Unpacking Changing Multi-Actor and Multi-Level Actor Ties in Transformative Spaces: Insights from a Degraded Landscape, Machubeni, South Africa

Menelisi Falayi [1],*[ID], **James Gambiza** [1] **and Michael Schoon** [2]

1   Department of Environmental Science, Rhodes University, Makhanda 6140, South Africa; j.gambiza@ru.ac.za
2   School of Sustainability, Arizona State University Tempe, Tempe, AZ 85287-5502, USA;
    michael.schoon@asu.edu
*   Correspondence: falayimenelisi@gmail.com

Abstract: The loss of ecosystem services through land degradation continues to be a significant concern for policymakers and land users around the world. Facilitating collective action among various actors is regarded as imperative in halting land degradation. Despite extensive research on collective action, there have been few studies that continuously map social ties and detect network evolution as a way of enabling longitudinal analysis of transformative spaces. This paper seeks to examine the changing dynamics of multi-actor and multi-level actor ties over a period of two years in Machubeni, South Africa. To do this, we used social network analysis to detect continuities and/or discontinuities of multi-actor and multi-level actor ties over time. Overall, edge density, clustering coefficient, and reciprocity scores steadily increased over the two years despite a decline in the number of active organisations within the network. Our results demonstrate that the proportion of strong ties gradually increased over time across three governance networks. However, multi-level linkages between the local municipality and the local organisations remained weak due to a lack of trust and collaborative fatigue. While the transformative space has succeeded in enhancing collaboration and knowledge sharing between local organisations and researchers, further long-term engagement with government agencies might be necessary for promoting institutional transformations and policy outcomes, and building network resilience in complex polycentric governance systems.

Keywords: actors; collaboration; land degradation; learning; social capital; Social Network Analysis; transformative spaces

1. Introduction

Contemporary research shows that humanity is facing daunting environmental challenges that are increasingly dynamic and complex [1,2]. The past century has seen drastic changes in social structures, institutions, relations, and customs. In particular, these changes have defined how societies interact with one another and their ecosystems [3,4]. Ecosystem services play an important role in supporting human life on earth [5–7]. Here, we define ecosystem services as benefits that people obtain from ecosystems [8]. These benefits include food, fresh water, timber, natural medicines, climate regulation, and cultural values, amongst many others [8]. Given the importance of the Earth's ecosystems to human well-being, unsustainable resource consumption and waste have forced us into a new planetary era known as the Anthropocene [1]. This is not surprising considering that the degradation of ecosystem services through human activities is reported to be negatively impacting the coping capacity of at least 3.2 billion people around the world [9]. For example, land degradation decreases the capacity and flow of ecosystem services [10], thereby undermining people's livelihoods [11] and ultimately resulting

in livelihood erosion [12]. Despite accelerated biodiversity loss at both local and regional scales [5], environmental governance continues to be a major challenge [9,10].

There is general agreement that monocentric governance approaches in addressing environmental problems are inadequate [13]. This has prompted land users and policymakers to consider multi-actor and multi-level partnerships as a way to combat land degradation [14]. Here, multi-actor interactions are described as horizontal connections that link actors across a single organisation level, while multi-level interactions are vertical connections that link actors across multiple organisational levels [15]. For this paper, actors are groups or individuals that have a stake, right, or interest in land degradation and land rehabilitation initiatives [16]. These actors include natural resource users, grassroots organisations (hubs), government agencies, and research institutions.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reports that land degradation can be addressed through multi-actor participation and dialogue that recognises the importance of knowledge co-production [9]. Multi-actor forums (multi-stakeholder forums) play a pivotal role in bringing together actors from different interest groups to have dialogues, share challenges, address complex problems, and develop policy action [17]. One key principle of multi-actor forums is that they emphasize a democratic approach to reach decisions [18], thereby providing opportunities for representation of various groups drawn from the public, private, and voluntary sectors [17,19]. In recent years, multi-actor forums have received much attention from policymakers and resource users for their potential to address many of the "good" governance principles [18]. Several studies demonstrate the potential of multi-actor forums to address complex environmental challenges pertaining to climate change [20] and land degradation [16,21–23]. In research on land rehabilitation, Zoumides et al. [16] recommended that the sustainability of land rehabilitation initiatives might be achieved by institutionalising multi-actor forums. Such institutionalisation requires new governance structures that overturn the business-as-usual approaches of collaboration and engagement.

In this context, actors face critical questions of how they can contribute towards social-ecological transformations [24]. Here, transformation refers to "fundamental changes in structural, functional, rational and cognitive aspects of socio-technical-ecological systems that lead to new patterns of interactions and outcomes" [25] (p. 2). In other words, transformation refers to the process of profound change that leads to new outcomes or patterns [26–28]. Scoones et al. [29] argued that, in order to achieve the Sustainable Development Goals (SDGs), deliberate normative steering of transformation is necessary at both multi-actor and multi-level scales. Without detailing extensive debates on transformations to sustainability, this article will focus on the changing dynamics of multi-actor and multi-level ties in transformative spaces.

Transformative spaces are defined as "collaborative environments where actors invested in transformations can experiment with new mental models, ideas, and practices that can help shift Social-Ecological Systems (SES) onto alternative paths" [30] (p. 2). It is essential to note that transformative spaces are not transformations, but rather a form of readiness for a system to transform [14]. Put simply, transformative spaces act as starting points for institutional change through various groups drawn from the public, private, and voluntary sectors. They engage in dialogue and collaborative learning while reframing issues in a way that allows solutions [30,31]. In contrast to other participatory research designs that foster multi-actor engagement [17], transformative spaces are believed to be a promising stepping stone for SES transformations [32] and may lead to social innovation [33]. Here, social innovation is defined as a "process of learning and knowledge creation through which new problems are defined, and new knowledge is developed to solve them" [34] (p. 124).

It is believed that transformative spaces have the potential to enable systemic changes [31,33,35–40]. Here, systemic changes refer to changes that pervade all parts of a system. An example includes the Southern Africa Food Lab case study [33], which illustrates the importance of engaging with multi-actors to respond to systemic challenges. This case study highlights that multi-actor dialogue is a prerequisite for innovative action and for developing new relationships. Other examples include the

involvement of marginalised actors within the formal policy dialogues in developing new opportunities for intervention [36] and the importance of development actors in facilitating meetings that empower women in dealing with cultural barriers [40]. Within such collaborative arrangements, researchers do not perform traditional functions of solely being scientific advisors. Instead, they play an active role as "transformative space-makers" [39]. In this role, researchers play a pivotal role in selecting and organising social actors in transformative spaces while balancing power dynamics [32].

Another critical aspect is that transformative spaces may enable actors to transform adversarial relations and to foster new ways of working together [32]. However, in different circumstances, transformative spaces may 'feel' dangerous [31]. This is evident in the Food Lab case study where power-related tensions among participants created disgruntlement, thus reducing the safety of others [33]. This raises the case of whether transformative spaces are "safe" or "safe enough." Here, "safe" means that transformative change involves learning where actors can freely express their different views [41]. In other words, "safe" involves the concept of "learning, unlearning and relearning." We believe that, for a system to transform, changes might need to happen at a personal level first [32]. Therefore, understanding how actors interact within transformative spaces is critical for enabling or disabling systemic changes; however, the Monitoring and Evaluation (M&E) of these spaces is often ignored [32].

Despite an increase in the number of studies that focus on transformative thinking in the Global South, according to our literature search, no studies have managed to track how collaborative ties change over time within these spaces. Understanding the emerging collaborative ties is critical for tracking network evolution, highlighting the emergence of central and weak actors across and within scales, and comprehending system perceptions that may hinder or enable effective collaboration. Here, we contribute to the literature on transformative spaces and collaborative institutions by exploring the network evolution of the Masibambisane multi-actor forum between 2018 and 2020. Our study seeks to fill the gap in knowledge on how changing ties over time influence the flow of information sharing, inter-organisational trust, and views of shared goals within transformative spaces in South Africa. The case study area chosen for this endeavour is regarded as one of the most degraded areas in South Africa [42] and has dynamic environmental governance systems [43]; therefore, findings may help develop solutions to land degradation issues. By introducing the temporal aspects of how change occurs, we seek to understand the changing dynamics and system perceptions of how actors make decisions within transformative spaces over time.

A social-relational network perspective was applied to identify continuities and/or discontinuities of multi-actor and multi-level connections in transformative space between 2018 and 2020. Here a social-relational network perspective is defined as a set of actors (institutions or hubs) that are connected by a set of social relationships that enables the flow of information, inter-organisational trust, and views of shared interests.

