Contesting transdisciplinary climate knowledge:

A decolonial perspective on the FRACTAL project in Windhoek, Namibia

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Declaration of Authorship

I have read and understood the regulations governing the submission of a Masters dissertation, as contained in the rules of this University. I know the meaning of plagiarism and hereby declare that all of the work presented in this minor dissertation, save for that which is properly acknowledged, is my own.

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Abstract

Recent trends in sustainability research have particularly propagated transdisciplinary approaches in knowledge production. These new modes of knowledge production seek to deconstruct universalist principles and epistemic authorities from positivist research approaches. The potential of replicating existing power dynamics into these transdisciplinary spaces has, however, not sufficiently been critically questioned yet.

This study proposes that transformative change in development of African cities requires a deconstruction of these power dynamics, that current transdisciplinary sustainability research is not yet sufficiently engaging in. To examine the power dynamics, the study applied a decolonial lens in its analysis. In a novel approach to contesting climate knowledge, the study sought to deconstruct the foundational concepts that are operationalised in the transdisciplinary knowledge generation. The analysis focused on tracing assumptions to identify imaginaries, that construct the geopolitical space and condition knowledge politics within a transdisciplinary research programme in Windhoek, Namibia. It further sought to reveal the mechanisms in the programmatic research design that condition epistemic authorities and subjectivities in the collaborative processes.

Power dynamics were traceable through imaginaries as well as the evidencing of epistemic authority. Two overarching imaginaries could be traced, which are based in the construction and engagement of the geopolitical space in Windhoek: the imaginary of the social impact and desirable future and the imaginary of the science-policy interface. Both imaginaries were underpinned by the vision of transformation, whose operationalisation revealed to be instrumental in determining the actual transformational potential in contrast to the envisioned one. The analysis indicated the concept of transformation to be an inhibiting factor due to uncontested power dynamics that were replicated in the transdisciplinary space.

Epistemic authority was especially evident in connection with the climate information that was generated to inform the knowledge co-production. A contestation of authoritative knowledge was evident with regards to contextualising the information for present and future climates in Windhoek. However, the scientific climate information itself was not questioned for its authority. The conceptual design of the stakeholder engagement revealed to be the main mechanism that created subjectivity.

The study concluded with an exploratory section, an ‘epistemic disobedience’, which engages the principle of *Walking With* that is used by the indigenous activist movement of the Zapatistas in Mexico to create a vision of a new world. *Walking With* is used to reconstruct a vision of a decolonial approach to generating climate knowledge in an

African urban space. This exploration further exemplifies a dimension of decolonial criticism, which is the importance of going beyond deconstruction towards fostering decolonial thinking.

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Abbreviations

ACDI - African Climate and Development Initiative
AU - African Union
CCVA - Climate Change Vulnerability Assessment
CEO - Chief Executive Officer
COP21 - 21st Conference of the Parties
CoW - City of Windhoek
CSAG - Climate System and Analysis Group
GHG - Greenhouse Gas
GIS - Geoinformation System
MCD - Modernity/Coloniality/Decoloniality
MET - Meteorological Services
MRC - Multidisciplinary Research Centre
NamWater - Namibia Water Corporation Limited
NCCC - Namibia Climate Change Committee
NDP - National Development Plan
NUST - Namibia University of Science and Technology
SADC - Southern African Development Community
SASSCAL - Southern African Science Service Centre for Climate Change and Adaptive Land Management
STS - Science and technology studies
SE - Strategical Executive
T21 - Threshold 21

TD - Transdisciplinary

UCT - University of Cape Town

UK - United Kingdom

UNAM - University of Namibia

UNFCCC - United Nations Framework Convention on Climate Change

1. Introduction

Transdisciplinary research is becoming more and more of a buzz word for funders especially for climate change adaptation in the global South (Schmidt and Pröpper, 2017). With this growing trend towards engaging in transdisciplinary spaces, transdisciplinary knowledge processes have developed into a preferred mode of knowledge generation (Meehan, Klenk and Mendez, 2018). Transdisciplinarity as a concept applied in the research space is characteristic of the ambiguous space in which this mode of research is being applied. It encompasses an emphasis on plurality, complexity and diversity in a collaborative process that transcends disciplinary boundaries with a wide range of social groups as potential actors and participants (Darbellay 2014: 166; Klein, 2013: 192). The departure from traditional modes of knowledge generation with narrow worldviews to this epistemological shift that marks a major “change in the way knowledge is conceptualised, created and assessed” (Taylor et al., 2017: 4) has opened the space of knowledge generation from academic disciplines towards a broader socio-political engagement. At the same time, these new transdisciplinary knowledge regimes have created “implicit logics of accountability and imaginaries of social impact” (Meehan, Klenk and Mendez, 2018: 760) that have hardly been examined critically. Specifically, contestations and problematisations of the applied theoretical concepts as well as of the academic worldviews that get replicated, are until today very scarce (Schmidt and Neuburger, 2017: 54). In light of the gaining popularity of this mode of knowledge production it is, therefore, imperative that the transdisciplinary research space, and the knowledge generation processes it creates, are examined critically.

While critical investigations of knowledge generation processes and their embedded knowledge politics are only just emerging in the area of transdisciplinary sustainability science, critical investigations of knowledge generation and the embedded knowledge politics have been a central concern for postcolonial and decolonial critiques in political and social sciences (see for example Freire, 1970; Spivak, 1988; Bhabha, 1994; Chakrabarty, 2000; Mignolo, 2009; Maldonado-Torres, 2007; Grosfoguel, 2012). Both

streams of criticism contest modernity as a replication of colonial principles, such as the perpetuation of universalisms in knowledge production. The theoretical genealogies of both criticisms, however, diverge (Ndlovu-Ghatseni, 2015: 491). While postcolonial theory engages primarily a Eurocentric critique rooted in post-structuralism, decolonial approaches connects with political activism, creating “radical political and epistemological shifts” (Mignolo, 2007: 452). Postcolonial theory is foremost concerned with contesting and deconstructing cultural dimensions, while decolonial theory enacts more directly the political sphere (Bhambra, 2014: 115).

The research of this study centres on decolonial theory to apply a critical lens towards transdisciplinary knowledge generation. It is a novel approach with regards to climate knowledge, as the epistemic interventions of the decolonial project at present have not been applied as a critical lens in this field. Critical contestations of knowledge production in the climate change discourse are currently drawing on postcolonial critique, as is demonstrated in the literature review in chapter two. While postcolonial theory has a more extensive legacy of being applied in critiques of knowledge politics than decolonial theory, the decisive political perspective and connection to activism that decolonial critique draws on, allows for a deeper critical reflection. Decolonial theory links modernity to coloniality as the inherently same system, understanding it as colonial modernity (Asher, 2015: 832).

The concept of coloniality, which decolonial theory is based on and which this study’s applied perspective is based on, draws on the Modernity/Coloniality/Decoloniality (MCD) research programme, which understands existing power relations in regions that experienced colonialism as directly rooted in this experience (Ndlovu-Gatsheni, 2015: 487). One of its most prominent contributors, Walter Mignolo, defines coloniality as the ‘darker side’ of modernity that exists as “an embedded logic that enforces control, domination, and exploitation disguised in the language of salvation, progress, modernization, and being good for everyone” (Mignolo, 2005: 6) and that must be unmasked as such. Therefore, understanding both coloniality and modernity as projects based on the same principles allows for a more fundamental questioning of power

dynamics that are replicated in the modern geopolitical space and socio-cultural norms. Decoloniality in the context of modernity and coloniality was therefore centred as the analytical perspective for this study as a necessary dimension for an examination of a complex space of intersections such as transdisciplinarity that seeks to solve highly complex challenges posed by climate change and urbanisation.

1.1. Research overview

In the research approach of this dissertation, the decolonial perspective is applied to critically engage with and problematise the theoretical concepts, ontologies and epistemologies in transdisciplinary research and the collaborative learning spaces in which it is implemented. The following propositions are guiding the research approach:

- The study proposes that in geographical spaces of colonialism, the collaborative processes in transdisciplinary research reproduce a power dynamic that is rooted in the colonial project.

- It therefore proposes that transformative change in development of African cities requires a deconstruction of these power dynamics, that current transdisciplinary sustainability research is not yet sufficiently engaging in.

To investigate the research aim, the transdisciplinary research project Future Resilience for African CiTies and Lands (FRACTAL) was examined, particularly the design of the project and the implementation of the collaborative learning spaces in one of the three focus cities of the project, Windhoek, Namibia. FRACTAL was initiated in June 2015 and will run until 2019, coordinated through the Climate Systems Analysis Group (CSAG) at the University of Cape Town. The City of Windhoek was selected as the focus of this study because it is one of the three Tier 1 cities of the project, which were

the cities in which a more formalised space of co-exploration[1] and co-production[2] was set up as City Learning Labs (FRACTAL proposal, n.d.). Windhoek was favoured over the two other Tier 1 cities as it offered accessibility as a research space through its proximity to Cape Town, particularly considering restricted funds for travel by the author of this study, and for timing reasons. It offered the opportunity to accompany the FRACTAL project researchers on their field work, as the timing of the project's field work in Windhoek coincided with the timing of the field work for this study.

The aim of the study is to examine underlying power dynamics within this research space by analysing how and among whom the structures of control of climate knowledge are distributed within the FRACTAL project in Windhoek. The decolonial perspective applied in this study translate into the following three objectives:

Objective 1
Construction of the geopolitical space: Identify the regimes of knowledge mobilization across spatial, historical and geographical scales

Objective 2
Socio-cultural creation of subjectivity: Analyse the embodied geopolitics of the participants in the knowledge generation process

Objective 3
Knowledge politics: Examine the epistemic authority of the different knowledge regimes and imaginaries

[1] Co-exploration is a participatory approach to collaborative knowledge generation that refers to a mutual questioning and sharing of knowledge between the different participating stakeholders and does not seek to transcend the science-society binary (Taylor et al., 2017: 11f).
[2] Co-production of knowledge is employed as a mechanism to bridge the science-policy gap through a mutual and equal shaping of knowledge by all stakeholders who participate in the process (Pohl et al, 2010: 269).

1.2. The FRACTAL project

FRACTAL is one of five large international research projects under the umbrella of the Future Climate for Africa (FCFA) programme that aims to explore the use of medium to long term climate information to inform development decision-making in Africa. It is funded through the FCFA programme, which was established in 2014, and which in turn is funded by the UK Department for International Development and the UK Natural Environment Research Council. ("CDKN", n.d.). As part of a broader multi-consortia programme, the research set-up of the FCFA as well as its funding structure inevitably influences requirements and large-scale aims of the FRACTAL research design. The programme's coordination, capacity-building and knowledge exchange is led by the African-based agency SouthSouthNorth while the larger framework of the programme is supported through large international institutions based in the global North, such as PricewaterhouseCooper and the aforementioned UK government agencies (ibid.). Even though a thorough examination of the interdependencies between FCFA and FRACTAL cannot satisfactorily be undertaken within the limited scope of this study, the context of the funding agencies in the UK is particularly noteworthy as a dimension of dependency that connects this study's focus region Windhoek in Namibia with the larger developmental strategies of funds that support projects tackling global challenges such as climate change, migration and poverty. Noxolo (2017: 343) points out an important shift in the strategic vision for these funds by the UK Department for International Development – from partnerships and transnational community envisioned in previous strategies (Department for International Development, 1997; Noxolo, 2012) to the current vision of "investment opportunities around the world" with the UK as a global leader for international development (HM Treasury & Department for International Development, 2015: 3f). The new strategy builds on terminology that invokes dependencies from a colonial mindset, for example as it emphasises the need for a controlled process that drives value for money to ensure national interests are met (ibid.: 4). Such shifts in the terminology of the UK's strategic approach point towards a weakened emphasis of building long-term development relationship and "throws substantial amounts of money behind a colonialist approach that […] views knowledge

as something to be extracted and applied, resulting in measurable ‘impact’ in relation to global challenges, and with the emphasis on ‘value for money’ for the UK taxpayer” (Noxolo, 2017: 343). Such a strategic setting as the context of funding for critical, transdisciplinary research in the global South points towards complex and difficult interdependencies within larger consortia research programmes with possible impacts all the way to the local scale such as the FRACTAL cities. It also points to a funding context for the FRACTAL project that itself is reflective of a trend towards colonialist mindsets rather than away from it.

Within this context, the FRACTAL project is set up as one of five “independent research consortia” (“FCFA”, n.d.) set under a central coordination unit that aim to address the global challenge of climate change in a regional context. FRACTAL is the only African-led project among the research programmes and operates at the intersection of two major issues for Southern Africa, which are climate change and urbanization. The main focus is set on collaboration between researchers and practitioners, including city officials and other key decision-makers (Daron et al., 2016: 5). In order to establish the required relationships, dialogues and processes that create “an enabling environment for trans-disciplinary discussion, research and learning on the most pressing needs facing select cities in Southern Africa due to a changing climate” (Daron et al., 2016: 15), the project sets up a space of joint knowledge production. For FRACTAL’s work in Namibia, this means understanding, identifying and proposing ways to successfully integrate the scientific information on projections of future climates for the area of Windhoek into local decision-making processes in conjunction with all participants.

FRACTAL’s proposed theory of change sets up a framework towards institutional transformation, enhanced information use capacity and improved understanding and availability of appropriate information for decision-making in urban spaces (“FRACTAL ToC”, n.d.). It is centred around transdisciplinary learning, relying on the concepts of co-production and co-exploration, which are based on learnings from the literature and projects with similar aim and design, to increase resilience in the cities of Southern Africa (Taylor et al., 2017). These underpinning concepts are integrated at different

stages into the design of the research with the aim to create an ongoing dialogue among decision-makers, practitioners and researchers from the fields of climate science, social studies, governance and adaption. Core elements of the process are the spaces of transdisciplinary knowledge production, the City Learning Labs, which are being conducted in three cities: Lusaka, Maputo and Windhoek. At these events, the participants engage in collaborative learning processes about climate change (Arrighi et al., 2016: 12). The Learning Labs as well as the City Learning Dialogues are embedded in a process of collaboration and exchange, which involve embedded researchers, who are immersed in the working world and practices of the people shaping and making climate-related decisions in the urban areas (Daron et al., 2016: 12).

1.3. The FRACTAL project in Windhoek

Windhoek is one of three focus cities within FRACTAL, termed Tier 1 cities in the project, and is therefore one of the cities in which the activities of the FRACTAL research, including modelling climate information, developing material based on the climate information, conducting research in the city to understand and map the decision context and conducting collaborative learning processes, are being implemented (City of Windhoek, 2016). Windhoek, Lusaka and Maputo were chosen as the focus cities as they “are key cities in the sub-continent, and represent a strong climate gradient from arid to wet subtropical, a significant contrast of society and culture, and a range of risk exposures and governance issues with local and regional dependencies” (FRACTAL proposal, n.d.). In these Tier 1 cities, a partnership is set up including a Memorandum of Understanding between the project coordinators at the University of Cape Town and the local municipality and a local university to steer the implementation process of the project. In Windhoek, the local FRACTAL team is from the Environmental Management Division of the City of Windhoek and the Department of Biological Sciences at the University of Namibia.

FRACTAL works with the concept of an embedded researcher, in which an academic researcher is recruited for the project and works both for and with the local government and the local university ("FRACTAL Brochure", n.d.). In Windhoek, the embedded researcher together with the project leads at the City of Windhoek and at the University of Namibia have coordinated and facilitated joint learning and policy workshops beyond the collaborative events set up through the FRACTAL research design, such as the Learning Lab events (McClure, 2018d; Iipinge, 2018a; Iipinge, 2018b). Participants in these jointly organised collaborative spaces and workshops of FRACTAL in Windhoek have included city councillors, regional councillors, representatives from neighbouring municipalities, representatives from different departments of the local government as well as bodies of the Namibian government, representatives from international and local nongovernmental organisations, local research agencies, national meteorological services, national media as well as official project partners (Mfune et al., 2017; Iipinge, 2017a; Iipinge, 2017b; FRACTAL, 2018b; Iipinge & Haukelo, 2018).

1.4. Rationale: Contesting knowledge production in transdisciplinary research

While social and political science scholars have a long-standing tradition of engaging in critical reflection on the hegemonies of power dynamics and concepts of knowledge generation, researchers in geographical science have only recently started questioning these dimensions (Sundberg, 2014; Radcliffe 2017). Academic disciplines such as geography, urban studies and sustainability science, which all intersect in the transdisciplinary research arena established within FRACTAL, notably struggle with a prevalence of dualist construction of concepts and imaginaries – nature and culture, city and nature, global and local (Jasanoff, 2010; Hulme, 2010; Hulme 2011; Lang et al., 2012; Castree, 2014; Eriksen, Nightingale & Eakin, 2015). Consequently, fundamentally questioning and contextualizing such concepts in their application in a research environment, that aims to establish transformation towards resilience within Southern African cities, is necessary.

