Stockholm Resilience Centre
Research for Biosphere Stewardship and Innovation

Stockholm University

Master's Thesis, 60 ECTS
Social-ecological Resilience for Sustainable Development
Master's Programme 2014/2016, 120 ECTS

Learning to bridge conservation and development: A case study of the Environmental Monitors Programme in Kruger to Canyons Biosphere Reserve

Cláudia Florêncio

Supervisor: Dr. Lisen Schultz, Stockholm Resilience Centre

Co-supervisor: PhD Student Simon West, Stockholm Resilience Centre

Co-supervisor: Dr. Karen Kotschy, University of Witwatersrand

Examiner: Dr. Elin Enfors Kautsky, Stockholm Resilience Centre

SRC Theme: Stewardship

GLEAN Project (A Global Survey of Learning, Participation and Ecosystem Management in Biosphere Reserves)

Table of Contents

1 INTRODUCTION 9
2 Theoretical framework 11
2.1 Adaptive management and adaptive co-management 11
2.2 Bridging organizations 12
2.3 Learning 13
3 Case study description 15
3.1 Study area description 15
3.1.1 Environmental Monitors Programme 15
3.2 Historic background 17
4 METHODS 19
4.1 Semi-structured interviews 19
4.2 Participatory observation 21
4.3 Data Analysis 21
4.3.1 Coding interview transcripts 21
4.3.2 Data Triangulation 22
4.4 Critical reflexion of methods and data sources 22
5 RESULTS 24
5.1 General aspects of the EM Programme 24
5.2 Bridging Functions 27
5.2.1 Facilitate learning 27
5.2.2 Promote networking and collaboration 32
5.2.3 Conflict resolution 35
5.2.4 Trust building 36
5.3 Outcomes and adaptive responses and their relationship with bridging functions 37
5.3.1 Conservation Outcomes 37
5.3.2 Development outcomes 38
5.3.3 Adaptive responses 39
5.3.4 Attributed reasons for the outcomes 41
6 DISCUSSION 42
6.1 Bridging functions 42
6.1.1 Facilitate learning 42
6.1.2 Networking, collaboration and trust building 44

6.1.3 Conflict resolution 45
6.2 Outcomes and adaptive responses 45
6.3 Features of adaptive management and co-management 46
6.4 Development challenges 47
6.5 Study limitations 48
7 CONCLUSION 49
8 REFERENCES 51
9 APPENDICES 57

Tables

Table 1 – Summary of the stakeholders' main interests and aims by categories stated in interviews and reports (SANParks 2016, UP 2016) that lead to their participation in the EM Programme 24
Table 2 – EMs main tasks related to the main interests of the several stakeholders. For detailed list please see Appendix E 26
Table 3 - Type of data collected by EMs according to the main themes of the EM programme. For detailed information please see Appendix G 31
Table 4 – List of interviewed stakeholders in 2015/2016 57
Table 5- List of stakeholders interviewed in 2013 that were involved in the EM Programme creation phase 58
Table 6 – Interview Guide 60
Table 7- Coding used to analyse the content of interviews 72
Table 8– Ecological and socioeconomic context of the K2C region 79
Table 9– EMs main tasks related to the main interests of the several stakeholders 81
Table 10 – Training provided to EMs 83
Table 11- Type of data collected by EMs according to the main themes of the programme and its use identified during interviews, researcher observation and documents (SANParks 2016, UP 2016) 84
Table 12 - Raw data regarding examples of quotes from interviews with stakeholders 87

Figures

Figure 1- Inter-linkages between learning, knowledge, adaptive co-management, adaptive management, resilience and sustainable development 14
Figure 2 - Regional location of K2CBR in South Africa showing the area where the EM Programme was deployed (area in orange colour) 17
Figure 3 – Examples of drivers impacting the K2CBR: poverty, xenophobia, diseases and poaching (©Cláudia Florêncio) 18
Figure 4 - Host Institutions Part of K2C EM Programme that were interviewed in 2015/2016 20
Figure 5 – Training sessions (©Cláudia Florêncio) 28
Figure 6 – Environmental education: a) and b) ONG library, c) bush school (©Cláudia Florêncio) 29
Figure 7 – Monitoring activities: a) dip tank, b) ticks' inspection, c) tree growth monitoring experience and d) rain water monitoring 30
Figure 8 – Data capture and reporting: a) cyber tracker, b) diary, c) reporting using tablets (©Cláudia Florêncio) 32
Figure 9 - Training opportunities, information and knowledge sharing flows among stakeholders within and across levels 35
Figure 10 - Brainstorm exercise about rhino poaching at a facilitation training and firewood harvesting 36
Figure 11 – Rehabilitation project activities in a landscape severely affected by erosion 40

Acronyms

BR	Biosphere Reserve
DEA	Department of Environmental Affairs
DC	Data Collator
EM	Environmental Monitor
EPWP	National Government's Expanded Public Works Programme
HI	Host Institution
K2CBR	Kruger to Canyons Biosphere Reserve
MAB	Man and the Biosphere
NGO	Non-Governmental Organization
PA	Protected Area
SANParks	South African National Parks
SES	Social-ecological systems
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organization

ACKNOWLEDGEMENTS

I want to thank to my family namely to my parents, brother, my grandparents, especially João Neto who is the person from who I inherited the passion and love for nature and all living creatures, to my godparents and to my god daughters.

To all my friends which are another big treasure that I have in my life and that were always there when I needed.

To my supervisors Lisen Schultz, Karen Kostchy and Simon West for all they taught me, for their patience and support. I feel very lucky in having had you all as supervisors!

To all my incredible master colleagues for all the good times, laughs and support in crucial moments. We made it together and I hope our friendship will be long-term. To the master class 2013-2015, to the PhD and Post-Doc students that provided me important insights and advices in the beginning of my thesis.

To all the researchers at SRC who contributed to the knowledge I have today, that provided me windows of opportunity, helped me navigate in the necessary transformations and that contributed also for me to further strengthen my personal resilience.

I cannot thank enough to Kruger to Canyons and all the people I interviewed for all the time, patience and everything I learned from all of you, namely the meaning of the word "Ubundo" (being human). Without all of you this thesis wouldn't have been possible and I hope that through this work I can also contribute something back to you.

I am also grateful to Dra Anabela Trindade, head of the Unesco Portuguese Committee of the Programme Man and the Biosphere (MAB) Programme for having nominated my research project to be submitted to the Unesco Young Scientist Award 2016.

Last, but totally not the least, I am very thankful to Novartis Farma, for all the support and for having granted me an unpaid leave for me to be able to do the master.

"*Be the change you want to see in the world*" – Mahatma Gandhi

ABSTRACT

We live in a world that faces several social and environmental problems and achieving sustainable development in contexts where it is necessary to alleviate poverty without eroding the capacity of the ecosystems to support future generations is challenging. Therefore, fostering sustainable development requires enabling both society and environment to cope with disturbances, adapt to and shape change (resilience). Literature suggests that adaptive co-management practices are appropriate for building resilience and fostering sustainable development. Additionally, studies have highlighted the role of bridging organizations in coordinating and facilitating adaptive co-management. However, adaptive co-management has not been studied in poverty contexts.

This thesis aims to understand what the main tasks of bridging organizations are, and how they facilitate and stimulate adaptive co-management in poverty contexts and their role in nurturing sustainability. The Environmental Monitors Programme of the Kruger to Canyons Biosphere Reserve was chosen as a case-study. Biosphere reserves are considered learning sites for sustainable development. The programme was studied through the lenses of a bridging organization.

Semi-structured interviews and participatory observation with stakeholders identified: 1) the importance of existing networks and collaborations; 2) monitoring contribution to the identification of social and environmental issues, experimentation contribution to the implementation of sustainable harvesting practices; 3) environmental education combined with social learning lead to community empowerment and adaptive responses that e.g. address erosion; 4) environmental monitors have a crucial role in linking organizations and communities; 5) challenges related to low income settings include communities' basic needs.
This study illustrates the need to address both social and ecological problems in a concerted manner, by capacitating and empowering communities while conserving the environment. Additionally, points out the need of studying alternative co-management strategies that give focus on different priorities regarding stakeholders' interests and the influence of power in decision-making in poverty contexts.

Key words: adaptive co-management, biosphere reserve, bridging organizations, resilience, social-ecological systems, sustainable development.

1 INTRODUCTION

The world faces many social and environmental challenges, and the magnitude and speed of changes affects the relations between people and between people and the environment (PAF 2016). Achieving sustainable development in complex social-ecological systems (SES) is a challenge, especially in contexts where it is necessary to alleviate poverty without eroding the capacity of the ecosystems to support future generations (Biggs et al. 2015). Therefore, preparing and enabling both society and the environment to cope with disturbances, adapt to and shape change is essential for SES resilience (Coetzer et al. 2013).

The importance of conserving natural resources and biodiversity while fostering socioeconomic development has become central in political agendas, most recently through the UN Sustainable Development Goals in the 2030 Agenda (Zapatrina 2016). Integration of conservation and socioeconomic development is difficult for a range of reasons. One is the lack of fit between institutions (rules and norms) and ecosystems, and between diverse stakeholders (Brown 2003), partly because of different values, interests and knowledge held among the stakeholders of SES (Galaz et al. 2008, 2014; Coetzer et al. 2013). Another is the fact that decision makers often only understand SES superficially (Galaz et al. 2014) and agencies often do not adapt their management policies to new information about the SES because they lack appropriate learning structures (Camacho 2009).

Literature proposes that adaptive co-management practices are adequate to deal with the complexity of SES and to build resilience (Schultz and Lundholm, 2010; Olsson et al. 2004). Additionally, studies have highlighted the role of bridging organizations in coordinating and facilitating these practices between stakeholder groups and consequently fostering sustainable development (Schultz 2009; Berkes 2009). However, adaptive co-management has been insufficiently studied in settings where natural resources experience high population growth and high levels of poverty (Schultz 2009).

The aim of this thesis is to contribute to understanding what the main tasks of bridging organizations are, how they facilitate and stimulate adaptive management and adaptive co-management features in poverty contexts and their role in nurturing sustainable development.

The Environmental Monitors (EM) Programme of the Kruger to Canyons Biosphere Reserve (K2CBR) was chosen as a case study to explore the functions performed by bridging organizations in practice.

The EM programme aims to both promote nature and biodiversity conservation and alleviate poverty. It was studied through the lenses of a bridging organization.

Research Question:

How do the bridging functions of the EM Programme contribute to conservation outcomes, development outcomes and adaptive responses to change, i.e. sustainable development?

a) What, and how, are bridging functions realized by the K2C EM Programme?

b) What are the relationships between the bridging functions and the conservation outcomes, development outcomes and adaptive responses to change for which the programme was responsible for?

It is intended that the findings of this study may be of interest to policy makers and managers in national parks and protected areas in South Africa and elsewhere as they learn to adapt in a rapidly changing world.

2 THEORETICAL FRAMEWORK

In this thesis will be given focus to the adaptive management, adaptive co-management and bridging organizations concepts.

SES are complex adaptive systems as they have non-linear properties, such as trophic cascades, dynamic thresholds and surprises, and their behaviour has limited predictability, meaning that they can shift rapidly and irreversibly to an alternative state due to environmental and socioeconomic factors acting at different temporal and spatial scales (Hughes et al. 2007, Galaz et al. 2014).

Since knowledge of SES is always incomplete and becoming out-dated and because the system changes through time, continuous learning processes among managers, researchers and resource users must be in place to enhance resilience and to foster sustainable development (Crona and Parker 2012, Cundill et al. 2015, Folke et al. 2005, Holling 1978).

Social-ecological resilience, or the capacity to absorb disturbances, adapt to changes and transform while keeping the structure and essential function of SES (Hahn 2006; Holling 1973), depends both on biodiversity and institutions, defined as rules and norms, that can learn from and adapt to changing social-ecological conditions (Anderies and Janssen. 2013). Learning is considered key for building resilience as it contributes to knowing how to navigate change and respond effectively to disturbances (Holling 1978, Walters 1986). Learning can be defined as a process where existing knowledge is revisited and new knowledge is created (Cundill et al. 2015).

2.1 Adaptive management and adaptive co-management

The concepts of adaptive management and adaptive co-management are recognised as key approaches to managing SES in a way that explicitly supports learning (Cundill et al. 2015).

Adaptive management involves learning-by-doing through monitoring and experimentation to understand SES dynamics and the continuous integration of knowledge into management practices of organizations allowing managers to adapt to changes (Folke et al. 2005, Holling 1978, Hahn et al. 2006). Monitoring captures information from the SES, from natural

experiments or expected shocks (e.g. drought), feeding it into management processes. Experimentation consists of planned manipulation of specific SES processes or structures and comparison of outcomes with the aim of aiding decision-making (Cundill et al. 2015).

Adaptive co-management combines the dynamic learning characteristic of adaptive management (Holling 1978) with the linkage characteristic of cooperative and collaborative management (Buck et al. 2001; Folke et al. 2003; Gadgil et al. 2000).

Adaptive co-management requires collaboration between diverse stakeholders across sectors and scales, recognizing and combining different values and types of knowledge (Folke et al. 2005, Olsson et al. 2004). Adaptive co-management means involving relevant stakeholders in decision-making; and sharing power, rights and responsibilities among stakeholders (Berkes 1999, Brown 2003). Its core features are learning, collaboration and multi-level governance (Armitage et al. 2007).

Plummer and Armitage state that "Adaptive co-management brings together collaborative and adaptive approaches in pursuit of sustainable resource use and social-ecological resilience" (Plummer and Armitage, 2007). Adaptive co-management together with inclusive decision making is considered to contribute to the creation of institutions that fit conservation and development (Brown 2003). Adaptive co-management is associated with higher levels of effectiveness in meeting development goals without compromising conservation, although it is important to note that it is not a panacea and is must be applied in a context-sensitive manner (Ostrom et al. 2007; Schultz et al. 2011).

2.2 Bridging organizations

Bridging organizations link actors across multiple sectors strategically to solve problems that neither one would have been able to solve alone (Brown 1991). Depending of their degree of organizational formalization, scope, number and variety of stakeholders, bridging organizations can take many shapes and dimensions (Brown 1991; Westley and Vredenburg 1991).

The existence of bridging organizations is considered essential for adaptive co-management because they act as an arena for building trust, learning, sense making, multilevel collaboration

(horizontal and vertical) and networking, identification of common interests and conflict resolution (Folke et al. 2005, Hahn et al. 2006, Schultz 2009). Additionally, they provide flexibility, foster innovation, identify opportunities to solve problems (Galaz et al. 2008), channel resources and provide social incentives that promote participation in projects by reducing the transaction costs of collaboration and resolving conflicts (Folke et al. 2005, Hahn et al. 2006). By creating a common vision, space for institutional innovation and the capacity to cope with change and uncertainty they contribute to SES resilience (Galaz et al. 2008, Galaz 2014). However, little is known about how bridging organizations facilitate learning (Crona and Parker, 2012) and their role in resilience and sustainability also needs to be further investigated (Hahn et al. 2006).

2.3 Learning

In SES literature learning is considered crucial for sustainability (Gunderson and Holling 2002; Armitage et al. 2008). Learning is defined and conceptualised in many different ways (Armitage et al. 2007). It is both a process and a product, meaning that learning leads to further learning, and it is difficult to separate the cause and the effect (ibid).

In resource management there are three main theories about learning: transformative, experiential and social learning theory. Transformative theory states that learning is a reflective process that allows the perceptions and awareness of individuals to be modified (Mezirow 2000).

In experiential learning theory, learning is an iterative process where knowledge is created through experience, or learning-by-doing (Kolb 1984).

Finally, social learning takes place through: 1) sharing and integrating – co-producing – different types and sources of knowledge and perspectives between stakeholders across scales in a trusting environment; and 2) monitoring and experimentation (Cundill et al. 2015; Galaz 2008).

