




UN DECADE ON ECOSYSTEM RESTORATION

TECHNICAL ARTICLE

# Knowledge exchange enhances engagement in ecological restoration and rehabilitation initiatives

Nicola Favretto<sup>1,2</sup> , Lindsay C. Stringer<sup>3</sup>, Andrew J. Dougill<sup>1</sup>, Liezl Kruger<sup>4</sup>

Effective knowledge sharing and community engagement can be major enablers in the pursuit of socially relevant benefits from ecological restoration and rehabilitation. Focusing on two ecological restoration and rehabilitation practitioner organizations and their workers, this paper evaluates perceptions of the extent to which short-term knowledge exchange contributes to social goals in ecological restoration and rehabilitation in South Africa through (1) stakeholder engagement and awareness of community well-being, and (2) knowledge enrichment. Data collected through impact questionnaires, participatory site visits, practical work exchange, focus group discussions, and a workshop are analyzed using thematic analysis framed by the International Principles and Standards for the Practice of Ecological Restoration #1 and #2. We explore participants' perceptions of knowledge exchange benefits and discuss implications for future collaboration in establishing long-term knowledge exchange. Findings show that knowledge exchange is perceived to result in enhanced teamwork engagement, and strengthened knowledge on restoration techniques through mutual learning, inspiration, and a strengthened sense of community. Findings suggest that sustained knowledge exchange and engagement activities between different practitioner organizations is key to realize and transform short-term perceived benefits into long-term applied socio-ecological impacts across landscapes in dryland Africa. There is a need to progress from short-term, horizontal learning, to long-term (horizontal and vertical) knowledge exchange, to inform restoration project design and implementation.

**Key words:** Africa, capacity building, social learning, stakeholder engagement

## Implications for Practice

- Short-term and localized knowledge exchange grounded in practice is perceived to foster benefits across multiple social dimensions through stakeholder engagement and knowledge enrichment.
- Combining different engagement approaches in knowledge exchange and advancing from short-term to systemic and long-term knowledge exchange is essential to enhance different forms of learning and deliver applied socioecological benefits.
- Professionally facilitated knowledge exchange processes help to raise visibility of best practices and explain potential sources of future support.
- Systemic and long-term knowledge exchange will likely provide a useful collaborative tool for facilitating knowledge aggregation to guide future activities of practitioner organizations.

## Introduction

Global ecosystem degradation results in losses of socio-economic and ecological landscape values, costing 10% of annual gross domestic product and threatening the well-being of 3.2

billion people, predominantly concentrated in drylands (Costanza et al. 2017; IPBES 2018). In addressing these challenges, ecological restoration and rehabilitation are central. While international policy efforts such as the United Nations Decade on Ecosystem Restoration, 2021–2030 (UN 2019) bring a global focus to restoration, they acknowledge the importance of exchanging local knowledge and engaging stakeholders without providing empirical insights. Limited theoretical, methodological, or empirical grounding hampers the capacity to engage

Author contributions: NF conceived, codesigned, implemented the research, and wrote the manuscript; LCS secured the funding, provided research guidance, and edited the manuscript; AJD secured the funding, provided research guidance, and edited the manuscript; LK designed Figure 2.

<sup>1</sup>School of Earth and Environment, University of Leeds, Leeds LS2 9JT, U.K.

<sup>2</sup>Address correspondence to N. Favretto, email n.favretto@leeds.ac.uk

<sup>3</sup>Department of Environment and Geography, University of York, Heslington, York YO10 5NG, U.K.

<sup>4</sup>Living Lands, 5 Noordhoek Main Road, Sunnydale, Cape Town 7950, South Africa

© 2021 The Authors. Restoration Ecology published by Wiley Periodicals LLC on behalf of Society for Ecological Restoration.

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

doi: 10.1111/rec.13565

Supporting information at:

<http://onlinelibrary.wiley.com/doi/10.1111/rec.13565/supinfo>

local stakeholders and appreciate their knowledge of restoration practices (Reed et al. 2014; Gann et al. 2019), while challenges persist in the integration of different knowledge types. Expert guidance is needed in the use of multi-actor learning to inform best practices (Tisenkopfs et al. 2015).