The concept of knowledge co-production is a popular approach in transdisciplinary knowledge production, through which climate information generated in the academic space is envisioned to become useful for the participating stakeholders (Muñoz-Erickson, 2017). It is the mechanism expected to bridge the science-policy gap, that has been identified as one of the main barriers for successful climate change adaptation (Lemos, 2015; Meadow et al., 2015). As a principle, it envisions the different knowledge systems of the stakeholders, who participate in the process with equal relevance to mutually shape the outcomes of the knowledge process (Pohl et al, 2010: 269). Such a vision assumes that power dynamics between the knowledge systems and the participants in co-production can be deconstructed sufficiently. However, current reviews of transdisciplinary knowledge production indicate that the implementation of this envisioned equality has been challenging.

One challenging dimension is the prevalence of epistemic authority that is still prescribed to scientific knowledge, even in these transdisciplinary research spaces. Non-academic knowledge has started gaining recognition within environmental and climate science as a valid source of information to be used in decision-making particularly in rural areas, where communities rely on natural resources and the cultivation of land for their livelihood (Vaughan et al., 2016: 71; Bezner Kerr et al., 2017; Daly, 2016). In the urban space, however, ‘local’ knowledge for climate change adaptation usually refers to practitioner knowledge about processes and contexts, not about the physical system (Miranda Sara and Baud, 2014; Corburn, 2003). As observed in other transdisciplinary research projects, scientific knowledge to inform decision-making is still regarded as “superior to and more powerful than any other forms of knowledge” (Felt et al., 2016: 755). Yet while concepts of culture and nature as well as traditional spaces of knowledge institutions rooted in Eurocentric literary tradition are still theorized in current scholarship without problematizing and fundamentally challenging all universalist claims, the generated knowledge runs the risk of continuing to reproduce colonial legacies and subordinate other ontologies (Sundberg, 2014: 34f).

As cities are still considered separate from nature, people's experience with weather in urban areas and their corresponding expectations on climate does not find any consideration in adaptation plans and policy in cities. Local knowledge for urban spaces is considered to be practitioner's knowledge, the knowledge of decision-makers and influencers (see for example Negev & Teschner, 2013; Cloutier, 2015; Clark et al., 2016; Buizer, Jacobs & Cash, 2016). Relevant knowledge is framed within a paradigm based on the principles of modernity. As (post)colonial thinkers have pointed out, knowledge systems and institutions need to be questioned specifically in geographical spaces with colonial legacies and re-built from a de-colonial, inclusive perspective to not fall into the same trap that creates indigenous knowledge as an additional, ethnic voice that is not part of the general scientific discourse, but instead defined as "alternative", always in juxtaposition to the assumed universal concept of scientific knowledge (Mignolo, 2009; Grosfoguel, 2012; Quijano, 2007; Keet, 2014).

Therefore, it is the underlying imaginaries, institutionalized rules and value orders that are especially deeply entrenched in academic research that need to be questioned. Current research points towards radical changes that will be necessary in order to achieve the desired societal changes that research based on transdisciplinary co-production is trying to achieve (Felt et al., 2016: 756). To conceptualise the complex theoretical space that will allow for such an analysis in this study, the literature review provides an overview of different conceptual approaches to this topic within the literary discourse, based on which the theoretical framework in chapter three is built.

1.5. Structure of the thesis

The study largely applied an established approach to qualitative research in the structure and implementation, centring an empirical analysis informed by the current literary discourse and assessing the research questions in the context of this discourse. In addition, however, an engagement with an indigenous principle is deliberately

inserted into the standard structure to disrupt and exemplify the epistemic disobedience that decolonial thinkers have called for (Mignolo, 2009).

In the following sections, a literature review is conducted of the academic discourses that engage with the dimensions that the space in which transdisciplinary climate knowledge is generated is fundamentally shaped by. These dimensions include conceptualisations of transdisciplinarity, the consideration of climates from a geopolitical perspective, and the discourse investigating knowledge and power in relation to coloniality. The reviewed concepts serve to establish the theoretical framework for analysis for this study and which is outlined in the subsequent chapter. Here, the contestations across the literary discourses are converged into the theoretical frame. From this frame, the dimensions of analysis are derived, echoing the dimensions of colonial modernity, which are the ‘coloniality of power’, the ‘coloniality of being’ and the ‘coloniality of knowledge’. These dimensions structure the analytical discussion in chapter five. In the discussion, the concepts and assumptions that were traced in the FRACTAL document review are contextualised to illustrate the imaginaries that are evoked in the context of the transdisciplinary research. The results from the document analysis and the participant interviews are then analysed with the decolonial lens established through the theoretical framework. A concluding section at the end of the study aims to both summarise the presented study as well as to shine light on further steps that similar work could take towards integrating decolonial approaches into examinations of transdisciplinary knowledge generation.

1.5.1. The Epistemic Break

Contrary to a standard approach to qualitative research, the theoretical framework is separated both from the literature review and from the methodology. This is to formally give space to the dimensions of analysis that are derived from the theoretical framework, which in part draw on principles of indigenous methodologies. The aim of this study, and specifically the decolonial perspective, required a deconstructive

approach in the implementation of this research, that seriously engages with new epistemologies.

To a certain extent, this deconstructive dimension is applied in the analytical framework in chapter three, by incorporating approaches from decolonial criticism. Yet, a genuine engagement with this criticism and their emphasis on de-linking from universalisms as part of a redemptive and liberatory epistemology (Mignolo, 2007: 453) would require the deconstruction to go further. Ndlovu-Gathseni (2015: 489) reflects on the problematic application of methodologies rooted in the colonial projects in sites of colonialism:

> Schools, colleges, churches, and universities in Africa are sites for reproduction of coloniality. We so far don't have African universities. We have universities in Africa. They continue to poison African minds with research methodologies and inculcate knowledges of equilibrium. These are knowledges that do not question methodologies as well as the present asymmetrical world order. In decoloniality, research methods and research methodologies are never accepted as neutral, but are unmasked as technologies of subjectivation if not surveillance tools, that prevent the emergence of another-thinking, another-logic, and another-world view. Research methodologies are tools of gate-keeping.

As West et al. note (2012: 1584) in their conceptualisation of an indigenous research method, it is necessary to assert indigenous methodologies in their ability to credibly stand alone in order to "avoid the inadvertent 'colonization' that occurs when combining them with Western methodologies". The division of research design and theoretical framework therefore creates the necessary space to negotiate the different epistemologies and ontologies of scientific research that is rooted in "Eurocentric modernity [that] obscures the specificities of race and place, and invisibilized other epistemes to masquerade as universal and total" (Asher, 2013: 832). It was therefore indispensable to consciously create the necessary space, which is intended in the separation of the theoretical framework into its own chapter.

As a way to sincerely address this criticism, this study additionally incorporates an exploratory section to "go beyond critique and deconstruction to foster decolonial thinking" (Asher, 2013: 833), which is a central aim of the decolonial project. This

section draws on a principle applied by the indigenous activist movement of the Zapatistas in Mexico and explores the possibilities to engage with “non-Eurocentric” forms of knowing, not only as an alternative perspective, but also as the building principle for academic engagement in transdisciplinary knowledge generation. It is a thought experiment that seeks to envision the application of an indigenous principle in the urban space of southern Africa, to show ways to engage and to help remove the hesitation of engaging with indigenous epistemologies outside of research, that directly concerns these communities. This exploration was not originally anticipated to be part of the research of this study, but emerged as a necessity to seriously connect with the call for decolonising knowledges that is becoming more and more pressing especially in the African institutions of higher education (Ndlovu-Gathseni, 2015: 492).

2. Literature review

2.1. Introduction

The interplay between science, policy and society has been extensively researched in different academic fields, with social and environmental science being two of the prominent ones. Global change processes and climate change in particular have sparked a diverse discourse on the need for a closer interaction between science, policy and society as well as the need for new approaches particularly in connection with knowledge processes (Castree, 2014). Both the broader theoretical discourse around the science-policy-society ‘gap’ and knowledge co-production are relevant theoretical themes for understanding the research space in which FRACTAL operates. Therefore, the review of the literature starts with a broader contextualisation of the concept of knowledge generation in transdisciplinarity and its specific application in relation to the climate change discourse. The review proceeds to examine the literary discourse in which location, space and power are examined in the context of climate change and which predominantly takes place in the academic field of science and technology studies. The third academic discourse that is relevant to this study are contestations of

power dynamics in relation to coloniality in the academic fields of environmental sustainability and geography. Here, the examination exemplifies the emerging engagement of these fields with decolonial criticism. The literary discourses of these different academic discourses converge at times, but due to their differing theoretical genealogy are still happening in distinct academic spaces. The review of the literature therefore concludes with an assessment of the convergences and divergences in the different discourses, with the aim to link commonalities in the discourses and help construct a theoretical framework from which to base the analysis of the research on.

2.2 Bridging the science-policy-society gap through transdisciplinary research

Scholars researching the science-policy interface have traditionally either focused on improving the available scientific knowledge or improving the availability of this knowledge (Kirchhoff, Lemos and Dessai, 2013: 394). The use of new technologies to capture climate data and model future climates led to a better quality and availability of climate information about the climate system (Vaughan and Dessai, 2014: 890). This improved understanding of the system fostered a growing attention to climate change as a global issue and quickly made apparent the necessity for transmitting these findings to the relevant stakeholders in society and gave way for the emergence of climate services as a discipline (Visbeck, 2008; Giannini et al., 2016). However, especially with regards to issues related to climate change, scientific knowledge is still being used far less than expected in decision-making (Cash et al., 2003: 8086). This has fostered an increased attention to limitations and barriers of climate-information uptake in society in recent years. The persistent paradigm of scientific research in natural science, which propagates a linear model, postulates a “hegemony of theoretical or […] experimental science” that is driven from within the discipline and which assumes “authority of scientists and their host institutions, the universities” (Nowotny, Scott and Gibbons, 2003: 179). Such research approaches of providing scientific ‘expert’ knowledge, which subsequently is used to increase the scientific relevance of policies,

has been assessed as insufficient in the context of complex global change challenges like climate change, sustainable development and urbanization (Parnell and Oldfield, 2015).

As a consequence, research designs especially in climate change adaptation have generally steered away from linear approaches, also referred to as ‘Mode 1’ or positivist, towards alternative models of knowledge production, which remove the user-producer binary and include stakeholders into the process of scientific production (Dilling and Lemos, 2009; Kirchhoff, Lemos and Dessai, 2013; Gibbons, 2000; Rosendahl et al., 2015). Already in 1994, Gibbons et al. proposed a new ‘Mode 2’ concept to describe the transformative processes that knowledge production and scientific research was beginning to grapple with and the accompanying shift towards a new, ‘postnormal’ scientific paradigm (Felt et al., 2016: 736). Mode 2 describes a new paradigm of knowledge production characterized by being “socially distributed, application-oriented, trans-disciplinary, and subject to multiple accountabilities” (Nowotny, Scott and Gibbons, 2003: 179). Subsequently, these concepts have started to get mainstreamed into academic research, albeit they have not yet successfully been moved firmly out of the margin and into the centre of academic research approaches (Jahn, Bergmann and Keil, 2012: 2). Due to different disciplines engaging in this new form of research, a variety of terms are today used to refer to a process, in which non-academic stakeholders are active participants. In addition to Mode 2, they include ‘participatory research’, ‘public participation’ and ‘transdisciplinarity’ (Brandt et al., 2013: 2). These concepts have especially gained popularity within sustainability science as their focus on involving scientists alongside societal actors meet the increasingly voiced demand for new approaches in research that are more suitable than traditional disciplinary models, to deal with the complexity of global change challenges (Felt et al., 2016: 733; Lawrence, 2015: 1; Schmidt and Neuburger, 2017: 54). At its core, the concept of Mode 2 relies on participatory, collaborative knowledge instead of discipline-driven scientific knowledge, with the aim of generating ‘usable’ and ‘socially robust’ knowledge (Rosendahl et al., 2015: 18) that meets the needs of decision-makers at different scales.

Within this new knowledge production paradigm, different levels of cooperation and collaboration within the academic space and with actors outside of it, have led to the concepts of multidisciplinarity, interdisciplinarity and transdisciplinarity being applied in similar spaces of contemporary academia (Austin, Park and Goble, 2008: 557). While they overlap in their inclusionary approaches to research, they differ in their area of engagement. Multidisciplinarity focuses on cooperation that surpasses the restrictions of single disciplines, where two or more disciplines approach a subject of research from their respective viewpoints. However, these interactions with the subject of research occur mostly "in succession and in isolation without any real interaction between them" (Darbellay 2014: 165). Interdisciplinary work goes a step further from merely juxtaposing, towards collaborating with an integration of different competencies and knowledges from multiple academic disciplines to establish new fundamental understandings through a joint production of knowledge (Darbellay, 2014: 166; National Academies, 2005: 2). Transdisciplinarity, then, represents the most collaborative concept out of the three, which least relies on pre-existing disciplines (Nowotny, Scott and Gibbons, 2003: 186; Austin, Park and Goble, 2008: 557) and the process of knowing transcends beyond disciplinary boundaries to solve a societal problem that falls outside of these boundaries by "bringing political, social, and economic actors, as well as ordinary citizens, into the research process itself" (Darbellay, 2014: 166). While it does not delineate a clearly defined theory or methodology, transdisciplinary research is characterized by a transcending of traditionally narrow worldviews in disciplines and is usually complex, diverse, uncertain and multidimensional (Klein, 2013: 192).

Often the terms inter- and transdisciplinarity are used synonymously or in conjunction, as for example in Felt et al. (2009) and Schmidt and Neuburger (2017). This points to their close conceptual connection as well as the need for a more consistent theoretical framing of the two concepts that has been one of the main criticisms of transdisciplinary research in general (Brandt et al, 2013; Jahn, Bergmann and Keil, 2012). Other authors, such as Popa, Guillermin and Dedeurwaerdere (2015: 47) however, question this criticism and argue that "transdisciplinarity does not aim at establishing a common

theoretical framework, but rather at fostering self-reflection". Further studies have established the importance of the notion of reflexivity as a core element of transdisciplinary knowledge production that distinguishes this approach from other collaborative research concepts and which is necessary to ensure accountability in a setting involving stakeholders from science, policy and society (for example Kläy, Zimmermann and Schneider, 2014; Jahn, Bergmann and Keil, 2012; Felt et al., 2016). As observed by Felt et al. (2016: 755f), a lack in sufficient reflexivity in transdisciplinary research creates the danger of reducing its transformative potential to structural fixes instead of establishing spaces of negotiation, leading to reflexivity being marginalized and replaced by reflection. When considering transdisciplinary knowledge production, the ambiguity of the conceptual as well as epistemological frame therefore need to be analysed and contextualised in order to examine any implications that this form of research and its application in practice might have on the knowledge generation practice.

2.1.1. Transdisciplinary knowledge within FRACTAL

Being part of Future Climate for Africa programme and thus constituting one of the first large-scale research projects to build transdisciplinary climate knowledge within urban spaces across Sub-Saharan Africa, the FRACTAL project team has created a number of working papers to reflect on previous learnings and challenges to create a robust rationale for their theoretical framework approach. Based on the increasing promotion of engagement with practitioners in research, transdisciplinarity, co-production and co-exploration are selected as conceptual approaches with the aim of including diverse kinds of expertise both from scientific as well as local knowledge (Taylor et al., 2017: 2). A specific theory of change forms the basis of the research approach, in which the knowledge generation process is embedded as a result of institutional transformation processes, increased capacity to use climate information among participants, improved decision-making processes and the availability of appropriate climate information ("FRACTAL ToC", n.d.).

The framing of the research design around transdisciplinarity specifically aligns the project's aim with a high collaborative engagement across academic disciplines and a focus on transcending the science-policy-society division. The concept of transdisciplinary knowledge, as it is established within the FRACTAL research design, is based on critical reflections on the current literary discourse on the concept of 'Mode 2' knowledge production and post-positivist approaches to scientific research. With regards to knowledge systems, FRACTAL incorporates co-production of "various types of knowledge and ways of creating knowledge from across academic disciplines and from […] knowledge-holders outside academia, [which] are valued equally" (Taylor et al., 2017: 4) as the baseline for the knowledge generation process. Based on the high overlap between transdisciplinarity and knowledge co-production, the two concepts are accepted as "in effect the same thing, despite the two terms being used separately in different research foci of the FRACTAL project" (Taylor et al., 2017: 10), as both knowledge generation processes share the element of transcending "the boundaries between science and policy, and policy and practice".

Within inter- and transdisciplinary climate change research, the integration of notions of co-production has fostered an increased legitimization of practitioner's knowledge. Particularly in rural areas, the 'local' or 'indigenous' knowledge is beginning to get recognized as relevant for understanding changes in climate and thus also as necessary to be considered in strategic decision-making and policy work at the regional level (Naess, 2013; Hiwasaki, Luna & Shaw, 2014; Tengö et al., 2017; Obermeister, 2017). So far, for urban areas - as seen above - 'local' knowledge is commonly used to refer to the knowledge of practitioners, officials and representatives, who are credited with being 'experts' in their respective practical fields. This consideration of local knowledge as practitioner's knowledge is indicated in FRACTAL as well, where the assumption "that 'expertise is widely distributed' and that scientific and local knowledge need to be included in finding solutions to the environmental and social problems at hand" underpins the conceptualisation of diverse knowledge types of relevance (Taylor et al., 2017: 2).