Social learning, meaning how learning takes place (e.g. through social communication and interaction) includes loop learning, what is learned (e.g. new skills) (Cundill et al. 2015, Armitage et al. 2007). Single, double or triple-loop learning may occur. Single-loop learning

relates to a change in skills, practices or actions in order to meet goals (e.g. solve specific problems or improve outcomes) and leads to recommendations. Double-loop learning questions the reasons behind actions and its impacts resulting in fundamental changes in stakeholders' behaviour. Triple-loop learning questions the values and norms on which institutions and actions are based; and can result in beliefs and values restructuration leading to changes in management (Flood and Romm 1996; Armitage 2008).

Some authors also mention the concept of environmental learning and argue that environmental education may foster resilience when bridged with social learning (Krasny and Tidball 2009; Krasny et al. 2009). Additionally, there is growing interest in understanding how it contributes to sustainability (Lundholm and Plummer, 2010). Environmental education aims to empower individuals to take action and change their behaviours towards sustainability, through raising awareness and promoting understanding regarding nature (ibid).

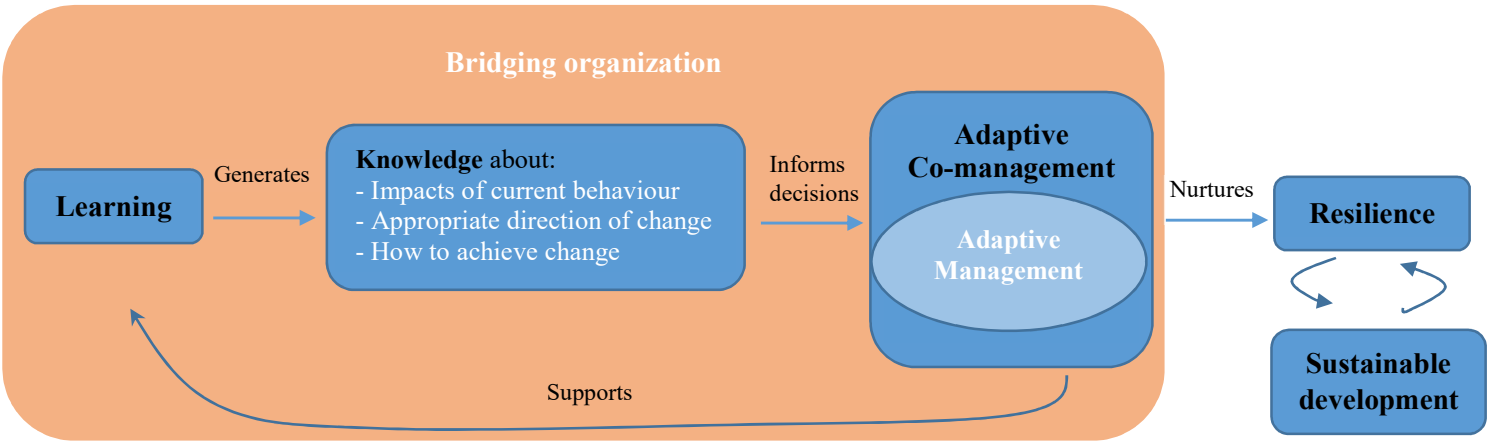


Figure 1- Inter-linkages between learning, knowledge, adaptive co-management, adaptive management, resilience and sustainable development

By studying the role of bridging organizations and, exploring adaptive management and adaptive co-management this research aims to understand how these theories play out in practice in poverty alleviation contexts.

3 CASE STUDY DESCRIPTION

The United Nations Educational Scientific and Cultural Organization's (UNESCO) Man and the Biosphere (MAB) Programme acknowledges human interests in protected areas. Its Biosphere Reserve (BR) model aims to create learning sites for sustainable development by aligning biodiversity conservation with socioeconomic development (UNESCO 2008). BRs have the following functions: conserving biodiversity, promoting sustainable development and supporting monitoring, research and education (UNESCO 2016). These functions and many of the BR Statutory Framework criteria correspond to features of adaptive co-management as it involves: monitoring, an integrated approach to both conservation and development, and recommendations derived from adaptive management and participation of relevant stakeholders (Schultz and Lundholm 2010; UNESCO 1996).

In the long-term, this approach has the objective of improving the relationship of people with the environment, allowing also them to reconnect with local ecosystems (Schultz 2009). Consequently, BRs require social and ecological management strategies to be aligned to achieve biodiversity conservation and environmental sustainability (Coetzer et al. 2014).

3.1 Study area description

Kruger to Canyons (K2C) was granted BR status UNESCO in September 2001. This BR is one of the sites included in the GLEAN project (A Global Survey of Learning, Participation and Ecosystem Management in Biosphere Reserves). This region is located in the north east of South Africa and covers approximately 2.6 million hectares. K2CBR is the largest biosphere reserve in Africa and the third largest in the world (Coetzer et al. 2010). It traverses the Limpopo and Mpumalanga Provinces, includes the Kruger National Park (KNP), several game reserves and adjacent impoverished communities (Figure 2). Approximately half of the BR area is dedicated to conservation, while the remaining unprotected area is used for community settlements and other economic activities such as agriculture, forestry and mining (Coetzer et al. 2014).

3.1.1 Environmental Monitors Programme

Although there are several K2C projects, the EM Programme was chosen for this thesis. This is because it involves a diverse set of stakeholders belonging to different types of organizations, namely research, reserves, governmental and non-governmental organizations working at

different levels; and it is indicative of continuous learning as outlined by the Programmes objectives. These include capacity building, co-learning, skills transfer and collaboration (SANParks 2016).

The Programme, which is under National Government's Expanded Public Works Programme (EPWP), was initiated nationally by the Department of Environmental Affairs (DEA) in 2012 to address the high unemployment rate and the increase of illegal wildlife trade, namely rhino poaching. This is done through monitoring, patrols and community environmental education activities, as well as job creation, training and skills development opportunities to previously unemployed community members from within K2C (Coetzee et al. 2012, SANParks 2016). The Biodiversity Social Projects Unit of South African National Parks (SANParks) is responsible for the programme's implementation and management (Swemmer et al. 2015).

The Programme employs environmental monitors (EMs) to help Host Institutions (HI) (research institutions, governmental and non-governmental NGOs and national and private reserves) achieve their mandates concerning biodiversity and ecosystem services conservation, while contributing to improved livelihoods and economic development (Swemmer et al. 2015).

By participating in this programme HIs gain free manpower and in return provide uniforms, training and skills development to their EMs and report the activities performed by the EMs (Coetzee and Biggs. 2012, SANParks 2016). K2CBR is responsible for the majority of the administrative work and for paying the wages to the EMs. Additionally, K2CBR as a HI itself also has EMs working directly for it.

The EM Programme was nationally deployed on protected areas and local communities late in 2012 and contains the following programmes: rangeland, protected area management, community engagement, river and environmental health programmes (Coetzee et al. 2012). A total of 265 EMs are working at K2CBR (approximately 20% of the EM's deployed nationally; SANParks 2016). Initially this was a 3-year programme but in December 2015 it was renewed for another 3 years.

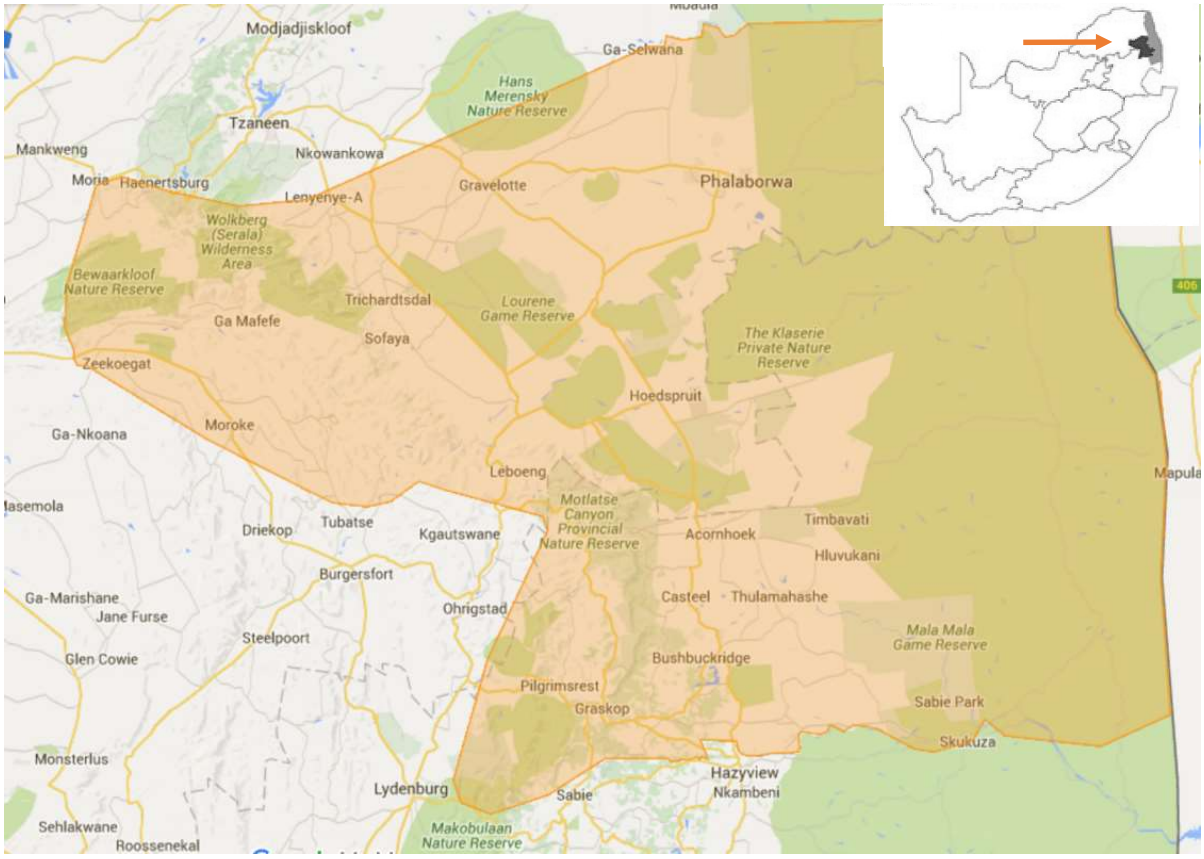


Figure 2 - Regional location of K2CBR in South Africa showing the area where the EM Programme was deployed (area in orange colour)

3.2 Historic background

The segregation of communities caused by the former Apartheid government has had lasting social-ecological impacts in this region (Coetzer et al. 2014), including a loss of sense of place, and unequal access to land and its resources (Du Toit et al. 2003, Nixon 2011). The BR designation aims to address these inequalities across the landscape by providing access to economic and livelihood opportunities that were unavailable before (Du Toit et al. 2003).

Drivers of change of this SES stated by literature that put pressure on sustainable conservation and socioeconomic development include: human settlement expansion; diseases such as HIV/AIDS; poor education; xenophobia to the influx of refugees and migrants; land fragmentation caused by e.g. agriculture, forestry, tourism and mining; poverty and high unemployment create a high dependence on natural resources which are used to supplement

household livelihoods (e.g. firewood harvesting and poaching) and droughts (CET 2015; Coetzer et al. 2013 and 2014; Hunter et al. 2011; Venter et al. 2008).

Figure 3 – Examples of drivers impacting the K2CBR: poverty, xenophobia, diseases and poaching (©Cláudia Florêncio)

4 METHODS

A case-study approach was chosen as it is appropriate to understand complex phenomena within a real-life context over which the researcher has little or no control, such as organizational and managerial processes (Ying 2009). Single case-study design is adequate for studying how theoretical concepts play out in practice in a specific context (ibid)

In order to answer the research questions associated with this case a mixed methods approach was used, comprising a literature review that included scientific articles, reports, books, news, social media and film documentaries; semi-structured interviews and participatory observation.

4.1 Semi-structured interviews

In-depth semi-structured interviews (Kvale 1996, Patton 2002) were carried out to identify the interests, needs and expectations of the stakeholders involved in the EM Programme as well as their perceptions of which types of knowledge are present, how learning and knowledge production takes place and what information is being shared. From this data, bridging functions could then be identified and analysed to see whether and how they are impacting ecological and social outcomes and responses to change.

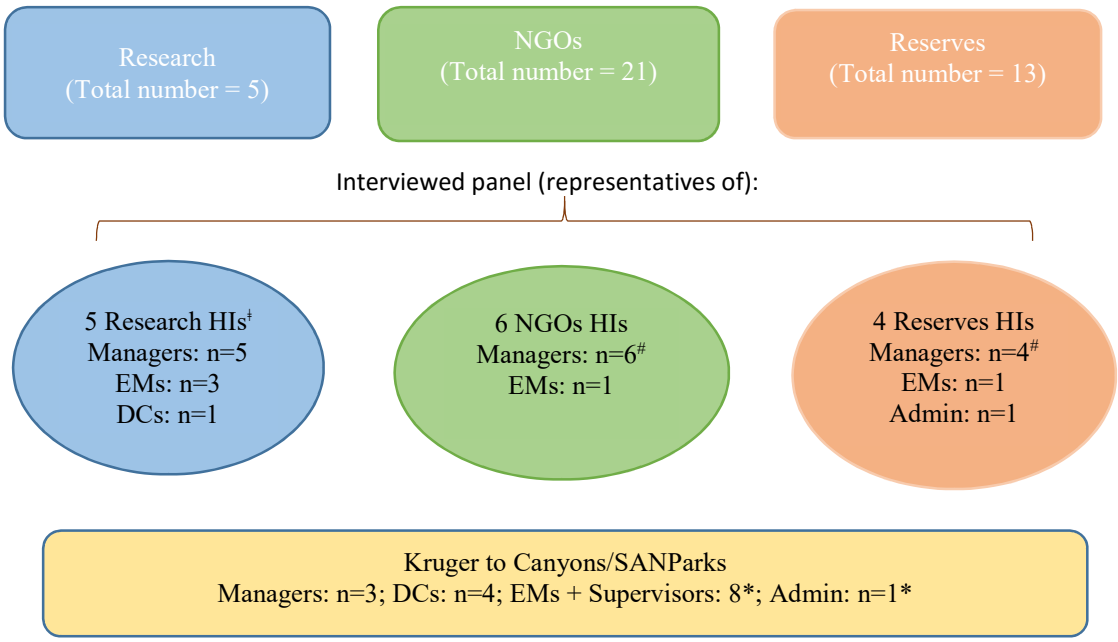
This research built on previous work conducted with K2C participants by the Stockholm Resilience Centre PhD student Simon West in November-December 2013. First, 14 interviews were selected from this research, the ones of the participants involved in the EM Programme creation, to understand the K2C region context, the stakeholders' interests and needs, and the framing of the EM Programme which had been implemented that year.

In a second phase follow-up interviews were made with some of the interviewees previously interviewed in 2013, and to identify additional stakeholders involved in the EM Programme. Snowball sampling (Biernacki and Waldorf. 1981) and participatory observation aided this selection process. The stakeholders targeted were: administrative staff, data collators (DCs), EMs and managers from HIs and SANParks representatives (see Appendix A). This allowed representativeness across scales. In total 37 individuals were interviewed from the EM Programmes first 3-year cycle during this stage (Figure 4). 35 were carried out face-to-face

during November and December 2015 and 2 were made via Skype in January and February 2016.

Interview guides were tailored for EMs, Data Collators (DCs), HIs and K2CBR/SANParks' managers (Kvale 1996, Patton 2002, Wagenaar 2011; Appendix B) because of the differences in their responsibilities and tasks. The guides have one set of common questions and one set of specific questions, designed for the respective roles of the interviewees in the program.