We interpret knowledge integration and sharing as the process of knowledge exchange (KE) that takes place across multiple groups (i.e. knowledge producers, intermediaries, and users), generating a range of impacts on policy and practice, classified as conceptual (awareness raising and experience sharing), instrumental (policy or practice changes), and symbolic (advocating existing policy or practice) (Reed et al. 2014). The extent to which KE affects ecological restoration practice has also been questioned, given the limited capacity for short-term research to be translated into increased long-term understanding of practitioner organizations as to how to implement successful restoration (Francis & Goodman 2011). A further gap relates to the lack of analyses and engagement that could stimulate learning between different restoration initiatives. This can take place through horizontal knowledge sharing between practitioners (parallel organizations at the same spatial scale and without leverage over each other), or vertical knowledge sharing across multiple governance levels; from practitioners to national and international governmental and intergovernmental bodies (Cohen-Shacham et al. 2019; Koontz 2021). A key bridging role in KE is played by knowledge brokers (such as nongovernmental organizations) that have access to local knowledge and are able to summarize it and transfer it to other actors at different scales or locations (Reed et al. 2014).

While enabling more effective KE is recognized as key to mutual enrichment of multiple knowledges, systematic appreciation of its applied practices remains contested (Phillipson

et al. 2012). This paper picks up these perspectives and considers how KE between different practitioner organizations involved in ecological restoration can potentially better support engagement and sharing of ecological restoration knowledge and efforts. We focus on two case studies from South Africa, a country known as a continental leader in applying restoration to achieve societally relevant goals (Carrick et al. 2015; Favretto et al. 2018). This paper aims to investigate how KE in ecological restoration can offer opportunities to enhance collaboration and knowledge sharing between practitioner organizations involved with ecological restoration and their workers. It effectively applies the International Principles and Standards for the Practice of Ecological Restoration #1 and #2 to assess the extent to which short-term KE is perceived to address social goals in ecological restoration and rehabilitation through (1) stakeholder engagement and awareness of community well-being, and (2) knowledge enrichment. Findings allow consideration of the implications of KE in informing future restoration and rehabilitation practices more widely (CBD and UNEP 2018; IPBES 2018).

## Methods

Two case study practitioner organizations that pursue ecological restoration and rehabilitation were selected for this study (Fig. 1).

While they implement varied restoration practices, the two organizations (Table 1) have a history of collaboration facilitated through a number of research and impact-acceleration projects led and undertaken by the authors of this manuscript since 2016 (e.g. Favretto et al. 2018). The two cases were selected to maximize added value and scope for KE across initiatives that



Figure 1. Ecological restoration and rehabilitation case study practitioner organizations, Baviaanskloof Hartland and Vanwyksdorp, South Africa. Source: Adapted from Favretto et al. (2018).

**Table 1.** Key characteristics of case study practitioner organizations, South Africa. *Source:* Living Lands (2021), GCBR (2021).

	<i>Living Lands</i>	<i>Jobs 4 Carbon</i>
Organization type	Not-for-profit company	Not-for-profit company, Gouritz Cluster Biosphere Reserve (GCBR)
Mission	Promoting social learning and fostering partnerships toward a “living landscape”	Implementing restoration and rehabilitation through thicket planting that seeks carbon mitigation, community upliftment, and job creation
Location	Baviaanskloof Hartland site, Eastern Cape	Vanwyksdorp, Western Cape
Years of operation	Since 2008	Since 2014
Vegetation types	Thicket, Fynbos, Nama-Karoo, Succulent Karoo, Grassland, Savannah, and Forest	Fynbos, Succulent Karoo, Thicket, and Maputoland-Tongoland-Albany
Land degradation types and drivers	Degradation of thicket vegetation, soil erosion, reduced water retention, and creation of gullies. Driven by overgrazing and exacerbated by climate change, high rainfall unpredictability, and extended droughts	Soil degradation, erosion, and thicket loss. Driven by overgrazing under historical land use (goat farming), exacerbated by climate change, and high rainfall variability
Type of activities implemented	Thicket restoration through Spekboom planting, rehabilitation of hillslopes through resloping and erosion prevention—that is installation of anti-erosion barriers and brush-packing to cover top soil, catchment management, awareness raising, and business development for essential oil production	Thicket through Spekboom restoration through Spekboom planting, job creation, erosion control through anti-erosion saudades and brush-packing, business development for production, and sale of Spekboom cuttings, elementary school food gardening, and environmental awareness raising
Land-tenure situation	Cluster of state-owned protected lands within a network of private and communal land	Cluster of private lands under a biosphere reserve
Socioeconomic context	Population: 1,000. Economic activities focused on goats and sheep farming, cattle and ostriches, and production of vegetable seeds	Population: 800. Marginalized and vulnerable area with high unemployment and poverty levels. Limited economic activities focused on livestock farming, irrigated agriculture, and some tourism
Funders	The Coca Cola Foundation, Rain Global Environment Facility 5, Nationale Postcode Lotterij Netherlands, Commonland	South African Government “Extended Works Programme,” European Union, Private Dutch foundations
Types of stakeholders	Not-for-profit company, project workers, private land owners, local community, church community, governmental agencies, and international funders	Not-for-profit company, project workers, private land owners, local community, governmental agencies, Wildlife and Environment Society of South Africa, and international funders

pursue similar overarching goals, building on a depth of knowledge and trusted interactions generated over time.