In addition to the concept of transdisciplinary co-production, the research design is extended with the emerging idea of co-exploration, which also refers to a participatory approach, but which, in contrast, does not seek to transcend the science-society binary. Rather, it denotes a mutual questioning and sharing of knowledge between scientists, practitioners and policy-makers. It explores the “development and resource management context in which the decision-makers are operating and [.] whether climate data, information or knowledge is needed, and if so, what information is specifically relevant to the decision(s) and how can it be most effectively provided” (Taylor et al., 2017: 11f). In this regard, FRACTAL critically engages with current problematisations of transdisciplinary research by including an approach that allows for a reflexive space regarding the scientific input into the knowledge generation process.

2.3 Critiques of locality and culture in climate change discourse

The academic discourse concerned with the science-policy-society interface at times, but not centrally, engages in contestations of the geopolitical space and perpetuations of hegemonic principles in science. This discourse is still an emergent one and is at present applied as a mode of critiquing by specific scholars of academic fields that conduct research at the intersection of science and society. Most notably it is scholars of science and technology studies (STS) who triangulate the dimensions of locality and the geopolitical space in their criticism of academic research. In their theoretical genealogy, contestations of place, space and power mostly draw on postcolonial criticism, which has served as the basis for critical engagements with different subject matters of relevance to this study. These are traced in the following section.

Postcolonial scholars have long questioned the epistemological authority of Western-centric scientific knowledge, analysing its relevance in the colonial system, and accordingly the representation of science in historic accounts (Spivak 1988; Said, 1995; Chakrabarty, 2000; Anderson and Adams, 2008; Harding, 2016; Jazeel, 2017).

Emerging from this criticism, STS scholars have also been scrutinised for the manner in which they have grappled with different knowledge regimes (Watson-Verran et al., 1995; Goonatilake, 1998; Odora and Hoppers, 2011). As scholars in feminist postcolonial studies have pointed out, there is also a long-standing tradition in STS to engage a situated perspective into the discourse (Haraway, 1988; Harding, 2011: 3; Pollock and Subramaniam, 2016: 957). In addition, feminist criticism is increasingly used as a theoretical vantage point to engage in STS and questions of locality. Pollock and Subramaniam (2016) review the epistemological intervention of feminist postcolonial thinkers to relation to science studies, who elaborate the colonial from a feminist perspective. This allows for a re-engagement with existing and more established feminist criticism of science, technology and society through applying a specific postcolonial frame[3], which has the potential to "illuminate the ongoing materiality of global inequalities" (Pollock and Subramaniam, 2016: 956).

Nevertheless, this attention to locality has remained in the margin of canonical STS literature and attention from universities and from within the scientific research disciplines is only now starting to become more extensive (Harding, 2011: 3). As a response to this criticism, STS scholars have begun to further reflect on the situatedness of knowledge claims, interrogating them and the applied networks in their specific historic and cultural contexts. Felt et al. (2017: 1f) assess this engagement with postcolonial criticism to have made STS "sensitive to the moral economies that guide scientific research and technological development as well as to the various sociotechnical modalities through which ways of knowing and living get arranged". Pollock and Subramaniam (2016: 955) as well as Harding (2011: 4) both echo the trend towards more robust encounters of STS with postcolonial criticism, with increasing institutionalisation in academic centres of the global South as well as an increasingly substantial publications that not only address but solely focus on postcolonial STS.

[3] Postcolonial perspectives in feminist criticism specifically engage in examining the interconnectedness of science and technology with colonial ideology and colonial structures of dominance from a gendered perspective (Pollock and Subramaniam, 2016: 956).

For the field of geography and particularly climate change, postcolonial critical considerations have only been taking place in specific contexts. Rodina et al. (2017: 147) point out that geographical scholarship concerned with urban resilience and climate resilience has largely excluded historical dimensions and not actively questioned their implications for considering vulnerability in adaptation work. The authors note a need for greater attention to the situatedness of knowledges that are being integrated into resilience building and, in this context, specifically acknowledging and questioning the process and politics of knowledge production.

Within the discourse of climate knowledge production, Mahony and Hulme (2018: 307) propose the concept of epistemic geographies as a theoretical frame to further engage in the interrogation of climate knowledge politics. The authors draw on the notions of episteme and epistemic community, thus interrogating objectivity in scientific knowledge as well as the authority of experts from a spatial perspective. By adopting this particular angle in their analysis, they aim to draw “attention to the uneven geographies of scientific authority, the spatialities of the boundaries drawn between the scientific and the political, and the situated co-production of epistemic and normative commitments” (Mahony and Hulme, 2018: 307). This concept reflects the increasingly robust engagement with the socio-political context of research at the science-policy nexus, as seen for example with Meehan, Klenk and Mendez (2018), who expand the concept of epistemic geographies into a geopolitical framework for transdisciplinary research.

The representation of climate in academic discourse as well as in societal arenas such as policy and the media is generally based on a descriptive narrative of scientific parameters, as is for example illustrated in the definition of *climate* by the Intergovernmental Panel on Climate Change (IPCC, 2014: 1760):

> Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

Particularly at the global scale and in the policy arena, these scientific knowledge regimes continue to govern the representation of climate in general and future climates in particular. An emerging perspective in climate change discourse challenges these representations based on descriptive scientific parameters, pointing out the decoupling of climate from its cultural significance by detaching knowledge from meaning (Endfield and Morris, 2012; Livingstone, 2012; Hulme, 2015; Jasanoff, 2010; Meehan, Klenk and Mendez, 2018). Hulme determines that this “climate reductionism is driven by the hegemony exercised by the predictive natural sciences over contingent, imaginative, and humanistic accounts of social life and visions of the future” (2011: 245). Livingstone (2012: 92) terms it the ‘tyranny of the mean’, which “exerts its statistical power in climate discourse”, leading to an omission of elements that do not fit the global narrative established around planetary boundaries and global temperature means.

Questioning this hegemony which contextualizes climate facts as impersonal observations, Jasanoff (2010: 233) interrogates the tensions and conflicts that arise when the constructed representation of climate as an “impersonal, apolitical and universal imaginary" is applied in a space that is determined by lived experiences. In this context, the introduction of cultural dimensions into the discourse about changing climates constitutes an alternative perspective from which to construct a representation of climate that allows for an understanding of the pivotal roles of place and space in the “production, reception, circulation, application and testing of climate change knowledge” (Endfield and Morris, 2012: 2).

Due to this growing consensus on the importance of place and people’s locality as the spaces in which knowledge is produced and distributed, the situatedness of climate has increasingly become recognised as an important consideration especially in science-society boundary-spanning research. In what she terms an analysis of ‘civic epistemology’, Jasanoff (2010: 239) points out the strong linkages between environmental science and the “norm-building capacities of nation-states”. These civic epistemologies reflect “shared, culturally rooted experiences with issues related to technoscience, sense-making narratives, experiences, and recognized processes of

nonexpert participation" (Felt et al., 2016: 738) and determine the conditions which the validity and actionability of knowledge is judged by. While scholars across science and technology studies like Sheila Jasanoff have been examining the spaces of knowledge production in global and climate change research (see for example Jasanoff, 2007; Jasanoff, 2011; Jasanoff & Kim, 2013), geographers have engaged less intently with this particular discourse (Hulme, 2008: 6). However, Mahony and Hulme (2018: 307) are able to identify progress towards the integration of situatedness into climate change knowledges in geographical scholarship. The notion of locality remains, nevertheless, firmly in the space of the 'other', the 'alternative'. While Mahony and Hulme (ibid.) note an increasing attention to including different knowledge systems into the research, such as local, indigenous and traditional narratives, they highlight a lack of critical engagement regarding the prevailing dichotomy between disembodied global science and embodied local knowledge.

2.4 Considerations of coloniality in transdisciplinary knowledge generation

While locality has been of interest for researchers within climate change adaptation for quite some time, albeit on the margins, the mechanisms of knowledge politics and the implications of colonialism are only now beginning to attract the attention of a broader scholarly audience. Investigations of the socio-political processes that underpin adaptation have been emerging especially in the context of participatory research and community-based adaptation (Pelling, 2010; Simon and Leck, 2015; Chu, Anguelovski, and Carmin, 2016; Kaika, 2017). However, as Eriksen, Nightingale and Eakin (2015: 523) point out, conceptualizations of adaptation applied today have "by-passed critical analytical lessons learned in relation to other society-environment issues", disconnecting the political context of adaptation. The authors therefore propose a reconceptualization of adaptation fundamentally as a contested socio-political process. Even though they do not explicitly engage with dimensions of (post)colonialism, by reframing adaptation in an inherently political context that serves to negotiate and

contest authority, knowledge and subjectivity, it transcends cultural dynamics and may "serve as a platform from which to resist domination and assert alternative ways of addressing climate change adaptation" (Eriksen, Nightingale and Eakin,2015: 528).

Comparable conceptualisations of the embedded socio-cultural- as well as geopolitical dimensions- of climate knowledge mobilization have been applied in two recent dissertations, contributing concrete case studies to this theorization in an urban context. These are in the Netherlands in an urban context (Boezeman, 2015), as well as in a rural context in Tanzania (Daly, 2016). Another example constitutes the case study by Bezner Kerr et al. (2017: 238) within a participatory research project in Malawi, which questions not only the notion of knowledge authority, but specifically evaluates the knowledge dynamics for their political, social and environmental implications. All three case studies traced power dynamics within the knowledge co-production spaces, for example in relation to the epistemological dimensions (Bezner Kerr et al., 2017: 238) and by reproducing subjectivities (Daly, 2016: 216) and the transformational capacity of co-produced climate knowledge claims (Boezeman, 2015: 113). While historical dimensions are addressed in all case studies, the contestation of the co-production spaces draws mainly on the literary discourse of science and technology studies, without specifically engaging postcolonial criticism.

An emerging engagement with Latin American contributions to (post)colonial critiques is taking place within the discourse on geographical knowledge generation (Sundberg, 2014; Asher, 2013; Radcliffe, 2017). The theme of decolonizing geographical knowledge has gained traction on different platforms of academic knowledge transfer, most recently and extensively as the leading theme of 2017's annual conference of the Royal Geographical Society with the Institute of British Geographers. Radcliffe (2017) reviews the potential contribution that this decolonial framing proposes for the academic discipline of geography. She proposes that the 'decolonial turn' allows for re-engagement with "critiques of racialization, colonial-modern resource distributions and epistemic violence" (Radcliffe, 2017:331) within geographical science, thus building on and extending postcolonial and feminist criticism. Implementations of epistemic

interventions, as that proposed by Radcliffe grounded in the Modernity/Coloniality/Decoloniality (MCD) research programme, are discernible in Latin America, where the theme of social justice has become a central part of the analysis of relations between science and society (Harding, 2016: 1065).

Concurrently, this grappling with the “long-standing patterns of power that emerged as a result of colonialism” (Maldonado-Torres, 2007: 243) in geographical science has, in turn, been scrutinized for its effectiveness and contribution to the larger project of decolonization in academia. Esson et al. (2017) critically examine the approaches on decolonising geographical knowledges for their ability to implement decoloniality’s transformative potential within geographical science. The authors point out the necessity to engage with the decolonial movement beyond academic platforms, for it to go deeper than creating epistemological changes and to challenge institutions and structures (Esson et al., 2017:385). Jazeel (2017: 336) voices similar concerns when he acknowledges the danger to engage in theoretical debates and instead calls for scholars of geography to “think carefully about how to de-link the production of geographical knowledge from the hegemony of our disciplinary infrastructure”. Furthermore, he points out the risk of mainstreaming the decolonial imperative possibly leading to replacing one kind of theoretical orthodoxy with another (Jazeel, 2017: 335).

This concern is echoed by Noxolo (2017: 342) when she cautions that extending decolonial theory into areas beyond specific contestation of struggles based in the experience of colonialism creates a serious risk of it becoming harnessed and domesticated by Western academic spaces. She problematizes the research funding system in present academia specifically in the United Kingdom to inhibits deep engagement with decolonial approaches. Noxolo (2017: 343) identifies a trend towards re-colonisation in UK research funding that is visible in an epistemological shift within the national international development regulations – from previously promoting ‘partnerships’ to declaring “the UK to be ‘driving’ global development initiatives”. Such national geopolitical epistemologies are an important determinant for the possibility to translate the “radical power” (ibid.) of decolonial theory within academic spaces like

geography. A similar barrier has been described by Meehan, Klenk and Mendez (2018: 2) in a Colombian context, where they found that national sociotechnical imaginaries, development priorities, and local social orders shape research at the science-policy interface on different scales.

Sundberg (2014) goes further in her reflection on the potential of geographical engagement with post-humanism to go beyond contestations of dualist ontologies and fundamentally challenge institutionalised structures with her problematisation of prevailing reproduction of colonial ways of knowing and being in this body of literature. She, in fact, proposes three steps towards decolonizing geographical engagements based on conceptualisations from the insurgent political imagination of the Zapatista activist movement and Spivak's concept of *homework* (Sundberg, 2014: 39): a self-reflexive analysis in which geographers question their own and their discipline's epistemological and ontological assumptions, a sincere engagement with indigenous epistemologies, ontologies and methodologies and applying indigenous principles in learning processes. With this proposition, Sundberg makes a first step at a different way of conceptualizing. She thus addresses what has been contested by STS scholars in Latin America for some time, the necessity for theorisations of the social studies of scientific knowledge based on own frameworks that are not limited by epistemologies, boundaries and theories from the global North (Harding, 2016: 1065).

2.5 Conclusion: The intersection of academic discourse in the context of this study

The reviewed literature demonstrates that scholars concerned with the intersection of science and society in areas of sustainability are beginning to question epistemic authorities as well as actors in research spaces, and that this is predominantly rooted in STS criticism. Different academic disciplines are engaging with these questions in parallel, creating perspectives which only partially bridge into a larger critical conversation that inform these different dialogues. As seen above, transdisciplinary

knowledge has been scrutinized extensively due to its application in various academic disciplines, yet the discourse has been far from cohesive. Environmental knowledge for sustainability has grappled with similar questions as transdisciplinary knowledge and in cases in which both are framed in conjunction; their critical analysis informs each other. Climate knowledge, as a kind of environmental knowledge, is only beginning to form its own critical analysis of socio-cultural and geopolitical dimensions and is closely connected to the larger discourse on knowledge for sustainability.

There has been little examination of how postcolonial, decolonial, and feminist criticism in sustainability and geographical knowledge generation processes mutually shape and inform one another. As seen above, the discourses in the academic fields are only partially informing each other and while authors have applied with these criticisms for quite some time now, often drawing on the same critical dimensions from postcolonial theory, few scholars have attempted to bring together the different dialogues. As such, the concepts of relevance for this study are quite fragmented across different disciplines and the level of engagement with the contestations of place, race and power also vary distinctly.

For the conceptual basis of the analysis it is therefore necessary to converge the elements of the contestations from across these different academic discourses into the common ground that they establish. In this context, it is particularly necessary to examine the critical dimension of coloniality that scholars in sustainability and transdisciplinary science do not engage in and that need to be examined further. A discrepancy for the reviewed contestations is an apparent shortcoming to connect directly with the sources of contestation from postcolonial theory. This prevents the critical examinations to explore the different dimensions that postcolonial and decolonial critiques apply. The theoretical framework for this study, that is established in the following chapter, therefore not only converges the elements of contestation in the broader fields of STS and sustainability science but engages directly with criticisms of coloniality to establish the conceptual frame for the analysis of power dynamics in transdisciplinary climate knowledge generation in a southern African context.

3. Theoretical framework

The reviewed literature demonstrated that critical contestations of knowledge systems and epistemic geographies in relation to actors, agency, the epistemological frame and, to a certain extent, the geographic and historic context, are emerging. Where the discourse so far falls short is the contestation of the concept of climate and climate knowledge in dimensions surpassing the cultural framing. Additionally, scholars only marginally critically reflect on the prevalence of Northern paradigms within academic research within these academic disciplines. This focus on contesting knowledge systems from a predominantly cultural perspective, to focus on provincialisation, is mainly due to the discourse drawing on postcolonial theory, which has the "tendency […] to remain firmly in the realm of the cultural" (Bhambra, 2014: 115).