Interviews were recorded when approved by the participants, otherwise notes were taken. The transcripts or notes were sent to the interviewees for them to check their content and consequently their accuracy. Follow-up questions where made via email when necessary.



Legend: ‡One of the research HIs initially was part of the programme because it had a DC working for it. However, when the DC was employed permanently there, this HI stopped being part of the programme; #one manager represents both a NGO and a Reserve; *some of these individuals work activities are integrated in one of the NGOs.

Figure 4 - Host Institutions Part of K2C EM Programme that were interviewed in 2015/2016

4.2 Participatory observation

Participatory observation was used to better understand the context and to verify and triangulate information.

This is a qualitative data collection method that allows the researcher to learn about the activities of the individuals being studied by observing or being involved in their daily tasks and in their natural setting. Consequently, the researcher obtains a holistic understanding of the case under investigation (Kawulich 2005). In this study it involved participation in meetings, events, trainings and direct observation of EMs daily activities through observation, informal conversations, note taking, photography and video documentation after requesting permission.

4.3 Data Analysis

4.3.1 Coding interview transcripts

After transcribing the interviews, they were analysed using thematic analysis to identify the bridging functions performed through the EM Programme, understand how they contribute to adaptive management and adaptive co-management and foster sustainable development. This is a method to identify and analyse repeated patterns of meaning (Braun and Clark. 2006). Thematic analysis is flexible, as it allows a wide range of analytical options to be explored, and can provide rich and detailed, although complex, results. Additionally, it is adequate for researchers with limited experience in qualitative research as it is easy and quick to learn; summarizing key characteristics, identifying similarities and differences of the data set and allows the generation of unforeseen insights (ibid).

The transcripts, data from participatory observation and other relevant data sources were coded using qualitative analysis programme NVIVO, version 11, to sort and examine the data (Boyatzis 1998; Flick 2014; Wagenaar 2011). First, data segments were labelled and grouped by categories (Braun and Clark 2006; Flick 2014). The process of defining the codes was done in a first step in a deductive way, so the coding themes and subthemes were theory-driven (e.g. bridging functions) (Braun and Clark. 2006; Flick 2014).

In a second step an inductive approach was used, the coding themes and categories were data-driven, meaning that they emerged during the analysis of the data (e.g. challenges) which enabled a richer description and more detailed analysis (Braun and Clark. 2006).

A pilot was performed to test the initial version of the coding using four interviews (EM, DC, HI and K2CBR Manager) and necessary revisions were made. Finally, the codes were used to describe the data and to potentially inform adaptive management and co-management theory, more specifically bridging organizations (see Appendix C).

4.3.2 Data Triangulation

Information from semi-structured interviews was triangulated (Flick 2014, Kvale 1996) with documents (e.g. reports, newsletters, news, HIs' internet sites and social media) and field observations (e.g. attending meetings and trainings). Moreover, triangulation was achieved by interviewing different HIs individuals working at different levels inside the HIs, individuals that belong to organizations outside the programme but that interact with it and individuals that no longer work within the programme. This provided the opportunity to assess eventual contradictory information and check the accuracy of the information received.

4.4 Critical reflexion of methods and data sources

Conducting and analysing qualitative interviews is time consuming and complex (Kvale 1996). This limits the number of respondents that can be involved and hence requires careful selection of interviewees to represent the diversity of perspectives present.

As snowballs were initiated by HIs and the K2CBR manager this could have biased the sample towards individuals with a more positive attitude towards the programme (Sanghera & Thapar-Björkert, 2008). However, the majority of EMs interviewed were not appointed by the HIs or K2C, they were chosen by me according to the availability of the interviewees. Additionally, all DCs as well as all research HIs were interviewed.

Due to time constraints, neither non-EM communities or government representatives were interviewed but this could add richness to future studies.

In qualitative research, the interpretation of interview statements and participatory observations might be influenced by the researcher knowledge, skills, motivations and views (Kvale 1996). In order to minimize bias, and consequently assure the validity and reliability of the results, the researcher separated observation and interpretation, identified patterns in the data, regularly confronted her opinions with the findings while at the same time performed continuous triangulation between diverse data sources, selected citations that are representative of the significant patterns in the interviews, and questioned the conclusions.

Additionally, interviewees might have perceived the researcher as an evaluator of the programme, and as a result might have not have talked freely or been totally truthful. The researcher tried to overcome this by allowing people to feel comfortable by choosing an adequate interview setting and through assuring anonymity. Moreover, taking photos during field work acted as an ice breaker, as it facilitated the interaction with the majority of interviewees, namely the EMs.

5 RESULTS

This section answers the research sub-questions starting with the actors' interests that are being linked by the Programme and the bridging functions that are realized. It then proceeds with an explanation regarding the relationship between the bridging functions and the outcomes achieved so far and concludes with an answer the main question: How do the bridging functions of the EM Programme contribute to development outcomes, conservation outcomes and adaptive responses to change?

5.1 General aspects of the EM Programme

The EM Programme ensembles several organizations from research, reserves and NGOs and establishes links between them, and between them and local communities. Each of these stakeholders have interests and needs that lead them to participate in the programme (Table 1).

Table 1 – Summary of the stakeholders' main interests and aims by categories stated in interviews and reports (SANParks 2016, UP 2016) that lead to their participation in the EM Programme

	Types of stakeholders and aims			
Interests	Research HIs	Reserves HIs	NGOs HIs*	EMs as community representatives
Conservation	Ecological monitoring Create long term data sets Data collection in a wider area Support and influence decision making (e.g. rangelands management) Build SES resilience Raise environmental awareness of local communities	Ecological monitoring Wildlife protection Implement adequate rangeland management practices Raise environmental awareness of local communities Engage youth to pursue career nature conservation	To engage youth to pursue career nature conservation To raise environmental awareness of local communities	To progress their career or studies in nature conservation[#]
Development	Capacity building of local communities (e.g. skills development)	Promote sustainable social empowerment of local communities, in particular	To improve quality of school system To assure food security	To access education To access job opportunities and career progression

		women, and alleviate poverty Empower local communities Promote tourism activities	To address social issues (e.g. gender violence, xenophobia) To improve access to healthcare To create role models in the communities To promote sustainable social upliftment of local communities Alleviate poverty and empower communities	To access to healthcare To access to natural resources (e.g. water, reserves) Improve community livelihoods and well-being Empowerment of communities Preserve traditional knowledge and practices
Legend: *Some of the NGOs operating in the region were created by Game Reserves. # Regarding the individuals that had studied nature conservation before entering the programme and the ones that became interested in this field after having started working in the programme.				

The previous table shows that stakeholders share common interests. However, the main priorities of these stakeholders differs as research HIs interests focus mainly in research activities linked to conservation, reserves HIs in conservation and NGOs and communities in development. The K2CBR unites these by engaging both in conservation and development, while representing the interests of DEA and SANParks.

In order to understand how the programme is addressing these interests and needs it will be mentioned the main tasks performed by EMs working in the HIs. In case additional background information about the K2CBR ecological and socioeconomic context, besides the one presented in section 3, is needed to understand the issues that the programme tackles please see Appendix D.

Throughout interviews, participatory observation and by consulting reports (SANParks 2016, UP 2016) the following main tasks performed by the EMs were identified (Table 2):

Table 2 – EMs main tasks related to the main interests of the several stakeholders. For detailed list please see Appendix E.

Interests	**Main tasks performed**	**Examples**
Conservation	River and rangelands' monitoring in PAs and local communities	Monitor water quality and alien plants
	PAs integrity patrols linked to anti-poaching activities	Identification and removal of snares
	Village patrols	Identification of environmental issues such as illegal dumping sites
	Restoration activities	Removal of alien plants
	General maintenance activities and infrastructures construction	Creation and maintenance of vegetable gardens at schools
	Environmental education and awareness	Campaigns in local communities: waste collection, rhino anti-poaching and animals' anti-poisoning awareness
	Community engagement	Recruitment of individuals from local communities to work as tree-preneurs and waster-preners*
Development	Animal health promotion and awareness	Rabies and foot and mouth disease vaccination campaigns
	Human health education and awareness	Teenage pregnancy, sexually transmitted diseases and nutrition.
	Social problems awareness	Gender based violence and xenophobia
	Community engagement	Recruitment of individuals from local communities to work as tree-preneurs and waster-preneurs*

Legend: *One of the NGOs has a programme were people from local communities are identified by EMs working for different HIs and are employed as Tree-preneurs or Waste-preneurs. Tree-preneurs collect seeds and grow trees, and in return they receive once per year food hampers according to the trees' height. Waste-preneurs collect waste that will be recycled and they receive money according to the weight of the waste they deliver.

One of the enrolment selection criteria in the programme for the EMs based in local communities is that they live in those villages because of their knowledge about: local languages (e.g. Tsonga, Zulu), geographic area and local structures (e.g. local tribal leaders).

K2CBR EMs work is evaluated through performance appraisals and they have individual development plans (KBRM1, KBRDC3, KBRDC1). It was identified by the majority of

interviewees that some EMs have difficulties in adapting to work due to: multiple, and sometimes monotonous tasks and tough weather conditions; low motivation due to low salaries, lack of supervision and conflicting expectations or interests. In order to solve part of these challenges some HIs responded by toping-up the salaries and additional training opportunities were provided by the programme.

"*As a HI you have to think about motivating your EMs and many of them get just bored because it is the same job every single day. So that is where you need to start and plan your trainings in certain ways that keeps the people enthusiastic and gives them opportunity to learn different things and maybe evolve a little bit more.*" (Research HI manager, HIRM2)

5.2 Bridging Functions

The EM Programme facilitates learning; promotes networking, collaboration and trust-building and contributes to conflict resolution. Each one of these functions will be detailed bellow.

5.2.1 Facilitate learning

The identified activities supported by the EM Programme that might facilitate learning include: training of EMs, education of communities and monitoring and experimentation (learning-by-doing).

5.2.1.1 Training of EMs

HIs and DCs are responsible for providing training to the EMs through formal courses and workshops and informal 'learning on the job' training opportunities.

EMs receive training on different topics according to the tasks they perform in the HIs and to identified needs (Figure 5). The educational needs or relevant topics are identified by managers and DCs through their interaction with the EMs. For example, in the monthly Maeba Group (constituted by all supervisors of the EMs and DCs) meetings three different training activities are chosen based on either environmental education, life skills development (e.g. time management, conflict resolution) or health and safety. For detailed information about the types of training EMs receive please see Appendix E.

EMs can do at least two learning exchanges per year, to visit EMs from a different area or Kruger National Park to exchange ideas and experiences with other teams. DCs attend further training i.e. project management and facilitation.

The majority of the interviewed EMs did not have previous knowledge about conservation. Several EMs, including the ones that studied conservation previously, expressed their wish to continue their studies. K2C and several of the HIs encourage and support (e.g. financially or working time flexibility) EMs to progress their studies.

Figure 5 – Training sessions (©Cláudia Florêncio)

It was stated by the majority of HIs managers that due to budget and time limitations they cannot provide as many trainings and supervision as they would like to their EMs.

5.2.1.2 Educating communities

EMs deliver classes on nature conservation (e.g. recycling) and health (teenage pregnancy) at schools and bush schools (schools in reserves) aligned with school curriculum (Figure 6). Classes are complemented with other educational activities such as educational games, assist in homework (e.g. Homework Club initiative) and exams preparation. The targets groups are children since kinder garden until high school.

Figure 6 – Environmental education: a) and b) ONG library, c) bush school (©Cláudia Florêncio)

Many respondents expressed their conviction that environmental education of children will have long-term and large-scale effects on pro-environmental behaviour in the communities.

"*by teaching a child you are teaching his family as well because he goes home and he tells them."* (EM, KBREM4)

"*the reason we have chosen to use environmental education as a tool is that we have a lot of people in the communities that do a lot of things because of lack of knowledge. Some people think that we will always have water, these trees will always be here; these resources are not depleting, we find them here and we will leave them here because most of the people that are not exposed to any other information other than that one. (…) I think that the solution of all environmental issues is environmental education*." (DC KBRDC3)

Education is also provided to local communities in awareness campaigns on social (e.g. sexual abuse) and ecological problems (e.g. littering, poaching). The ways used to communicate the information are documentaries, theatre, door-to-door visits and community meetings that

gather individuals and local tribal authorities. Communities also have access to courses, such as financial education.

5.2.1.3 Monitoring and experimentation

EMs collect data during field patrols in reserves, in village patrols, at dip tanks – places in villages where cattle is inspected, see Figure 7a – and in clinics. Additionally, EMs working for research HIs help researchers, Master's and PhD students to collect data for their research and act as translators, facilitating communication with local communities due to their knowledge of local languages (e.g. Tsonga, Zulu).

Figure 7 – Monitoring activities: a) dip tank, b) ticks' inspection, c) tree growth monitoring experience and d) rain water monitoring

The type of data collected by EMs and its use identified in interviews, participatory observation (Figure 8) and documents (SANParks 2016, UP 2016) is summarized in Table 3.

Table 3 - Type of data collected by EMs according to the main themes of the EM programme. For detailed information please see Appendix G

Programme theme	Monitoring activity / Data collected	Application
Protected areas management and Rangeland monitoring	Land and vegetation monitoring: e.g. perennial and annual grasses %	Identification of: soil and vegetation degradation, illegal sand mining
	Land use: e.g. crops rotation	Study main planted crops to determine fields utilization and drought impact
	Wildlife monitoring: e.g. game counts	Define anti-poaching strategies Control animal population
Fresh water monitoring	Rainfall	Study rainfall patterns and determine environmental change
	Rivers monitoring	Determine water quality
Health monitoring	Cattle and dog demographic and health indicators' data	Public Health: e.g. prevent rabies outbreaks
	Human health information: e.g. diagnosed diseases	Public Health
Monitoring of socio-economic trends in rural communities	Collect data regarding livelihoods: e.g. people's income and house size	Assess communities' needs
	Firewood purchased and harvested quantities; and regrowth of trees under different harvest regimes	Understand natural resources use patterns and find sustainable ways of harvesting wood (action research)

There are occasions when EMs contribute to scientific research carried out by HIs leading to the integration of local knowledge with scientific knowledge (Research HI manager, HIRM2). Research is perceived as important to find and implement adequate management practices (KBRW2, HIRM5): "*research is the only way that you know that this is working [and] this is not working*." (K2C EM KBRW2)

Figure 8 – Data capture and reporting: a) cyber tracker, b) diary, c) reporting using tablets (©Cláudia Florêncio)

Research HIs managers stated that in the beginning of the programme they envisioned the creation of a network of monitors collecting data throughout the Loweveld, through which they would be working closely together and sharing data between them and reserves. However, due to several challenges namely due to different research agendas, lack of resources such as time and personnel these expectations have not been fully achieved (HIRM2, HIRM3, HIRM4, HIRM4).

"*we are all in our own different institutes experiencing capacity challenges, (…) and the reality is in the end you start stepping back. I remember, in the beginning, very soon just before we started the EM Programme there was so much engagement that there was, there started being engagement fatigue*." (HIRM5)

5.2.2 Promote networking and collaboration

Before the beginning of the EM Programme there were existing networks, namely the Anyway Stakeholder Group, and forums where diverse stakeholders participated. These were considered essential, by the majority of the HIs, for the creation of the programme.

The programme created new networks among EMs and DCs and also established vertical links between the HIs and local communities. EMs are perceived as key by HIs because they act as

links between HIs and local communities. HIs seek collaboration and want to build good relations with local communities and that is being achieved through the EMs which act as communication channels, as they conveying information in both directions (HIRM2, HIRM5, HINM3, HIGM1, HINM4).