The specific objectives include: (a) to identify what kind of social-relational connections dominated the transformative space between 2018 and 2020; (b) to identify which actors dominate the transformative space; (c) to examine system perceptions, i.e., barriers and enablers; and, (d) to see what strategies can be developed to support the priority needs of the transformative space. This study builds explicitly upon and extends emerging research focusing on transformative spaces as platforms for transformative dialogue, collaboration, and exchange of knowledge between actors that previously did not have dialogues [31,33,39]. This article is organised as follows: in the following section, we outline a brief discussion of the theoretical underpinning; the next section includes a detailed overview of the case study area and an account of the research methods used to answer the key questions; the results section follows, and describes the changing relational pattern of multi-actor ties within the transformative space and actors' perceptions of barriers to effective collaboration and coordination; the paper concludes by discussing the critical implications of the findings.

2. Theoretical Background

Linking Social Capital, Polycentrism, and Social Network Analysis

Social capital is used to describe personal relationships within networks that help to build trust, norms of reciprocity, and community participation [44]. In other words, social capital is a mechanism by which social relational ties are created among diverse groups, with norms of reciprocity [45]. Social ties are composed of several key components: trust, shared norms, information channels, and authority [46]. One key advantage of examining social capital is that it provides a holistic approach to understanding how cultural, social, and institutional dynamics of communities affect their capacity for dealing with collective action problems [47]. In terms of natural resource governance, social capital is viewed as a critical institutional mechanism that enables collective action and cooperation across scales [47]. In that way, social capital is essential to successful collaboration, learning, sharing of knowledge, and developing new ideas [48]. An example includes the Mexico case study, which illustrates that effective social capital can enhance collaboration among different institutions [49]. Most importantly, trust is viewed as a central linkage between social capital and collective action. Trust is defined as a "particular level of subjective probability with which an actor assesses that another actor will perform a particular action" [50] (p. 217). Put simply, trust enables actors to work together on common issues [44]. By establishing common goals and trust processes, actors may have the potential to transform adversarial relations and to foster new ways of working together across scales [51]. Drawing from social capital theory, we seek to measure the evolving multi-actor and multi-level ties in polycentric governance systems, i.e., their changing shared beliefs, ties of information sharing, and inter-organisational trust over time.

Polycentric governance refers to multiple interacting governing authorities across scales with the autonomy to create and implement rules and guidelines within a specific geography [52,53]. Semi-autonomous governing authorities are often described as overlapping, because they are nested at multiple scales [54]. Overlap may facilitate the flow of information among actors or institutions across scales, thereby enabling knowledge co-production and learning [55]. Here, we define scale as an administrative level to which a specific institutional configuration applies [56]. Therefore, polycentrism involves a combination of various governing authorities drawn from multiple levels (e.g., local, district, provincial, and national) that are not limited to formal governance bodies [54]. The seminal work by Ostrom [57] highlighted that the polycentric governance concept is more flexible than a monocentric one in that, if one governance entity fails, others across scales can step in. In this regard, polycentrism attempts to provide more opportunities for different actors across scales to take responsibilities in initiating and implementing sustainable solutions [58]. For this paper, we are interested in indigenous resource user groups, government agencies, and research institutions that are involved in land degradation and land rehabilitation discourse. Given the perennial challenges posed by land degradation to people's livelihoods and the environment, polycentrism is therefore required to enhance effective governance systems [59,60].

Many scholars assert that polycentrism has the potential of enabling collective action in the face of rapid and unpredictable global environmental change [52,58]. Thus, polycentric governance systems are essential for three reasons. First, polycentric systems have a greater capacity to adapt to social-ecological changes than monocentric forms of governance [61,62]. The advantage of institutional diversity is that it enables cross-scale deliberation and learning, which are processes that enhance the adaptive capacity of governance systems [63,64]. By engaging in social learning processes, actors can share information and experiences across scales, while developing new relationships [65]. Furthermore, combining both local and scientific knowledge is essential as it produces more relevant results, compared to using only one of the approaches [66]. The second advantage of polycentricity is that it enables broader levels for participation [19]. It enables diverse actors to dialogue and implements actions to problems they hold in common, thereby enhancing fit [67]. Here, institutional fit refers to a match between an institution and the problem it seeks to address [68]. The third advantage

of polycentric governance systems is that they enhance connectivity, modularity, and functional redundancy that can minimise and correct errors in governance systems [52]. Given the myriad environmental challenges faced by policymakers and land users, functional redundancy is regarded as necessary when an institutional failure occurs [55,63,69]. For example, multi-level governance systems with different political jurisdiction have a higher probability of enhancing connectivity and modularity when governance systems fail or collapse [70]. In other words, the existence of multiple institutions at different levels may help mitigate the risk of institutional failure [70,71].

Social Network Analysis (SNA) is a process commonly used to explore social structures and linkages [15,72,73]. SNA provides methods to quantify relations among actors and resultant network structures [74]. In particular, it enables greater understanding beyond the characteristics of individual actors, thereby allowing an in-depth understanding of actor positions and relations, and how these complex ties impact the network structures [74,75]. As argued by Schoon et al. [72], SNA is an ideal tool to measure the relational pattern of multi-actor ties, evolution, and the emergence of environmental collaborations over time. Social network literature discusses ways in which actors and groups influence each other [15,72,73,76]. For example, actors sharing strong ties tend to influence, trust, and communicate effectively with each other more than those sharing weak ties [77]. Actors with stronger ties are more likely to enhance mutual learning and sharing of information resources within the network [77]. Recent studies show that actors who share common values or beliefs communicate easily [77]. Still, such homogeneity, concentration of power, and resultant threat to 'safety' of space can be problematic as transformation requires different views and opinions across scales and within scales.

As highlighted above, social capital is fundamentally about how actors cooperate [47], and this paper focuses on the analysis of social connections in transformative spaces. Given the polycentric relational nature of transformative spaces, SNA offers an approach to study the horizontal (multi-actor) and vertical (multi-level) connections between groups across scales. We focus specifically on measuring the evolving multi-actor and multi-level ties in polycentric governance systems, i.e., their changing shared beliefs, ties of information sharing, and inter-organisational trust. Furthermore, we assess the barriers to effective collaboration in transformative spaces. In this paper, barriers are obstacles that reduce the effectiveness of collaboration and coordination. Based on our literature review, we offer two hypotheses:

Hypothesis 1 (H1). *Transformative spaces will enable broader levels of participation among actors between and within scales [32].*

Hypothesis 2 (H2). *Strong social-relational linkages (i.e., network ties) will increase over time across and within scales.*

3. Study Area

3.1. Overview of Machubeni Communal Land: Setting the Scene

The Machubeni communal land (31°30′53.92″ S; 27°9′53.49″ E) falls within the Emalahleni Local Municipality of the Chris Hani District in the Eastern Cape, South Africa (Figure 1).

Machubeni also falls under the former Transkei homeland, where land allocation is primarily controlled by both traditional structures and the post-1994 democratic local governance structures, such as the local municipality [10,43]. According to the Emalahleni local municipality, Machubeni is comprised of 13 villages, but the Traditional Leaders Council (TLC) claim that the area is comprised of 17 villages. This contest over ward boundaries was primarily caused by the Municipality Demarcation Board (MDB), which dissolved the spatial layout of the apartheid legacy [78]. The Municipal Demarcation Act No. 27 of 1998 enabled the creation of new municipal areas which were non-racial, but in some cases such as Machubeni, it failed to follow complex social boundaries. This escalated conflicts over land management between the traditional authority and the local municipality.
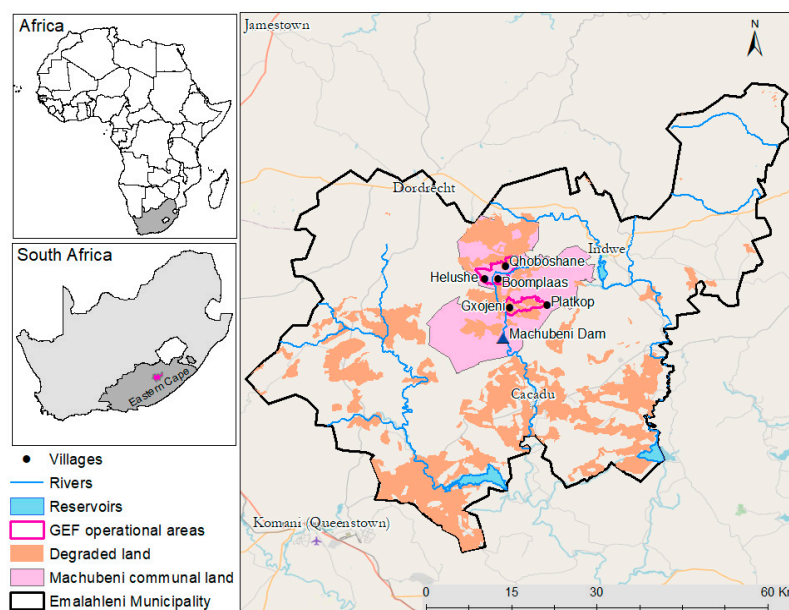
Figure 1. Map showing the location of Machubeni communal lands and the Global Environmental Facility (GEF) operational areas.