KE activities involved two “learning journeys,” one in each site and a final workshop, with perceptions of knowledge enrichment assessed through an impact questionnaire administered at the beginning and end of the KE. The learning journeys were pursued through 1-day participatory site visits, followed by a 1-day “work exchange,” where mixed teams from both practitioner organizations undertook joint manual work in the field of *Portulacaria afra* (hereafter called Spekboom). This was selected as joint practical task as planting Spekboom is the main overlap among the two organizations, where shared learning can be maximized. Learning journeys concluded with reflective focus group discussions guided by a similar set of questions as in the impact questionnaires detailed below. Results were then summarized and consolidated in a final workshop for all who participated.

Matched baseline and impact questionnaires were administered to all eight workers from Living Lands (all those engaged in restoration at the Baviaanskloof Hartland site), one Living Lands manager, six workers from Jobs 4 Carbon (J4C) (those

available out of 24 active at this site), and two managers (total  $n = 17$ ) to assess the perceived benefits of the KE. Sample selection aimed to involve the largest number of managers and workers that operate in the field with both practitioner organizations.

Three questions aimed at testing initial knowledge of the activities carried out by the other practitioner organization were addressed in a baseline questionnaire focused on participants’ knowledge of the restoration work, and achievements and challenges of the other practitioner organization (Supplement S1). An extended impact questionnaire (with a total of nine questions, all open except the first one using a Likert scale) was administered after the KE activities to assess the perceived “knowledge enrichment” impacts of the KE. Baseline and impact questionnaire responses were compared to assess differences and identify whether changes to knowledge took place (as per Marques et al. 2020). The additional questions addressed in the impact questionnaire focused on aspects of mutual learning (i.e. what one practitioner organization can learn from the other) and the potential for future replication of the identified

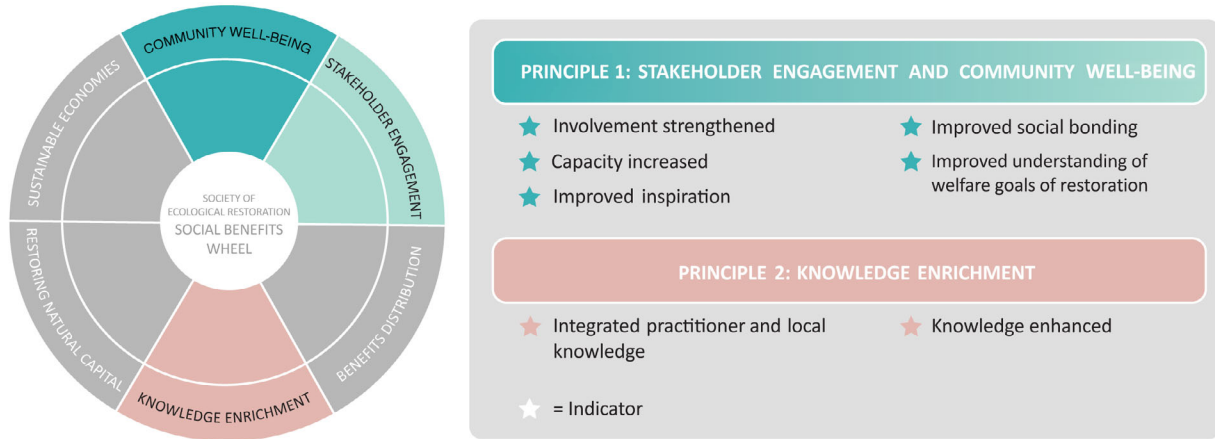


Figure 2. Adapted qualitative indicators to assess perceptions of progress toward social goals in ecological restoration and rehabilitation for two South Africa practitioner organizations, drawing on the Society for Ecological Restoration social benefits wheel and grounded on International Principles and Standards for the Practice of Ecological Restoration #1 and #2. *Source:* Adapted from Gann et al. (2019).

best practices (see Supplement S1 for a more detailed description of how the sets of questions were compared and expanded). The extended responses were integrated in the preworkshop qualitative thematic analysis (see the following text).