"EMs became the backbone because we realized that having people with their abilities around, in the community, everybody knows them, they are invaluable when it comes to our community engagement side. (...) Without those guys we would not have been where we are now." (HI Research Manager HIRM5)

The EM Programme is seen as a collaboration platform that allowed synergies between HIs that did and did not interact before, and between HIs with other organizations and communities. Synergies and collaborations take place among stakeholders that have common interests, for example there are interactions between the EM Programme with other programmes such as the Tress for Life. Collaboration between organizations inside and outside the programme involves information and resource sharing, such as resources, transportation and trainings (HIGM2, HIGM3, HIRM3, KBRSM3).

5.2.2.1 Information sharing

Networking promotes information sharing among stakeholders. Information is shared during meetings, informal interactions and formal monthly reporting as EMs, EMs supervisors, DCs and HIs managers have to report to K2C which then reports to SANParks and DEA. For example, the type of information that is shared in formal reports consists of the activities performed by EMs, their successes and challenges.

At organizations' level information is shared in K2C forum meetings involving HIs managers and Tribal Authorities. Traditional authorities participate together with local governmental authorities in decision-making. Regarding the EM Programme, Tribal Authorities were involved since the beginning and stated in which villages the EMs would be deployed and oversaw the recruitment process (KBRM1). However, these meetings happened more regularly in the setup phase and first year of the programme; nowadays they happen when needed and possible being rare (HIGM2, HIRM2, HIRM3, HIRM5). Information sharing related with the data collected by the EMs takes place when HIs are involved in the same project or projects

that have synergies, and on an *ad hoc basis* (KBRM1, HIRM1, HIRM2, HIRM3, HINM1, HIGM3).

At EM level there is information sharing between different groups of EMs and between EMs and professionals from other organizations with who they work close with (e.g. Health Professionals and Police) (KBREM3, HIREM2, HIREM3, KBRSM3). For example, there are traditional healers employed as EMs working together with healthcare professionals. These EMs share their knowledge regarding traditional medicines (e.g. medicinal herbs) with the doctors and nurses, which exchange their knowledge with them (e.g. treatment dosages) (KBREM2).

"*So the EMs that are working on livestock they also interact with EMs that are doing environmental education (…) there is a big mix, a lot of capacity building and they are actually learning a lot from each other.*" (DC KBRDC1)

At a community level information is shared by EMs through door-to-door visits and campaigns and individuals from communities also provide information, namely about their needs (e.g. water) and poaching activities (KBRSM3, KBRDC3, KBREM1). Research HIs report the findings of their work and issue recommendations through the publication of reports, articles and meetings with local government and communities (HIRM2, HIRM3, HIRM5).

However, not all data is shared due to: intellectual property rights (HIRM1, HIRM2, HIRM5, HINM1), confidentiality issues (e.g. rhino poaching) (HIGM1, HIGM3) and legal frameworks (e.g. notifiable diseases) (HIRM5). At the moment each HI stores independently the data collected by their EMs (HIRM1, HIRM2, HIRM3, HIRM4, HIRM4, HINM1, HIGM1, KBRM1).

The on-going creation of a common database will allow individuals to know the projects and type of data being collected by the different HIs, avoid duplication of work and harmonize data making and comparisons for improved accuracy (HINM1, HIRM1, HIRM3).

In summary, the EM Programme facilitates learning and scientific, local and traditional knowledge sharing and integration within and across levels (Figure 9).

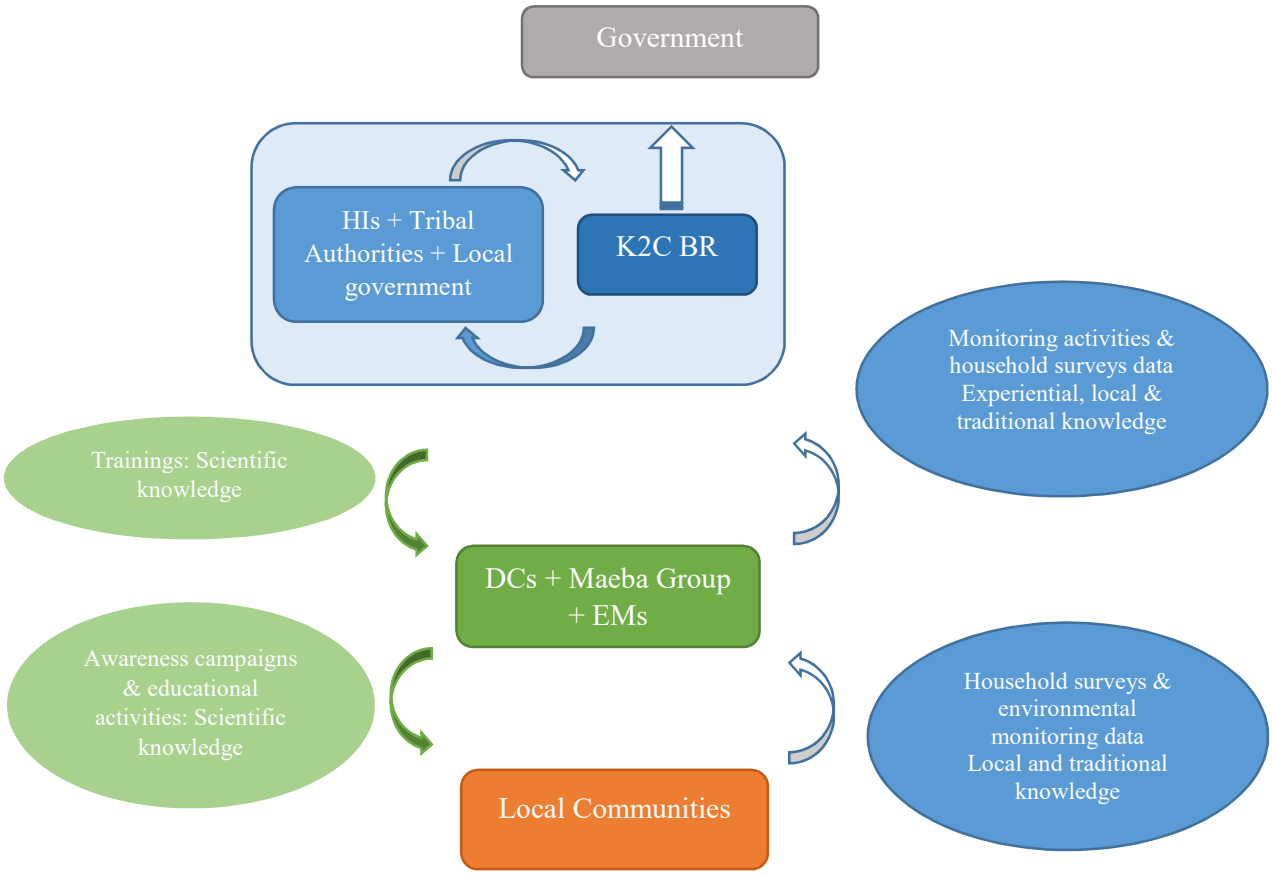


Figure 9 - Training opportunities, information and knowledge sharing flows among stakeholders within and across levels

5.2.3 Conflict resolution

Tensions between conservation and development interests among stakeholders were identified.

It was highlighted by some interviewees that in their point of view more focus is being given by some HIs to anti-poaching activities versus research (HIGM1) and versus providing awareness regarding other topics (HINEM1). That approach is causing resources, such as time and money, to be deviated from research and activities that could contribute to empower communities. There are different opinions between some of the HIs regarding the right approach to tackle poaching (HINEM1, HIGM3).

"(...) every day is like we are approaching the rhino poaching theme and then it is limiting us to talk more about the other environmental issues." (NGO EM HINEM1)

"*Conservation can only happen as aby product of poverty being alleviated*." (NGO HI manager HINM4)

Data from interviews did not show evidence of how the programme is trying to address this issue.

Tensions between local communities and reserves regarding access to natural resources is being tackled by the programme through enabling communities to reconnect back with wildlife, e.g. students go on game drives in reserves (HINM3, HINM5), and by allowing collection of some natural resources (HINM1).

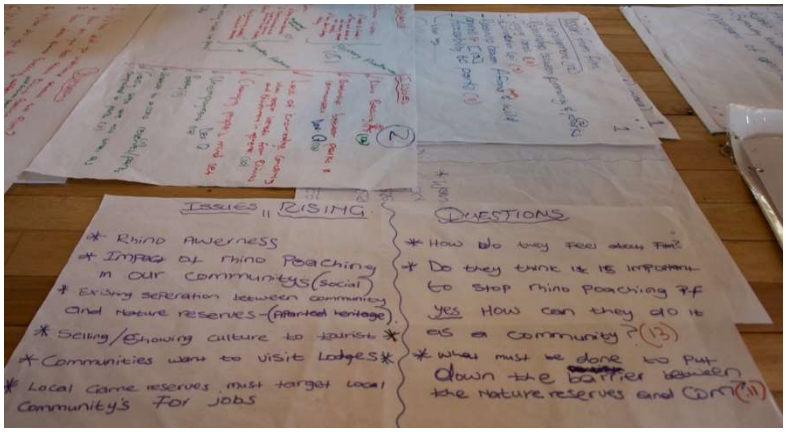


Figure 10 - Brainstorm exercise about rhino poaching at a facilitation training and firewood harvesting

5.2.4 Trust building

Trust has been already established by networks of HIs that were already collaborating before (HIRM5). Trust building between stakeholders is seen to be important for information sharing and collaboration between stakeholders (KBRDC3, HINM1). For instance, individuals suffering from gender violence now approach more openly EMs and NGOs to ask for their help (KBREM4, KBRSM1).

Trust building between communities and HIs, namely reserves, seems to happen when people perceive that they benefit from conservation, for example through job opportunities in reserves, skills development opportunities and access to assess to natural resources (HIGM4). The programme also built trust among local community members, for example traditional healers were previously seen as witches and now they are respected (KBREM2).

5.3 Outcomes and adaptive responses and their relationship with bridging functions

The EM programme has achieved both conservation and development outcomes as well as increasing the capacity for adaptive responses. The main achievements will be outlined below as well as the relationship between the bridging functions performed through the programme and the outcomes.

5.3.1 Conservation Outcomes

The EM Programme has so far addressed some of the environmental issues present in the region such as poaching, littering and illegal dumping, natural resources harvesting such as sand mining (extraction of sand for construction purposes), soil erosion and alien plants due to monitoring and data collection. Moreover, monitoring contributed to a better understanding of SES dynamics regarding natural resources use by local communities, namely firewood harvesting patterns. Collected data has shaped natural resources management practices, such as the reserves' strategies for anti-poaching, removal of alien plants, animal population control; and addressing environmental issues such littering and alien plants expansion. Together with other interventions taking place in the area, the programme seems also to have contributed to the decrease in rhino poaching. Experimentation carried out by one research HI lead to the implementation of sustainable firewood harvesting practices that were implemented in three villages (HIRM4).

"*Two of the three involved communities have implemented controlled harvesting of coppice regrowth and now actively prevent outsiders from harvesting on their communal land*" (Research HI manager HIRM2)

Since the start of the programme some changes in communities' behaviours have been observed by the majority of the respondents such as: recycling instead of littering, cattle being

inspected at dip tanks, rotational grazing, and sustainable harvesting of firewood and medicinal plants. Environmental education, monitoring and experimentation, trust building and collaboration are appointed by respondents to be responsible for these outcomes.

"People are changing their behaviour, especially by dumping or littering. Even I was not aware that when I take my rubbish and put it in a hole or river that I [pollute] but now I do know, and [now] I can tell the people." (K2C EM KBRSM1)

5.3.2 Development outcomes

In general terms, the EM Programme contributed to local communities' empowerment, improvement of livelihoods and well-being through the job opportunities created that allowed, for instances, EMs to be able to support their families and improve their housing.

The Programme tackled some of the community needs. Food security is being addressed e.g. by vegetable gardens at schools. Education students' grades improved due to educational practices implemented such as the Homework Clubs. Disease prevention and access to healthcare has been promoted and as a result i.e. the use of condoms in communities increased. Moreover, there is the perception that a higher number of farm workers with HIV/AIDs are taking medication now. By being employed the EMs are able to provide food and clothing to their families and many have improved their housing conditions. Finally, there is a perceived reduction of sexual abuse suffered by female migrants working on farms. The factors behind these outcomes appoint to the learning, networking, collaboration and trust building functions performed through the EM Programme.

Trainings and day-to-day work resulted in EMs' capacity building through new skills and knowledge, greater self-confidence in public speaking and through gaining respect from community members; job progression inside and outside the programme organizations; creation of entrepreneurs as e.g. one EM supervisor implemented rainwater collection in his village; and creation of role models as e.g. some of the children want to follow career in conservation and want to be EMs.

"*The opportunities is that in our community about 48 people are employed in the EM Project and my opportunities is that now I can survive on my own, I can make decisions, I can take care of myself.*" (K2C Supervisor, KBRSM1)

Concerning the community, the trainings, information sharing, awareness campaigns and job opportunities (e.g. tree-preneurs and waste-preneurs) contributed to their capacity building and empowerment. Moreover, it also increased their engagement and collective action such as seen in e.g. collecting waste campaigns.

"We can say that actually we are empowering the community to empower itself." (KBRDC3)

Finally, the programme contributed to increase capacity building of HI as they have additional personnel to fulfil their mandates; and to an improvement in the relationship between HIs and communities achieved through trust building, information and benefit sharing. However, some of the HIs managers expressed their concern regarding the fact that they think that some HIs are using EMs just as a source of free labour and are not contributing to their skills development according to the programme goals (HIRM5, HINM1).

The outcomes achieved so far have been acknowledged by several national and international awards. For example, the EM Programme received the Best National Project at Kamoso Awards 2014 and one of the EMs groups was awarded the Best Rhino Conservation Practitioner and UN Champions of the Earth Award 2015. The EM Programme is perceived by stakeholders as a flagship programme and it has granted recognition to HIs.

5.3.3 Adaptive responses

A range of adaptive responses were mentioned by interviewees such as rotational grazing, strategies to fight soil erosion, vegetable gardens at schools, rain water collection to fight drought and sustainable firewood harvesting.

Rotational grazing practices were implemented in some of the communities, avoiding overgrazing and assuring that there is enough grazing for cattle. The creation of vegetable gardens allows vulnerable households to be able to complement their livelihoods.

Through the knowledge acquired by trainings and by carrying out monitoring activities a group of EMs was empowered and besides just identifying that soil erosion was a big issue in their area, they took the initiative and were responsible for the creation of the Rehabilitation Project. This project created several additional job opportunities and lead to empowerment of individuals as a new job role called "contractors" was created. Previous EMs work now as contractors which are self-employed individuals that hire people from local communities to build and lead a team that works then in this project. The project has expanded to another four villages.

"*The most I learned is when I am monitoring because now I can know different types of that the land is damaged, those big gullies and dongas. (...) we successful achieved to bring a project of rehabilitation (...) Then we managed to bring the project in our area by writing proposal to the DEA and then they funded us (...) the project is growing bigger and bigger*" (EM Supervisor, KBRSM1)

Figure 11 – Rehabilitation project activities in a landscape severely affected by erosion

Similarly, one EM Supervisor became an entrepreneur due to the knowledge that he received and started collecting rain water in his village to face drought periods.

"His [EM Supervisor] whole mission now is to get people to collect rain water in his village. He is doing it slightly because of profits, because he is helping them put up the caters and stuff,

but at the same time he is doing it because he realizes, and he got that knowledge through the EM project. So those sort of small seeds that you can water, that will grow and bring a lot of fruit. So I think the programme planted a good seed." (NGO HI Manager, HINM1)

5.3.4 Attributed reasons for the outcomes

Stakeholders identified several reasons why the achievements reached so far were possible. One is the coordination, leadership and facilitation of the K2CBR manager, DCs and Maeba group performed across levels. Additionally, K2CBR has a big network of contacts, good relationships with tribal authorities and is responsible for the majority of the administration work. The organizational structure provided by SANParks together with DEA funding are also considered important.