Most households rely on livestock farming, state social grants, and remittance as their primary sources of income. Livestock farming is a crucial livelihood in the area, comprising approximately one-third of the average household's income [10]. However, overstocking of livestock and weak governance institutions that work in silos have been blamed for the significant soil erosion in the area. Moreover, the culture of collaboration is reported to be ineffective, with little to no sharing of knowledge and learning across actors, sectors, and scales [79,80]. In 2004, the Department of Economic Development, Environmental Affairs and Tourism identified Machubeni as one of the most impoverished communities in South Africa [43]. The Machubeni community received over ZAR 7 million from Public Works funding under the Sustainable Land-Based Livelihoods programme to improve the agricultural production system and reverse the process of land degradation. Through this program, the community received specialised training and support in land management; however, the program was characterised by distrust and jealousy among project beneficiaries [80]. The vegetation cover in the region is dominated by *Euryops floribundus* shrub, *Eragrostis trichodes*, and *Eucalyptus saligna* [81]. The mean annual rainfall is 590 mm. The underlying geology of the area consists mainly of sandstones and mudstones. The soils are generally stony and shallow, except in the valley bottoms. The hilly slopes and valley bottoms in the region are affected by sheet and gully erosion which, in turn, has affected both crop and livestock farming [10].

3.2. The Problem Space

As highlighted above, Machubeni is a highly degraded landscape coupled with disputes over land management, fragmented governance structures, and a lack of collaboration and coordination between actors across scales. The Machubeni landscape has low levels of social capital. To enhance social capital, the Rhodes University GEF5 project team initially designed the Machubeni transformative space, in 2018. This transformative space is expected to run for four years until 2022. The transformative space serves as a platform where actors discuss and "freely think without the weight of disciplinary history or institutional commitments to a given approach that may constrain dialogue, co-create and prepare innovative ideas and innovations" [82] (p. 6035). For this paper, the Machubeni transformative space is also known as the Masibambisane multi-actor forum. Masibambisane means "let us work together" in the isiXhosa language. It is from within this context that we engaged numerous actors across scales in the process of a transformative space, intending to strengthen the ability of local government

structures and rural communities to adopt knowledge-based Sustainable Land Management (SLM) for improved functioning of land and ecosystems that are degraded. The transformative space seeks to foster a new culture of collaborative learning, develop new partnerships, and knowledge sharing between multi-actors that had previously not been part of any dialogue (supplementary: Table S1). The Machubeni multi-actor forum is a space where actors learn while attempting to create new relationships that enable SLM. The specific objectives of the transformative space are: to (a) develop strong social connections among actors across and within scales; (b) create new ideas that enable collaboration and knowledge sharing; and, (c) develop institutions that exhibit good institutional fit and functional redundancy.

4. Approach and Methods

4.1. Criteria for Selecting Actors

We identified actors that were involved in SLM or environmental governance, or affected by land degradation in Machubeni, by following a two-part stakeholder identification design proposed by Leventon et al. [83]. Firstly, the Rhodes University team conducted an extensive literature search to identify: (a) actors who live in the area (e.g., traditional leaders, natural resource user groups, and ward committees); (b) external actors who have an interest in the management and governance of natural resources or work within the specific environment (e.g., researchers and government agencies). Sources of literature identified included research articles [10,84,85], dissertations [79], and scientific reports [43,86]. After the extensive review of literature, the research team identified four natural resource user groups and three departments from the local municipality, district municipality, and the provincial government, respectively (supplementary: Table S1). In the second phase, the research team contacted the identified actors. The identified actors were asked to identify other actors who they considered necessary for the transformative space, using a snowball sampling approach [83]. Five new natural resource user groups and three local municipality departments were identified. In total, sixteen semi-autonomous institutions were identified in the governance network, representing a range of administrative levels (Figure 2).
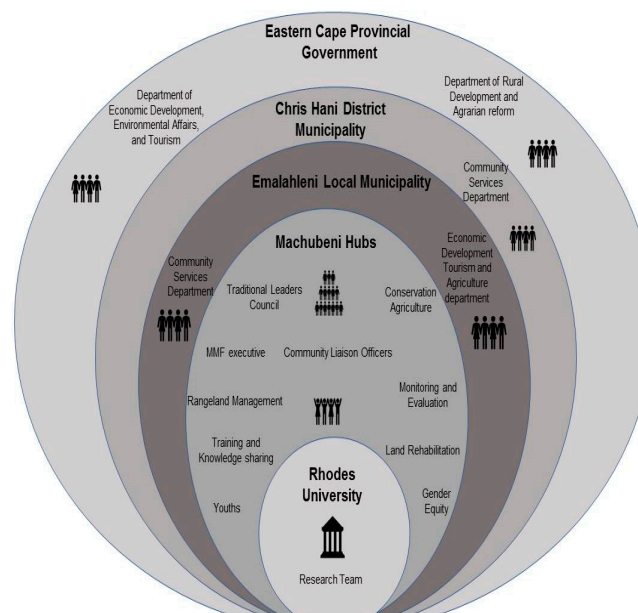

Figure 2. Multi-actor and multi-level onion diagram.

Participatory Learning and Action (PLA) workshops are regarded as an essential vehicle for enhancing dialogue among actors from different backgrounds and perspectives [87]. Therefore, a workshop was held in order to organise the multi-actor forum. In order to achieve

the objectives of a transformative space, actors adopted the hub concept. A hub is a group of actors with similar interests, e.g., livestock farmers. Local actors from Machubeni communal lands were organised into seven SLM groups/hubs based on their interests: conservation agriculture hub (CA); land rehabilitation hub (LR); rangeland management hub (RG); training and knowledge-sharing hub (TKS); M&E hub (ME); gender equity hub (GE); and the youth hub (YH). These groups are semi-autonomous within the governance networks. After organising the seven SLM Hubs, actors organised a transformative space (multi-actor forum) to enhance partnerships, collaborations, knowledge sharing, transformative institutional change, and mainstreaming of SLM approaches into local government policies. Throughout this paper, the SLM hubs represent local organisations.

4.2. Data Collection

We used a mixed-methods approach that included a socio-metric survey [88], Participatory Learning and Action workshops [87], and semi-structured interviews and document review. Data for this study were collected from the Rhodes University GEF5 SLM project between March 2018 and March 2020. A social-relational pattern was applied to detect continuities and/or discontinuities of multi-actor and multi-level actor connections in the transformative space between 2018 and 2020 (2 years). The evolution of the Masibambisane multi-actor forum allows us to: (a) detect the changing social-relational connections over time; and (b) identify how and why these patterns change. To examine the changing dynamics of horizontal and vertical multi-actor ties, social network data were collected using a socio-metric survey [15]. The socio-metric survey was administered through personal interviews, telephone interviews, and emails with SLM hub members, government representatives, and Rhodes University researchers. Social-metric data were collected in two phases, (a) July 2019 and (b) February 2020; this allowed us to identify the changing social-relational connections over time. The first author collected data with the aid of a translator. Table 1 shows the characterisation and distribution of organisational actors across and within scales.

Table 1. Characterisation and distribution of organisational actors.

Scale	Phase 1: Number of Respondents	Phase 2: Number of Respondents
Research team	13	12
Local hubs	75	71
Local municipality	15	12
District municipality	2	0
Provincial government	8	8
Total	113	103

Out of 135 actors, 113 managed to complete the socio-metric survey in the first phase. In the repeat survey (phase 2), we interviewed the same actors (n = 103); however, we did not receive responses from the district municipality. This means that our results might be biased towards experiences of more active organisations. The socio-metric survey was divided into three main sections of organisational ties: (a) views of common goals; (b) inter-organisational trust; and (c) information sharing amongst actors. For analytical purposes, actors were asked to list the organisations they cooperated with in their respective networks. Specifically, actors were asked to consider three different types of organisational ties: (a) views of common goals; (b) inter-organisational trust; and, (c) information sharing. Views of common goals are organisational ties concerning mutual interest between and among various organisations within the network. Inter-organisational trust consists in ties concerning the extent to which members of one organisation trust the members of a partner organisation. Information sharing consists in organisational ties concerning the exchange and sharing of land degradation and SLM information among various organisations (e.g., observation

of environmental change, rangeland conditions, land rehabilitation, invasive species, conservation agriculture, and bylaws.

