring, evaluation, reflection & learning (PMERL) framework*. Grahamstown: NLEIP Internal Report, Rhodes University.
- Brand, G., Morrison, P., Down, B., & WestBrook, B. (2014). Scaffolding young Australian women's journey to motherhood: A narrative understanding. *Health & Social Care in the Community*, 22(5), 497-505.
- Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D. J., Newig, J., Reinert, F., Abson, D. J., & von Wehrden, H. (2013). A review of transdisciplinary research in sustainability science. *Ecological Economics*, 92, 1-15.
- Burns, M., & Weaver, A. (2008). *Exploring sustainability science: A Southern African perspective*. Stellenbosch: African Sun Media.
- Chapin, F. S., Chapin, C., Kofinas, G. P., & Folke, C. (2009). *Principles of ecosystem stewardship: Resilience-based natural resource management in a changing world*. New York, NY: Springer.
- Cockburn, J., Rouget, M., Slotow, R., Roberts, D., Boon, R., Douwes, E., O'Donoghue, S., Downs, C. T., Mukherjee, S., Musakwa, W., Mutanga, O., Mwabvu, T., Odindi, J., Odindo, A., Proche, erban, Ramdhani, S., Ray-Mukherjee, J., Sershen, Schoeman, M. C., Smit, A. J., Wale, E., & Willows-Munro, S. (2016). How to build science-action partnerships for local land-use planning and management: Lessons from Durban, South Africa. *Ecology and Society*, 21(1), 28.
- Collins, K., Blackmore, C., Morris, D., & Watson, D. (2007). A systemic approach to managing multiple perspectives and stakeholding in water catchments: Some findings from three UK case studies. *Environmental Science & Policy*, 10(6), 564-574.
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed methods approaches*. Thousand Oaks, CA: Sage Publications, Inc.
- Cumming, G. S., Barnes, G., Perz, S., Schmink, M., Sieving, K. E., Southworth, J., Binford, M., Holt, R. D., Stickler, C., & Van Holt, T. (2005). An exploratory framework for the empirical measurement of resilience. *Ecosystems*, 8(8), 975-987.
- Cumming, T. L., Shackleton, R. T., Förster, J., Dini, J., Khan, A., Gumula, M., & Kubiszewski, I. (2017). Achieving the national development agenda and the Sustainable Development Goals (sdgs) through investment in ecological infrastructure: A case study of South Africa. *Ecosystem Services*, 27, 253-260.
- Cundill, G., Cumming, G. S., Biggs, D., & Fabricius, C. (2012). Soft systems thinking and social learning for adaptive management. *Conservation Biology*, 26(1), 13-20.
- Cundill, G., & Rodela, R. (2012a). A review of assertions about the processes and outcomes of social learning in natural resource management. *Journal of Environmental Management*, 113, 7-14.
- Cundill, G., & Rodela, R. (2012b). A search for coherence: Social learning in natural resource management. In H. Lotz-Sisitka (Ed.), *(re)views on social learning literature: A monograph for social learning researchers in natural resources management and environmental education* (pp. 56-88). Grahamstown/Howick: Environmental Learning Research Centre, Rhodes University/EEASA/SADC REEP.
- Cundill, G., Roux, D. J., & Parker, J. N. (2015). Nurturing communities of practice for transdisciplinary research. *Ecology and Society*, 20(2), 22.

- Cundill, G., Shackleton, S., Sisitka, L., Ntshudu, M., Lotz-Sisitka, H., Kulundu, I., & Hamer, N. (2014). *Social learning for adaptation: A descriptive handbook for practitioners and action researchers*. Grahamstown: IDRC/Rhodes University/Ruliv.
- Danermark, B., Ekström, M., Jakobson, L., & Karlson, J. C. (2005). *Explaining society: Critical realism in the social sciences*. London, United Kingdom: Routledge.
- Denier, L., Scherr, S., Shames, S., Chatterton, P., Hovani, L., & Stam, N. (2015). *The little sustainable landscapes book*. Oxford: Global Canopy Programme.
- Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., Larigauderie, A., Adhikari, J. R., Arico, S., Báldi, A., Bartuska, A., Baste, I. A., Bilgin, A., Brondizio, E., Chan, K. M. A., Figueroa, V. E., Duraiappah, A., Fischer, M., Hill, R., Koetz, T., Leadley, P., Lyver, P., Mace, G. M., Martin-Lopez, B., Okumura, M., Pacheco, D., Pascual, U., Pérez, E. S., Reyers, B., Roth, E., Saito, O., Scholes, R. J., Sharma, N., Tallis, H., Thaman, R., Watson, R., Yahara, T., Hamid, Z. A., Akosim, C., Al-Hafedh, Y., Allahverdiyev, R., Amankwah, E., Asah, S. T., Asfaw, Z., Bartus, G., Brooks, L. A., Caillaux, J., Dalle, G., Darnaedi, D., Driver, A., Erpul, G., Escobar-Eyzaguirre, P., Failler, P., Fouda, A. M. M., Fu, B., Gundimeda, H., Hashimoto, S., Homer, F., Lavorel, S., Lichtenstein, G., Mala, W. A., Mandivenyi, W., Matczak, P., Mbizvo, C., Mehrdadi, M., Metzger, J. P., Mikissa, J. B., Moller, H., Mooney, H. A., Mumby, P., Nagendra, H., Nesshover, C., Oteng-Yeboah, A. A., Pataki, G., Roué, M., Rubis, J., Schultz, M., Smith, P., Sumaila, R., Takeuchi, K., Thomas, S., Verma, M., Yeo-Chang, Y., & Zlatanova, D. (2015). The ipbes conceptual framework — connecting nature and people. *Current Opinion in Environmental Sustainability*, 14, 1-16.
- du Toit, J. T., Biggs, H. C., & Rogers, K. H. (2003). *The Kruger experience: Ecology and management of savanna heterogeneity*: Island Press.
- Fabricius, C., Biggs, H. C., & Powell, M. (2016). *Research investment strategy: Ntabelanga and Lalini ecological infrastructure project (NLEIP)*. Pretoria: Department of Environmental Affairs, Natural Resource Management Programme.
- Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, 16(3), 253-267.
- Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society*, 21(3), 41.
- Görg, C., Wittmer, H., Carter, C., Turnhout, E., Vandewalle, M., Schindler, S., Livorell, B., & Lux, A. (2016). Governance options for science–policy interfaces on biodiversity and ecosystem services: Comparing a network versus a platform approach. *Biodiversity and Conservation*, 25(7), 1235-1252.
- Head, B. W., Ross, H., & Bellamy, J. (2016). Managing wicked natural resource problems: The collaborative challenge at regional scales in Australia. *Landscape and Urban Planning*, 154, 81-92.
- Hillman, M. (2005). Justice in river management: Community perceptions from the hunter valley, new south wales, Australia. *Geographical Research*, 43(2), 152-161.
- Ison, R. (2018). Governing the human–environment relationship: Systemic practice. *Current Opinion in Environmental Sustainability*, 33, 114-123.
- Ison, R., Collins, K., Colvin, J., Jiggins, J., Roggero, P. P., Seddaiu, G., Steyaert, P., Toderi, M., & Zanolla, C. (2011). Sustainable catchment managing in a climate changing world: New integrative modalities for connecting policy makers, scientists and other stakeholders. *Water Resources Management*, 25(15), 3977-3992.
- Jacobsson, S., Vico, E. P., & Hellsmark, H. (2014). The many ways of academic researchers: How is science made useful? *Science and Public Policy*.
- Kates, R. W. (2011). What kind of a science is sustainability science? *Proceedings of the National Academy of Sciences*, 108(49), 19449-19450.

- Keeler, B. L., Chaplin-Kramer, R., Guerry, A. D., Addison, P. F. E., Bettigole, C., Burke, I. C., Gentry, B., Chambliss, L., Young, C., Travis, A. J., Darimont, C. T., Gordon, D. R., Hellmann, J., Kareiva, P., Monfort, S., Olander, L., Profeta, T., Possingham, H. P., Slotterback, C., Sterling, E., Ticktin, T., & Vira, B. (2017). Society is ready for a new kind of science—is academia? *BioScience*, *67*(7), 591-592.