Professional facilitators (i.e. the paper authors) played a key role in the delivery of the learning journeys, where the KE participants were guided through a mix of indoor meetings, which involved presentation of the work of each practitioner organization, and field visits where participants gained a practical overview of the breadth of work implemented. Facilitators guided the participants in taking notes and drawing their own observations and comparisons focused on four key areas: (1) benefits of KE, (2) similarities and differences between practitioner organizations, (3) best practices, and (4) future engagement opportunities (Guest et al. 2012). These themes were discussed and summarized each day through a “wrapping up” focus group.

Using qualitative thematic analysis, notes from the site visits, work exchanges, focus groups, and impact questionnaires were categorized according to emergent patterns focused on the themes listed earlier. Data were discussed in a 1-day workshop, to share experiences across the themes identified, particularly considering knowledge enrichment about best practices and engagement implications for the practitioner organizations and their workers (see Supplement S2).

Following the workshop, the thematic analysis was refined and findings were regrouped (qualitatively and using basic frequency counts) to assess the implications of KE activities for achieving principles #1 and #2 of the International Principles and Standards for the Practice of Ecological Restoration (Gann et al. 2019). Qualitative indicators adapted from the Society for Ecological Restoration “social benefits wheel” (Gann et al. 2019) were developed to guide the thematic discussion of our findings (Fig. 2). Stakeholder engagement and awareness of community well-being (principle #1) is intended as the collaborative building dialogue between practitioner organizations and local communities aimed at exchanging knowledge about ecological restoration and rehabilitation practices (Gann et al. 2019). It was assessed through the

following indicators: strengthened involvement, increased capacity, improved inspiration, improved social bonding, and improved understanding of welfare goals of restoration. “Knowledge enrichment” (principle #2) is understood as the identification of different knowledge sources that generate new knowledge with the potential to inform project implementation, planning, or monitoring (Gann et al. 2019), assessed through the following indicators: integrated practitioner and local knowledge, and knowledge enhanced. Figure 2 details how the original indicators from the social benefits wheel were adapted to the indicators listed earlier.

## Results

Data from all the activities show that KE between the two practitioner organizations generated 12 major perceived benefits, which have potential for longer-term impacts through ongoing KE activities (Table 2).

### Principle 1. Stakeholder Engagement and Awareness of Community Well-Being

**Involvement Strengthened.** Social interaction through KE strengthened involvement in collaborative tasks of staff across both practitioner organizations by sharing ideas, opportunities, and tools used to seek common solutions based on practice: “[The KE] gave the feel of what other working colleagues do, and the chance for both groups to relate to each other” (manager, J4C, workshop). A process of future continued engagement was considered a key prerequisite to achieve joint benefits in the long-term: “We need to be primed, almost forced, to make time for this type of activity” (manager, Living Lands, workshop).

Through collaborative dialogue where multiple viewpoints were shared, the group strengthened trust in one another, building on the history of collaboration through previous research and KE activities. In turn, this stimulated further commitment. For applied benefits to be derived in the long-term, workshop discussions called for continued KE, such as a system that enables exchanging

**Table 2.** Adapted Society for Ecological Restoration social benefits wheel indicators and perceived benefits to assess progress toward social goals in ecological restoration and rehabilitation framed across International Principles and Standards for the Practice of Ecological Restoration #1 and #2 for two South Africa practitioner organizations. *Source:* Adapted from Gann et al. (2019).

<i>Original Indicator (Social Benefits Wheel)</i>	<i>Adapted Indicator</i>	<i>Perceived Benefits</i>
<b>Principle 1: Stakeholder engagement and awareness of community well-being</b>		
Involvement attracted	• Involvement strengthened	Enhanced engagement and partnership
Capacity increased	• Capacity increased	Project management
—	• Improved inspiration	Inspiration
Social bonding improved	• Improved social bonding	Teamwork
Health and welfare improved	• Improved understanding of welfare benefits of restoration	Enhanced awareness of community building
<b>Principle 2: Knowledge enrichment</b>		
TEK reinforced; science drawn upon	• Integrated practitioner and local knowledge	Mutual learning; enhanced mitigation knowledge; environmental conservation awareness
Knowledge improved	• Knowledge enhanced and innovated	Erosion control; restoration and rehabilitation techniques; planting; transferable lessons

a constant flow of workers and groups between practitioners. This would help to extend these benefits beyond the group involved. Practical examples identified included exchanging workers on a biweekly basis to carry out joint work, organizing larger monthly exchanges, and planning regular learning experiences with universities to enable shared field-based learning on erosion control and restoration practices. These findings indicate that broader stakeholder engagement will maximize benefits from targeted KE, which may otherwise remain limited.