The key difference between decolonial and postcolonial criticism, besides their referencing of two distinct colonial projects, is the emphasis on de-linking in decolonial theory (Mignolo 2009: 178). It builds on the activist tradition of participatory research in Latin America, intended to be used by social justice movements, and thus also associates itself strongly with radical scholarship and societal activism (Harding, 2016: 1064; Jazeel, 2017: 335; Nixolo, 2017: 342). Decolonial scholarship actively seeks to deconstruct and to rebuild and reconceptualise a knowledge that is "otherwise" and that creates "pluriverses" and "multiepistemic literacy" (Grosfoguel, 2008; Harding, 2016: 1077; Radcliffe, 2017: 330). For this purpose, decolonial thinkers look to epistemes and knowledge traditions outside sources rooted in the Eurocentric concept of modernity, such as Indigenous knowledge (Mignolo, 2010).

Situated in the context of the broader conceptual and comparative literature reviewed in the literature review, the analysis for this study uses a geopolitical framework, as it is applied by Meehan, Klenk and Mendez (2018), for its point of departure. Expanding on the concept of epistemic geographies of Mahony and Hulme (2017) as elaborated above, Meehan, Klenk and Mendez establish a geopolitical framework to knowledge mobilization which allows shifting the focus of analysis from the cultural to the political

realm. In their framework, they integrate not only a framing of locality on science and society analysis, but also engage with social justice and power imbalances by examining the sociopolitical imaginaries that are reproduced in programmatic research designs (Meehan, Klenk and Mendez, 2018:3). By questioning the dominant regimes of evidence of idealized 'delivery-uptake' and 'supply-demand' binaries they explore power imbalances between knowledge systems and the potential for these sociotechnical imaginaries to displace alternative pathways of knowledge mobilization ((Meehan, Klenk and Mendez, 2018: 6). This deliberate introduction of the social and geopolitical context into knowledge mobilization also draws on Latin American scholars' critique of coloniality and reveals "a plurality of science-policy interfaces produced by local social orders and global hegemonic ideas and practices" (Meehan, Klenk and Mendez, 2018:16).

While the conceptual approach draws on decolonial thinkers, its application in the context of the study follows post-colonial STS approaches. Considering the established discourses within science and technology studies and climate knowledge, as seen in the literature review, they reflect and engage with dimensions of situatedness. They hardly, however, have addressed the radical potential of decolonial scholarship, which so far is limited to an initial engagement with geographical knowledge. Even though still few evaluations of the transformative potential of transdisciplinary research, that draws on postcolonial scholarship, have been realized, they rather indicate a concern that (post)colonial contestations for societal change are achieving little more than epistemological adjustments (Rosendahl et al., 2014; Felt et al., 2016; Schmidt and Neuburger, 2017). At the same time, out of the initial engagements of decolonial theory with geographical knowledge, scholarly voices are calling for a sincere and substantial engagement with fundamental questionings of existing knowledge hegemonies and institutions (Esson et al., 2017; Jazeel, 2017; Noxolo, 2017). In their study, Meehan, Klenk and Mendez (2018) succeed in questioning dominant, universalist regimes that shape the knowledge mobilisation process, but do not go further in deconstructing the institutions and systems on which this process relies. By touching upon colonial

legacies but not actively deconstructing them, the approach is limited in its potential to fundamentally contest and create new epistemologies.

Based on these reflections, a further engagement with decolonial thinking is necessary in order to ensure an analytical frame that allows for a critical examination not only of FRACTAL's processes, episteme and ontology, but also regarding the embedded structures and institutions that may reflect power dynamics. A critical contestation drawing on decolonial criticism shifts the focus away from provincializing Euro-centric claims towards "re-thinking the world *from* Latin America, *from* Africa, *from* Indigenous places and *from* the marginalised academia in the global South" (Radcliffe, 2017: 329; emphasis in original). In order to expand the analytical frame proposed by Meehan, Klenk and Mendez (2018) and take their examination further into a deconstructive exploration, it is therefore necessary to incorporate dimensions of decolonial criticism.

3.1. Identifying the dimensions of analysis

Meehan, Klenk and Mendez' argument (2018: 1) departs from a geopolitical contextualisation of knowledge mobilisation, in which they question idealised models of the science-policy interface. They focus on examining divergences between sociotechnical imaginaries in transdisciplinary research and the lived experiences of participants in knowledge generation processes in international collaborations of scientists and societal actors. Their analytical dimensions centre around plurality of scale, which they define as "immanent, emergent, and embodied 'sites' of spatial and social relations" (Meehan, Klenk and Mendez, 2018: 8), following an argument brought forward by Arturo Escobar in his 2008 publication *Territories of Difference: Place, Movements, Life, Redes*. In their study, Meehan, Klenk and Mendez explore three scales specifically, the scale of global circulation, the nation-state and the individual participants. On the global scale, they sought evidence for universalised visions of knowledge mobilisation in the design of the transdisciplinary research, on the national scale evidence of "sociotechnical imaginaries of transdisciplinarity as a mechanism of

economic development" (Meehan, Klenk and Mendez, 2018:8) in the country of Colombia and using the individual scale as a contrasting site, in which the participants continuously confronted and negotiated the global and national discourses that shaped the environment they worked in.

These three sites of coproduction from Meehan, Klenk and Mendez' geopolitical approach to conceptualising transdisciplinary knowledge mobilisation can be linked to and expanded by the analytical themes of the Modernity/Coloniality/Decoloniality (MCD) research programme. Conceptualisations from within the MCD programme are structured around three analytical themes, the 'coloniality of power', referring to the construction of the geopolitical space, the 'coloniality of knowledge', referring to knowledge politics and epistemologies and the 'coloniality of being', referring to historic and socio-cultural dimensions of the creation of subjectivities (Maldonado-Torres, 2007; Quijano, 2000; Ndlovu-Gastheni, 2015). The first dimension, the coloniality of power, links to Meehan, Klenk and Mendez' site of analysis, that is the nation-state and the connection of a neoliberal development agenda, that steers the possibilities for knowledge mobilisation and adds an additional layer of historic consideration grounded in a contestation of institutionalised colonial paradigms, that get reconstructed in the approach to development in modernity.

The second dimension, the 'coloniality of knowledge', links directly to the universalised visions and global regimes of knowledge mobilisation, which continuously get recreated in research designs. In this space particularly, analysing epistemologies of knowledge with a deliberate framing in coloniality allows to not only contest the epistemologies at play, as exampled by Meehan, Klenk and Mendez, but also requires a deconstruction of the knowledge institutions and knowledge regimes themselves. In the third dimension, the 'coloniality of being' connects the embodied geopolitics of the individual participant, which in Meehan, Klenk and Mendez' approach served as a contrasting site for the other two sites, with the dimension of actors and agency. This incorporation and framing from an agency perspective shifts the contestation into an active rather than passive framing, which allows for a deconstructive approach towards embodied geopolitics, that

includes a contestation of the creation of privileged forms of being expressed at the individual level and at the systemic level of society, and considering these creations and re-creations of subjectivities actively through and by society, as well as the individual.

Although the exploration of Meehan, Klenk and Mendez builds on decolonial thinkers and can be linked with the decolonial dimensions of analysis, it does not seriously engage with new epistemologies, as in both their data collection and analysis, the authors of the study choose to follow in the paradigms of established research. This is, however, a crucial aspect that decolonial approaches are basing their engagement on, as mentioned above in the reflection on this research's limitations in chapter 4.3. Thus, a decolonial approach in an analytical framework needs to conceptualise from the perspective of deconstruction, of decolonial criticism. Consequentially, the dimensions of analysis centre around the three themes of the MCD programme, which expands the framework to connect with elements of different decolonial and deconstructionist principles.

One such element, that connects with the themes of the MCD programme, is Sundberg's conceptualisation for decolonizing posthumanist geography, in which she proposes to engage with the principle of *walking with* from the Zapatista movement as a step to redefine solidarity (2014: 41). In their political activism, the Zapatistas set out from the Tojolabal indigenous notion of "walking while asking questions", which is based in the democratic principle of "commanding while obeying (Grosfoguel, 2012: 98):

> They set out from the idea of "walking while asking questions," in which the program of struggle is a concrete universal constructed as a result, never as a starting point, of a critical transmodern dialogue which includes within itself the epistemic diversality and the particular demands of all the oppressed people of Mexico. […] "Walking while asking questions" leads to what the Zapatistas call a "rearguard movement," against the "walking while preaching" of Leninism, which gives rise to the "vanguard party.

Basing political engagement on such a democratic principle creates a solidarity among everyone involved and thus uses the common struggle as a way to frame all participants in inclusive rather than differentiating terms, as engagement with and

among “communities and individuals, as intellectual and political subjects, colleagues in the practices of producing worlds” (Sundberg, 2014: 41). Such an engagement takes different forms, depending on the context. For the purpose of this study, *walking with* serves as an extension of the analytical dimensions of the MCD programme and provides a site of reflection for a more active engagement with the lived experiences within the FRACTAL project in Windhoek and the sociocultural and geopolitical context. Here, the principle of *walking with* serves as a thought experiment and a means to envision a new epistemology of the transdisciplinary space of FRACTAL in Windhoek.

4. Research context and methodology

This chapter discusses the methodological approach that was used in this study. The dimensions of analysis, that were built from the theoretical framework, are referenced in this chapter as the analytical focal points. As discussed above, the theoretical framework is deliberately separated into its own chapter to create the space for the voices of deconstruction both from the decolonial criticism and from the considerations of engaging with indigenous principles and methodologies as part of this study. This approach reflects the hybrid nature of the study: Providing a decolonial perspective on the topic of the research also necessarily requires reflection of this criticism with regards to the study and applying it in the research itself. Part of this perspective therefore is a problematisation of standard research methods, which is further discussed in the research limitations in chapter 4.3.

In the following sections the methodological framework and rationale for selecting the methods applied in this study is presented, including an overview of the field work that was conducted and the dimensions it comprised of. A discussion of the research limitations and ethical considerations conclude the presentation of the research approach. Both the sub-sections on research limitations and ethical considerations contain reflections for the established methodology applied in the study as well as the application of decolonial concepts of reflection and interrogation. Here, the process of

reflexivity that was used throughout the course of the research is presented and reflected on. This was a necessary mechanism in applying the novel perspective of decoloniality in transdisciplinary climate change research.

4.1. Study area context: Knowledge generation, colonialism and climate change in Windhoek, Namibia

Namibia's current social and cultural setting is significantly determined by its colonial past. Located on the southwestern coast of Africa, human occupation dates back to the Stone Age approximately 25,000 to 27,000 years ago (Biraimah, 2016: 46). It was in this time period that the nomadic hunter-gatherer San people came to this area. Pastoral groups extended into these regions significantly later, about 2,600 years ago, and settled in the northern, central and eastern areas of the region, first the Khoekhoe-speaking peoples, including the Nama people who are still present there today, followed by the Bantu-speaking people of the Ovambo and the Kavango (Biraimah, 2016: 47; Wallace, 2011: 20ff). The Herero people arrived in the seventeenth century to the northern part of what is today referred to as Namibia.

Before the arrival of European powers in Africa, the peoples living in the different regions were "socially, economically and politically organized as empires, tribes, chiefdoms and semi-autonomous communities" (Uzomah, 2018: 35). With regards to knowledge generation and sharing of knowledge, the education was organised as a shared responsibility within the community, involving parents of the children and authoritative figures such as traditional leaders and elders. Rituals and folk tales were part of the "pre-colonial educational curriculum in Africa with the indigenous language as the medium of instruction, communication, speech and writing, and through with knowledge is transmitted from one generation to another" (ibid.). Rodney (1972) evaluates the traditional African education as outstanding for "its closer link with social life, both in material and in spiritual sense, its collective nature, its many sidedness and […] no separation of education and productive activity or any division between manual

and intellectual education" (Rodney, 1972: 239). Mushi (2009: 38f) on the other hand also notes limitations to the traditional education in Africa as it focused on the transmission of cultural heritage from one generation to the next, which was closely connected to the lived experience of the elders, but which in turn also lacked proper methods for storing knowledge beyond this mode of relaying knowledge. The knowledge systems were stored and applied rather in physical dimensions of activities and experience than in abstract ones. The main purpose centred on passing on cultural identities in a rather linear process of giving and receiving between adults and children Mushi (2009: 39). However, considering these entrenchments between traditional knowledge processes and cultural identity, it becomes apparent that the disruption of these traditional education systems in the indigenous communities as part of the colonial process inevitably deeply impacted their cultural values, norms and heritages.

While the European presence in the region started with the arrival of Portuguese explorers on the coast of Namibia in 1486, it was not until the expansion of white Afrikaans-speaking farmers called Oorlams into the area of the Nama and Herero peoples that descendants of European settlers started establishing themselves in the region and occupying territory, with what today is the area of Windhoek as their strategic centre for trade with the Cape Colony in the south (Biraimah, 2016: 47; Wallace, 2011: 38). Direct European rule, however, started with the declaration of Namibia as a German colony after the Berlin Conference that "formalised the 'scramble for Africa' in 1884-85" (Wallace, 2011: 97) and the subsequent violent enforcement of a 'protection treaty' in 1894 by German forces against local guerrilla resistance (Biraimah, 2016: 47). The colonial project carried out by the German Empire in Namibia is marked by systematic dispossession of land and systematic violence that culminated in the installation of concentration camps and genocide of Herero people and other cultural groups (Biraimah, 2016: 47; Wallace, 2011: 180). This eradication of indigenous communities and their traditions, values and heritages was also carried out through a systematic imposition of a hierarchical and segregated education system in the occupied territories. Atsuko Shibata (2005: 15) observes that the "intent of the German Empire in attempting to gain control is reflected in the education policies adopted in

South-West Africa", which was designed to ensure the continuation of German culture and values in the colonial territory. Education curricula in colonial Africa served as instruments to propagate the religion, history, language, and culture of the colonial power and purposefully disrupt and undermine African indigenous knowledge systems (Uzomah, 2018: 37). Ngugi Wa Thiong'o (1986: 391) assesses that this was, in fact, the most important area of domination of colonialism, "the mental universe of the colonized, the control, through culture, of how people perceived themselves and their relationship to the world".

The implementation of a policy of *apartheid* by the South African mandate that followed German colonial rule in Namibia continued with a policy of segregation and dominance based on racial categories (Hartigan, 1997: 499). Only with Namibia's official independence in 1990 following decades of armed struggle by the South West Africa People's Organisation (SWAPO) and other groups of resistance did the systemic discrimination end that had regulated the access to education for people in Namibia for a long time (Biraimah, 2016: 48). Policies were set in place to establish equality and freedom and the right to an education, but the fulfilment of these goals has proven to be challenging. Access to quality education is still dependent on socioeconomic factors, with ethnicity and language representing further challenges that have not been levelled out yet. This remains not only a limitation in Namibia but in all formerly colonised African regions. Uzomah (2018; 38) argues that the disruption of African indigenous traditions, values, languages, histories, beliefs and education in the colonial regimes directly contribute to the symptoms of underdevelopment in Africa, namely poverty, unemployment and poor economic growth. Uzomah further relates that the continued inability to successfully generate pragmatic solutions to these problems from within African knowledge institutions as based on the continued orientation and borrowing from foreign education policies that are rooted in a Eurocentric worldview. Ndlovu-Gathseni's (2015: 489) contention that there are no African universities, only universities in Africa, and that all formalised educational institutions are sites for reproduction of coloniality echo Uzomah's sentiment. Ziegler & Lehner (2018: 1102) further note the linguistic, financial and ideological domination of Eurocentric worldviews over African

education particularly in science education. They echo Uzomah's assessment that adequate reforms, infrastructure and resources have not been successfully implemented yet, but which are vital in order to move beyond the legacies of colonialism in the knowledge generation space.

This historic contextualization for the study area Windhoek, and moreover Namibia, suggests that formalised education even in local institutions needs to be regarded as predetermined by colonial dependencies and a Eurocentric worldview. Most, if not all, participants of the FRACTAL project in Windhoek[4] can be considered to have passed through the formalised higher education system. While participants are from different locations and some also from outside the region, the knowledge processes which they have participated in as part of their formal education is fundamentally based on a Eurocentric system, also in the southern African context. It is an educational system in which knowledges are not questioned for their potential to reproduce coloniality. This needs to be taken into consideration as an important determining factor when the knowledge generation processes in the research space of FRACTAL are analysed.

4.1.1. The research scene: Local climate change concerns

Namibia's geography is dominated by an arid landscape with sparse population that is concentrated in only a few regions, most notably the central region including the capital Windhoek with 400,000 inhabitants out of the overall 2.1 million people living in Namibia (BTI, 2016: 2). Out of these inhabitants, 29.2 % are now living in impoverished structures. The FRACTAL research sub-group that focused on generating regionally-specific climate information identified clean water access as a significant challenge, especially in the context of future climate risks (Daron et al., 2016: 14). As a country heavily dependent of the mining industry, which in turn requires sufficient water supply, the ability to manage water demand and supply effectively also directly impacts

[4] Participants' background and institutional affiliation were assessed based on the participant lists of the reports on workshops and meetings (see Iipinge, 2017a; Iipinge, 2017b; Iipinge, 2018a).