After identifying active organisations, actors were asked to measure if they shared information, trusted, or had similar objectives with the identified organisation. Ties resting on the level of inter-organisational trust, the flow of information amongst organisations, and views of common goals were measured using a 5-point Likert test. This process was repeated in the second phase (repeat survey). Semi-structured interviews were used to further explain the changing dynamics emerging from the SNA [77]. Semi-structured interviews (n = 54) were conducted with SLM hubs, government agencies, and the research team. Four PLA workshops were held to reflect on the outcomes of the SNA and to identify strategies to overcome barriers to effective collaboration and coordination in transformative spaces. Altogether, 50 actors participated in four PLA workshops. Interviews were digitally recorded, and ethical research clearance was obtained from the Rhodes University Ethical Standards Committee (Code: 2019-0658-813). Workshop or attendance registers were used to record and track the regularity of actor participation per workshop. Grey literature accessed from the Emalahleni municipality was triangulated with socio-metric and semi-structured interview data.

4.3. Actor Ties Analysis

In order to test our two hypotheses, five network metrics were calculated, based on ranked scores elicited directly from participants: in-degree centrality, betweenness centrality, edge density, clustering, and reciprocity. In-degree centrality measures the number of incoming ties received by a node from others [74]. Nodes with high in-degree centrality are considered to be highly connected as they are in contact with many others. Betweenness centrality measures the extent to which a node falls along the shortest path between the various nodes in a network [74]. An actor with the highest betweenness centrality is usually referred to as a gatekeeper or broker [74]. Reciprocity measures the degree of cohesion within networks, while clustering is the average of the densities of the neighbourhoods of all the actors. Put simply, clustering measures "how many of my friends are also friends of themselves" [72] (p. 680). Edge density measures the degree to which the transformative space is cohesive. To assess the strength of the inter-organisational ties within the transformative space, ties were categorised as either weak or strong [15]. Network data were dichotomised three times. First, all ties, both weak and strong, were combined, and any tie greater than 0 became 1 [15]. Second, weak ties were identified as either rarely or occasionally. Here, ties that were equal to 1 and 2 became weak ties. This allowed us to measure and analyse the number of observed weak ties within and between groups. Third, strong ties were identified as either very often or extremely often [15]. Here, ties that were equal to 3 and 4 became strong ties. This then allowed us to measure and analyse the number of observed strong ties within and between groups [15]. This process was done for all three networks.

4.4. Qualitative Analysis

Semi-structured interviews and PLA workshop notes were analysed using manual coding and Nvivo 12 software. Qualitative data analysis followed inductive, iterative, and integrative processes [89]. We open-coded the data to identify key themes related to system perceptions, i.e., barriers and enablers. The word count tool found in Nvivo 12 was used to identify dominant keywords (i.e., barriers) emerging from workshop discussions and semi-structured interviews. The merging of SNA and qualitative analysis provided a comprehensive understanding of the changing system perceptions.

5. Results

Results from the Machubeni case study are presented here to test our two hypotheses that: (a) transformative spaces will enable broader levels of participation among actors between and within scales (Section 5.1), and (b) strong social-relational linkages (i.e., network ties) will increase over time across and within scales (Sections 5.2–5.4). Results from our two hypotheses will help identify which

key barriers and strategies enable effective collaboration and coordination in transformative spaces (Section 5.5).

5.1. Trends in Participation

Figure 3A,B shows the trend in the number of actors who attend workshop meetings in Machubeni over time. Our results show that the total number of actors who attended workshop meetings steadily increased between Phase 1 and Phase 2 (Figure 3A,B). There was a 134% increase in the total number of actors who attended workshop meetings between Phase 1 and Phase 2 (Figure 3A). In total, 58 members—28 local community members, 18 government officials, and 12 researchers—were identified as active members in both phases (Figure 3A). Twelve were based at the local municipality, three at the district level, and six at the province level, indicating that the transformative space was composed of different actors across and within scales (Figure 3B).
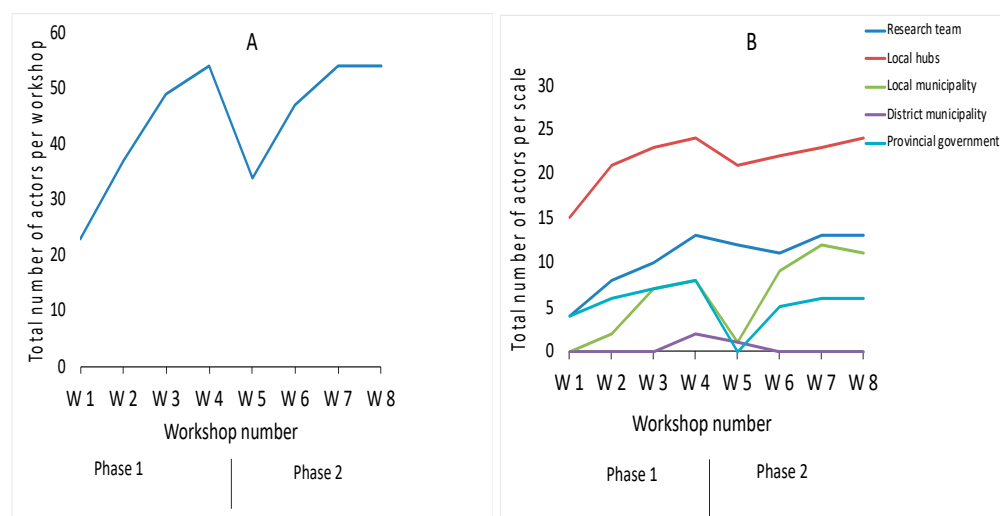

Figure 3. Trends and changes in the number of workshop attendees over time. (**A**) depicts changes in the total number of attendees and (**B**) depicts changes in the total number of attendees per scale. W represents workshop number.

Network members highlighted that the change of workshop venue led to an increase in attendance (coded 87 times). Provision of transport (coded 89 times) for local hub members to attend workshop meetings was cited as one of the reasons that led to an increase in attendance. Based on interview responses, network members cited environmental reasons for participating in the transformative space including:

> *"I joined the transformative space because I would like to help transform the Machubeni landscapes into a better sustainable area. I have realised that land degradation has rapidly increased over the past 60 years. Therefore, its has become a necessity to stop land degradation and bush encroachment which is affecting our livelihoods."*

Others cited cross-scale collaboration as a reason for joining the transformative space (coded 71 times): *"I joined the transformative space because I like the idea of working together. Moreover, the workshop allows us to interact and share knowledge with government officials who hardly visit Machubeni."*

While the transformative space enabled broader levels of participation in Machubeni, there was a slight decrease in the number of active actors in Phase 2 (Figure 3B). Based on workshop attendance data, there was a high turnover of government officials and the youths (Figure 3B). In Phase 2, we observed that district municipality staff and the youths stopped attending the workshop meetings (Figure 3B). High turnover of network members was identified as a major leakage of human capital

(coded 31 times). In terms of youth, the high turnover was due to a disinterest in home gardening and community-based land rehabilitation (coded 24 times).

Further probing revealed that most youth did not aspire to having green jobs. Here, green jobs refers to work related to the conservation of the environment. One youth member suggested that the high turnover was due to the fact that youth anticipated employment opportunities as data enumerators and not as land rehabilitation workers. In some instances, the youths emphasised that the transformative space was not a safe space and their safety was often compromised. As one youth member noted:

"Whenever we make suggestions during forum meetings, the older participants always interject us. However, we cannot argue with the elders in public because this is against our culture."

Interviewer: *But the forum is a safe space where all network members are equal?*

Respondent: *In principle, it is a safe space, but usually after the workshops, we often get a rebuke from the elders for highlighting divergent points to theirs. This resulted in youths keeping quiet during workshop discussions. "It is better to be safe than sorry."*

Out of the 22 government officials identified in Phase 1, 36% represented the public service, while 64% represented the local government. Inclusively, 9% (n = 2) represented senior management, 72% (n = 16) middle management, and 18% (n = 4) junior management. In Phase 2, there was a 12% decline (n = 2) in the number of middle management actors. Middle management actors interviewed related this 12% turnover rate to being overworked within the district (coded 12 times) and collaboration fatigue (coded 19 times). Figure 4 depicts the changes in the frequency of attendance by government actors over time. Further analysis revealed that the attendance ratio of senior management actors was highly fluid (Figure 4).
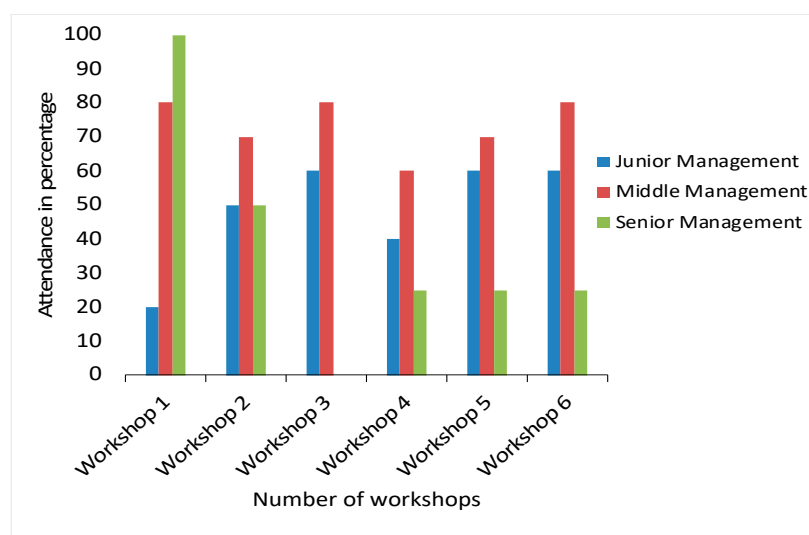

Figure 4. Changes in the frequency of attendance by government actors over time.