**Capacity Increased.** KE resulted in a perceived increase in capacity to understand the broader priorities and challenges experienced by managers. For example, it was realized that project implementation is often hampered by factors linked to politics or funder demands. New understanding increased appreciation for the need to invest in KE as a long-term effort.

**Improved Inspiration.** KE activities enabled participants to learn about other realities, familiarize themselves with peers from other contexts, and gain a broader understanding of wider restoration efforts. By feeling part of a broader “family” that tackles degradation, participants perceived their inspiration to do more: “It was an opportunity for myself to see things in a different way [...] we are a family” (worker, Living Lands, focus group). This was mirrored by managers, who stressed that KE provided all participants with the opportunity to “encourage each other, boost, empathize” (manager, Living Lands, focus group), and identify common ground.

**Improved Social Bonding.** Social bonding was perceived to be strengthened through KE and teamwork in field based training: “We are now all colleagues and we are reference points to our peers [...] we are leaders, and can complement each other” (worker, Living Lands, focus group). This was mirrored in the impact questionnaire, where all respondents stated that the two practitioner organizations will now work together, despite questions on the financial and logistical feasibility of future collaboration.

**Improved Understanding of Welfare Goals of Restoration.**

Improved understanding of the welfare goals of both practitioner organizations was perceived by all participants. While the two practitioner organizations pursue similar community goals, the KE showcased different approaches, with a view to replicating good practices. Workshop discussions showed that while Living Lands’ efforts focus on generating business opportunities (e.g. helping farmers shift toward sustainable land uses), J4C focuses more on job creation and providing training and support to school children in the context of restoration projects. This generated conversations and awareness on how each practitioner could combine some of these approaches for greater long-lasting benefits.

**Principle 2. Knowledge Enrichment**

**Integrated Practitioner and Local Knowledge.** Exchange of knowledge, practical tips, and experiences between peers pursued through social interactions during the practical restoration work enabled shared learning. Participants perceived this learning could be used for wider dissemination and application across the respective communities. Sharing practitioner knowledge based on restoration experiences of managers was key in helping workers understand the rationale behind their practical work. For example, during workshop discussions on the use of brush-packing (an anti-erosion technique used to protect top soil around trees), workers’ knowledge complemented explanations from managers about the implications for topsoil temperature reduction and increased water infiltration. While all workers employed by both organizations received training on these techniques, they found that integration of similar knowledge across two different organizations and landscapes provided added-value as it generated more comprehensive insights.

**Knowledge Enhanced.** Drawing on impact questionnaires, Table 3 summarizes key questions and thematic areas in which KE is perceived to have enhanced knowledge.

**Table 3.** Impact questionnaire responses showing knowledge enhancement from KE.

Questions	Response (Total n = 17)	Notes (with Frequencies)
a. How much did you learn in this journey?	<ul style="list-style-type: none"> <li>• A lot (in a 1 [nothing]–3 [a lot] range of Likert scale) (17)</li> </ul>	Themes learnt about (presented in decreasing frequency): knowledge of restoration and rehabilitation techniques (17), enhanced knowledge and inspiration through teamwork and mutual learning (9), enhanced engagement and partnership (8), environmental conservation awareness (7), community upliftment (3), and project management (1)
b. Describe three or more intended benefits sought by the other practitioner.	<ul style="list-style-type: none"> <li>• One to four new benefits described (14)</li> <li>• Same as in baseline (3)</li> </ul>	Benefits listed by decreasing frequency: community upliftment and job creation (17), Spekboom planting (9) rehabilitation and erosion control pursued through multiple techniques (5), and carbon sequestration (3)
c. Give three practical examples of the work done by the other practitioner in the field.	<ul style="list-style-type: none"> <li>• One to four new examples described (15)</li> <li>• Fewer examples described than in baseline (2)</li> </ul>	Examples related to the following themes (by decreasing frequency): rehabilitation and erosion control techniques (17), Spekboom planting (14), carbon sequestration (2), and environmental awareness (1)
d. Describe what J4C does <i>similar</i> to Living Lands.	<ul style="list-style-type: none"> <li>• One to two new similarities described (16)</li> <li>• Fewer similarities described than in baseline (1)</li> </ul>	Similarities described (by decreasing frequency): Spekboom planting and nursery (17), rehabilitation and erosion control techniques (12), and community upliftment and job creation (8)

Likert scale responses showed that all respondents perceived that they learnt “a lot” from the KE. The majority of respondents across both practitioner organizations, showed enhanced knowledge in multiple answers (see Supplement S1). When asked to list the intended benefits sought by the other practitioner organization, most respondents were able to provide between one and four new examples compared to their baseline responses, noting community upliftment and job creation, Spekboom planting, rehabilitation, and erosion control pursued through multiple techniques, and carbon sequestration. Only four respondents (from 17) perceived unchanged knowledge. When asked to provide practical examples of the work implemented by the other practitioner organization, most respondents could explain up to three new examples, and were able to identify one or two new similarities (mostly focused on Spekboom planting).