Namibia's economy. Another sensitivity regarding local impacts of climate change was identified regarding energy security (Daron et al., 2016: 14). Namibia has an energy deficit that requires imports from sources in South Africa to supplement local sources. The strategic aim for the future is to reduce dependencies from imports, for example by increasing expansion of renewable energy sources. With a higher dependency on climate sensitive energy sources, changes in the local climate will likely have an impact on energy security. Based on these considerations, the research group identified increasing temperatures and evaporation, rainfall variability and changes in wind and solar insolation as the key climate risks facing the City of Windhoek (Daron et al., 2016: 15).

The identification of burning issues in the context of climate change impact were also an important part of the First Learning Lab in Windhoek. Participants suggested, discussed and voted on what they perceived as the most pressing challenges. Water supply, with the city's growth currently exceeding water supply capacity, and energy, specifically the lack of resources and access in the informal settlements, were identified as the most important issues (Iipinge, 2017a). Comparing the assessments from the FRACTAL research group and the results from the First Learning Lab, the perception of future climate risks for Windhoek reach a similar conclusion in both the theoretical and the applied evaluations. As a result, water and energy were chosen as the focus areas for subsequent workshops as well as the governance research conducted in Windhoek as part of the FRACTAL project.

4.2. Research methods

The methodology for this case study is set up with an interpretive research frame with qualitative data collection. A qualitative strategy in data collection and analysis was identified as the most suitable form because of its inherent open-endedness and exploratory nature (Elliott & Timulak, 2005: 149). This flexibility was a crucial requirement in the examination of socio-cultural dimensions in a research field such as

transdisciplinarity that has hardly been critically examined yet in its application. This is particularly the case as it is set in a highly complex space, at the science-policy-society interface in a southern African urban area.

To allow for the intended grounding in theoretical concepts both in the data collection and analysis on the one hand, and allow for an opening up of the structure on the other hand to incorporate deconstructional elements deriving from decolonial criticism in the analysis, an interpretive research approach was adopted. Interpretive research is "based on the assumption that social reality is not singular or objective but is rather shaped by human experiences and social contexts (ontology), and is therefore best studied within its socio-historic context by reconciling the subjective interpretations of its various participants (epistemology)" (Bhattacherjee, 2012: 103). It is, therefore, centred around examining the two dimensions that are also the focus of this study, the ontology and epistemology within the FRACTAL project and its socio- and geopolitical context. An interpretive case research as the methodological frame thus provided the necessary flexibility for applying theoretical approaches in a new research environment and lowered the risk of reproducing the same hegemonies that are the focus of this study's examination.

Incorporating a dimension of flexibility was, moreover, an important dimension of expanding the study space to a decolonial dialogue, which asserts itself through the ambiguous nature of the spaces in which it is enacted (Bhambra, 2014: 116f). While the scope of the study is not sufficiently extensive to thoroughly work out and provide a decolonial perspective on the methodologies of qualitative research themselves, conscious and deliberate levels of ambiguity can serve towards opening up the paradigms. For that purpose, and following Elliot and Timulak (2005) and Barker, Pistrang and Elliot (2015), who criticise the further categorisation of interpretive research methodologies into different 'brand names' to emphasise relatively minor differences between the methods rather than acknowledging their extensive commonalities (Elliot and Timulak, 2005: 148), a more inclusive approach towards the applied methodologies is used in this study.

The methodology, however, is grounded in thematic analysis, as it has proven to be "the most useful in capturing the complexities of meaning within a textual data set" (Guest, MacQueen and Namey, 2012: 11). Similar to grounded theory, thematic analysis relies on identifying, comparing and contrasting themes in the collected data. However, an important distinction is the output of the analysis, which in grounded theory is always the conceptualisation of a theoretical model grounded in the data, whereas in thematic analysis it may or may not be the outcome (ibid.:12). The method has been criticised for its high dependability on the researcher's interpretation as well as for its unclear definition, as it is mostly defined in contrast to other methods, rather than by criteria unique to the method (Braun and Clarke, 2006: 8). However, it is precisely this element of ambiguity that induces a more flexible approach needed for a research design with a deconstructionist aim.

In order to examine the three fields that shape the transdisciplinary knowledge process within the FRACTAL project, namely science, policy and society, two main spaces within the project were identified that offered such opportunities: the design of the research in FRACTAL and the implementation of the theorised collaborative learning process. The science field could best be examined through its representation in the composition of the research project itself and its influencing environment, namely the design of the research aims, the frameworks that guide the research, foundational theories, conceptualisation of the collaborative space and the mechanisms for reflection and evaluation. For both the policy and society fields, it was the spaces of collaboration that offered the primary possibility to examine the transdisciplinary learning process in its application. Both the research design and the implementation of collaborative learning were investigated with a qualitative analysis of documents of the available project working papers, reports, websites, blogs, presentations, academic publications, as well as feedback and reflection documents, that were sourced from the published material on the FRACTAL website[5] as well as through the internal documents shared on a google drive with the whole research team. In addition, the urban governance

[5] The FRACTAL project website can be found under http://www.fractal.org.za/

research was identified as the main opportunity to examine the geopolitical and socio-cultural space, in which the transdisciplinary knowledge process takes place. As part of the urban governance research, stakeholders from all three fields, science, policy and practice, were interviewed to enhance the understanding of the decision context regarding climate change in the FRACTAL focus cities. The author of the study was invited to take part in these interviews by the supervisor of this study, who is the lead researcher for the urban governance research.

The implementation of FRACTAL in the City of Windhoek was selected as the case study, as it is one of three cities in which the city learning process is conducted. The collaborative spaces in Windhoek consisted mostly of the Windhoek City Learning Labs, of which three had taken place during the time period of this study (First Learning Lab: 14-15 March 2017, Second Learning Lab: 1 October 2017, Third Learning Lab: 14-15 August 2018). Additionally, three workshops took place, that applied learnings from earlier reflections within the project, namely a climate change training for the Windhoek City Councillors (17 July 2017), a workshop on Transformation Leadership for City of Windhoek's Strategic Executives (18-19 April 2018), and a learning exchange between participants of the FRACTAL project in Windhoek and the FRACTAL project in Lusaka, Zambia (1-3 November 2017). The preparation, documentation and reflection of these Learning Labs and workshops of FRACTAL in Windhoek, together with the interviews conducted as part of the urban governance research in Windhoek, serve as the study area in which lived experiences as well as the larger socio- and geopolitical context of the participants in FRACTAL were examined.

4.2.1. Research aim and objectives

The aim was to examine the transdisciplinary approach to generating knowledge within the analytical framing based on postcolonial, decolonial and feminist critiques. As outlined in chapter two, critical examinations of transdisciplinary co-production are still very scarce, especially concerning an interrogation of its transformational capacity to

establish knowledge generation spaces that redefine power dynamics and break with the tradition of reproducing colonial structures. However, with the increasing mainstreaming of transdisciplinary methods in climate change research such an interrogation is necessary.

This study aims to contribute towards critically examining this new mode of knowledge generation by examining the power dynamics that underly the knowledge process as it is being implemented in Windhoek as part of the FRACTAL project. Providing a decolonial perspective on transdisciplinary knowledge generation implied adopting a deconstructive lens in the research aim. According to Elliot & Timulak (2005: 149), the aim in exploratory research questions is deconstructive in that it sets up questions to interrogate the socio-political and cultural patterns and implications of the research environment. Based on these considerations, both the aim and objectives draw mainly on decolonial criticism.

The main research seeks to understand how and among whom, structures of control of climate knowledge for adaptation within FRACTAL in Windhoek are distributed. Two main supporting questions particularly guided the analysis of the data, questioning the assumptions made in the transdisciplinary research and whom these assumptions serve. These research questions were examined based on the theoretical framework as it is set up and defined in chapter three. The different dimensions of analysis translate into three objectives and formed the basis of the interviews that were conducted within the field work portion of data collection for this study.

Objective 1
Construction of the geopolitical space: Identify the regimes of knowledge mobilization across spatial, historical and geographical scales

Objective 2
Socio-cultural creation of subjectivity: Analyse the embodied geopolitics of the participants in the knowledge generation process

Objective 3
Knowledge politics: Examine the epistemic authority of the different knowledge regimes and imaginaries

4.2.2. Document analysis

The study initially involved a desk-top analysis of the currently available publicised material of the project, such as websites, brochures and presentations, to gain an insight into the geographical space, the participants, the research design as well as planned activities. This information was reflected and contextualized as part of the preparation of the interview questionnaire.

Examining the transdisciplinary space in which the FRACTAL research is located required an understanding of the planning, design, funding, implementation and evaluation processes of the research project. For this purpose, a review and document analysis of FRACTAL project proposal, reports, meeting minutes, online communication as well as outputs such as publications, climate narratives, and infographics was conducted. Since all of these documents were authored by researchers that are part of the FRACTAL team or work in collaboration with them, the evidence derived from the document analysis was primarily allocated to the examination and representation of the space of science and the socio-political contexts that participants from that space are navigating within the transdisciplinary knowledge generation process.

To inform objectives 1 and 3 and examine the institutional and epistemological dimensions of knowledge regimes at play in the transdisciplinary space of FRACTAL in Windhoek, the document analysis concentrated on identifying concepts that were applied as fundamental building blocks of the research approach and implementation. These comprised of the concepts that had been formalised in FRACTAL, for example in the frameworks and conceptualisations that guide the rationale of the research

approach and the way the research is conducted, or concepts that were frequently evoked in different contexts of the research.

The analysis was mainly conducted in a structured manner and identified the concepts of climate, climate change, transdisciplinarity, knowledge, transformation, resilience as foundational for the FRACTAL research design. However, the concepts were revised and expanded based on emergent themes and contextualisation, adding the concepts of learning and further distinguishing climate into past and future climates. The final selection of foundational concepts are listed in table 1.

Table 1: Conceptual themes that were evidenced during the preliminary data analysis were applied as thematic codes for the coding process and expanded with themes that arose during the coding process.

Concepts
Past, present and future climates
Transdisciplinarity and Third Space
Knowledge
Learning
Transformation
Resilience

After the initial stage of selecting the conceptual themes, the primary focus of the analysis shifted to identify the context in which these concepts occur within the documents. Here, the selected concepts were applied as thematic codes for the review. The documents were examined and coded using the qualitative data analysis tool NVivo. The codes were refined throughout the analytical process. An archive of all data was compiled on the author's One Drive that included the interview questions, audio recordings of the interviews, interview transcripts and the FRACTAL project documents that were used for analysis.

4.2.3. Semi-structured interviews

The interviews took place from 21 August to 28 August 2017 as part of the larger urban governance research that was conducted by FRACTAL in Windhoek. Interviews were for the most part undertaken in the participant's work environment but in certain occasions, such as for example with some youth activists, the interviews were held in public spaces or the workplace of the embedded researcher of FRACTAL in Windhoek[6]. They were conducted separately with one stakeholder at a time, with the exception of a research team that was interviewed at the same time, and either recorded on a dictaphone or through notes by the interviewers, which included the embedded researcher, the lead researcher of the FRACTAL urban governance research and the author of this study. A list of the interview participants and dates is attached in Appendix 2.

The interview themes and questions mostly derived from themes that emerged after reviewing the academic literature as well as the FRACTAL project documents. The interview questions were semi-structured and thus based on a previously developed set of questions that were grouped into topics (Appendix 1). This question guide was purposefully left structurally flexible to be easily adaptable to each participant's area of work and background (Mack et al., 2005: 34). As with the methodological design of this study, the question guide was strategically open-ended to accommodate the necessary flexibility and adaptability of the inquiry. They were set up in thematic clusters that all aimed at informing various issues that particularly served to meet objectives 2 and 3, which was to examine the socio-political context of the participants within FRACTAL Windhoek and the politics of epistemic authority connected to the use of imaginaries. The themes around which the questions were clustered comprised of:

1. The role of different stakeholders, their perceptions of the issues and platforms of involvement

[6] In the concept of the embedded researcher, a person is recruited for the duration of the who works both for and with the local government and the local university, with the aim to "better understand the un-codified everyday practices of governance that influence the ability to engage with climate information and the perceived limitations to existing climate information" (FRACTAL proposal, n.d.)

2. Expectations and expected use of climate information and transdisciplinary knowledge from FRACTAL
3. Engagement with communities and stakeholders outside the FRACTAL project and the representation of their issues and needs within the project
4. Perceptions of knowledges that are mobilised in connection with burning issues such as water and climate change and the importance of the context in which they are mobilised

These questions were initially developed before the interviews in relation to the problematisations within the theoretical concepts but were adapted throughout the interview process. All recorded interviews were transcribed, and all identities of the participants were anonymised in the transcript in order to maintain confidentiality. The transcripts were subsequently analysed based on the same thematic codes that were applied in the document analysis.

4.2.3.1. Stakeholder identification

The identification of stakeholders was based on the stakeholders that were selected by the FRACTAL governance research team for interviews. These stakeholders included government officials of different levels within the City of Windhoek as well as the national ministries, representatives of government ministries and agencies, representatives of NGOs and researchers from the two main universities in Windhoek. In meeting objective 1, to *identify the regimes of knowledge mobilization across spatial, historical and geographical scales*, the selection of interview partners for this study from among this group of defined stakeholders aimed to be as wide spread as possible, with representations of stakeholders from different career levels, different cultural backgrounds and working in different spaces in science, policy and society.

To ensure enough representation of these three different spaces within the project, an expert sampling of interview partners applied with a minimum quota of three persons

per category was included in the selection process of interview partners from the urban governance stakeholders (Bhattacherjee, 2012: 69). With particular consideration of objective 3, that aims to examine the epistemic authority of the different knowledge regimes and imaginaries, a preference was given to interview partners whose work intersected or connected directly to local communities that are not actively involved with the FRACTAL knowledge process. This preference opened up the possibility to critically examine stakeholders outside the project's definition of relevance and the epistemic authority awarded to them through the selection as a partner of interest for the FRACTAL project.

The sampling frame consisted of 15 interviews, of which most of them were with one interview partner but in two cases with several participants, and which were arranged by the embedded researcher of the project in Windhoek. Four participants work at universities, seven in local or national government functions and at agencies owned by the government, five participants work for or in a representative function of a civil society organisation. All recorded interviews were transcribed electronically using Microsoft Word and the online tool Transcribe[7], with notes that were taken during the interviews supplementing the transcriptions or, in cases where no recorded audio was available, used as the source for the transcription.

4.2.3.2. Governance interviews

Within FRACTAL, representatives from outside of academia were invited to participate in the different opportunities for co-producing and co-exploring climate knowledge at the Learning Labs and dialogues. To inform objectives 1 and 2, it was necessary to examine the existing geopolitical as well as socio-cultural spaces in which these participants are embedded, and which also inform the design, composition and implementation of the research project of FRACTAL itself. The larger urban governance

[7] Available: https://transcribe.wreally.com

research that formed part of the research design within FRACTAL offered an important opportunity to examine these spaces and conduct interviews, primarily with participants from policy and society. The interviews took place between 21 August 2017 and 28 August 2017 and they were conducted in conjunction with the interviews which formed part of the larger urban governance research within FRACTAL. All official representatives from government sectors were sampled from the water sector to ensure comparability in terms of themes and critical issues discussed, infrastructural and policy environment as well as stakeholder involvement and decision-making processes. The water sector was selected as one of two focus areas for Windhoek, specifically because it constitutes the sector with the most pressing concerns in terms of climate change impact, as discussed above. The organisation of the interviews was realised by the local embedded researcher, who locally drives the project in Windhoek and who is in charge of building and maintaining relationships to all local project partners.

Conducting the interviews for this study as part of the larger urban governance research offered the advantage that official representatives were more readily available for interviews and that findings from this study can be more easily contextualised within the larger findings of the FRACTAL research. However, by accompanying the FRACTAL researchers on their interviews and merging the research for this study into the urban governance research for the FRACTAL project also increased the probability of time constraints preventing the author from having time to question the participants on all topics that the author intended to include in the study. While this approach provided access to interview government officials and other stakeholders, that would have been severely limited if the interviews for this study were conducted apart from the FRACTAL research, it also provided a difficult environment to negotiate the research interests for this study. Despite these limiting factors, the ability to form part of the project's research and not only observing it, offered an important additional insight into and experience of the implementation phase of the FRACTAL research itself.

4.3. Research Limitations

Two dimensions need to be reflected on in the context of the limitations of this study's research; the limitations that arose from the data collection in the field and the limitation of the deconstruction that decolonial criticism relies on. Regarding the stakeholder interviews, time constraints were a limiting factor in the selection of the most appropriate stakeholders to interview. Although the sampling criteria were met, to ensure a representation of a minimum of three representatives from the science, society and policy fields, only six out of the 14 interview partners participated in one or more FRACTAL learning labs. Insights into the collaborative learning process were therefore limited to these six participants. Furthermore, as the author participated in the interviews that were conducted as part of the FRACTAL urban governance research, the time for the questions relevant to this study to be discussed with the participants varied, particularly in topics that were not central to the urban governance research priorities. Most importantly, though, the field work was done at an early stage of the research to leverage the opportunity of collecting the data in interviews together with the FRACTAL researchers and the focus of this study evolved quite significantly afterwards. The study was previously designed as a more content-focused investigation and changed subsequently into the process-focused investigation that is presented here. For budget reasons it was not possible to reconduct the interviews based on the shifted research focus. The data analysis for this study therefore relies more heavily on the document analysis than anticipated in the outset of the research. This is because the data from the stakeholder interviews was limited to providing insights into the broad and general geopolitical and socio-cultural context in which the FRACTAL project is being conducted rather than contributing to the investigation of the specific dimensions of the research objectives.