The variety of organizations involved is perceived as strengths of the programme. This is because they cover a wide spectrum of objectives and perspectives, offer organizational flexibility and training and skills development opportunities. Lastly the fact that the programme employs people from local communities and focuses on empowering them.

6 DISCUSSION

During the first 3-year cycle the K2CBR EM Programme already had several successes.

This thesis supports the fact that adaptive co-management contributes to sustainable development (Ostrom et al. 2007; Schultz et al. 2011). It also shows the role of bridging functions in connecting diverse stakeholder groups and the challenges faced in contexts of poverty alleviation (Brown 1991). This study has showed the role of bridging functions such as learning, networking and collaboration in nurturing resilience and sustainable development by enabling communities to cope with change through the adaptive responses that were identified.

This section will start with the analysis of the main findings of the study related to bridging functions and achieved outcomes. Then it discusses the role of bridging functions in facilitating adaptive management and adaptive co-management in practice in a poverty alleviation context.

6.1 Bridging functions

Among the bridging functions identified the learning function and the networking are most evident ones being facilitated and promoted through the programme and the ones contributing mainly to the achieved outcomes as the following section will discuss.

The bridging functions identified impact each other as they can potentiate one another and if one is not in place that can have an effect on others. For example, the existence of a wide network composed by several diverse stakeholders increases the probability for learning and collaboration to be promoted. Information sharing happens if trust was built. On the other hand, for trust to be built conflicts have to be solved. For solving conflicts, for instances it is important that collaboration between stakeholders exists, but for collaboration to take place trust among individuals is a requisite.

6.1.1 Facilitate learning

Learning processes taking place in the programme is in the pursuit of three main goals. Firstly, to build capacity through the development of skills and knowledge transfer from HIs to individuals from local communities, which in turn enables them to find other job opportunities. Secondly, to influence people's behaviours thereby making people more socially and

ecologically responsible. Thirdly, to understand further the social-ecological dynamics in order to find and implement solutions to address natural resource depletion while securing livelihoods. This last goal is set to assure long-term sustainability (e.g. sustainable firewood harvesting and rotational grazing) and influence management practices and policy-making (e.g. foot and mouth disease).

The EM Programme is a platform where several types of learning were identified: social learning, multiple-loop learning, environmental and health education. These contributed to a better understanding of the SES dynamics, capacity building and empowerment of communities, to the creation of local stewards and bottom-up solutions such as some of the identified adaptive responses.

Social learning results from the interaction between stakeholders across scales that leads to knowledge and information sharing, for example, during meetings and EMs' learning exchanges. There is also the integration of different knowledge sources and types such as scientific, local and traditional as seen between traditional healers and healthcare professionals.

Single-loop learning is taking place as EMs gained skills through training and by performing day-to-day work activities; and monitoring activities lead to management recommendations in reserves, for example, regarding anti-poaching strategies. Double-loop learning is happening through insights gained from scientific experiments. For example, several communities understood the impact of unsustainable firewood harvesting and practices were implemented towards better management.

Environmental education is being used to provide knowledge about environment' dynamics and as a tool to raise awareness. There is evidence that it was responsible for a change in communities' behaviours such as recycling instead of littering together with the fact that individuals perceived the benefits they gain from it.

The combination of learning through adaptive co-management, due to social and multi-loop learning, with environmental education that is taking place in the EM Programme was also found in other BRs (Channel Islands, Schorfheide-Chorin and Wienerwald) (Schultz and Lundholm. 2010).

Since EMs explain the consequences that pollution has on people's and animals' health, health education together with environmental education also seems to be important as it might also be one of reasons that contributed to the change in habits of some individuals. However, this would need to be further investigated.

6.1.2 Networking, collaboration and trust building

The existing networks, namely the Anyway group, collaborations and trust between the stakeholders involved in the set-up and implementation phase of the programme were a prerequisite. They created the foundation for programme establishment and for the expansion of the network leading to further collaboration and trust building, namely with other organizations and local communities.

By employing individuals from local communities, the programme catalysed the creation of links between EMs and HIs and communities. EMs perform a crucial role in linking organizations and local communities by acting as communication channels and by building trust between them.

Collaboration takes place between HIs that have the same or complementary interests such as among the same type of HIs, between research and reserves HIs, and between reserves and NGOs. However, it could be further strengthened or stimulated especially in terms of data sharing. Several of the HIs managers that were interviewed stated that they had expected the programme to have led to a closer collaboration between HIs but managers do not have enough time or resources to engage with other HIs or have different agendas. The programme did not achieve as much horizontal collaboration and information sharing as initially expected but vertical collaboration has been enhanced by bridging communities and organizations.

6.1.3 Conflict resolution

The fact that several stakeholders are part of the programme can be seen as a "double-edged sword", being ambiguous to the outcomes, in the sense that on one side the existence of multiple perspectives, experiences and knowledge can contribute to finding solutions. However, on the other side multiple perspectives, opinions and interests can lead to conflicts or make it more difficult to achieve a common agreement regarding priorities and strategies among stakeholders. This was identified in the programme regarding the focus and resources that are provided to e.g. anti-poaching activities versus research and versus raising awareness and tackling other issues.

It is important to find an adequate balance between the needs and interests of the stakeholders and to evaluate the possible impacts of the trade-offs of decisions in the communities' livelihoods and the environment short-term and long-term needs (Armitage et al, 2008) as people and the environment are dependent of one another.

Conflict resolution and trust building features between the different interests of the stakeholders emerged less in the discourses of the informants. Meaning that these two areas can be further strengthened in the second cycle of the EM Programme.

6.2 Outcomes and adaptive responses

The creation of role models in this type of settings can have a domino effect, for example, children by wanting to be EMs when they grow up or go to study environmental conservation they can later influence others to be working in this area.

The development of skills and knowledge gained by EMs provides them qualifications to be able to progress to other jobs, providing them the chance to escape poverty.

The emergence of adaptive responses such as the Rehabilitation Project which was an idea of the EMs shows that, by providing tools through learning to individuals, programmes like the EM Programme can contribute to empower individuals and their communities. By being able to find solutions to problems they face, they become less dependent on external help, such as social grants and less vulnerable.

In K2CBR without the EM Programme, probably the identified adaptive responses would not have emerged, and access to educational and job opportunities would not have been promoted as much as they were. However, after this first 3-years' cycle managers have to reassess the programme and improve some of its aspects, such as collaboration, data sharing at HIs level and EMs motivation.

6.3 Features of adaptive management and co-management

The research findings show that there is evidence that bridging functions performed through the EM Programme enable and promote some of the features of adaptive management and adaptive co-management.

Adaptive management is promoted through the monitoring activities and scientific experiments taking place. Namely, as mentioned previously EMs working in reserves involved in anti-poaching activities collect data by mapping location and movements of animals. This contributed to the improvement of management strategies through the identification of the areas where anti-poaching activities need to be intensified.

The EM Programme applies strategies to facilitate or improve co-management such as bridging scientific and traditional knowledge and combining skills and capacities of different actors such as described in literature (Berkes 2008; Eamer 2006; Reid et al., 2006).

In the programme are reflected core features of adaptive co-management, learning and collaboration between diverse stakeholders belonging to different sectors and across scales (Armitage et al. 2007) which were discussed above. There is a degree of involvement of stakeholders in decision-making as in local community meetings tribal authorities, local government and EMs representing the HIs discuss topics and some decisions are made to address identified needs. Additionally, as stated in the results, when research HIs communicate their research findings they issue recommendations to decision makers.

The goals of the programme to pursue both conservation and development in an integrated way, by bridging the interests and needs of relevant stakeholders and by promoting collaboration between them, is a feature of adaptive co-management by itself.

6.4 Development challenges

Communities in contexts of poverty are more directly and severely impacted by environmental and political changes (Brown 1991).

The EM Programme faces challenges arising from drivers that act at different scales. In K2CBR poor communities face environmental problems such as deforestation, food shortage due to crop failures, diseases and lack of grazing for animals due to droughts. These factors affect both humans and stock animals. There is also a high dependence on social grants and lack of adequate infrastructures and services, such as access to water and garbage collection which contributes to the vulnerability of these populations.

It is important to educate communities whose basic needs are not fully covered and that are dependent on natural resources about the impacts that overharvesting has on the long-term. In this way, they could start to become more environmentally conscious, as the impact of their actions on the environment eventually will have an impact on them also.

In order for sustainability to be achieved, it is necessary to assure people's livelihoods and wellbeing by addressing their needs and, at the same time, secure natural resources. However, all of this is dependent on national and regional policy, collaboration between several sectors and involvement of all stakeholders as their support and involvement is crucial for achieving success (Brown 1991).

Although the programme has been renewed for a new 3-year cycle, continuity will have to be assured through the necessary funding. This will enable the programme to continue the work done so far. To strengthen further collaboration managers mentioned the need for more personnel and logistical support. Furthermore, some HIs need support in developing the skills of EMs rather than using them simply as a free-source of labour as HIs are not responsible for paying their salaries.

6.5 Study limitations

The programme seems to have more social than ecological outcomes. Since the programme has been running only for three years, that has limited the ability to capture long-term outcomes as more time is needed for certain outcomes to be realized. The duration of the EM Programme so far is not enough to derive further conclusions.

Learning strategies that work well in one region might not work in another (Armitage et al., 2008). The learning and cooperation outcomes are context specific. That can be due e.g. to the resources available, extend of cooperation and networking and the type of social-ecological changes. Consequently, scaling-up or transferring practices to other contexts is challenging. Due to these reasons, there are limitations in the generalization of the findings of this study to other locations.

The use of semi-structured interviews versus self-administered questionnaires makes the findings to be more vulnerable to investigator bias due to the interpretation of the information being dependent of the subjectivity of the researcher. To control for this factor peer-reviews of the information have been integrated before concluding this research.

Please consult Appendix H for raw data concerning quotes from interview transcripts.

7 CONCLUSION

The EM Programme bridges the interests of multiple stakeholders and connects actors such as research organizations, NGOs, game reserves, local government and local communities. It acts as a platform mainly for learning, networking and collaboration. So far it enabled the empowerment of communities; creation of local stewards of change; expansion of the existing stakeholders' network that now links local communities, organizations and other projects allowing information, knowledge and resource sharing.

This case study supports the importance of programmes similarly to the EM Programme with a holistic approach addressing socio-economic together with environmental needs in poverty alleviation contexts.

Combining environmental and health education with co-management practices seems to play an important role in poverty alleviation settings, as these communities have lack of access to information and knowledge. There is evidence that social learning and environmental education contributed to changing behaviours, e.g. from littering towards recycling. Adaptive management and adaptive co-management contributed to finding the balance between conservation and development, finding solutions that assure both, such as sustainable harvesting practices and rotational grazing.

Through the EM Programme, the K2CBR as a bridging organization created conditions that allowed to identify and/or contribute to solve some of the conservation and development issues, such as sand mining, firewood harvesting, access to education and poverty. This study provides further evidence of the facilitating role of bridging organizations and their contribution to adaptive co-management practices. Consequently, they can contribute to the achievement of long-term nature conservation and communities' wellbeing.

However, it would be important to study the power relations involved in, e.g. managing eventual priorities regarding the differing interests of stakeholders, in the decision-making process of resource management between the different stakeholders to understand how these might have influenced the outcomes.

Moreover, it would be interesting to study the impact on the outcomes reached so far if more resources, such as time, money and personnel, would be devoted to address communities' basic needs such as access to water, food, housing, education and health to understand if that would lead to a decrease in poaching. The assumption is that if people's basic needs are covered and if education is provided for them to understand the short and long-term impacts on their lives that overexploitation of natural resources have, there would be less incentives for activities such as poaching to take place.

8 REFERENCES

- Anderies, J. M., & Janssen, M. (2013). Sustaining the commons. Arizona State University.
- Armitage, D., F. Berkes, and N. Doubleday. (2007). Adaptive CoManagement: Collaboration, Learning, and Multi-Level Governance. Vancouver: UBC Press.
- Armitage, D., Marschke, M., & Plummer, R. (2008). Adaptive co-management and the paradox of learning. Global environmental change, 18(1), 86-98.
- Armitage, D. (2008). Governance and the Commons in a multi-level world. International Journal of the Commons 2, 7–32.
- Berkes, F. (1999). Sacred ecology: traditional ecological knowledge and management systems.
- Berkes, F., 2008. Sacred Ecology, second ed. Routledge, New York.
- Berkes, F. (2009). Evolution of co-management: role of knowledge generation, bridging organizations and social learning. Journal of environmental management, 90(5), 1692-1702.
- Biernacki, P., & Waldorf, D. (1981). Snowball sampling: Problems and techniques of chain referral sampling. Sociological methods & research, 10(2), 141-163.
- Biggs, R., C. Rhode, S. Archibald, L. M. Kunene, S. S. Mutanga, N. Nkuna, P. O. Ocholla, and L. J. Phadima. (2015). Strategies for managing complex social-ecological systems in the face of uncertainty: examples from South Africa and beyond. Ecology and Society 20(1): 52. http://dx.doi.org/10.5751/ES-07380-20015
- Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. Sage.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77-101.
- Brown, L. D. (1991). Bridging organizations and sustainable development. Human Relations, 44(8), 807-831.
- Brown, K. (2003). Integrating conservation and development: a case of institutional misfit. Frontiers in Ecology and the Environment, 1(9), 479-487.
- Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. Sage.
- Buck, L. E., Geisler, C. C., Schelhas, J., & Wollenberg, E. (Eds.). (2001). Biological diversity: balancing interests through adaptive collaborative management. CRC Press.
- Camacho, A. E. (2009). Adapting governance to climate change: managing uncertainty through a learning infrastructure. Emory Law Journal59:1-78

- CET (2015), Children's Eco Training Annual Report 2014/5, Klaserie Private Nature Reserve.
- Coetzee, M., Biggs H.C., and Malan, S. (2012) Sharing the benefits of biodiversity: a regional action plan to nurture and sustain the contribution of biodiversity and ecosystem services to livelihoods and resilient economic development within the Kruger to Canyons Biosphere. Report first officially presented on 16th November 2012 in Nelspruit.
- Coetzer, K. L., Erasmus, B. F., Witkowski, E. T. F., & Bachoo, A. K. (2010). Land-cover change in the Kruger to Canyons Biosphere Reserve (1993-2006): a first step towards creating a conservation plan for the subregion. South African Journal of Science, 106(7-8), 1-10
- Coetzer, K. L., Erasmus, B. F., Witkowski, E. T., & Reyers, B. (2013). The Race for Space: Tracking Land-Cover Transformation in a Socio-ecological Landscape, South Africa. Environmental management, 52(3), 595-611.
- Coetzer, K. L., Witkowski, E. T., & Erasmus, B. F. (2014). Reviewing Biosphere Re-serves globally: effective conservation action or bureaucratic label?. Biological Re-views, 89(1), 82-104.
- Crona, B. I., & Parker, J. N. (2012). Learning in support of governance: theories, methods, and a framework to assess how bridging organizations contribute to adaptive resource governance. Ecology and Society, 17(1), 32.
- Cundill, G., A. M. Leitch, L. Schultz, D. Armitage, and G. Peterson. (2015). Principle 5: encourage learning. In the book Biggs, R., Schlüter, M., & Schoon, M. L. (Eds.). (2015). Principles for building resilience: sustaining ecosystem services in social-ecological systems. Cambridge University Press.
- Du Toit, J. T., Biggs, H. C., & Rogers, K. H. (Eds.). (2003). The Kruger experience: ecology and management of savanna heterogeneity. Island Press.
- Eamer, J. (2004). Keep it simple and be relevant: The first nine years of the Arctic Borderlands Ecological Knowledge Co-op. Whitehorse, Yukon: Environment Canada.
- Flick, U. (2014). Mapping the field. The SAGE handbook of qualitative data analysis, 3-19.
- Flood, R and Romm, N. (1996). Diversity –management Triple Loop Learning. Chicester: Wiley.
- Folke, C., Colding, J., & Berkes, F. (2003). Synthesis: building resilience and adaptive capacity in social-ecological systems. Navigating social-ecological systems: Building resilience for complexity and change, 352-387.

- Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. Annu. Rev. Environ. Resour., 30, 441-473. http://dx.doi.org/10.1146/annurev.energy.30.050504.144511
- Gadgil, M., Seshagiri Rao, P. R., Utkarsh, G., Pramod, P., & Chhatre, A. (2000). New meanings for old knowledge: the people's biodiversity registers program. Ecological applications, 10(5), 1307-1317.
- Galaz, V., Olsson, P., Hahn, T., Folke, C., & Svedin, U. (2008). The problem of fit among biophysical systems, environmental and resource regimes, and broader governance systems: insights and emerging challenges.
- Galaz, V. (Ed.). (2014). Global environmental governance, technology and politics: The Anthropocene gap. Edward Elgar Publishing.
- Gunderson, L. H., & Holling, C. S. (2002). Panarchy: understanding transformations in systems of humans and nature. Island, Washington.
- Hahn, T., P. Olsson, C. Folke, and K. Johansson. (2006). Trust building, knowledge generation and organizational innovations: the role of a bridging organization for adaptive comanagement of a wetland landscape around Kristianstad, Sweden. Human Ecology 34(4):573-592. http://dx.doi.org/10.1007/s10745-006-9035-z
- Holling, C. S. (1973). Resilience and stability of ecological systems. Annual review of ecology and systematics, 1-23.
- Holling, C. S. (1978). Adaptive environmental assessment and management. Wiley, Chichester, UK.
- Hughes, T. P., Gunderson, L. H., Folke, C., Baird, A. H., Bellwood, D., Berkes, F., ... & Worm, B. (2007). Adaptive management of the great barrier reef and the Grand Canyon world heritage areas. AMBIO: A Journal of the Human Environment, 36(7), 586-592.
- Hunter, L. M., Twine, W., & Johnson, A. (2011). Adult mortality and natural resource use in rural South Africa: Evidence from the Agincourt Health and Demographic Surveillance Site. Society and Natural Resources, 24(3), 256-275.
- Kawulich, B. B. (2005). Participant Observation as a Data Collection Method. Forum: Qualitative Social Research, Vol 6, No 2, Art. 43. http://www.qualitative-research.net/index.php/fqs/article/view/466/996
- Krasny, M. E., & Tidball, K. G. (2009). Applying a resilience systems framework to urban environmental education. Environmental education research, 15(4), 465-482.

- Krasny, M. E., Tidball, K. G., & Sriskandarajah, N. (2009). Education and resilience: Social and situated learning among university and secondary students. Ecology and Society, 14(2), 38.
- Kvale, S. (1996). Interviews: An introduction to Qualitative Research Interviewing. Sage Publications.
- Lundholm, C., & Plummer, R. (2010). Resilience and learning: a conspectus for environmental education. Environmental Education Research, 16(5-6), 475-491.
- Mezirow, J. (2000). Learning as Transformation: Critical Perspectives on a Theory in Progress. The Jossey-Bass Higher and Adult Education Series. Jossey-Bass Publishers, 350 Sansome Way, San Francisco, CA 94104.
- Nixon, R. (2011). Strangers in the eco-village: race, tourism and environmental time. Postcolonial Ecologies, 159-181.
- Olsson, P., T. Hahn, and C. Folke (2004). Social–ecological Transformation for Ecosystem Management: The Development of Adaptive Co-Management of a Wetland Land-scape in Southern Sweden. Ecology and Society 9(4): 2. [online] URL: http://www.ecologyandsociety.org/vol9/iss4/art2
- Ostrom, E., Janssen, M. A., & Andereis, J. M. (2007). Going beyond panaceas. Proceedings of the National Academy of Sciences, 104(39), 15176–15178.
- Patton, M. Q. (2002). Qualitative interviewing. Qualitative research and evaluation methods, 3, 344-347.
- PAF, Portugal-Africa Foundation (2016); Africa: The ways ahead. Publication from the Conference held at Oporto in 20th November 2015.
- Plummer, R., & Armitage, D. (2007). A resilience-based framework for evaluating adaptive co-management: linking ecology, economics and society in a complex world. Ecological economics, 61(1), 62-74.
- Reid, W. V., Berkes, F., Wilbanks, T., & Capistrano, D. (2006). Bridging scales and knowledge systems: Linking global science and local knowledge in assessments. Millennium Ecosystem Assessment and Island Press, Washington.
- Sanghera, G. S., & Thapar-Björkert, S. (2008). Methodological dilemmas: Gatekeepers and positionality in Bradford. Ethnic and Racial Studies, 31(3), 543-562.
- SANParks BSP/K2C (2016). Environmental Monitor Programme Close Out Report 2013-16. South African National Parks, Department of Environmental Affairs, South Africa.

- Schultz, L. (2009). Nurturing resilience in social-ecological systems: lessons learned from bridging organizations.
- Schultz, L., & Lundholm, C. (2010). Learning for resilience? Exploring learning opportunities in biosphere reserves. Environmental Education Research, 16(5-6), 645-663.
- Schultz, L., Duit, A., & Folke, C. (2011). Participation, adaptive co-management, and management performance in the world network of biosphere reserves. World Development, 39(4), 662-671.
- Swemmer, L., Uys, M., Marshall, T., Malepe, M., Muroa, S,, Morale K. (2015). Report on the social and economic impact of the Kruger to Canyon Biosphere – Impact on the Environmentaç Monitors. South African National Parks.
- UNESCO (1996). Biosphere Reserves: The Seville Strategy and the Statutory Framework of the World Network. UNESCO, Paris.
- UNESCO (2008). Madrid Action Plan for Biosphere Reserves (2008–2013). UNESCO Division of Ecological and Earth Sciences, Paris.
- UNESCO (2016) About the Man and Biosphere programme. Website. http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme/about-mab/ . Retrieved March 2016.
- UP (2016). Environmental Monitors Close Down Report: 2013-2016. University of Pretoria.
- Venter, F. J., Naiman, R. J., Biggs, H. C., & Pienaar, D. J. (2008). The evolution of conservation management philosophy: Science, environmental change and social adjustments in Kruger National Park. Ecosystems, 11(2), 173-192.
- Wagenaar, H. (2011). Meaning in action. Interpretation and dialogue in policy analysis. ME Sharp Inc, New York, 6.
- Walters, C. (1986). Adaptive management of renewable resources. Macmillan, New York, New York, USA.
- Westley, F., & Vredenburg, H. (1991). Strategic bridging: The collaboration between environmentalists and business in the marketing of green products. The Journal of applied behavioral science, 27(1), 65-90.
- Yin, K. Y. (2009). Case Study Research: Design and Methods. Thousand Oaks, California: SAGE Publications

- Zapatrina, Irina (2016). Sustainable Development Goals for Developing Economies and Public-Private Partnership. European Procurement & Public Private Partnership Law Review, 11 (1), 39-45.

9 APPENDICES

Appendix A – List of Interviewed Stakeholders in 2015/2016

Table 4 – List of interviewed stakeholders in 2015/2016

Interviewee Code	Institution Type	Role
KBRM1	K2C	BR Manager
KBRM2	K2C	SANParks Manager
KBRDC1	K2C	DC
KBRDC2	K2C	DC
KBRDC3	K2C/NGO*	DC/EM*
KBRDC4	K2C	DC/EM*
KBRW1	K2C	Manager
KBRW2	K2C	Admin/EM*
KBREM1	K2C	EM
KBREM2	K2C	EM
KBREM3	K2C	EM
KBREM4	K2C	EM
KBREM5	K2C	EM
KBRSM1	K2C	Supervisor & Maeba/EM*
KBRSM2	K2C	Supervisor & Maeba/EM*
KBRSM5	K2C	Supervisor & Maeba/EM*
HIRM1	Research	Manager
HIRM2	Research	Manager
HIREM1	Research	EM
HIRM3	Research	Manager
HIRDC1	Research/K2C*	DC
HIRM4	Research	Manager
HIRM5	Research	Manager
HIREM2	Research	EM
HIREM3	Research	EM
HINM1	NGO/Reserve*	Manager
HINM2	NGO	Manager
HINM3	NGO	Manager

HINEM1	NGO	EM
HINM4	NGO	Manager
HINM5	NGO	Manager
HIGM1	Reserve	Manager
HIGA1	Reserve	Administrative support
HIGEM1	Reserve	EM
HIGM2	Reserve	Manager
HIGM3	Reserve	Manager
HIGM4	Reserve	Manager

Legend: * Previous positions of the interviewees. Interviewees written in grey colour were interviewed both in 2013 and 2015

Table 5- List of stakeholders interviewed in 2013 that were involved in the EM Programme creation phase

Interviewee Code	**Institution Type**	**Role**
KBRM1	SANParks/K2C	BR Manager
KBRM3	SANParks	SANParks Manager
KBRM4	SANParks	SANParks Manager
KBRDC1	SANParks/K2C	DC
KBRDC2	SANParks/K2C	DC
KBRDC5	SANParks/K2C	DC
HIRDC1	SANParks/K2C & Research	DC
HIRM1	Research	Manager
HIRM2	Research	Manager
HIRM3	Research	Manager
HIRM4	Research	Manager
HINM6	NGO	Manager
HINM1	Reserve	Manager
HIGM1	Reserve	Manager

Appendix B – Interview Guides

As stated previously in the methods section, different interview guides were created for: EMs (includes EMs with supervisor role), DCs, HIs and K2C BR/SANParks' managers.

Interviews duration ranged from 45 minutes up to 2h30, depending on the interviewee availability and amount of information shared. All the interviews were performed in English as all stakeholders know English. However, in one interview a third person, chosen by the interviewee, was present to act as translator as the interviewee felt more comfortable in answering using the local language.

The interview guides have one set of questions common to all stakeholders and one set of specific questions according to the different roles of the interviewees involved in the program. Additionally, the interview guide is divided into three main sections accordingly to the sub-research questions: a) bridging functions; b) outcomes and adaptive responses; and c) relationship between bridging functions and outcomes. The questions were tested previously and were revised accordingly.

For simplification purposes, the questions made to all stakeholders are presented in the following table. The common questions made to all individuals are written in black. The specific questions made to each one of the groups are written in grey and the group targeted is stated between brackets.

Table 6 – Interview Guide

Sub-research question	Objective	Question
a) What are the bridging functions realized through the K2C EM Programme? What interests, actors and types of knowledge is the programme bridging, and how?	Background/History	First I am interested in the beginning stages of the EM programme. Could you describe me what the work of your Host Institution consists of? If you go back to the very beginning of this project, how was it born? [K2C BR/SANParks' Managers] - Regarding the goals of the EM Programme, could you tell me how they were decided/established? Who contributed to them? - What were the visions/goals you had? Have those changed meanwhile? Could you please explain? Could you briefly explain how the structure of the EMs Programme is? [K2C BR/SANParks' Managers] - What was the rationale behind the actual structure?
	Interests	In general terms, what was/is your HI aiming to achieve with this programme? [HI, K2C BR/SANParks' Managers] How did your HI become involved in this programme? [HI] - How was the EM Programme sold to you?

		How did you become involved in this programme? - What motivated you to participate in the programme? I would like to know which were your personal expectations when you started working in the programme? - What do you personally want to achieve? Regarding the HIs involved in this programme, could you explain me how it was decided which ones to approach to ask for their participation? [K2C BR/SANParks' Managers] Could you walk me through the steps that were taken to invite HIs to participate in the EMs Programme? [K2C BR/SANParks' Managers] - How was the Programme advertised? Who was responsible for that? - Which challenges, if any, did you face to convince HI to participate? How where they overcome? Could you describe me how was the EMs' recruitment process? What were the strategies used to engage communities to participate/collaborate in the EMs programme? [K2C BR/SANParks' Managers]

	Alignment	In your opinion how do the goals of the EMs Programme converge or diverge from the needs of the different stakeholders (e.g. HIs, local communities and government)? [K2C BR/SANParks' Managers] - How do you balance the dual goals of biodiversity and environment protection on the one hand, and socio-economic development on the other hand? In your opinion, how do the goals of the EM Programme fit you HIs' mandate? In your opinion, how do you think that the goals of the Biosphere Reserve converge and/or diverge from the ones of the EM programme? [DC] In your opinion, how do you think that the goals of the Environmental Monitors Programme converge and/or diverge from the ones of the local communities? [EM]
	Stakeholder's responsibilities	Now I am interested in focusing on the EMs work, the data that is collected, information that has been shared and how it has been being used so far. What are your responsibilities? [K2C BR/SANParks' Managers, DC] Could you describe me how is a typical day of your work? [DC, EM] Could you please describe me what are the main day-to-day activities performed by EMs working for your Host Institution? [HI, K2C BR/SANParks' Managers]

	Skills and knowledge required	What skills do you as a DC need to have in order to perform your work in this project? [DC] - How did you gain them? - And the environmental monitors? Which type of training do the EMs receive and which entities are responsible for it? [HI, K2C BR/SANParks' managers] Could you describe me which was the training that you received when you started working for the Programme? [EM] - Which other training opportunities have you had while working for the EM Programme? [EM]
	Data collection	Could you walk me through the decision process regarding what type of data to be collected by the EMs? [HIs, K2C BR/SANParks' managers] - Who was involved? Who gave inputs? - How is the type of data collected aligned with the needs of the stakeholders that participate in the programme? - Have all of the 5 themes of the EM Programme been equally covered in the data collection? [K2C BR/SANParks' managers]

		Could you describe me the monitoring/data collection process done by EMs (e.g. where do EMs go, how they collect data)? [HI, DC] - Could you tell me what type of data is being collected by the EMs? Could you tell me what type of data are you collecting? [EM] - Could you describe me the monitoring/data collection process?
	Data quality	Can you explain me how is data quality being verified? [DC, HI, K2C BR/SANParks' managers] - Who is responsible for doing that?
	Data Storage	Could you describe the process of how data is being stored? [DC, HI, K2C BR/SANParks' managers]
	Data/Information sharing	What type of data collected is available for all the stakeholders? [DC, HI, K2C BR/SANParks' managers] - What type of data collected by your HIs is available to the others? - How did you choose which data is or is not available? Could you explain me the reasons? [HI, K2C BR/SANParks' managers] - Have you been actively providing information *to* others? [HI, K2C BR/SANParks' managers]

	Networks/Collaboration	- Have you received or requested data *from* others? How is that data made available? [HI, K2C BR/SANParks' managers] How do you provide feedback of your work to your organization? - What is it used for? - Does your superior gives you feedback about the information stated in the reports? If yes, which type of feedback (e.g. recommendations/suggestions, request additional information, etc)? Regarding the meetings and workshops that you attend, can you describe how a typical meeting/workshop takes place? - How often they take place? - What are the topics that are usually discussed? What information is shared? How do you see the role of social media in promoting the work of the EMs Programme (Pinterest, Facebook K2C page and Twiter)? [K2C BR/SANParks' managers] - Which are the impacts that it has until now? (e.g. extra donations, increase the awareness of the public for the conservation issues) I am also interested in knowing about stakeholder relations in the EM programme. What was the impact of the EM Programme on the existing network? [K2C BR/SANParks' managers]

		Does your HI usually engage with other HIs, local communities, local and national government for example? - Could you describe me how does your HI engage with the other stakeholders? - What is the purpose of engaging with these stakeholders? How is the collaboration between the DEA, the South African BRs and the other African BRs (for example through AfriMAB)? [K2C BR/SANParks' managers] - Do you participate in those meetings? - What are the main topics discussed? - Which type of experiences/information is shared? In your opinion, who or which organization stands out in terms of their knowledge in the project, if any? - For example, what have you learned from this person/organization? Can you describe me the circumstances of when that happened? - How have you been applying what you have learned so far? Could you give me an example? Which are the groups of people or organizations that you find useful for you to contact during your work in this programme? - Could you describe me how do you interact with them?