Improved understanding of the carbon sequestration potential of Spekboom exemplifies the new insights people perceived they gained. General statements about the capacity of Spekboom to sequester carbon were raised in baseline questionnaires, but after the KE, a deeper understanding was shown in workshop discussions, where workers noted: “Spekboom captures [stores] atmospheric carbon in the soil, and when there is more carbon, there is more water being stored,” and as a result “other plants will be able to better survive and grow in the enriched soil” (worker, Living Lands, workshop).

Workshop discussions identified scope to transfer some practices in future engagement among the two organizations, e.g.: “Bacterial composting [for Spekboom nursery] would be cheap and easy to replicate” (manager, J4C, workshop). However, it was noted that although the skills and knowledge are transferable, improved enabling institutional

and regulatory frameworks are needed to support such engagement.

### Discussion

KE based on the use of participatory site visits, focus groups, and workshop discussions has potential to raise awareness of benefits across the International Principles and Standards for the Practice of Ecological Restoration #1 and #2. Mirroring experiences in using social learning processes in environmental management planning (Marques et al. 2020), and drawing on wider lessons from practice on stakeholder engagement in landscape management across the African continent (Favretto et al. 2021), we found that bringing together practitioner organizations and their workers for KE can result in perceived strengthening of trust, and learning. Focus on two organizations that operate across a common and diverse landscape as knowledge brokers and landscape facilitators, has shown that effective shared learning is feasible, and perceived as beneficial at the landscape scale (Cockburn et al. 2020). Best practices stress the importance of sharing knowledge to empower those groups tackling degradation in practice (Stringer et al. 2017). As noted in analysis of transdisciplinary projects aimed at generating new knowledge and action in ecosystem management in South Africa, knowledge sharing enables upscaling by promoting systems thinking grounded in practice (Sitas et al. 2016). This research acknowledges that while short-term KE does not necessarily translate into long-term benefits for complex problems, it can catalyze engagement and knowledge sharing that, if implemented in a more systemic manner, will help to ground long-term system thinking in practice (Falayi et al. 2020).

South Africa is actively pursuing engagement aimed at fostering cross-sectoral transformation for environmental conservation (Gelderblom et al. 2020). Combining different types of

engagement to maximize interaction and enable learning is a building block for transformation (Stringer & Dougill 2013). Expanding observations of Nicolletti et al. (2020), we show that local-level KE initiated and facilitated by academics in cooperation with practitioner organizations can trigger social interaction and bonding with a view to identifying practical opportunities and pursuing common solutions aligned with the needs and perceptions of KE participants. The KE undertaken here built on existing collaborations between researchers and case study practitioner organizations, helping a short-term and workshop-based KE activity to generate tangible perceived impacts, while acknowledging that collaborative outcomes are shaped by the social–ecological context under which they occur (Schoon et al. 2021). However, for KE to be initiated and maintained, continued mutual engagement must be enabled. Systemic KE is not commonly practiced due to its high organizational, time, and financial costs. Workshop discussions stressed the need for diversified funding streams to implement multiple local and short-term projects. This mirrors project-based learning literature, which stresses how the temporary nature, time urgency, and limited incentive mechanisms of “project task” contexts limit the willingness to exchange knowledge (Bakker et al. 2011). As identified by our KE participants, and expanding observations on participatory process design in social–ecological systems in global drylands (De Vente et al. 2016), the professionally facilitated processes that enabled this KE can play a leading role in raising visibility and explaining potential sources of future support (i.e. by collating and generating evidence on perceived benefits and impacts of KE focusing on the practical work of case study partners). However, such professional facilitation and research also require adequate resources to sustain long-term knowledge sharing.