Time and budget constraints also prevented the author of this study to attend a collaborative learning space in person. Data collection for the analysis of the transdisciplinary space therefore concentrated on gathering a diverse set of primary documents from the project for the documentary analysis and was sought to represent a

wider time frame to move beyond a mere momentary snapshot of the processes within FRACTAL. To balance the difficulties regarding the available data from the stakeholder interviews, the document analysis was conducted in an encompassing and comprehensive manner to supplement the interview data with records and reports of discussions, reflections and conversations within the FRACTAL team spaces that related to the research objectives. These documents were also selected specifically for their relevance to the location of the case study, in Windhoek. In this context, it is necessary to emphasise that, since FRACTAL operates in different cities at the same time, the focus of this study constitutes only one sub-process of the broader FRACTAL project. The dynamics and ways of implementation of FRACTAL differs among the cities, depending on the actors who were involved in the implementation of the project in a particular city and how the city learning processes were facilitated. The processes were co-produced by the particular set of participants. A generalisation of the findings of this study for the entire FRACTAL project is therefore not intended as each city is embedded in its own socio-political-historical context.

With regards to the methodological approach, the scope of this study and the fact that it is a study required to obtain an academic degree constituted in themselves limiting factors. As part of the established approaches to qualitative research, the researcher is expected to use “constant critical (but not paralysing) self-reflection and challenging scepticism with regard to the analysis methods and the emerging results” (Elliott & Timulak, 2005: 152). This usually relates to ensuring an organised and systematic approach in the process of analysing the data.

The aim of this study, however, requires a profound reflection on the applied methodology and moving further into a deconstructive approach that deeply engages with new epistemologies. Upon careful reflection on the possibilities within the scope of this study, the author recognises the limitations in terms of the extent of the research and its problematisation as well as through the necessity to comply with established structures of research, as it is judged as a proof of ability to master academic research. Applying a decolonised methodology both in the methodological approach as well as in

data analysis would require a translation of, for instance, indigenous research methods such as the practice of deep listening, *Dadirri,* which so far has only been used in research with indigenous people, to an urban space (for example by West et al., 2012). As mentioned above, such an approach needs to be diligently and critically reflected before inserting, combining or applying it in a standard research approach, which is based on the ontologies that have categorically silenced indigenous principles and methodologies. To effectively do this, a broader scope would be crucial to avoid engaging with these methodologies in less than a sincere manner.

Based on these limitations, this study neither provides a methodological framework for decolonising climate knowledge nor does it provide a concrete assessment of the effectiveness of the transdisciplinary research to build resilience in Southern African cities within FRACTAL. The study aims to provide a perspective that shines light on areas in which paradigms are currently being left unquestioned. It does so by combining a methodological approach with modes of data collection based on established research methods with a deconstructionist theoretical framework based on decolonial concepts for data analysis. The decolonial perspective of this study can therefore not go beyond providing an example of engaging decolonial criticism with transdisciplinary climate knowledge and working towards decolonising climate knowledge in a Southern African context.

4.4. Ethical considerations

The findings of the study contribute to the larger aims and objectives of the FRACTAL project. As the interviews were conducted in conjunction with the governance research of the FRACTAL project, the author of the study was positioned as an official member of the FRACTAL governance research team to the interviewees and complied with the ethics guidelines and restrictions defined for the research project (see appendix for ethical clearance by the University of Cape Town). In all interviews, the researcher of the urban governance team in FRACTAL was present and, in most occasions, the local

embedded researcher of the FRACTAL project in Windhoek attended the interviews as well. It was generally the governance researcher who took the lead in the interviews with regards to choosing the appropriate topics and questions for the particular interview.

4.5. Applying the concept of *Homework*

Geography scholar Juanita Sundberg (2014: 39) suggests “a first step to decolonizing posthumanist engagements in geography: locating our body-knowledge in relation to the existing paths we know and walk”. It draws on a concept by postcolonial scholar Gayatri Spivak which she calls *Homework*. In this concept, Spivak calls for a “self-reflexive analysis of one’s own epistemological and ontological assumptions […and] how these have been naturalized in and through geopolitical and institutional power relations” and practices (ibid.). This concept is the basis for the following reflection on positionality.

As a researcher of Mexican-German descent with less than two years‘ time living in South Africa and never having lived nor stayed in Namibia for a longer time, I am aware and am continuously reflecting on my restrictions to conduct research in a culturally, historically and politically complex field such as decolonial studies. Questions of legitimacy of representation, distortion of epistemologies and privilege through geographical and cultural heritage are precisely the questions that form part of my own research and it is therefore my duty to continuously examine, question and reflect on these questions and how they influence my research.

Throughout the course of this research, I have come to realise my naturalised ontological assumptions through engaging with decolonial criticism in the academic forum as well as through listening and learning through activist perspectives both in Windhoek and in Cape Town. The location of the case study in Namibia, which was one of four countries colonised by Germany, provided an important context for reflection and

problematisation for me, being born and mostly raised in Germany. The persistent silencing of the colonial trauma of the Namibian people, of which I am inherently part of having gone through and benefitted from the German education system, was one of many realisations throughout my research that made the limitations of my contribution towards furthering the engagement with decoloniality in southern Africa very apparent. I can hardly provide more than the view of an accomplice in the struggle of the voices who in academia as well as other forums of power have been marginalised and silenced for so long. For this reason, my engagement with colonialism in this study references the broader critiques of colonialism and not the specific colonial project that was realised in Namibia. It is a level of specificity that, having hardly been physically present in the location of my research, is one that I cannot sincerely engage in. I therefore chose to consciously engage with the broader critiques of scholars from geographical locations of colonialism.

For the exploratory part of my research, I deliberately turned to a principle that is used by an indigenous activist movement from Mexico. Here, my complicity to the struggle of the Zapatista community is one conditioned through my cultural proximity and whose political struggle and demands I am much more familiar with than those of any indigenous communities outside of Mexico. That is not to say that I can relate to their lived experience, which is one of constant resistance to a system that continues to silence and negate them their validity as people. Even though culturally I was raised both in the German and Mexican culture, my life experience is predetermined by my appearance as a white person. It has allowed me to experience this world from the most privileged perspective, with my gender being the only dimension of marginalisation that creates the experiences that I live. My privilege determined the opportunities that having been born and raised in a Western European society are simply given to me based on that circumstance. My privilege as a white person determines that my entitlement of being in a place and space is not questioned based on my appearance, only based on my gender. It predetermined that I have the luxury and the entitlement to choose to engage in these contestations – it is not something that is vital to my existence, because my existence is not negated. My mixed background, however, determines an

internal need to engage with these contestations, as they are part of my cultural heritage, albeit not of my lived experience. All of this is to say, that I was able to seriously engage with the political activism of the Zapatistas on the level of an accomplice to their struggle, because of a shared understanding of the continued subjugation and systemic racism they are fighting in Mexico.

Doing research in the field of decolonial theory in a cultural context outside of my own has shown me the importance of incorporating and applying reflexivity and being willing to stay in a space of ambiguity that comes with a sense of uncomfortableness. It has shown me the imperative necessity for this discomfort and to take it as exactly what it is: an indicator that I am actually engaging sincerely. It comes with knowing that many spaces of contestation are left unaddressed and that it is necessary for other voices, academic or from other areas, to voice these contestations and challenge not only the research that I am doing but also my engagement with decolonial criticism, my assumptions, my privileged position and the forums this privilege has given me access to, which are still denied to other voices that could speak a lot better to the points made in this study. It is exactly these contestations that have helped me challenge my own epistemological and ontological assumptions and that have helped shape the work presented in this dissertation.

5. Contesting transdisciplinary knowledge in FRACTAL

5.1. Introduction

Walter Mignolo (2007: 451) approaches conceptualising and tracing dimensions of coloniality in a deconstruction of totalitarian epistemologies. He draws on Anabel Quijano's project on *Totality* concepts which roots the contestation of universalities in a decisively non-European frame. To trace the coloniality, the present geopolitical space needs to be examined from a perspective that comprehends concepts and epistemologies of modernity in that space as a legacy of coloniality. It is therefore not

sufficient to provincialise modern conceptualisations to create a relevant non-European, non-universalist context. Moreover, the fundamental universalist principles that are rooted in the colonial project and that have been institutionalised through modern principles, need to be traced and deconstructed (Quijano, 2000: 218). This deconstruction allows for an epistemic de-linking from modernity/coloniality principles, which is necessary so as not to reconstruct the authoritative assumptions and presumptions of universalisms into the present space (Mignolo, 2007: 494). Deconstruction therefore opens up the possibility to build new, decolonised epistemologies and question universalist ontologies that are reproduced in modern principles and concepts.

This chapter not only seeks to trace assumptions and imaginaries in the design and implementation of the FRACTAL research but identify critical engagements within the project that question universalist ontologies, hegemonies and prescribed power structures, particularly where it draws on postcolonial criticism. Examining these mechanisms allows for a consideration of the dimensions of critical deconstruction that current engagements with postcolonial conceptualisations in transdisciplinary sustainability research allow and also to show their limitations. From that point, a consideration of the potentials of a deep engagement with decolonial thinking in transdisciplinary research can be explored.

In the following sections, an overview of the analytical process applied in the study is first presented and followed by the analysis based on the three dimensions of decoloniality. The three sections investigate the geopolitical space of FRACTAL in Windhoek, the mechanisms of subjectivities evident in the project and the knowledge politics that could be identified. It concludes with an assessment of the spaces and platforms in which contestations of these power dynamics are already engaged with in the project.

5.2. Tracing imaginaries in the knowledge generation process in FRACTAL

Examining the underlying power dynamics within transdisciplinary research required an investigation of underlying assumptions and imaginaries that are created within the collaborative spaces and the knowledge generation processes of FRACTAL. To achieve this, the conceptual foundations of the FRACTAL research design were examined, specifically for the way the concepts were composed and utilised within the research design and implementation. In order for the investigation to consider diverse perspectives and scales in the analysis, a case study within the FRACTAL project was selected, which contributed the possibility for a deeper examination of the research practice.

The study centred on the plan, design and implementation of the research project FRACTAL in one of its focus cities, Windhoek in Namibia. For the duration of the study the project was in its implementation as well as in the beginning of its evaluation phase, as it was set to run until June 2019. The fact that this study coincided with the ongoing project for more than a year allowed for the collected data to reflect both the environment of the initial expectations of stakeholders towards the outcomes of the project and include reflections and evaluations on its achievements and critical discussion of the applicability regarding the research design.

The document analysis is based on a sighting and preliminary review of the material that had been published in the course of the project, most of which are consolidated on the FRACTAL website, including academic papers, reports, working papers, think pieces, conference proceedings and blog entries. Additionally, internal documents that were made available to the whole research team were sourced. The preliminary review focused on the identification of documents with relevance to the objectives and identified concepts from the literature review. Based on this review, documents were pre-selected for analysis and structured into two categories: baseline documents and documents reflecting the implementation process. This categorisation allowed for a

better consideration of the research progress. The final selection of documents was based on three questions of interest:

1. How are the framing concepts represented in the FRACTAL documents (context, terminology used, selected format, internal/external document and platform of publication)?

2. How have the concepts been problematised and reflected on in the course of the project? Where are platforms of reflexivity evident?

3. How is agency created within the research design of FRACTAL?

This process resulted in altogether 72 documents that were selected for the analysis. Preference was given to publicly available documents, supplemented with internal documents when these could add significant insights into the research questions and/or research objectives. An archive was created with all documents selected for analysis as well as an overview of these documents in an excel database (Appendix 3).

Coding was undertaken based on a theoretical approach to thematic analysis, thus the coding process was driven deductively by the research questions. The conceptual themes were derived from the reviewed literature, most directly from the fields of transdisciplinary sustainability science and the literary discourse on epistemic geographies. They included climate, climate change, transdisciplinarity, knowledge, transformation and resilience (table 1). During the coding process, the additional theme of learning arose and was added to the foundational concepts to be investigated further based on the research questions. In this stage, the concepts of climate change and climate were consolidated into the conceptual theme of past, present and future climates, as the examination of their contextual use indicated a significant overlap.

Table 1: Conceptual themes that were evidenced during the preliminary data analysis were applied as thematic codes for the coding process and expanded with themes that arose during the coding process.

Concepts
Past, present and future climates
Transdisciplinarity and Third Space
Knowledge
Learning
Transformation
Resilience

In a subsequent preliminary analysis, the identified conceptual themes were examined for their composition and operationalisation in the context of the FRACTAL research design. Out of these contexts, underlying assumptions were traced that underpin the use, application and problematisation of these concepts within FRACTAL, as well as the visions that are created through the assumptions and imaginaries. This overarching vision, the processes in relation to the vision and their interdependencies are visualised in figure 1.

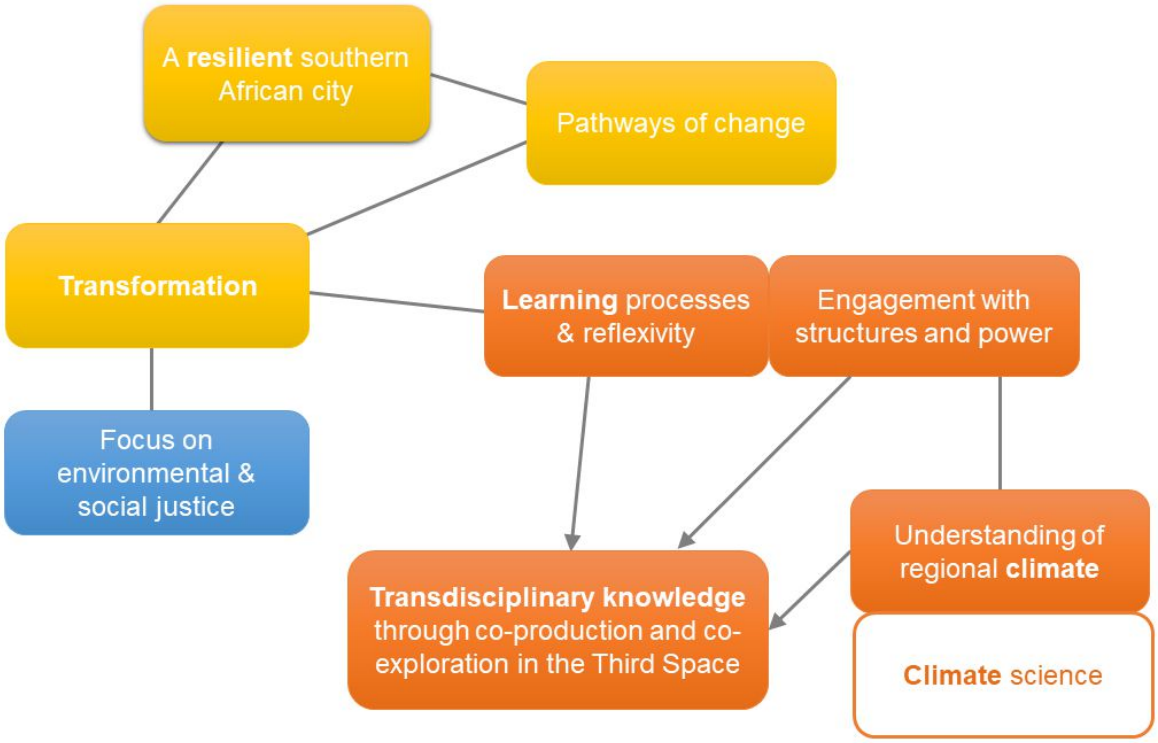

Figure 1: Visualisation of assumptions for processes in the FRACTAL research design. A regular line indicates an assumed requirement or engagement, a line with one arrow indicates an assumed input and outcome. The colour coding refers to: yellow – vision, orange – process components, white – input, blue – problematisation. Framing concepts are in bold.

The following sections present the different visions, expectations, processes and their underlying assumptions that could be traced in the document analysis. The analysis focused on contextualising these into the larger imaginaries that they indicate in the FRACTAL project in Windhoek. Additionally, the assumptions are reviewed for evidence that indicates whether they have been problematised in the reflexive platforms of the project. To engage a decolonial perspective, the assumptions and imaginaries are analysed based on the dimensions of decoloniality, structured into the domains of power, being and knowledge, as set up in the theoretical framework in chapter three.

5.3. Coloniality of power: Construction of the geopolitical space in FRACTAL

Two overarching imaginaries could be traced which are based in the construction and engagement of the geopolitical space in FRACTAL in Windhoek. The first one establishes the imaginary of the social impact of the project, which is closely connected to assumptions and visions created around the desired future in the project. The second one is the imaginary of the science-policy interface, which drives conceptualisations of the space that is created as the space of engagement for the transdisciplinary research.