We observed that the frequency of attendance by junior management in 2019 steadily increased from 20% to 80% over two years, and this coincided with the rapid decline of senior management attendance. Based on interview responses, all senior management actors indicated apathy for future collaboration (coded 12 times). As one senior management actor articulated:

. . . "When the university finally exits the project in 2022, I do not see any senior government actors from District or Provincial level attending forum meetings because it will be the mandate of the local municipality as an implementer to take over . . . ..Our role at the Provincial level is to help with policy interpretation, but if the local municipality is non-functional there is nothing we can do" . . .

Further probing revealed that there were deep structural tensions between the local municipality and the district municipality. One district municipality official highlighted that the Municipal Structure Act of 1998 states that the role of the district municipality is to provide technical assistance to local municipalities, including sharing of specialised capacity. However, local municipality officials emphasised that the idea of shared priorities is an ideal concept on paper, but it is rare in practice, signifying governance mismatches. Overall, edge density, clustering coefficient, and reciprocity scores steadily increased on average over the two phases, despite a decline in the number of active organisations within the polycentric governance network (Figure 5). We observed that the reciprocity score of the inter-organisational trust network increased steeply from 0.33 to 0.85 (Figure 5). This might signify an increase in collaborative cohesion among different actors within the polycentric governance network.
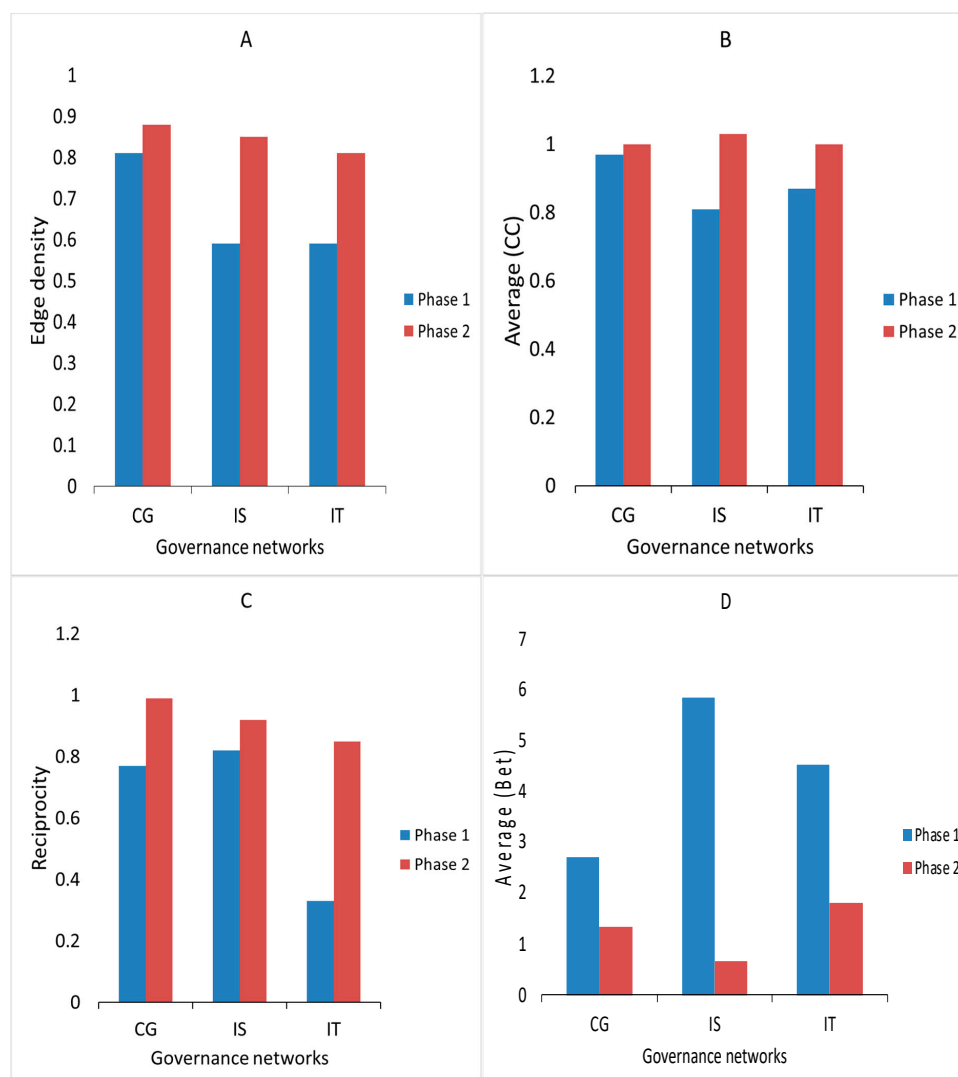

Figure 5. Network metrics evolution. (**A**) depicts changes in edge density; (**B**) changes in average clustering; (**C**) changes in reciprocity; and (**D**) changes in average betweenness. CG (Common Goals network), IS (Information-Sharing network) and IT (Inter-organisational trust network).

Furthermore, 90% of the respondents reported that the transformative space demonstrated strong cohesion (e.g., "*The transformative space discussions have enabled us to form new bonds and build strong relationships with other villages and government actors. Furthermore, I have realised that by working together as different villages, government departments and researchers, we can arrest land degradation because we all bring different strengths. For example, Rhodes University is glueing us together, the government*

departments are providing technical support, and the community is providing the energy to rehabilitate the land"). The social facilitation process enabled attitudinal changes: network members generated a "together-we-can" mentality. We observed an increase in edge density, as well as clustering and reciprocity within the network (Figure 5). The increase of these metrics scores over time suggests that there is an increase in cooperation and knowledge sharing among different semi-autonomous institutions within the polycentric governance network. While there is an increase in network density, clustering coefficient, and reciprocity, the average betweenness steeply declined over time (Figure 5, supplementary: Tables S2–S5).

Most importantly, we observed that the overall number of strong ties increased on average, while the number of weak ties decreased over time (Figure 6). The changes in the proportion of direct ties observed within respective governance networks in Machubeni ranged widely, with the common goals network having an increase of 6%, information-sharing network 25%, and inter-organisational trust network 33%. Furthermore, the proportion of strong ties steadily increased, with the common goals network having an increase of 66%, information-sharing network 29%, and inter-organisational trust network 17%. In terms of multi-actor ties, strong linkages were prevalent between local–local hubs, while weak vertical ties were prevalent between the local hubs and the local municipality (Figure 6). Overall, the proportion of strong ties between the university and the government departments remained stable over time across three networks (Figure 6).
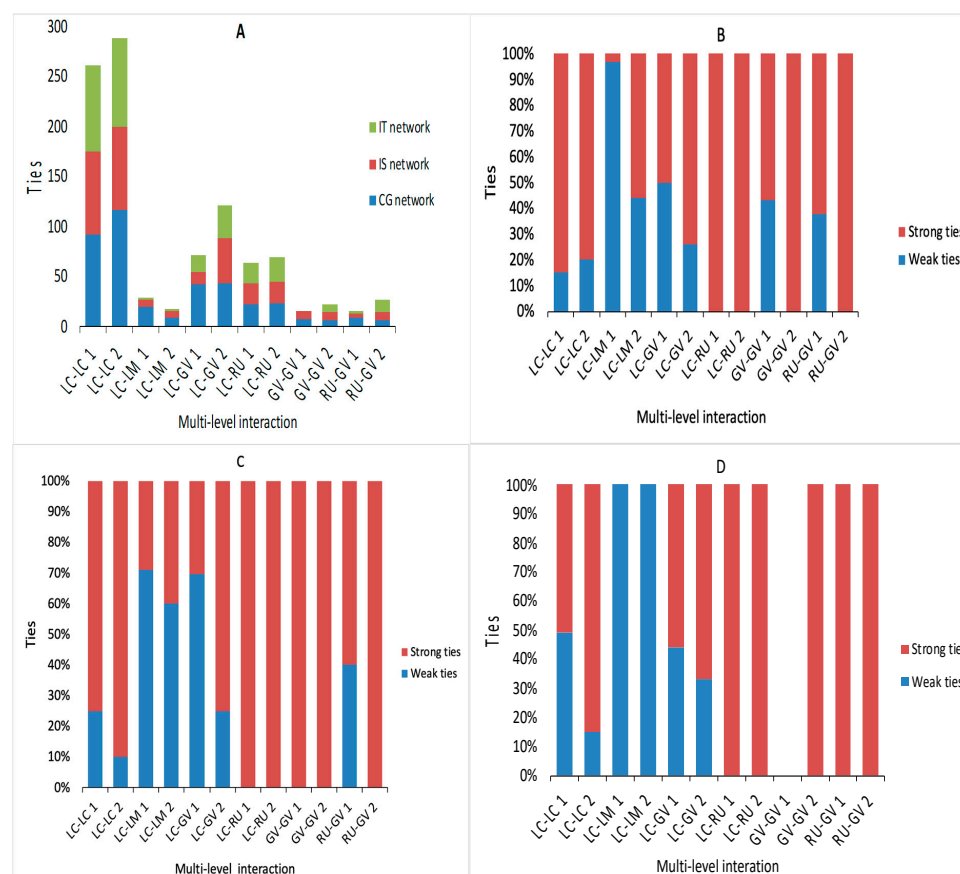