KE was perceived to enable horizontal learning at the practitioner organization level and integration of multiple forms of knowledge via interactions between the participants. This suggests that KE can support multi-actor learning to inform best practices (Tisenkopfs et al. 2015). We stress the need to progress from short and horizontal learning to long-term (both horizontal and vertical) learning to translate the initial identification of perceived benefits and engagement into sustained restoration and rehabilitation. As regards vertical learning, workshop discussions noted that while skills and knowledge of best practices are transferable, a lack of adequate enabling legal and regulatory systems hampers vertical mainstreaming of KE. For example, the capacity of the two practitioner organizations to replicate the use of specific rehabilitation techniques is constrained by multiple rules and laws (e.g. National Environmental Management Act, National Environmental Management Biodiversity Act, National Forests Act, and South African Water Act). In some instances topsoil removal through re-sloping is forbidden to avoid changes in soil composition, while in other instances the use of restorative techniques requires environmental impact assessments prior to project approval. Given that practitioner organizations operate under short time frames imposed by the available project funding, they are often unable to test and implement innovative techniques at a small scale. Longer-term funding received from private foundations partially increases

operational flexibility; however, going into longer-term projects remains a challenge. Research is required to assess coherence and conflicts in regulatory frameworks, to enhance alignment and identify the changes needed to facilitate identification and replication of best practices. KE focused on practical implementation proves a useful collaborative tool to facilitate knowledge aggregation about these themes and generate evidence aimed at informing funding and decision-making.

While this research has focused on learning journeys of just two organizations, it demonstrates that localized KE should be considered as a starting point in fostering multidimensional ecological restoration and rehabilitation more broadly. Short-term KE activities permit participation of limited numbers of workers and managers due to financial constraints, time limitations, and the need for proximity to the workplace. The new (horizontal) knowledge generated across practitioner organizations enhances a sense of shared purpose among KE participants and empowers them to become reference points to their peers. This research emphasizes that well engaged local-level KE participants are a building block in a knowledge sharing system grounded in practice. The novel application of the International Principles and Standards for the Practice of Ecological Restoration #1 and #2 proved highly useful in guiding the best practice assessment and drawing key lessons, showing that KE holds particular promise in identifying best practices and engaging participants in joint activities and learning that can inform ecological restoration and rehabilitation practices across dryland Africa (CBD and UNEP 2018; IPBES 2018; Gann et al. 2019).

## Acknowledgments

This research was funded by the Economic and Social Research Council’s Centre for Climate Change Economics and Policy (CCCEP) (grant number: ES/K006576/1). The authors thank the staff of Living Lands and Jobs 4 Carbon, and the local communities involved with both organizations, for their time and enthusiastic cooperation. L.K. (from Living Lands) did not participate in the KE. Her role of coauthor in the paper consisted of producing Figure 2. Her opinions as Living Lands’ staff did not influence the analysis and presentation of the data grounded on the KE attended by her field colleagues.

## LITERATURE CITED

- Bakker RM, Cambré B, Korlaar L, Raab J (2011) Managing the project learning paradox: a set-theoretic approach toward project knowledge transfer. *International Journal of Project Management* 29:494–503
- Carrick P, Erickson TB, Becker CH, Mayence CE (2015) Comparing ecological restoration in South Africa and Western Australia: the benefits of a “traveling workshop”. *Ecological Management & Restoration* 16:86–94
- CBD and UNEP (2018) Pan-African action agenda on ecosystem restoration for increased resilience. Secretariat of the Convention on Biological Diversity and United Nations Environment Programme. <https://www.cbd.int/doc/c/274b/80e7/34d341167178fe08effd0900/cop-14-af-hls-04-final-en.pdf>
- Cockburn J, Cundill G, Shackleton S, Cele A, Cornelius SFA, Koopman V, et al. (2020) Relational hubs for collaborative landscape stewardship. *Society & Natural Resources* 33:681–693