	Conflict resolution & challenges	- How has this changed since you are working in the programme? - Could you please describe in what ways have you been learning from such groups? What are the topics that make people discuss/debate more now? - When people have different opinions, how does the group address these disagreements? Could you give an example? In your opinion, what are the main challenges or barriers that you have faced so far? - Could you describe to me what their impact was? - Could you explain to me how they were handled? Could you describe me how is your work relation with your colleagues? [EM, DC] - And with the Data Collators? [EM] - And with the local communities? [EM, DC]
	Trust Building	Can you describe to me how trust has been built within the project (between HIs, and HIs and local communities)?
2) What evidence is there to suggest that the EM Programme has resulted in social outcomes, ecological	Opportunities	Now I would like to talk about the opportunities brought by this programme. What is the overall perception that you have about the programme? How do you define success in this programme?

outcomes and adaptive responses to change?		- What do you think that was/were the main achievement(s) of the programme so far? In your opinion, which were the opportunities that the EMs programme brought? Which were the programme impacts that you have observed in local communities so far? / How has the project changed the lives of people involved? - What incentives, if any, do you receive for your work? [EM] Concerning skills development and work opportunities. Now focusing in your experiences in the programme so far, how have these affected your daily-work, knowledge and your skills? [EMs] - Could you exemplify please? What type of job opportunities and/or career progression became available to Environmental Monitors? What type of job opportunities and/or career progressions became available to Data Collators? [DC] How has recognition of the work performed by the different stakeholders involved in the programme had an impact in their levels of engagement and motivation? - Could you describe me how has the recognition of the work developed been done? - What kinds of incentives, if any do people working for the EM Programme receive?

	Knowledge application/Data use	What was the application so far of the data collected by the EMs? - What was the impact of the use of data collected so far? (e.g. in management measures or policies, in understanding about social or environmental issues in the K2C region) - Could you please exemplify? Can you describe how the data collected by your organisation has been used so far? Could you please provide an example? [DC, - What practical impact, if any, did it have? What do you do with the reports that you receive every month? [K2C BR/SANParks' managers] In your opinion, how has the knowledge created so far been useful to your organisation? Could you describe in what ways? [EM, DC] If you think about the other stakeholders you've worked with in the EM project, has working with them changed your opinion about other stakeholders in the K2C region? - Could you please explain in what ways and give examples? (e.g. understanding about the other stakeholders' work and needs) How have your values changed since the beginning of the programme?

	Stakeholder participation & Cross-scale interactions	If any, what were the effects of having employed EMs from local communities in the relationship between your HI and these communities? [HI, K2C BR/SANParks' managers, DC] - For example, what were the results of the educational campaigns? Do you work in the region where you live? [EM] - If yes, what impact does it have on your work, if any, the fact that you already know the region and the people?
	Community engagement, conflict resolution & trust building	How has the level of trust changed throughout the programme? Could you please give an example? Could you describe me how do you interact with the other groups of people that you contact with while working (e.g. with the host institutions, local communities)? - How has this changed since you are working in the programme? How do you define success in this programme? In your opinion, among the people involved in this programme, who are the ones you find key for the Programme to be successful (individual people and/or organizations)? - Could you describe a situation that has happened?

		What are the topics that make people discuss/debate more? - When people have different opinions, how does the group address these disagreements? Could you give an example?
General aspects of the programme to capture additional information regarding the features of adaptive management and adaptive co-management, namely information that can help answer: c) What are the relationships between the bridging functions and the outcomes reached so far?	Strengths Weaknesses/Improvements Others	We are in the last part of the interview. - What are the strengths of the programme? - Could you describe me how do you think that they contribute to the programme? In your opinion, if you could change something in the programme what would you change? - And what wouldn't you change? What for you has been different about the EM project when compared to other monitoring programmes that you might know? (e.g. different in terms of the way in which it functions, different in terms of the outcomes achieved, etc.)
Closing question		These questions cover what I wanted to ask you. I would like to give you the opportunity to think back over the interview. What haven't I covered that you think is important for me to understand? - What would you like to add? Thank you very much for your time and I hope that this was also useful for you.

Appendix C – Coding

Table 7- Coding used to analyse the content of interviews

Theme	**Subcategory level 1**	**Subcategory level 2**	**Subcategory level 3**
1) EM Programme Background	Historical background & context of the area	Ecological context	
		Economic context	
		Social context	
	History of EM Programme creation process	Factors that lead to the creation of the programme	Host Institutions goals and needs – motivations and mandates of HIs
			Existing networks & Collaborations - existing networks and collaborations before the official creation of the K2C BR and EM Programme
			Windows of opportunity
		Stakeholders engagement - strategies used to engage the different stakeholders	Communities engagement
			Host Institutions
			Reasons for people to apply for job - reasons for EMs and Data Collators to have applied to work for the K2C EM Programme
2) EM Programme Aims and activities	Aims and objectives		
	Responsibilities and tasks – of the HIs, K2C BR Managers (Coordinator and Implementer), Data collator/Field Assistants,		

	Supervisors/Maeba Group and EMs		
	Expectations – of the HIs, K2C BR Managers (Coordinator and Implementer), Data collator/Field Assistants, Supervisors/Maeba Group, EMs and local communities		
3) Bridging organization functions – e.g. Knowledge sharing and production, learning, collaboration/participation/networking, trust building, conflict resolution.	Conflict resolution – e.g. different opinions/views and/or interests (e.g. conservation vs socioeconomic development, access to the PAs)		
	Learning - BO acting as a learning platform where information sharing and knowledge creation takes place	Monitoring: type of information/data collected	
		Data gathering –data storage (e.g. data base)	
		Data quality – e.g. ways to assure the quality of the data collected by the EMs	
	Networking and collaboration	Information/data sharing - among all stakeholders	Ways used to share information/Communication channels - e.g. reports, meetings, events, awareness campaigns, workshops, courses and/or trainings.
			Type of information shared
			Data that is not shared and why – e.g. due to intellectual property rights or because it is sensitive data (e.g. rhino poaching)

			Types of Knowledge - scientific, local and traditional knowledge
		Information/data use - use given to the data collected by the EMs and of the information shared between the stakeholders.	
		Horizontal linkages	
		Vertical linkages	
		Multilevel linkages	Closing gaps - role in closing gaps.
			Newly created networks - due to the creation, roll out and implementation of the EM Programme.
		Key stakeholders-partners	Frequent interactions - stakeholders with who the interviewees interact more frequently with and why.
			Partners' knowledge and experience - partners that were identified as key, for e.g., due to their knowledge or experience on a specific topic.
	Trust Building		
4) Challenges/Barriers	Types of challenges	Adaptation to job	
		Bureaucracies – complicated organizational procedures, lack of organization/coordination and flexibility	
		Career progression/job opportunities - progressing inside or outside the institution, new and/or permanent job opportunities.	
		Changing mentalities and lack of knowledge – e.g. rhino poaching	

		Correspond to expectations	
		Communication – e.g. lack of feedback, communication problems.	
		Data related collection	Data collection
			Data harmonization/comparability
			Data analysis
		Geographical distances	
		Inequalities – different wages, incentives among EMs of different HIs, recruitment process (e.g. gender)	
		Lack of access to PAs and/or to its benefits - lack access to PAs and to the benefits that people can retrieve from them.	
		Lack of interaction/collaboration – e.g. between HIs or lack of community engagement.	
		Lack of performance recognition – e.g. not giving incentives, wage increases, bonus, verbal incentives.	
		Lack of motivation/ poor performance – keep EMs motivated, EMs not performing their tasks and not being responsible.	
		Unproductive meetings - e.g. due to the fact that many people are not able to attend them and then that leads to repetition.	
		Resources - e.g. transport, financial, man power, time.	
		Security issues – e.g. threats, transportation safety.	

		Social challenges - e.g. personal problems impacting work performance, cultural differences.	
		Trust issues	
	Solutions found - ways to solve the identified challenges/barriers.		
	Future of the EM Programme (next 3 years' cycle) - next steps (e.g. contract renewal, changes/improvements to the programme)		
5) Outcomes of bridging functions - indirect and indirect impacts/outcomes of the programme for all the stakeholders (e.g. HI, EMs, local communities)	Addressing environmental & social issues	Adaptive responses – e.g. rehab programme to fight soil erosion	
	Capacity building	Skills	
		Career Progression/Job opportunities - progressing inside or outside the institution, new job opportunities.	
		Commitment - People being committed and responsible for their work and creating a passion	
		Creation of good relationships - e.g. friendships, stronger bounds with stakeholders.	
		Empowerment & creation of role models – e.g. people showing a "healthy" ambition	
		People wanting to improve their knowledge - e.g. EMs and Data Collators by wanting to continue their	

		studies (e.g. going to university, attending courses/trainings, or informally by asking to their bosses or colleagues); and local communities wanting to know more.	
		Motivation	
		Self-confidence	
	Changing behaviour - e.g. changing behaviour and creating understanding, raising awareness, sharing knowledge.		
	Creating a common vision		
	Flexibility/adaptability - organizational flexibility		
	Knowledge generation/Learning	Issues identification - e.g. sand mining.	
		Understanding the SES - understanding (better) the resources, ecosystem dynamics, social aspects, HIs roles and challenges of this SES.	
		Learning opportunities – e.g. trainings, courses.	
		Performance evaluation	
	Livelihoods Improvement - e.g. people being able to be economic independent, to provide for their families, etc.		
	Networking opportunities		
	Programme visibility and value recognition - internal and external recognition of the achievements, success and value of the		

	programme so far; and increased visibility of the programme in the region and internationally (e.g. EM programme seen as a flagship, received awards).		
	Reduction of transaction costs – e.g. administrative role, shared responsibilities.	Financial opportunities - additional resources (e.g. manpower, logistics, equipment).	
		Facilitation	
		Shared responsibilities	
		Synergies - identification of win-win situations.	
	Sense of place creation		
	Trust building		

Appendix D

Ecological and socioeconomic context

The main aspects stated by the interviewees that in their opinion characterize the ecological and socioeconomic context of the K2C region and that are relevant for understanding the EM Programme are the ones summarized in the table below. The programme tries to address some of the mentioned issues.

Table 8– Ecological and socioeconomic context of the K2C region

Context	**Aspects**
Ecological	Lower biodiversity level in the Lowveld vs the Blyde Canyon (e.g. communal lands are poor in vegetation) Regulated hunting in game reserve areas Poaching activities in Protected Areas (PAs) (e.g. rhino)* Pollution in rivers and rural lands (e.g. due to littering)* Absence of waste collection by municipalities in local communities* Drought and soil erosion* Presence of alien plant species* Endemic area for mouth and foot disease (affects buffalos and cattle)*
Social- Political	Conservation not perceived as being a government priority Exclusion of local communities from PAs* High illiteracy and unemployment rate* Poverty alleviation perceived as one of government priorities Deficient public educational system (e.g. high teachers' absenteeism rate)* Alcohol abuse, drug traffic and prostitution Corruption in some sectors (e.g. government) High number of orphan children and vulnerable households High rate of HIV/AIDS and teenage pregnancy* Domestic violence, sexual abuses and xenophobia* Women have lower status vs men*
Economic	Rural communities highly dependent on cattle as a source of income Fishing activities affected by rivers pollution Demand for rhino horns (illegal market)

	Differences in land ownership and value between "white areas" (title deeds) and "homelands" (communal lands) Majority of owners of private game reserves are from overseas Wildlife economy and tourism are perceived as important opportunities

Legend: *Issues that the EM Programme tries to address

Appendix E

Table 9– EMs main tasks related to the main interests of the several stakeholders

Interests	Main tasks performed	Examples
Conservation	River and rangelands' monitoring in PAs and local communities	Water quality, alien and indigenous plants and animals' species
	PAs integrity patrols linked to anti-poaching activities	Identification and removal of snares, check fences, gate access control, vehicles and road blocks inspection
	Village patrols	Identification of environmental issues such as illegal dumping sites
	Restoration activities	Removal of alien plants and planting indigenous
	General maintenance activities and infrastructures construction	Creation and maintenance of vegetable gardens at schools; build water dams; roofs, fences, roads maintenance in reserves
	Environmental education and awareness	Lecture at public schools and bush schools (schools that belong to NGOs or Game Reserves): e.g. soil types, water cycle, recycling and food webs. Classes are complemented with several activities such as educational games, storytelling, pictures and videos, game drives to see wildlife. Campaigns in local communities: waste collection, rhino anti-poaching and animals' anti-poisoning awareness
	Community engagement	Recruitment of individuals from local communities to work as tree-preneurs and waster-preners*
Development	Animal health promotion and awareness	Cattle enrolment (e.g. tagging, tattooing, weighting) and dog enrolment (e.g. identification and sampling) Rabies and foot and mouth disease vaccination campaigns
	Human health education and awareness	Informing about health risk associated to waste management, teenage pregnancy, sexually transmitted diseases and nutrition. Testing and providing free condoms and medication for HIV/AIDs
	Social problems awareness	Gender based violence and xenophobia
	Community engagement	Recruitment of individuals from local communities to work as tree-preneurs and waster-preneurs*

Legend: *One of the NGOs has a programme were people from local communities are identified by EMs working for different HIs and are employed as Tree-preneurs or Waste-preneurs. Tree-preneurs collect seeds and grow trees, and in return they receive once per year food hampers according to the trees' height. Waste-preneurs collect waste that will be recycled and they receive money according to the weight of the waste they deliver.

Appendix F

As stated in the results, EMs receive training about different topics according to the tasks they perform in the HIs and to identified needs by their managers and DCs.
The table below states the trainings that EMs attend that were stated by the respondents during the interviews.

Table 10 – Training provided to EMs

Trainings	**Examples of topics**
Environmental monitoring and nature conservation	Identification of trees, grasses and animals' species Climate change Veld fire management
Field ranger and anti-poaching	Paramilitary training for armed EMs Bush skills like tracking spoor tracks (human tracks) Game identification
Animal health	Foot and mouth disease and rabies
Human health	Malaria, HIV/AIDs, tuberculosis and teenage pregnancy
Life skills	Time management, conflict resolution, leadership and team work

Appendix G

Table 11- Type of data collected by EMs according to the main themes of the programme and its use identified during interviews, researcher observation and documents (SANParks 2016, UP 2016)

EM Programme theme	Monitoring activity / Data collected	Application
Protected areas management and Rangeland monitoring	Land and vegetation monitoring: e.g. alien species collection, tree cover parameters, measuring trees, phenology (timing of leaf emergence in trees), collection of disk pasture meter and grass biomass, perennial and annual grasses %,	Identification of: soil (e.g. erosion) and vegetation degradation, illegal dumping sites and activities such as sand mining. Identification and mapping location of alien and invasive species (e.g. for the Bush Clearing team* to remove alien plants) Evaluate climate change impact on tress species, e.g. to identify which will benefit and which will not Evaluate how much grass is available in the rangeland for animals
	Land use: e.g. crops rotation	Study main planted crops and proportion of demarcated fields cultivated to determine fields utilization and drought impact Study the effects of different land uses and its effects on beetles
	Wildlife monitoring: e.g. game counts, capturing rhinos' movements and health status	Evaluate elephants' damage on marula trees Define anti-poaching strategies Control animal population
	Mopami worms monitoring	Understand the reasons behind yearly changes of the numbers of individuals

Fresh water monitoring	Rainfall	Collect data on rainfall due to non-existent rain gauges or weather station in former homelands Study rainfall patterns and determine environmental change (e.g. natural experiment undergoing due to current drought)
	Rivers monitoring: water appearance through visual inspection, and flora and fauna identification Water collection in mines Measuring water levels in wetlands	Determine water quality Identify alien species in water Assess damage of riparian vegetation
Health monitoring	Mosquito, small mammals, tick and wildlife species sampling	Disease ecology and prevention
	Cattle and dog demographic (e.g. births, deaths), production, trade and health indicators' data	Public Health (e.g. prevent rabies outbreaks)
	Human health information: e.g. diagnosed diseases and prescribed treatments	Public Health
Monitoring of socio-economic trends in rural communities	Collect data regarding livelihoods: e.g. how many people work and attend school, people's income, house size, what type of food people buy and how much money they spend per month on food	Assess communities' needs
	Firewood purchased and harvested quantities and regrowth of trees under different harvest regimes (e.g. surveys, active research involving monitoring of plots to record and measure new steams that have been cut) Collection of river water	Understand natural resources use patterns: e.g. monthly consumption patterns and rate of natural resources harvested Find sustainable ways of harvesting wood (action research)

	Medicinal plants, food plants and Mopani worms collection	

Legend: * The Bush Clearing team is part of the EPWP Working for Land Project and is responsible for clearing indigenous invader species with the aim to improve water yield but also to optimize grazing and carrying capacity of non-productive land.