Figure 6. Distribution of multi-actor and multi-level ties across three networks. (**A**) depicts the distribution of ties across three governance networks, i.e., IT (inter-organisational trust network), IS (information-sharing network), and CG (Common goals network) between Phase 1 and Phase 2. (**B**), (**C**) and (**D**) depict the distribution of strong versus weak ties across three governance networks (common goals, information sharing, and inter-organisational trust networks). LC (Local hubs), LM (Local municipality), GV (Government), RU (Rhodes University).

5.2. Evolution and Description of the Common Goals Network over Time

Our analysis revealed that the distribution of strong ties increased among actors and across scales over time (Figure 6). Semi-structured interviews revealed four processes that contributed to the increase of strong ties among local–local hubs over time. Network members highlighted that enhanced social facilitation (coded 43 times), personal relationships (coded 21 times), behavioural change (coded 13 times), and personal learning (coded nine times) were related to the increase of strong ties within the network over time. Network members elucidated that social facilitation enabled members to develop shared goals, thereby enhancing relational and collective agency. Most importantly, ties among local–local hubs were mostly strong with like-minded organisations such as CA, LR, and RG closely connected in both phases (Figure 7) because of personal connections, with one hub leader suggesting that "*over the past two years we have enjoyed working together as local organisations, and we have become stronger together.*"

Phase 1:
March 2018–February
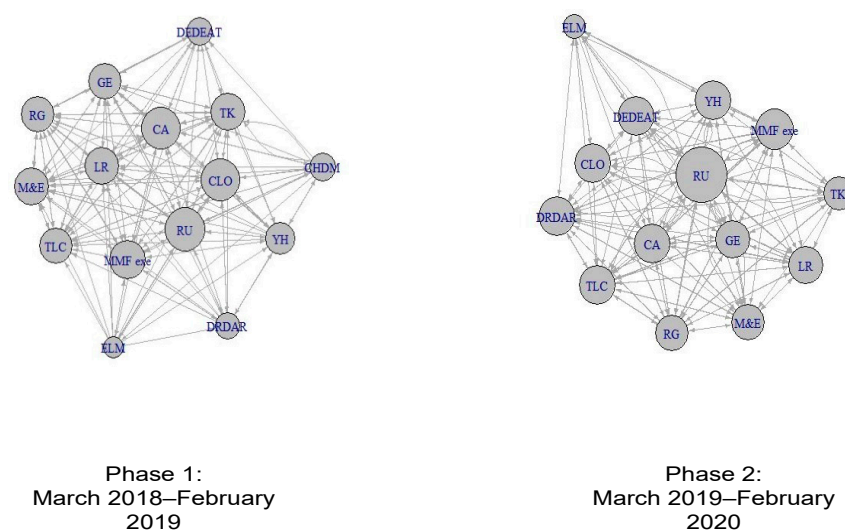2019

Phase 2:
March 2019–February
2020

Figure 7. Overview of the common goals network. Arrows represent directed, weighted ties and circle size represents degree centrality. Rhodes University (RU), Department of Economic Development, Environmental Affairs, and Tourism (DEDEAT), Department of Rural Development and Agrarian Reform (DRDAR), Chris Hani District Municipality (CHDM), Emalahleni Local Municipality (ELM), Traditional Leaders Council (TLC), Masibambisane multi-actor forum executive (MMF exe), GEF5 Community liaison officers (CLO), Conservation Agriculture Hub (CA), Land Rehabilitation Hub (LR), Rangeland Management Hub (RG), Training and Knowledge Hub (TK), M&E Hub (M&E), Gender Equity Hub (GE), and Youth Hub (YH).

Our data reveal that the local municipality was the least connected organisation across and within scales in both phases (Figure 7). Further probing revealed that municipal officials were hesitant in aligning their goals with the rest of the network because of limited resources for service delivery (coded 13 times) and a lack of clearly outlined rules of engagement between local municipalities and civil society (coded eight times). An ex-municipal employee elucidated that most municipal extension officers who attend the forum meetings were mere 'pen-pushers' with little or no authority to make decisions that enable institutional transformations.

5.3. Evolution and Description of the Information-Sharing Network over Time

Our analysis revealed that the distribution of strong ties increased between actors and across scales over time (Figure 6). In Phase 1, we observed that Rhodes University was the most central and dominating actor (Figure 8). However, in Phase 2, five organisations were identified as central in the information-sharing network. Based on interview responses, network members linked this to an increase of cross-scale coordination meetings, i.e., Intergovernmental Relations (IGR). Both the

Department of Economic Development, Environmental Affairs, and Tourism and Department of Rural Development and Agrarian Reform were seen as central government agencies that shared technical information within the transformative space. However, network members reported weak ties between local organisations and the local municipality in both phases (Figure 6).
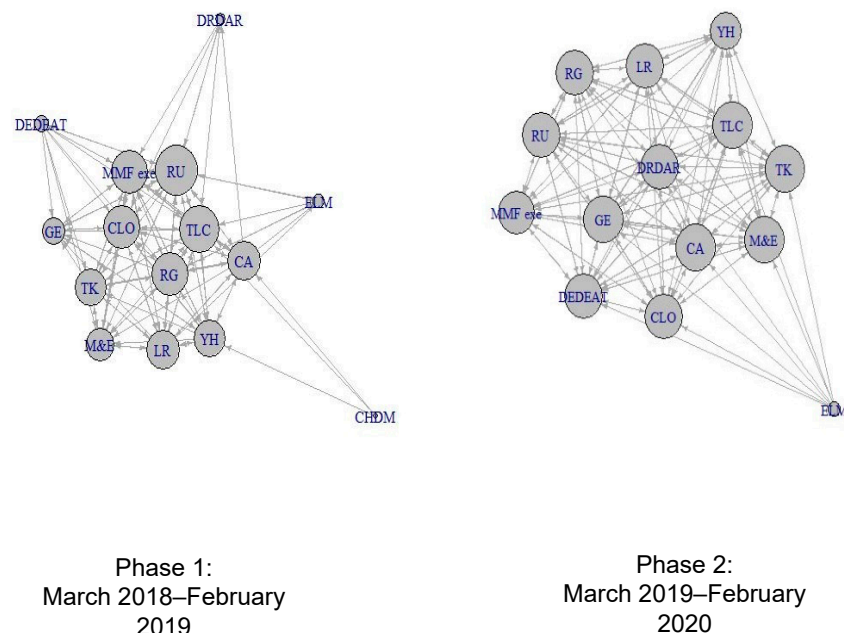

Phase 1:
March 2018–February 2019

Phase 2:
March 2019–February 2020

Figure 8. Overview of the information-sharing network. Arrows represent directed, weighted ties and circle size represents degree centrality. Rhodes University (RU), Department of Economic Development, Environmental Affairs, and Tourism (DEDEAT), Department of Rural Development and Agrarian Reform (DRDAR), Chris Hani District Municipality (CHDM), Emalahleni Local Municipality (ELM), Traditional Leaders Council (TLC), Masibambisane multi-actor forum executive (MMF exe), GEF5 Community liaison officers (CLO), Conservation Agriculture Hub (CA), Land Rehabilitation Hub (LR), Rangeland Management Hub (RG), Training and Knowledge Hub (TK), M&E Hub (M&E), Gender Equity Hub (GE), and Youth Hub (YH).