- Cohen-Shacham E, Andrade A, Dalton J, Dudley N, Jones M, Kumar C, et al. (2019) Core principles for successfully implementing and upscaling nature-based solutions. *Environmental Science & Policy* 98:20–29
- Costanza R, de Groot R, Braat L, Kubiszewski I, Fioramonti L, Sutton P, Farber S, Grasso M (2017) Twenty years of ecosystem services: how far have we come and how far do we still need to go? *Ecosystem Services* 28:1–16
- De Vente J, Reed MS, Stringer LC, Valente S, Newig J (2016) How does the context and design of participatory decision making processes affect their outcomes? Evidence from sustainable land management in global drylands. *Ecology and Society* 21:24
- Falayi M, Gambiza J, Schoon M (2020) Unpacking changing multi-actor and multi-level actor ties in transformative spaces: insights from a degraded landscape, Machubeni, South Africa. *Land* 9:227
- Favretto N, Dougill AJ, Stringer LC, Afionis S, Quinn CH (2018) Links between climate change mitigation, adaptation and development in land policy and ecosystem restoration projects: lessons from South Africa. *Sustainability* 10:779
- Favretto N, Shackleton S, Sallu SM, Hoffman T (2021) Editorial for special issue: “collaboration and multi-stakeholder engagement in landscape governance and management in Africa: lessons from practice”. *Land* 10:285
- Francis RA, Goodman MK (2011) Post-normal science and the art of nature conservation. *Journal for Nature Conservation* 18:89–105
- Gann GD, McDonald T, Walder B, Aronson J, Nelson CR, Jonson J, et al. (2019) International principles and standards for the practice of ecological restoration. Second edition. *Restoration Ecology* 27:S1–S46
- GCBR (2021) Gouritz Cluster Biosphere Reserve: Jobs 4 Carbon project <https://gouritz.com/portfolio/jobs-for-carbon/> (accessed 6 Jun 2021)
- Gelderblom C, Oettlé N, Clifford-Holmes J, Malgas R, Wilson N, Polonsky S (2020) Transformative cross-sectoral extension services dialogue synthesis report. South Africa. Department of Environment, Forestry and Fisheries, Cape Town, South Africa
- Guest G, MacQueen KM, Namey EE (2012) Applied thematic analysis. Sage Publications, Thousand Oaks, California
- IPBES (2018) In: Montanarella L, Scholes R, Brainich A (eds) The IPBES assessment report on land degradation and restoration. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany
- Koontz T (2021) Science and scale mismatch: horizontal and vertical information sharing in the Puget Sound polycentric governance system. *Journal of Environmental Management* 290:112600
- Living Lands (2021) Our journey on the landscape: past, present, future. Living Lands, Noordhoek, South Africa. [https://14598f95-b4d7-452e-b430-87f6add73498.filesusr.com/ugd/4f759e\\_62b6d48b19724daabb99675c4d604f1.pdf](https://14598f95-b4d7-452e-b430-87f6add73498.filesusr.com/ugd/4f759e_62b6d48b19724daabb99675c4d604f1.pdf) (accessed on 6 Jun 2021)
- Marques M, Oliveira M, Borges JG (2020) An approach to assess actors’ preferences and social learning to enhance participatory forest management planning. *Trees, Forests and People* 2:100026
- Nicolletti M, Maschietto F, Moreno T (2020) Integrating social learning into climate change adaptation public policy cycle: building upon from experiences in Brazil and the United Kingdom. *Environmental Development* 33:100486
- Phillipson J, Lowe Philip, Proctor Amy, Ruto Eric (2012) Stakeholder engagement and knowledge exchange in environmental research. *Journal of Environmental Management* 95:56–65
- Reed MS, Stringer LC, Fazey I, Evely AC, Kruijssen JHJ (2014) Five principles for the practice of knowledge exchange in environmental management. *Journal of Environmental Management* 146:337–345
- Schoon M, Chapman M, Loos J, Speranza CI, Kelman CC, Aburto J, et al. (2021) On the frontiers of collaboration and conflict: how context influences the success of collaboration. *Ecosystems and People* 17:383–399
- Sitas N, Reyers B, Cundill G, Prozesky HE, Nel GL, Esler KJ (2016) Fostering collaboration for knowledge and action in disaster management in South Africa. *Current Opinion in Environmental Sustainability* 19:94–102
- Stringer LC, Dougill AJ (2013) Channelling science into policy: enabling best practices from research on land degradation and sustainable land management in dryland Africa. *Journal of Environmental Management* 114:328–335
- Stringer LC, Reed MS, Fleskens L, Thomas RJ, Le QB, Lala-Pritchard T (2017) A new dryland development paradigm grounded in empirical analysis of dryland systems science. *Land Degradation and Development* 28:1952–1961
- Tisenkopfs T, Kunda I, Šūmane S, Brunori G, Klerkx L, Moschitz H (2015) Learning and innovation in agriculture and rural development: the use of the concepts of boundary work and boundary objects. *Journal of Agricultural Education and Extension* 21:13–33
- UN (2019) United Nations Decade on Ecosystem Restoration (2021–2030). United Nations General Assembly Resolution 2019 A/RES/73/284

## Supporting Information

The following information may be found in the online version of this article:

**Supplement S1.** Baseline and impact questionnaires.

**Supplement S2.** Workshop agenda.

Guest Coordinating Editor: Nichole Barger

Received: 16 June, 2021; First decision: 28 July, 2021; Revised: 9 August, 2021; Accepted: 22 September, 2021