5.3.1. The imaginary of the social impact and desirable futures

The vision of a resilient African city as the desirable future and the vision for the process towards this desirable future as pathways of change that enable transformative change are the two overarching visions that are set up in the FRACTAL research design. The overarching vision of the research approach and implementation within FRACTAL is the theme of resilience. As indicated in the title of the project, future resilience is evoked as the vision of the project and is framed in conjunction with the system for which the future resilience is envisioned, namely African Cities and Lands. The vision of urban resilience indicates the assumption of resilience as a characteristic or state that is desirable in the African context. The underlying hegemonic tendency is problematised when it is recognised that “the desired outcomes of resilience are not uniformly held, hence the need for interrogation of questions such as: Resilience for whom/ what?” and that there is a need “to tailor the resilience concept to be best applied in [the] specific context, related to the outcomes [the actors] seek” (Spires et al., 2017: 3).

The change processes that underpin the vision of a resilient city are conceptually connected to ideas of transformation and imagined on different levels. Transformation is envisioned as a characteristic of an outcome from the project, but the conceptualisation is left vague both in the design and implementation of FRACTAL research. The

proposal, for example, defines the learning process set up through the City Learning Lab concept as transformative (FRACTAL proposal, n.d.) and it is envisioned to enable "learning that transforms theory and practice for generating and using climate information" (FRACTAL, 2018a). The theory of change envisions the outcome of "some level of institutional transformation (cultural) within the study cities" ("FRACTAL ToC", n.d.).

These broad ideas of transformative action are conceptualised more concretely in a few specific contexts, most notably the training workshop on transformative leadership on climate change conducted in Windhoek. The workshop objectives list four dimensions of change: "(1) showcasing adaptation inspiration cases undertaken to address climate challenges in Africa; (2) co-producing principles for transformative leadership on climate change issues; (3) mainstreaming climate change into city planning and practice; and (4) an introduction to the climate future projections for Windhoek" (McClure, 2018d). These dimensions are envisioned as the "knowledge that will allow [decision-makers] to move away from the 'business as usual' way of decision-making, a requirement for the development of climate resilient cities" (Iipinge & Haukelo, 2018: 2). This example of how conceptions of transformation are implemented in the collaborative spaces indicate the assumption that a learning process that engages with existing structures and power dynamics initiates a process of transformative change.

However, an example from the workshop on transformative leadership, that took place from 18 to 19 April 2018, indicates the limitations of such an engagement. The training was organised in Windhoek by the FRACTAL team for "select decision-makers and Councillors" (McClure, 2018d). In a presentation held at the workshop by a representative from a project partner, the characteristic of transformative leadership was exemplified as the ability to look beyond sustainability and beyond persistence. The transformative change process was envisioned as a deconstructive process, in which leaders "change the system dynamics that created problems, which refers to sometimes needing to break down the resilience of a system that is not working. […T]his may require a change of complex properties such as power, roles, financial patterns, norms

and behaviours" (Iipinge & Haukelo, 2018: 23). Such an approach engages notions of systemic deconstruction that, in turn, decolonial criticism draws on as well. Contrasting to the conceptualised vision of transformative change, the operationalisation of the concept through the actions that were implemented at the workshop demonstrated an engagement with the systemic power dynamics, rather than a deconstruction of structures and power dynamics on an institutional level.

A concrete example is the principles of transformative leadership, which were co-produced at the training workshop. These principles are based on a set of principles for resilience that were developed in and for a global North context (Iipinge & Haukelo, 2018: 23). In the co-production process, the principles were questioned and adapted to reflect an African context. The aim was to Africanise resilience. This approach draws on the notion of provincialisation that is rooted in postcolonial theory and engages the cultural context. As such, it problematised the geopolitical context from within the system through engaging with the systemic structure. However, systemic power dynamics related to authority of leadership were not evident to have been questioned. The conceptualisation of transformative change to also necessitate to "break down the resilience of the system that is not working" (Iipinge & Haukelo, 2018: 23) would include to also question prescribed authorities and decision power. The participants who participated in this workshop were exclusively individuals with leaderships roles in government functions. Their position as leaders in the city therefore prescribed their participation for transformational leadership. It is based in the underlying assumption that the existing leadership functions are the right ones to also steer transformative change processes. The principles define dimensions of transformative decision-making but do not question if the existing systemic power structures inhibits or enable transformative processes. The underlying assumption is based on the participant's position of power and indicates a replicated authority from the city system to the transdisciplinary space.

This illustrates that the underlying assumptions regarding structure and power were not problematised as part of this engagement. The example shows the process of

transformation that is envisioned, which is a process of engagement with existing structures and a selective deconstruction within the transdisciplinary space. It reveals the limitations of a process that centres on an engagement with systemic structures and power rather than centring on deconstruction of power dynamics across different sectors and spaces in the city system. It would require a more fundamental engagement with the question about prescribed authority to decide what is working in the city system and what isn't. In this example of operationalising transformative change, the concept was actioned as "moving away from the 'business as usual' way of decision-making", assuming that this would enable the envisioned pathway of change towards transformation. This, finally, also reveals the limitations of the vision of what constitutes transformation, which due to its conceptual vagueness is adaptable to the context in which it is applied. For the envisioned transformational changes, these conceptual discrepancies need to be problematised, so as to remove limitations to the actual transformative potential of the engagements and learning processes in the transdisciplinary space.

5.3.2. The imaginary of the science-policy interface

The engagement with structures and powers is envisioned on two platforms, through understanding the decision-making context within the local government system and as part of the collaborative learning spaces in FRACTAL. This is evident in the theory of change, which defines four outputs towards the long-term goal of African urban climate resilience, three of which envision changes in the urban decision-making structures, namely "an enhanced capacity to use climate information [,…] changed/improved decision making processes that are able to integrate climate information […and] the availability of appropriate climate information to inform decisions" ("FRACTAL ToC", n.d.). This is echoed in the research design, in which the goal is set to increasing "the resilience of southern African cities by ensuring that decision-making processes are strengthened and include climate knowledge" (FRACTAL research, n.d.). The political sphere is thus defined as the main area of interest and the actors within this space are

assumed to hold the necessary power to bring about the envisioned changes. It reveals the underlying assumption that political power is the central dynamic that is able to steer the city system towards the desired state of future resilience.

In the collaborative spaces of FRACTAL, the engagement with the political economy of the knowledge generation process is expected to enable the generation of transformative knowledge (FRACTAL proposal, n.d.). This engagement in the City learning platforms is envisioned as a “dialogue based on mutual respect […] between people and groups of people with different knowledge and ways of thinking” that enables a “redistribution of power over shaping the research agenda, knowledge production process and outcomes” (Taylor et al, 2017: 8). The actors invited to participate in this dialogue are representatives from three sectors, science, policy, and practice, where the spaces of collaboration function to bridge the “science-policy-practice interfaces in city regions” by “translating and feedbacking between scientific knowledge and management practices in cities” (FRACTAL annual meeting, 2016: 13). The expectation for the engagement in these spaces is to break down “binaries between government, academia, civil society and the private sector to build sustainable partnerships of learning and action for urban development” (ibid.). In this context, the assumption that an enhanced understanding and collaboration between science and policy enables transformative change, is concretised. The engagement with the sector ‘practice’, however, remains less clear. While it is formally envisioned to exist and to take place on the same level as science and policy, an understanding of the sector and the role of the engagement of its representatives is not conceptualised in the FRACTAL research frameworks. The level of concretisation regarding the vision of engagement with the city system’s structures thus indicates the assumption that the spaces of relevance, in which decision-makers and knowledge-holders are located, are the academic and the political spaces.

The concept of the embedded researcher as an essential approach to create engagement illustrates the expected transdisciplinary engagement across the science-policy interface. The expected benefit of the embedded researcher approach, to “better

understand the un-codified everyday practices of governance that influence the ability to engage with climate information and the perceived limitations to existing climate information" (FRACTAL proposal, n.d.) envisions the embedded researcher as the "intermediaries between researchers, city officials and politicians" (Taylor et al, 2017: 15). This conceptualisation assumes for the embedded researcher to inhabit the transdisciplinary space in their lived reality. In conjunction with the conceptualisation of "entry [points] of climate science information into decision making [that may] lead to more resilient cities and city-regions" (Scott, 2017: 6), the idea of the science-policy interface reinforces the imagined barrier through the focus on mechanisms to bridge it. This conceptualisation of the interface does not fundamentally question the existence of the imagined barrier and therefore neither the institutional power dynamics in these systems outside of the transdisciplinary spaces. It conceptually reinforces a binary that requires an intermediary to create engagement, who inhabits a transdisciplinary space as part of their function to an extent that exceeds the engagement that is assumed to be possible for the actors in the science and policy spaces in their daily work. The actors in science and policy are envisioned to engage in transdisciplinary processes and in the Third Space but not to inhabit it as a fundamental part of their function in general. The vision of engagement created in FRACTAL thus assumes that transformation can be achieved within the existing power dynamics and through providing the 'right' tools to the 'right' people by inserting spaces and function that 'bridge' the barrier.

5.4. Coloniality of being: Socio-cultural creation of subjectivity within FRACTAL

The main mechanism that creates subjectivity within FRACTAL is the conceptualisation of the envisioned stakeholder engagement. The understanding of what constitutes a 'relevant' stakeholder fundamentally shapes the access of individuals from the city system to participate in the collaborative learning process. Access to the transdisciplinary spaces of FRACTAL is dependent on the research design, which envisions the project outcome as "knowledge that supports resilient development

pathways and enables decision-makers to better integrate pertinent climate knowledge in their resource management and urban development planning decisions" ("FRACTAL Brochure", n.d.). The conceptualisation of the implementation space is therefore closely framed with urban governance structures and power dynamics pertaining to the decision-making processes in the city. While the project envisions a diverse range of stakeholders from "universities, research organizations, networking organizations, consultancies, city governments, civic organizations, funding agencies and private enterprises" (Taylor et al., 2017: 13) as participants in the transdisciplinary work, decision-makers from the city system are frequently explicitly named, in juxtaposition to other relevant stakeholders, that are often grouped into a similar generic category (FRACTAL proposal, n.d.; Iipinge, 2017b). It prescribes the understanding of which stakeholders from within the city system are potentially deemed as 'relevant'. The framing centres stakeholders with decision power in the city system as the targeted individuals to engage with in the collaborative processes of FRACTAL.

The engagement in the transdisciplinary space in FRACTAL is envisioned as encounters in which "people with a range of roles, responsibilities and expertise can open up to new perspectives and alternative ways of doing things" (McClure, 2018e), which is expected to build "momentum towards transformative change" (ibid.). The type of engagement that is possible in the practice of the research is fundamentally shaped by the ability to deconstruct power dynamics between participants in the encounters of collaborative learning. Although this is envisioned in the conceptualisation of the transdisciplinary spaces in FRACTAL, the implementation is reflected to be challenging. A limiting factor in this context is the prescribed authority that is left intact based on the framing in the project design that draws on concepts of relevance and expertise. The transdisciplinary spaces are envisioned to integrate the "different types and scales of knowledge and worldviews across multiple boundaries – between science, policy and practice, between disciplines, across organizational levels, between the public and private sectors" (Taylor et al., 2107: 8), but the conceptualisations of co-production fall short in their deconstructive potential to achieve precisely this vision. One specific limiting factor is the focus on 'representatives' in the engagement of stakeholders, which

in contrast to engagement with communities relies on the prescribed authority towards the selected participant to represent a specific group, community or institution.

This approach in selective stakeholder engagement limits access to the collaborative learning process and frames the community as the passive recipients of the outcome of the process, while prescribing agency to the 'representatives' to engage the passive communities outside of the transdisciplinary space. Individuals who are part of these communities, but who do not hold prescribed authority that would allow them to access the transdisciplinary space as a 'relevant' stakeholder are denied agency in this process. Through the focus on representation, it is assumed that these individuals are represented. Yet, active engagement platforms to question and involve individuals outside out the research spaces are not firmly built into the project design. Representation of marginalised communities through non-governmental organisations that have not been questioned for their legitimacy recreates problematic assumptions in connection with epistemic authorities. These are for example prescribed in the assumption that NGOs are able to engage, let alone represent, the lived realities of these communities. In this way, the prescription of 'relevance' in the selection process of stakeholder engagement perpetuates a practice of silencing that is rooted in the institutional power dynamics within the city system.

The imaginary of representation is a mechanism of silencing that is commonly recreated in notions connected to vulnerability. Epistemologically, the individual scale is hardly represented in the FRACTAL research design. It is, however, evoked in context of inspiring climate change adaptation examples that are shared with decision-makers and representatives. Such a framing recreates a notion of passivity, as individuals are commonly referenced in the context of "the communities likely to be the most severely affected by climate change impacts [and who] are frequently the least equipped to cope and adapt" (Butterfield et al., 2017: 17). This passive framing is, however, problematised in a reflection in context of the inspirational adaptation examples. In the working paper, it is noted that "the roles of women and young people, in particular, are worth underscoring" not only for their suffering from impacts by climate change but

because “vulnerable women and young people offer largely untapped human capital and vitality – assets that can and should be mobilised in resilience-building efforts” (Butterfield et al., 2017: 131). This assessment is echoed by a youth activist who participated in the FRACTAL project in Windhoek:

> You have to look at the population of Windhoek, it mostly constitutes a lot of young people, because to Windhoek many young people come to study. In terms of saving water for instance young people are mostly the ones who waste the water and stuff. If then they are able to understand that we can do this and this to reduce the amount of water, then ok. If young people were to be involved in decision-making with regards to water, then there would be a difference. Most especially difference in the thinking, in the mindset. Young people are able to have so much influence, for instance at home. [NGO representative 1]

In this context, it is necessary to deconstruct mechanisms of silencing that are reproduced in transdisciplinary research designs, such as through stakeholder engagement in FRACTAL. What is more, it is necessary to deconstruct in a deliberate and self-aware way and not reinforce problematic ideas of ‘voiceless’ communities that need to be empowered, because as Arundhati Roy points out, “there's really no such thing as the 'voiceless'. There are only the deliberately silenced, or the preferably unheard” (Roy, 2004).

5.5. Coloniality of knowledge: Knowledge politics within FRACTAL

The process of learning on these scales is conceptualised as an “authentic and iterative learning process that moves beyond simple measurements of milestones and targets to deeper reflexivity and adjustment […]to address challenges and thereby enhance our research and practice” (Taylor et al, 2017: 15). Considering that reflexivity has been discussed as a core principle to enable the transformative potential of transdisciplinary research, for example by Felt et al. (2016: 755f), it is evident that the conceptualisation of learning in FRACTAL builds on the critical reflection within the academic discourse.

The document analysis revealed substantial indicators for the successful actioning of reflexivity in the research-set up of FRACTAL. Despite this, evidences of recreated epistemic authorities were equally traceable, specifically in connection with unproblematised universalist ontologies from the natural science field. While an engagement with the deconstruction of the epistemic authority of scientific knowledge was evidenced, the assumed epistemic authority of scientific information to inform understandings of physical processes was not problematised. Furthermore, the imaginary of actionable knowledge indicated mechanisms of prescribed authorities.

The conceptualised transformative knowledge generation in the transdisciplinary space shows evidence of engaging notions of deconstruction in its operationalisation. The vision created for the knowledge processes of the transdisciplinary spaces is underpinned by the concept of the Third Space, which draws on postcolonial conceptualisations of hybridity and ambiguity. Postcolonial scholar Homi Bhabha (1994), for example, terms the space of engagement that is necessary for the creation of new epistemologies the “Third Space of Enunciation”, which is an in-between space, a lived space, in which ambiguity is embraced and used as a form of empowerment instead of deficiency. Within FRACTAL, the idea of the Third Space is closely connected to the conceptualisation of transdisciplinarity, as it is imagined as a space “where people with different ‘safe home spaces’ come together in a hybrid space” (FRACTAL inception workshop). Similarly to reflections on the experience with reflexivity in the project, working in the Third Space was described by participants as “sometimes uncomfortable because people are not used to this type of research” (Annual meeting report, 2017) but also as an important experience, that is most successfully implemented when participants are physically present. Precisely the uncomfortableness of this “redistribution of power over shaping the research agenda, knowledge production process and outcome […] especially [.] for academics, who are used to driving research projects, and for those actors […] who are used to commissioning tightly defined, prescriptive pieces of research from consultants” (Taylor et al., 2017: 8) indicates a deep engagement with this space of ambiguity. It serves as

an example for an engagement with the deconstructive notions of the Third Space within FRACTAL's collaborative spaces.