Document analysis of grey literature from the Emalahleni municipality revealed that the local municipality did not have adequate scientific information to share with local communities concerning land degradation and rangelands. Further probing revealed that a lack of resource planners at the local municipality level, such as soil scientists, pasture scientists, and natural scientists, created communication barriers. Network members interviewed elucidated that political instability (coded nine times), high-level leadership instability (coded four times), deep structural tensions (coded eight times), and discontinuous participation by senior municipality officials (coded 48 times) from the local municipality impeded effective communication within the transformative space across scales. Despite most organisations and hubs having some informational ties in both phases, there were no informational ties reported for the district municipality in Phase 2. Two potential explanations for this emerged from interviews with district municipality officials, who highlighted that the participatory process was time-consuming considering that the transformative space focused on five villages within the district. Another reason might be insufficient budgets from the district municipality to fulfil demands of the transformative space, thereby resulting in self-exclusion, e.g., "*the district municipality is financially constrained, and we support six local municipalities, it will be difficult to commit to knowledge sharing activities.*"

5.4. Evolution and Description of the Inter-Organisational Trust Network over Time

Our analysis revealed that the distribution of strong ties increased between actors and across scales over time (Figure 6). Figure 9 depicts the overview of the Inter-organisational trust network over time. Although there was an increase in strong ties between local–local hubs, mistrust between the Traditional Leaders Council and the MMF executive was becoming more apparent. The MMF executive was accused of "capturing" the project and directing all project benefits to their cronies (coded 34 times). As one of the headmen stated:

"We are the custodians of this community, MMF executive is distributing lucerne seedlings without our blessings. What criteria did they use to distribute the seeds? As the headman, I am the father of the five villages, and I will never let anyone divide my community. Therefore, the selection criteria should include all local semi-autonomous hub leaders."
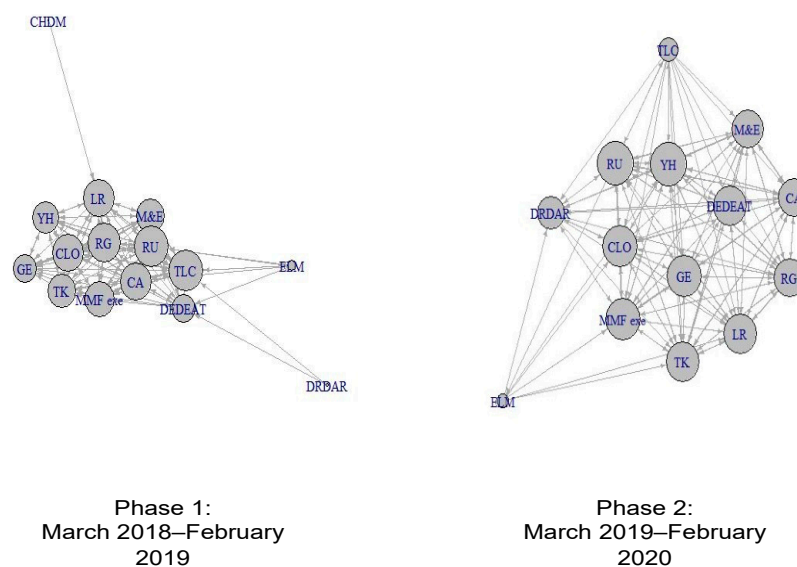

Phase 1:
March 2018–February 2019

Phase 2:
March 2019–February 2020

Figure 9. Overview of the Inter-organisational trust network. Arrows represent directed, weighted ties, and circle size represents degree centrality. Rhodes University (RU), Department of Economic Development, Environmental Affairs, and Tourism (DEDEAT), Department of Rural Development and Agrarian Reform (DRDAR), Chris Hani District Municipality (CHDM), Emalahleni Local Municipality (ELM), Traditional Leaders Council (TLC), Masibambisane multi-actor forum executive (MMF exe), GEF5 Community liaison officers (CLO), Conservation Agriculture Hub (CA), Land Rehabilitation Hub (LR), Rangeland Management Hub (RG), Training and Knowledge Hub (TK), M&E Hub (M&E), Gender Equity Hub (GE), and Youth Hub (YH).

However, the MMF responded by highlighting that:

"when making decisions, we include the two headmen and their seven sub-headmen. However, when a headman misses an important meeting, it is the responsibility of the sub-headman to inform their headman."

Further probing revealed that some of the tensions emanated from unclear communication channels among the multiple semi-autonomous institutions at the local level. Other network members highlighted that the diminishing legitimacy of traditional leaders, due to multiple independent institutions, created tensions within the transformative space (coded eight times). Further analysis revealed that there were more strong ties among different hubs and the MMF executive than with the Traditional Leaders Council.

5.5. Reflection Phase

Three months after analysing the social network data, transformative space members held a workshop to identify key barriers and strategies that enable effective collaboration and coordination. Network members identified four key barriers and practical suggestions to enable effective collaboration (Table 2).

Table 2. Identified strategies to overcome barriers to effective collaboration and coordination in transformative spaces.

Identified Barrier	Strategy
Time constraints	• Finding alternative dates that suit all actors. • Dissemination and sharing of institutional calendars to enable effective planning. • Deepen and accelerate the development of local municipality technical capacity.
Weak communication channels	• Extend and deepen collaboration, coordination, and communication across scales. • Facilitate vertical and horizontal communication. • Local leaders to oversee project performance and relationships.
Functional incompatibility of democratic and traditional structures at the local level	• Leadership training and capacity development of traditional leaders and hub leaders, e.g., conflict resolution training. • Strengthen and support MMF leadership to develop and implement relevant forum policies and a code of ethics.
Leakages of human capital	• Enhance women participation by including female-headed families and single women engaged in livestock farming. • Provide transport for network members. • Provide short-term employment for youths as data enumerators. • Support small business development for the local people, especially the youth and women.

Workshop participants suggested that constant M&E of governance process is a necessary way of identifying key barriers. First, workshop participants mentioned time constraints (coded 67 times) as one of the key barriers that affected effective collaboration. To solve this challenge, workshop participants highlighted the need for finding mutual workshop dates that enable inclusive participation of all actors across scales. Furthermore, government officials highlighted the need of sharing institutional work calendars as a way of enabling effective workshop planning and reducing high turnover rates. Second, workshop participants identified weak communication channels (coded 57 times) between local hubs and the Traditional Leader's Council as one of the key barriers to effective collaboration at the local level, with one hub leader highlighting:

> "I think failure to communicate effectively among ourselves has strained our relations and has resulted in us forming unnecessary cliques which are unhealthy."

Furthermore, network members emphasised that vertical and horizontal communication and accountability are necessary for effective coordination at the local scale, with one hub member suggesting that:

> "In order to achieve our goals, we need effective communication and transparency. I have realised that if we work in silos, we will not achieve most of the goals we set in 2018."

Additionally, network members suggested that information deficits could be addressed by extending and deepening collaboration, coordination, and communication. To achieve cross-scale coordination, the project team, Traditional Leaders' Council, and SLM hub leaders were to be included in the Emalahleni Intergovernmental Relations Forum (IGR). Third, network members identified functional incompatibility of local hubs and traditional structures (coded 32 times) as one key barrier to effective collaboration. Leadership training and capacity development of traditional leaders and hub leaders were suggested as key strategies to enhance functional compatibility. Most importantly, network members identified that there is a need to strengthen and support MMF leadership to develop and implement relevant forum policies, bylaws, and a code of ethics. Other strategies included enhancement of relationships, changing of mindsets, and renewal of commitments between actors within and across scales. Lastly, network members identified leakage of human capital (coded 27 times)

as a barrier to effective collaboration. Other identified strategies included providing transport for network members, creating short-term employment opportunities, and supporting small business development for the local people, especially the youth. One youth member highlighted:

> *"In order for real transformation to happen in Machubeni, the government and research institutes should create job opportunities that appeal to the youths. I took the youth garden job because I am desperate to make a living otherwise if I were to get a better job opportunity in Johannesburg, I would definitely quit the youth garden job. Moreover, after 2022, there will not be project funding; there is no need to stay permanently in Machubeni."*

6. Discussion

This research intends to achieve a greater understanding of how evolving multi-actor and multi-level ties influence the level of information sharing, inter-organisational trust, and views of shared goals in emerging transformative spaces over time. Our work has underscored the potential benefits and challenges of establishing a transformative space that includes multiple actors across and within scales, i.e., natural resource users, traditional leaders, key government departments, and researchers. Without overstating the claims of our results, the data support the two hypotheses: firstly, transformative spaces enable broader levels of participation among actors between and within scales; and secondly, strong social-relational linkages (i.e., network ties) increase over time across and within scales. Overall, our findings depict that bringing together a diverse network enabled open dialogue and reflexive learning among key actors within and across scales in Machubeni, mirroring what has been written about transformative spaces [30,32]. Below we discuss our findings from the perspective of transformative spaces, social networks, social capital, and polycentric governance literature.