Appendix H

Table 12 - Raw data regarding examples of quotes from interviews with stakeholders

Theme	Topic	Quote
Bridging functions	Learning: Education	"by teaching a child you are teaching his family as well because he goes home and he tells them." (EM, KBREM4) "Teaching at a primary school level, which is kids young enough to still change, conservation ethics. It means potentially we are sitting those kids on a pile of conservation, research, tourism as opposed to poaching before high school, before they get on an age where they have made up their decision of what kind of person they want to be" (NGO/Reserve HI Manager HIGM4) "the reason we have chosen to use environmental education as a tool is that we have a lot of people in the communities that do a lot of things because of lack of knowledge. Some people think that we will always have water, these trees will always be here; these resources are not depleting, we find them here and we will leave them here because most of the people that are not exposed to any other information other than that one. (…) I think that the solution of all environmental issues is environmental education." (DC KBRDC3)
	Learning: Monitoring and experimentation	"we actually collected a lot of data on waste management and then we realized that there are so many social and economic issues in our villages which need to be addressed by the municipality, even the government and even the community itself. So it actually made me and the EMs understand the social and economic impacts in our villages and that was when we *started with the rehabilitation project because we also identified different soil erosion and other degradation problems. From what we collected we learned a lot from it and now we have an understanding of what is going on in our villages" (DC KBRDC1) "we look at the disease in the area especially those that move between the animals and people but also linked the environment in his expression, the effective resilience of the area. A big example is, for instance, just the policy around disease control. That is probably some of the policies in this area that has the most significant impact on the, on the systems, because for instances veterinary control related to, to foot and mouth disease in the area has really defined this area. (…) meaning that there are opportunities and their thinking about land-use is completely influenced by that. So a lot of what we do is working to challenge the policy, to make changes where it is needed to the benefit of livelihoods, but also environmental sustainability. For instances influencing better rangeland and management practices but through the

		incentive of better animal markets, because markets are largely unavailable due to foot and mouth disease control policies." (Research HI Manager HIRM5) "we have people [EMs] working with our ecology team, where they do conservation work in rivers, veld samples, animal management, anything conservation related. (...) we publish vegetation studies every year and also our game count every year/month, based on the data that they [EMs] have collected, we publish a report that goes to all the land owners within the reserve. (...) So that informs they're land management as well. (...) We have also have an Ecology Sub-committee for the Reserve which includes both internal representatives and others like Local Authorities and neighbours and they use quite a lot of the data that they evaluate through their committee in terms of their conservation management decisions." (HI Reserve Manager, HIGM4) "research is the only way that you know that this is working, this is not working." (K2C EM KBRW2)
	Network and collaboration	"EMs became the backbone because we realized that having people with their abilities around, in the community, everybody knows them, they are invaluable when it comes to our community engagement side. (…) Without those guys we would not have been where we are now." (HI Research Manager HIRM5) "This was an excellent opportunity for real implementation and not just talk, by taking talented people, putting in a network, encourage their development and have a central point to talk to one another. (…) the EM program was the practical way for us to do both these things: the network and to empower people." (HI Manager KBRM1) "but in all EMs and how they link to the network and how the link to the other networks. And how that is starting to gel and it is on the human level, you know that we are there for one another, we make this landscape relevant. it is a sense of place, it is a sense of who we are!" (HI Manager KBRM1)
	Conflict resolution	"every day is like we are approaching the rhino poaching theme and then it is limiting us to talk more about the other environmental issues." (NGO EM HINEM1) "This is an unsustainable model. It is never going to work, they are just throwing more helicopters, more guns, more camouflage uniforms, more freaking military and that effort is on an exponential growth curve. Ok, and they claim that they are bringing the number of poaching down. I want to see poaching effort as well on this graph! So that is let's say ranger effort, or control effort, what about poaching effort? (…) That

		is eyes and ears. Coverage on the ground. (…) Not flying around all over the place with helicopters because it is so cool to be in the army!" (Reserve HI manager HIGM1) "We used to be purely focused on research and then this security issue put his ugly head, and I was reluctant to get involved but eventually we had to and now almost all of our resources are going to security." (Reserve HI manager HIGM1) "There's young ladies that need tampons and things like that. That will make a difference to their life. Putting a centre there with computers in there, everyone just comes and steals, doesn't give them anything. (…) You need to give people stuff they can actually use, that can make their lives on a daily basis a little bit better. Tampons, food and cleaning equipment and things they can use, like, utensils they can use for farming implements, that type of stuff. Those kind of programmes is where it makes a difference." (Reserve HI manager HINM3) "16 years ago it was fences to keep black people out and guns to make sure they don't come in. this war is not gonna get won like this. (…) If you wanna win the poaching war, you need to win the hearts and the minds of the people, the ones that are gonna do the poaching. It's actually unfair, so north of the Orpen road, you've got a handful of very, very wealthy landowners, they own huge amounts of land and run huge businesses that pump, that generate huge amounts of money. And then over the road you got hundreds of thousands of people that are living on or below the bread line. So, if I was living that side of the road, below the bread line, I would go and steal animals to feed my family too, I would do exactly the same thing." (Reserve HI manager HINM3)
	Trust building	"At first the community were not calling them traditional healers, they were calling names like witch, witch doctor. Now they are respecting them and call them traditional healer, not a witch because at first they were saying that they just performed miracles, magic, witch crafts." (K2C EM KBREM2) "the programme has started the communication even just through the recruitment process, it sort of opened channels of communication. The Rhino Ambassadors [name of a EMs group] have been a longer more detailed ongoing channel of communication between the reserves and the neighbouring communities. So I think that through those engagements, relationship and trust is built from that. And I also think it is important that the community sees sort of tangible benefits from the reserves. So I think that when people are employed, that gives, improves their outlook on the reserve because they are seeing benefits from it." (Reserve/NGO HI manager HIGM4)

Outcomes	Conservation outcomes	"two of the three involved communities have implemented controlled harvesting of coppice regrowth and now actively prevent outsiders from harvesting on their communal lands" (Research HI manager HIRM2) "now we have more communication with this people even the Sangomas, they come here and then under our supervision, the EM, then they go and collect whatever medicines they want." (K2C EM, KBRW2) "People are changing their behaviour, especially by dumping or littering. Even me I was not aware that when I take my rubbish and put it in a hole or river that I do pollution but now I do know, and then I can tell the people "Don't throw or don't litter in the river or anywhere because we are damaging our environment". I am enjoying because our community seems to be aware" (K2C EM Supervisor KBRSM1) "We have got people in the community that are recycling for their community. So now, the place has been kept clean and people got something in return." (DC KBRDC3)
	Development Outcomes	"We have got people in the community that are recycling for their community. So now, the place has been kept clean and people got something in return." (DC KBRDC3) "The opportunities is that in our community about 48 people are employed in the EM Project and my opportunities is that now I can survive on my own, I can make decisions, I can take care of myself." (K2C Supervisor, KBRSM1) "The first one it is the confidence to stand in front of people and talk, I think that is the biggest impact because before I didn't have that confidence to stand, I was shaking, nervous." (NGO HI EM, HINEM1) "Confidence is a big thing, especially you know for a black lady. (…) I put these girls in front of classrooms of 50 kids, (...) I remember theirs first weeks they were so intimidated, because they were like "The kids don't listen, I talk and they just get up and walk out.". And now I am like "How are the schools?", "Ah, no problems! It is going fine". And they come with constructive criticism like "Oh, we need notebooks for the kids." (…). You can see they actually feel confident as teachers now, and that is huge!" (NGO HI Manager, HINM4) "If I want to save this reserve, I need a community that has got a paediatric nurse, a paramedic and a school teacher and everybody has been through this programme has developed their skills and that community can now rely on various role players if they have a crisis. Then that community has been uplifted." (Reserve HI Manager, HIGM1)

		"This was an excellent opportunity for real implementation and not just talk, by taking talented people, putting in a network, encourage their development and have a central point to talk to one another. (…) the EM program was the practical way for us to do both these things: the network and to empower people. (…) the rhino poaching was more a funded driven thing, that is why they created the program but we used it as an opportunity for us. And we did have of course rhino poaching as well (…) but that was never for me a driver of the program (…).The overall objective of the program wasn't determined by us, it was determined by the government. What we did is we used this as an opportunity to get to our objectives." (K2C Manager, KBRM1)
	Adaptive responses	"So both gardens and those 2 schools, that was how we started ourselves as EMs. We took out money from our one pockets to buy seeds, and then the kids they were interested so we had like the motivation, so we bought our one seed went and plant it and then our manager saw that we're doing a great job and then he donated some money for us." (K2C EM KBRW2) "The most I learned is when I am monitoring because now I can know different types of that the land is damaged, those big gullies and dongas. (…) we successful achieved to bring a project of rehabilitation (…) Then we managed to bring the project in our area by writing proposal to the DEA and then they funded us and that is why they are rehabilitating it and restoring it (…) the project is growing bigger and bigger" (EM Supervisor KBRSM1) "his [EM Supervisor] whole mission now is to get people to collect rain water in his village. And he is doing it slightly because of profits, because he is helping them put up the caters and stuff, but at the same time he is doing it because he realizes, and he got that knowledge through the EM project. So those sort of small seeds that you can water, that will grow and bring a lot of fruit. So I think it planted a good seed." (NGO HI Manager HINM1)
	Attributed reasons for the outcomes mentioned by the stakeholders	"The K2C they go from helping local communities with the tribal authorities, to the healers, to the schools, to waste management, to the game reserves, to education, health. I mean it is very broad spectrum and that is what makes it so good (…). So I think there is a variation that is a good thing as well. It creates opportunities to have differences and people can learn from each other. But it also allows you to not be tied on to one concept because you have more perspectives and you have different people within those perspectives and that is how you change things as you can't just have a single mind-set" (NGO HI Manager HINM1)

		"we are all so busy and all varied in our capacities, in our skills and in our needs, so we as a stakeholder community just with funding from SANParks, we couldn't self-organise and run a successful EM programme. The success, it is absolutely dependent on K2C. Because we all have a vision of what we would like to happen when working more closely together etc, (…) to self-organise, such a diverse range of busy people, it's almost an impossible expectation. It takes somebody to really facilitate that process to make it happen and then to handle a lot of the time consuming logistics of it." (Research HI manager, HIRM2) "a pivotal thing in the success was the fact that there was a coordinating role played in the landscape. Without the role of K2C we wouldn't have lasted a few months. If you are not going to have a central structure like the K2C, the biosphere reserve but with that, the capacity around the office of them, of [name of K2C BR Manager] and role that she played I think like some of my close, close collaborators, stakeholders and work a lot closely with, they mention she is a glue. You know Marie-Tinka is a glue that keeps all things together and I really believe that. So without such a person, or a group or institution there is just no ways." (Research HI Manager, HIRM5) "to use local and build them up rather than just bringing in people from the outside." (NGO HI Manager HINM1) "the other Expand Public Works Programmes, it's probably not fair to compare because they are different and are run through different government departments. But when I see people slashing grass on the sides of the road, I think that's not a very stimulating kind, you're not getting many skills there, and that's all you do all year (…) these EMs gain much more skills and do much more stimulating work (…) I'm sure this is one of the most successful environmental kind of Expanded Public Works Programmes (…). I think it is a flagship." (Research Host Institution Manager - HIRM2)
Challenges	Data collection	"Different research agendas" (Research HI manager HIRM4) "we are all in our own different institutes experiencing capacity challenges, (…) and the reality is in the end you start stepping back. I remember, in the beginning, very soon just before we started the EM Programme there was so much engagement that there was, there started being engagement fatigue." (Research HI manager HIRM5)
	Information sharing	"I don't remember if we had any specific EM meetings or if EM meetings or discussion of EMs, I think it was piggy-backed onto one of these other things. I don't remember actually ever having a meeting just

		about EMs. I mean part of it is that it is really everybody is so busy and we are also far flung, that I think it is usually more efficient to try to integrate those meetings you know, if you manage to get everybody together on a particular day in Hoedspruit." (Research HI manager HIRM2)
	Collaboration	"synergies it's probably been more kind of ad hoc than I had originally hoped or anticipated, but it's come through. (…) because we're all so busy and sometimes it takes a K2C meeting in Hoedspruit for me to interact with my colleagues down the road. I think K2C just creates the space for interaction and synergies to emerge. (…) potential synergies or complementarities to the other programmes such as [HI name] research" (Research HI Manager, HIRM2)
	EMs motivation	"as a Host Institution you have to think about motivating your EMs and many of them get just bored because it is the same job every single day. So that is where you need to start and plan your trainings in certain ways that keeps the people enthusiastic and gives them opportunity to learn different things and maybe evolve a little bit more." (NGO Manager/Previous Reserve Manager HIR2) "the manager is just too busy to supervise" (Research HI Manager HIRM4) "EMs need a lot of motivation. They work alone in their communities and then if you don't visit them they feel very alone" (K2C DC KBRDC1)
	Resources: time, man power and money	"try to spend a bit of time with the guys and training them with plant identification etc, but as you find I am quite busy as well, so to find the time to do that kind of training is quite difficult to organise." (Research HI Manager HIRM2) "I don't have the time to train them and manage the data. We have a need for middle management for all the… And it's a pity that the programme didn't work in some higher level positions." (Research HI Manager HIRM4) "if we would have more resources available for training, not just formal training, informal training, more resources available to do what we set out to do." (K2CBR Manager, KBRM1)
	Social Problems	"our local people want jobs, because without jobs it leads to stealing, to committing crimes." (EM Supervisor, KBRSM3)
	Duration of the programme so far	"it's not like drastic change, it's just little but (…) there is change. We do see change but it's more in the kids than the parents." (K2C EM, KBREM4)

		"It's a long term project, it's not going to change anything overnight. So it will take a while." (Reserve HI Admin, HIGA1) "it is obviously upskilled a lot of people. I wouldn't say it has made people completely environmentally conscious, but has planted the seed that can be easily watered, that there is a need to be environmentally conscious." (NGO HI Manager, HINM1) "we've gone through the first 3 years or so of data collection it's really starting to show the value of that although it's still fairly short in term of what it's, what one need to really start drawing these inferences, it's a very good start." (Research HI Manager, HIRM5)

Stockholm Resilience Centre
Kräftriket 2B, Stockholm University, SE 106 91
info@stockholmresilience.su.se
www.stockholmresilience.su.se

A PARTNER WITH
The Beijer Institute of Ecological Economics
Kungl. Vetenskaps-Akademien
The Royal Swedish Academy of Sciences

FUNDED BY
MISTRA
The Swedish Foundation for Strategic Environmental Research