- Keen, M., Brown, V. A., & Dyball, R. (2005). *Social learning in environmental management: Towards a sustainable future*. London, United Kingdom: Earthscan.
- Keeney, R. L. (2009). *Value-focused thinking: A path to creative decisionmaking*. Cambridge, MA: Harvard University Press.
- Krueger, T., Maynard, C., Carr, G., Bruns, A., Mueller, E. N., & Lane, S. (2016). A transdisciplinary account of water research. *Wiley Interdisciplinary Reviews: Water*, *3*(3), 369-389.
- Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustainability Science*, *7*(1), 25-43.
- Levin, S., Xepapadeas, T., Crépin, A.-S., Norberg, J., de Zeeuw, A., Folke, C., Hughes, T., Arrow, K., Barrett, S., Daily, G., Ehrlich, P., Kautsky, N., Mäler, K.-G., Polasky, S., Troell, M., Vincent, J. R., & Walker, B. (2012). Social-ecological systems as complex adaptive systems: Modeling and policy implications. *Environment and Development Economics*, *18*(2), 111-132.
- Lotz-Sisitka, H., Mukute, M., & Belay, M. (2012). The 'social' and 'learning' in social learning research: Avoiding ontological collapse with antecedent literatures as starting points for research. In H. Lotz-Sisitka (Ed.), *(re)views on social learning literature: A monograph for social learning researchers in natural resources management and environmental education* (pp. 56-88). Grahamstown/Howick: Environmental Learning Research Centre, Rhodes University/EEASA/SADC REEP.
- Lubell, M. (2015). Collaborative partnerships in complex institutional systems. *Current Opinion in Environmental Sustainability*, *12*, 41-47.
- Macleod, C. J., Blackstock, K. L., & Haygarth, P. M. (2008). Mechanisms to improve integrative research at the science-policy interface for sustainable catchment management. *Ecology and Society*, *13*(2).
- Margerum, R. D. (2008). A typology of collaboration efforts in environmental management. *Environmental Management*, *41*(4), 487-500.
- Max-Neef, M. A. (2005). Foundations of transdisciplinarity. *Ecological Economics*, *53*(1), 5-16.
- Maxwell, J. A., & Mittapalli, K. (2010). Realism as a stance for mixed methods research *Handbook of mixed methods in social & behavioral research* (pp. 145-168). Thousand Oaks, CA: SAGE Publications Inc.
- Minang, P. A., van Noordwijk, M., Freeman, O. E., Mbow, C., de Leeuw, J., & Catacutan, D. (2014). *Climate-smart landscapes: Multifunctionality in practice*. Nairobi, Kenya: World Agroforestry Centre (ICRAF).
- Mingers, J. (2011). *Explanatory mechanisms: The contribution of critical realism and systems thinking/cybernetics. Working Paper no. 241*. Canterbury: University of Kent, Canterbury.
- Muro, M., & Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management*, *51*(3), 325-344.
- Nel, J. L., Le Maitre, D. C., Roux, D. J., Colvin, C., Smith, J. S., Smith-Adao, L. B., Maherry, A., & Sitas, N. (2017). Strategic water source areas for urban water security: Making the connection between protecting ecosystems and benefiting from their services. *Ecosystem Services*.
- Newig, J., & Fritsch, O. (2009). Environmental governance: Participatory, multi-level – and effective? *Environmental Policy and Governance*, *19*(3), 197-214.

- Olsson, P., Gunderson, L. H., Carpenter, S. R., Ryan, P., Lebel, L., Folke, C., & Holling, C. S. (2006). Shooting the rapids: Navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society*, *11*(1), 18.
- Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*, *325*(5939), 419-422.
- Pahl-Wostl, C. (2007). The implications of complexity for integrated resources management. *Environmental Modelling & Software*, *22*(5), 561-569.
- Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., & Taillieu, T. (2007). Social learning and water resources management. *Ecology and Society*, *12*(2).
- Pahl-Wostl, C., Mostert, E., & Tabara, D. (2008). The growing importance of social learning in water resources management and sustainability science. *Ecology and Society*, *13*(1).
- Palmer, C. G., Biggs, R., & Cumming, G. S. (2015). Applied research for enhancing human well-being and environmental stewardship: Using complexity thinking in Southern Africa. *Ecology and Society*, *20*(1), 53.
- Parwada, C., & Van Tol, J. (2016). The nature of soil erosion and possible conservation strategies in Ntabelanga area, Eastern Cape province, South Africa. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science*, *66*(6), 544-552.
- Pollard, S., Biggs, H., & Du Toit, D. R. (2014). A systemic framework for context-based decision making in natural resource management: Reflections on an integrative assessment of water and livelihood security outcomes following policy reform in South Africa. *Ecology and Society*, *19*(2).
- Popa, F., Guillermin, M., & Dedeurwaerdere, T. (2015). A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures*, *65*, 45-56.
- QSR International. (2017). *NVivo 11 for Windows. Edition: Pro*. Melbourne, Australia: QSR International, Pty Ltd.
- Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., & Stringer, L. C. (2010). What is social learning? *Ecology and Society*, *15*(4), 1.
- Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. H., & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, *90*(5), 1933-1949.
- Reyers, B., Roux, D. J., Cowling, R. M., Ginsburg, A. E., Nel, J. L., & Farrell, P. O. (2010). Conservation planning as a transdisciplinary process. *Conservation Biology*, *24*(4), 957-965.
- Roberts, D., Boon, R., Diederichs, N., Douwes, E., Govender, N., McInnes, A., Mclean, C., O'Donoghue, S., & Spiers, M. (2012). Exploring ecosystem-based adaptation in Durban, South Africa: "Learning-by-doing" at the local government coal face. *Environment and Urbanization*, *24*(1), 167-195.
- Roux, D. J., & Foxcroft, L. C. (2011). The development and application of strategic adaptive management within South African national parks. *Koedoe*, *53*(2), Art. #1049.
- Roux, D. J., Nel, J. L., Cundill, G., O'Farrell, P., & Fabricius, C. (2017). Transdisciplinary research for systemic change: Who to learn with, what to learn about and how to learn. *Sustainability Science*, *12*(5), 711-726.
- Roux, D. J., Rogers, K. H., Biggs, H. C., Ashton, P. J., & Sergeant, A. (2006). Bridging the science-management divide: Moving from unidirectional knowledge transfer to knowledge interfacing and sharing. *Ecology and Society*, *11*(1), 4.
- Roux, D. J., Stirzaker, R. J., Breen, C. M., Lefroy, E. C., & Cresswell, H. P. (2010). Framework for participative reflection on the accomplishment of transdisciplinary research programs. *Environmental Science and Policy*, *13*(8), 733-741.

- Roux, J. J. L. (2018). Sediment yield potential in South Africa's only large river network without a dam: Implications for water resource management. *Land Degradation & Development*, 29(3), 765-775.
- Saldaña, J. (2013). *The coding manual for qualitative researchers*. Thousand Oaks, CA: SAGE Publications Inc.
- SANBI. (2014). *A framework for investing in ecological infrastructure in South Africa*. Pretoria. Available online: <http://www.sanbi.org/sites/default/files/documents/documents/framework-ieimarch2014sanbi.pdf>; South African National Biodiversity Institute.
- Seidl, R., Brand, F. S., Stauffacher, M., Krütli, P., Le, Q. B., Spörri, A., Meylan, G., Moser, C., González, M. B., & Scholz, R. W. (2013). Science with society in the Anthropocene. *AMBIO*, 42(1), 5-12.
- Seo, M.-G., & Creed, W. E. D. (2002). Institutional contradictions, praxis, and institutional change: A dialectical perspective. *Academy of Management Review*, 27(2), 222-247.
- Shackleton, C. (2009). Will the real custodian of natural resource management please stand up. *South African Journal of Science*, 105, 91-93.