Results presented in this study show that the proportion of strong ties across three governance networks (common goals, inter-organisational trust, and information sharing) increased over time. This increase may suggest that broader levels of participation and interaction of different actors across scales may be necessary for enhancing collaboration and coordination in transformative spaces. For example, multi-actor ties among government institutes, local hubs, and the research team contributed to the increase in knowledge sharing and coordination. That multi-level ties connected actors vertically (across multiple levels) demonstrates that polycentrism might be essential in enhancing cross-scale learning and knowledge sharing in transformative spaces. Furthermore, evidence from interviews suggests that inter-organisational trust played an essential role in enhancing knowledge sharing and coordination in transformative spaces. This finding supports points elucidated by Newel and Swan [90], who suggested that inter-organisational trust is central for the effective operation of governance networks. Therefore, we argue that increased social capital can enhance collaboration and coordination in multi-actor and multi-level networks.

Another important finding that emerged from our study is that it takes time to develop and nurture multi-level trust. Network members highlighted that high turnover of government and municipality officers affected inter-organisational trust and knowledge-sharing networks. For example, whenever a new government or municipality official joined the transformative space, it meant that new trust-building, learning, and engagement processes must take place, thereby making it challenging to develop and nurture trust [80]. Cundill and Fabricius [80] highlighted that mistrust from government or municipality will remain there until they can solve their operational challenges. It is therefore critical for government or municipality officials to take charge in building trust with local communities. This requires building social capital and resilience and strengthening human capacities of rural communities. Therefore, we urge researchers and government agencies involved in transformative spaces to continuously monitor and track network perceptions that influence trust throughout the stages of network development.

Results from the SNA analysis indicate that Rhodes University plays a vital role as a transformative space-maker within the transformative space. Compared to other organisations within the transformative space, Rhodes University recorded significantly high metric scores in both phases,

demonstrating its importance as a convenor, facilitator, and knowledge provider. On the other hand, significantly high metric scores (e.g., in Phase 1) might mean that the transformative space is highly centralised around Rhodes University. Given that university-supported transformative spaces have limited funding and strict time frames [32], we suggest that it is necessary to foster and strengthen capacities of other semi-autonomous organisations within the network, especially the local hubs. Building network redundancy of other semi-autonomous organisations within transformative spaces might help reduce exposure to institutional failure [55,63,69]. For instance, capacity building of local hubs may help build network resilience and, in turn, improve multi-level connectivity.

Our study has highlighted the importance of analysing the administrative powers of key actors. We propose that it is "more than just engaging with any government official"; there is a need to balance engagement between junior-, middle-, and senior-ranking officials when establishing a transformative space. Our case analysis has demonstrated that the absence of senior-ranking officials in transformative spaces hinders decision-making and transformative institutional change. Both junior- and middle-ranking officials do not have administrative powers to implement crucial decisions that may enable effective collaboration and coordination. Given the complex nature of the administrative setup of government organisation, we acknowledge that there is no 'silver bullet' in addressing these power imbalances, but transformative learning is a critical prerequisite for finding solutions to address structural dimensions [91]. Furthermore, we propose that the community services department at the local municipality is best suited to effect transformations in Machubeni, given that its role is to contribute towards a safe and secure environment. However, this requires skills capacity development and training in systems thinking. Improving the institutional capacity of local municipalities might necessitate effective coordination of multiple municipality departments and knowledge sharing [92,93].

Governance literature highlights the importance of scale-crossing brokers' collaboration in networks [94]. In South Africa, local government is identified as a critical administrative level to effect transformations [95], considering that it is the first point of contact between local communities and government [96]. Furthermore, local municipalities are identified as the most appropriate policy implementers at the local level [97]. However, we pinpointed a weakness in their connectivity within the transformative space. The relatively weak ties between the local municipality and the rest of the network implied their low capacity to influence knowledge exchange in transformative spaces. Given the low capacity to influence knowledge exchange and collaboration, the local municipality might not be able to effect transformations and knowledge sharing within Machubeni [95]. Failure to effect transformations might exacerbate the rate of land degradation, thereby eroding people's livelihoods and pushing them further into poverty. Failure to effect transformations might depress innovation and productivity in the area, which is highly dependent on social grants. We recommend that transformative and robust leadership are needed to steer implementation in the right direction at the local municipality level.

Prell et al. [98] suggested that actors sharing weak ties may find it challenging to engage in open dialogue. Our results depict that the weak ties between the traditional leaders and MMF executive at the local level might hinder or fracture transformations and collaboration at the local level. Interview data revealed that the tensions at the local level might have been caused by jealousy and ineffective communication channels. However, a more in-depth analysis revealed that the creation of multiple semi-autonomous hubs at the local level created tensions, because it diluted the influence of the traditional leaders in the area. We attributed this to the power of hubs to make individual decisions without consulting the traditional leaders. The question as to whether the current governance arrangements foster long-term cooperation or whether they are prone to disintegrate further remains to be seen. Some authors argue that it is difficult to merge democratic and traditional structures in South Africa because of possible dictatorial tendencies of traditional leaders [99,100]. However, we argue that the traditional leadership is compatible with modern democracy and has the potential to improve governance and collaboration, and also effect transformations in rural South Africa for two reasons. Firstly, from a SLM perspective, the Communal Land Tenure Policy (CLTP) mandates the traditional

leaders to distribute land in their areas [101]. As such, it is their role as traditional leaders to ensure that community needs and interests are factored into local and district planning. Secondly, the Municipal Structures Act allows traditional leaders to attend and participate in council meetings as ex-officio members, thereby enhancing co-operative governance across scales [92].

Despite the importance of traditional leadership in a modern democracy, we identified three institutional gaps that may hinder transformations in rural South Africa. Firstly, we identified traditional leaders' inadequate skills and knowledge to pursue their mandate effectively as a major barrier. For example, our study highlighted that traditional leadership was ineffective in managing partnerships for the benefit of the whole community. Secondly, our results showed that traditional leadership structures (e.g., headman and sub-headman) were ineffective in consulting and engaging with communities. Thirdly, our analysis revealed that women were not represented in traditional structures in Machubeni, which is far below the 33.3% national policy requirement [102]. Therefore, it is necessary to strengthen and capacitate traditional leaders as a way of enhancing transformative governance to promote sustainability in rural South Africa. Lack of female representation might lead to the exclusion of women from participating in transformative spaces, making it an "all men affair." Women constitute 70% of the Machubeni population and their main source of livelihood is farming and livestock [103]. For transformation to occur, we propose that transformative spaces need to be inclusive of all key actors, including women.

Furthermore, our paper demonstrates the importance of longitudinal data and M&E for elucidating transformations in transformative spaces. With growing interest in transformations to sustainability [30,32,82], there is a need for adequate M&E. Lessons learned from this study include the importance of monitoring network dynamics and system perceptions as a way of tracking the actual performance of transformative spaces. Without an understanding of network dynamics and system perceptions, we believe it will be difficult to envisage network pathways that influence institutional change in transformative spaces. We reason that project teams or research institutions involved in land degradation initiatives should consider strengthening M&E. This might be crucial in achieving developmental impacts and detecting institutional change that is attributed to transformative change [32]. M&E might help in informing transformations and identifying barriers to transformations. We also recommend that M&E can be used as an effective tool for learning. We argue for future researchers to employ Exponential Random Graph Models (ERGM) to test for more specific propositions, such as analysing the conditions of institutional fit within transformative spaces [104].

7. Conclusions

Our results support the two hypotheses: that transformative spaces enable broader levels of participation among actors between and within scales and, secondly, that strong social-relational linkages (i.e., network ties) increased over time across and within scales. With regard to the first hypothesis, this paper has highlighted the implications of polycentrism in enabling broader levels of participation, cross-scale collaboration, and learning in transformative spaces. Despite the findings highlighting the potential role of transformative spaces in ensuring broader levels of participation, ineffective communication channels at the local level caused tensions among the semi-autonomous hubs. This suggests that polycentric governance networks might present specific challenges. We identified leadership training and capacity development of traditional leaders and hub leaders, e.g., conflict resolution training, as necessities to enhance effective collaboration and coordination.

The findings from this study illustrate the importance of employing a social-relational perspective in analysing changing social connections and relationships in transformative spaces. We observed that actors with strong ties of trust also possessed similar strong ties of information sharing within the network. In particular, inter-organisational trust played an essential role in enhancing knowledge sharing and coordination. We found that learning is a critical prerequisite for finding solutions to address structural dimensions within a transformative space over time. Network members identified strategies to strengthen collaboration and coordination in transformative spaces through

learning. While the transformative space in Machubeni has succeeded in enhancing collaboration and knowledge sharing between groups that did not previously dialogue, further long-term engagement with government agencies might be necessary for promoting institutional transformations and policy outcomes, and building network resilience in complex polycentric governance systems.

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