- Shackleton, S., & Luckert, M. (2015). Changing livelihoods and landscapes in the rural Eastern Cape, South Africa: Past influences and future trajectories. *Land*, 2015(4), 1060-1089.
- Sigwela, A., Elbakidze, M., Powell, M., & Angelstam, P. (2017). Defining core areas of ecological infrastructure to secure rural livelihoods in South Africa. *Ecosystem Services*, 27, 272-280.
- Sitas, N., Reyers, B., Cundill, G., Prozesky, H. E., Nel, J. L., & Esler, K. J. (2016). Fostering collaboration for knowledge and action in disaster management in South Africa. *Current Opinion in Environmental Sustainability*, 19, 94-102.
- Stake, R. E. (2005). Qualitative case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (pp. 443-466). Thousand Oaks, CA: Sage Publications Inc.
- Stringer, L. C., Dougill, A. J., Fraser, E., Hubacek, K., Prell, C., & Reed, M. S. (2006). Unpacking 'participation' in the adaptive management of social-ecological systems: A critical review. *Ecology and Society*, 11(2), 39.
- Swilling, M., Musango, J., & Wakeford, J. (2016). Developmental states and sustainability transitions: Prospects of a just transition in South Africa. *Journal of Environmental Policy & Planning*, 18(5), 650-672.
- Tàbara, J. D., & Pahl-Wostl, C. (2007). Sustainability learning in natural resource use and management. *Ecology and Society*, 12(2).
- Tengö, M., Brondizio, E. S., Elmqvist, T., Pernilla Malmer, & Spierenburg, M. (2014). Connecting diverse knowledge systems for enhanced ecosystem governance: The multiple evidence base approach. *AMBIO*, 43(5), 579-591.
- UCPP. (2016). *Rangeland restoration model summary and toolkit guide: For landscapes and livelihoods* Matatiele, South Africa: Umzimvubu Catchment Partnership Programme. Retrieved from <https://umzimvubu.org/rangeland-toolkit/>
- van Kerkhoff, L. (2014). Developing integrative research for sustainability science through a complexity principles-based approach. *Sustainability Science*, 9(2), 143-155.
- van Kerkhoff, L., & Lebel, L. (2006). Linking knowledge and action for sustainable development. *Annual Review of Environment and Resources*, 31(1), 445-477.
- Van Ongevalle, J., Huyse, H., & Van Petegem, P. (2014). Dealing with complexity through actor-focused planning, monitoring and evaluation (PME). *Evaluation*, 20(4), 447-466.
- van Tol, J., Akpan, W., Kanuka, G., Ngesi, S., & Lange, D. (2016). Soil erosion and dam dividends: Science facts and rural 'fiction' around the Ntabelanga dam, Eastern Cape, South Africa. *South African Geographical Journal*, 98(1), 169-181.

- van Wilgen, B. W., & Wannenburg, A. (2016). Co-facilitating invasive species control, water conservation and poverty relief: Achievements and challenges in South Africa's Working for Water programme. *Current Opinion in Environmental Sustainability*, 19(Supplement C), 7-17.
- Vetter, S. (2013). Development and sustainable management of rangeland commons – aligning policy with the realities of South Africa's rural landscape. *African Journal of Range & Forage Science*, 30(1-2), 1-9.
- Westley, F. R., Tjornbo, O., Schultz, L., Olsson, P., Folke, C., Crona, B., & Bodin, Ö. (2013). A theory of transformative agency in linked social-ecological systems. *Ecology and Society*, 18(3), 27.
- Wondolleck, J. M., & Yaffee, S. L. (2000). *Making collaboration work: Lessons from innovation in natural resource management*. Washington, DC: Island Press.
- Wynberg, R. (2002). A decade of biodiversity conservation and use in South Africa: Tracking progress from the Rio Earth Summit to the Johannesburg World Summit on Sustainable Development. *South African Journal of Science*, 98, 233-243.
- Yin, R. K. (2009). *Case study research: Design and methods*. Thousand Oaks, CA: Sage Publications Inc.