Where the engagement of the transdisciplinary space as a Third Space reveals limitations is in the conceptualisation of knowledge and the knowledge generation processes themselves. A serious committed engagement with the postcolonial criticism implicated in the engagement in a Third Space requires a deconstruction of structures and power dynamics specifically regarding prescribed boundaries and authorities to be able to move into the space of hybridity and ambiguity (Bhabha, 1994: 256). It also necessitates a focus on transforming epistemologies and ontologies. As one of the foundational components of the transdisciplinary knowledge generation processes is an "improved understanding of regional climate process dynamics […which] should support the development of appropriate climate information for decision making" ("FRACTAL ToC", n.d.), the conceptualisation of climate is a decisive factor in the operationalisation of the process. The understanding of the regional climate is underpinned by the generation and availability of climate information through climate science, as is evident in the visualisation of the theory of change (ibid.). Climate information is framed to pertain to the "core climate science research within FRACTAL" (ibid.) and thus closely connected to climate science, locating the source for information firmly in the academic space. The understanding of the regional climate is conceptualised as an approach with two components, "the physical climate science and the urban-region system's codependency" ("Scientific Capacity Development", n.d.). More concretely, the process for understanding regional climate is defined as a parallel approach that combines top-down understandings of climate processes with bottom-up articulations of climate-risks for the system in question (Daron et al., 2016: 2). This conceptualisation assumes that climate information is generated apart from the systemic context and that the context dependency is limited to determining the type of information that is needed.

While the expectation of bringing together diverse "types of knowledge and ways of creating knowledge from across academic disciplines and from sources outside of academia" (FRACTAL, 2018a) underpins the co-production process in FRACTAL, this

vision is not extended to the process that generates information on regional climate processes, which is derived exclusively from climate data. This indicates the assumption that the city system itself is not a source for such climate information and perpetuates an epistemic authority of scientific information in the comprehension of physical processes. As discussed in the literature review in chapter two, academic discourse so far conceptualises relevant 'local' knowledge in urban systems as the contextual knowledge of local socio-cultural and political processes, rather than knowledge about the physical weather processes and understanding climate on a regional level. This approach to the conceptualisation of climate information is similarly evident in FRACTAL. On a conceptual level, the location of local knowledge as alternative, contextual knowledges from the policy and practice sectors conditions the framing of 'relevant' knowledge that is envisioned as part of the collaborative learning spaces. The framing of 'local' knowledge in FRACTAL is connected to the 'local' stakeholders from "across the public sector, civil society, business, industry and commerce" (Taylor et al., 2017: 4) that are envisioned as the participants in the collaborative learning spaces. However, the term 'local' is neither further contextualised nor defined. Contextually, 'local knowledge' is implied to refer to "other civil society and private sector knowledge-holders" (ibid.: 3). In a reflection on potentially projecting dominance of one knowledge system over the other, scientific knowledge is explicitly juxtaposed with policy knowledge. This use of terminology suggests that 'local' and 'policy' knowledge conceptually refer to the same knowledge system.

The prescribed authority of scientific knowledge over policy knowledge has been reflected on and problematised over the course of the project (ibid.), specifically regarding the transdisciplinary knowledge generation processes. Out of the context of the Learning Labs, a further problematisation is emerging regarding the significance of personal values and ethics that inform decisions made by climate scientists in the generation of climate information (McClure, 2018e). It is informing a new concept of 'climate information distillation' that in a "broader context […] even creates opportunities for decision makers to play a role in analysis decisions" ("Climate Information Distillation", n.d.). A problematisation of the assumed authority of scientific data as the

source of understanding of the physical climate processes was, however, not traceable. The assumptions underpinning the conceptualisation of climate are indicative of an epistemic authority that is recreated into the conceptual dimension of the FRACTAL learning spaces and only partially recognised and problematised through means of the reflexive processes of the project.

Another imaginary at play that creates epistemic authority is the imaginary of actionable knowledge as the outcome of the knowledge generation processes of the transdisciplinary spaces in FRACTAL. The impact of this knowledge is expected to be measurable by its usefulness and applicability (“FRACTAL ToC”, n.d.). Concretely the outcome is envisioned as actionable climate knowledge that “is credible (academically), relevant (to the regional context) and significant (for the pressing needs of each city)” (“FRACTAL Brochure”, n.d.). Conceptually, the parameters of impact are framed to indicate a successful engagement with the Third Space. This framing indicates the assumption that the outcome of the knowledge generation processes will enable transformative change towards resilience by being relevant, applicable and significant. The participants in the collaborative spaces are hereby centred as the authoritative subjects that evaluate the outcomes of the knowledge generation processes for their validity. In this context it is necessary to consider the source of authority, which stems from the ability of participating in the collaborative space in FRACTAL. In the context of the implementation of the Third Space in FRACTAL, the position of authority within the city system not only allowed the participants to be part of the knowledge production process but their presence in the process prescribed their authority for assessing the outcome of the knowledge process. Authoritative structures from within the city system are in this regard recreated within the transdisciplinary spaces of FRACTAL. This prescription of authority is not formally problematised within the FRACTAL conceptualisations. In an implementation of the Third Space, in which a conscious engagement with systemic power dynamics is a foundational aspect, this unquestioned prescribed authority constitutes a limiting factor on the transformative potential of envisioned change processes.

5.6. Conclusion: Transdisciplinary knowledge in FRACTAL and spaces of problematisation

The analysis was able to trace numerous assumptions that shape the operationalisation of the foundational concepts in the FRACTAL research as well as in the spaces of collaboration. They not only create imaginaries that participants engage with and that they need to critically examine as part of their work in the transdisciplinary space, but create spaces of contestation of epistemic authorities and connected power dynamics. While some of these have been questioned in the formalised reflexive platforms of the projects, others have not been problematised collectively but at times by individuals. Uncontested authorities and power structures, most notably on institutional levels of the city system, showed indication of being replicated in the transdisciplinary spaces of FRACTAL. As such, uncontested power dynamics are presenting limiting factors to the transformational potential of these spaces.

It is evident that FRACTAL incorporates the critical learnings and problematisations that academic discourse on transdisciplinary sustainability science currently engages in. From the reflections from the research participants it is especially evident, that FRACTAL is pushing these critical discourses even further. Reflexivity as well as a deep engagement with provincialisations of the different research and collaborations spaces in the project are evident. The conceptual underpinning of the collaborative processes with an envisioned engagement in the Third Space is exemplary of a deeper engagement with the necessity to address power dynamics and prescribed authorities that get inherently reproduced in programmatic research designs based on persistent universalist principles in academic research.

Even though a contestation of certain authoritative regimes is both evident in the design and implementation of the project, FRACTAL still operates within the established definitions, systemic structures and institutions that are set up in each of the science, policy and society areas. This is, in turn, a reflection of the conceptualisations in scientific research, specifically in natural sciences, as well as institutional structures in

academia which the transdisciplinary science discourse does not address or question so far.

The many layers of working through the challenges, which a genuine engagement with transdisciplinary research and working in the Third Space requires, have been voiced both in reflections and in formulations of frameworks. As for example noted in the conceptualisation of the knowledge processes, “[i]t is already clear within FRACTAL that doing justice to ideas of co-exploration and transdisciplinary knowledge co-production is not easy, far from it” (Taylor et al., 2017: 15).

A decolonial perspective in the analysis was able to work with and through these layers even further and provide insights into reproduced authorities and power dynamics that need to be incorporated into the spaces of contestation that are already embedded into the FRACTAL research approach. Voices that seek to push the deconstruction of prescribed authorities have also been arising from within the project, particularly the platforms of reflection. These epistemological interventions range from questioning the “trend of measuring everything; to push back against commodification of adaptation or resilience” (McClure, 2018a), to the discrepancies in implementing the vision of including all knowledge types into the knowledge generation process (FRACTAL, 2017) to calling for informality as a characteristic of and African city to be centred in the approaches to building resilience (FRACTAL, 2018b). Such voices of deconstruction also note the necessity to embrace co-production as “more of a disruptive process, to shift the dominant and business-as-usual technical approaches to water and climate change to consider issues of social justice in the impacts of climate risk and water insecurity” (Scott et al., 2018: 1379). These critical engagements are particularly important in contrasting global, universalist narratives pervasive in international climate change forums, such as the Intergovernmental Panel on Climate Change. As a FRACTAL team member points out:

> [D]ata and technology have enabled our current rate of consumption and production and hence, our crisis. If we chose to rely on these tools going forward,

> we are simply looking for more efficient means for the same gross patterns. To solve the problems associated with climate change we need transformations in values, systems and behaviour. To do this, we need to be thoughtful and bring environmental and social justice into the heart of the response instead of data and technology. We need new ways of producing solutions that recognise and integrate multiple knowledge types, and must be prepared to have difficult conversations that include every age, race and gender. (McClure, 2018c)

The emergence of epistemological interventions from within the context of the research project indicate the transformative potential of these collaborative spaces. These spaces need to be interrogated and deconstructed further, if transformation and a sincere engagement with new epistemologies and pluriverses is going to happen.

5.7. What follows: Epistemic Disobedience

The following chapter will build on these voices of deconstruction from within FRACTAL and envision an example of re-constructing the narrative with a new epistemology. It is intended as an epistemological break, an interruption and an intentional epistemic disobedience in the form of a disruptive insertion into the linear structure of this dissertation. It is a thought experiment that is intended to stand on its own, to honour the indigenous principle it engages with as a principle that can stand by itself. It is not intended to make an argument but to exemplify what decolonial thinking based on the deconstruction and critical contestation of this chapter could look like.

It deliberately does not try to follow an established structure with introduction and conclusion to avoid the merging of indigenous principles into the linear methodology of this study. Scientific methodology is based in Eurocentric knowledge generation principles and an incorporation of epistemological requirements of these methods would risk obscuring the indigenous principles that is engaged with in *walking with*. It requires the reader to leave the “existing paths we know and walk” as a step towards “*unlearning* that which one has learned; unlearning privilege, especially the privilege of sanctioned

ignorance that allows the perpetuation of silence about on-going colonial violence" (Sundberg, 2014: 39; emphasis in original).

6. Rethinking *from* Africa: *Walking with* climate knowledge in Windhoek

Building a new epistemology for climate knowledge *from* Africa instead of merely *about* Africa, requires a vision of deconstruction and re-construction, a vision of an engagement that builds from the premise of the people, whose pluriverses[8] are part of the socio-political collective that shape the outcome of collaborative learning processes (Sundberg, 2014: 41). The principle of *walking with* from the Zapatista movement in Mexico proposes a unifying vision as the focal point from which to build a sense of comradery, breaking up presumptions of borders, interfaces, missing links, but shifting into a perspective of a shared political goal (Grosfoguel: 2012: 99).

It is a vision that is similarly evoked in the concept of *Ubuntu*, which in the context of the southern African location of the FRACTAL research is a concept that can guide the process of building comradery from a cultural perspective, entrenched in place, space and people. In a reflection on building trust in transdisciplinary research, an embedded researcher from FRACTAL pondered the difficulties in engaging successfully in transdisciplinary and how researchers from locations in Europe seemed less inclined to create and actively engage in the messy space of transdisciplinarity than her colleagues from southern Africa:

> Reflecting on the South African situation and the concept of 'Ubuntu', gave some insights in why this may be the case. Ubuntu – "I am who I am because of what we are" – speaks about community, 'oneness', and trust. In my eyes and from personal experiences, this is one of the foundation stones for successful transdisciplinary research in South Africa. […] A wise mentor of mine once said that westerners are goal-orientated, while Africans are

[8] 'Pluriverses' and 'pluriversality' are both an epistemological break and a concept, introduced by decolonial scholars Walter Mignolo and Anibal Quijano to contrast the term and concept of 'universe' and 'universal' (see Mignolo, 2007). It seeks to replace ontological universalisms with ontological pluralism.

> relationship-orientated. Maybe the TD approach can conveniently cut across both these approaches and fill that uncomfortable 'third space'. Maybe this is why residents of our continent ought to naturally be good at following the TD approach. (van Rooyen, 2017).

Conceptually, *Ubuntu* has not been envisioned as part of the FRACTAL research design or implementation. However, this reflection indicates, that the cultural context of the transdisciplinary research in which FRACTAL is located has intrenched visions of community from which active participants in the transdisciplinary processes have been able to draw as a guiding principle in their engagement with the people in this created space.

As discussed above, the transformations in values, systems and behaviours that are necessary to solve the complex problems of climate change and urbanisation needs to put "environmental and social justice into the heart of the response" (McClure, A. 2018c). It creates the vision of a just city at the centre of transdisciplinarity and engagements in collaborative learning. Bringing *Ubuntu* into this space as the basic principle of engagement, this vision of a just city would start by drawing together all people that share the space in question – in the case of FRACTAL Windhoek, this would encompass all individuals that are part of the city system of Windhoek. Locating the different communities, the different platforms of engagement that exist in the city and identifying who has access to these platforms, who doesn't and why. *Walking with Ubuntu* to seek the stakeholders to engage with would centre the question "How do we engage all people who are interested into shaping the city's future?", instead of asking "Who makes decisions that shape the city's future?". It would entail questioning the platforms of engagement at different scales of the city from the ground up, looking for platforms to connect with instead of creating a space in a separate location which only select people are able to access. It would build from the lived reality of the people in the city and seek to connect to what they already connect with in their everyday lives.

Participants in FRACTAL Windhoek have voiced examples for issues that are already of interest to people and platforms, where communities connect, and which offer

opportunities to find the people willing to engage with opportunities to actively shape the future of their environment. One such platform could be communities of religious practice, as a youth activist from Windhoek suggested, because “the domain of religion in climate change is not well addressed yet. There's a lot of reluctance from the religious groups to actually getting on board.” He explained the approach by a climate scientist who is married to an evangelical pastor, “and her argument is from a religious perspective. Very very intelligent, I've not seen somebody who pushes it like that” [NGO2, 21 August 2017]. Another opportunity could be establishing connections to the issues that people are concerned about in their everyday lives, not to seek a change in their understanding of long-term issues, but to incorporate their vision of a just environment based on the terms that are relevant to their experience. As an NGO representative from Windhoek noted in the interviews, water scarcity, which is of high concern to decision-makers, is neither a topic with much awareness nor with much need in informal settlements as issues with water access and proper sanitation create a much more immediate concern [NGO4, 24 August 2017].

Another opportunity is the deconstruction of existing binaries between environmental and social engagement. As narratives of climate change generally frame connected issues from the environmental dimension, a vision that not only connects environmental and social concerns but that frames them as dimensions of the same system can create more diverse opportunities for engagement. Elements of such a vision were already traceable in the overall approach in FRACTAL, as observed in the previous chapter in the voices of deconstruction that emerged in the spaces of reflection, questioning for example the knowledge types that are actually considered in the transdisciplinary knowledge generation processes.

However, the conceptualisation of climate and climate change based on scientific parameters and definitions by the international scientific community did not reveal the same pluriversal understanding of the concepts. The climate risk narratives exemplify this discrepancy quite clearly. As observed by the participants in the co-production process of the narratives, “the person or people who write the first narrative very much

set the overarching theme for the stories" (McClure, 2018b: 6). Whereas the initial process was for the climate scientists to draft a narrative based on their generated information, which would centre the parameters they regarded as important, a contextual approach produced quite different results:

> Researchers from these cities who hold context-specific values, perspectives and knowledge developed the first vision for the future of their city, and a vulnerable sector in particular […]. Climate change information was provided to these researchers in the form of graphs and figures to be sure their first drafts of narratives were well informed. (McClure, 2018f)

Walking with climate information could adopt this immersive principle and expand it to other actors in the city system. Taking up the notion of the narratives primarily as "a good way to start conversations and engage" (ibid.) stakeholders, the focus of these narratives can be exactly this – engage the values and dimension that are important for the people. This could mean accuracy regarding climate variables for scientists, a representation of the fast-paced, complex environment of decision-making for local government representatives and a narrative about the "main issue […] proper sanitation […] and water access" [NGO4, 24 August 2017] for those informal settlements where this is the pressing concern. Such a vision of embracing the engaging potential of the narratives was also voiced in a reflection platform of the project, where a FRACTAL team member imagined that "Perhaps there is a need to take from the science-policy interface to speaking with communities; to try and get a sense of what different communities think about these futures. Maybe with a view to grow cultural narratives around climate-related issues or fit them into existing cultural narratives" (McClure, 2018b: 6). It would require shifting the purpose of the story, from a tool that seeks to convey information to a specific group of people to a tool that helps connecting to the way a specific group of people lives and talks.

At the same time, it would mean to engage with the people for the sake of engaging, without prescribed purpose, reducing the agency to simply seeking to forge a connection. *Walking with* seeks to "politically engage with communities and individuals as intellectual and political subjects, as colleagues in the practices of producing worlds" (Sundberg, 2014: 41). It would require everyone to step out of the official function and let go of expectations connected to assumed authorities that a function or role awards. It would require stepping into the common denominator, the category that creates unity, not distinction, which is the most basic category – that all are people living and sharing the same city system, that we are envisioning a future for together. The desire for such engagements is reflected in a participant's wish for "more deliberate networking so efforts would be more effective", to focus on a "relation between different actors" and find a way to remove the existing "dependency on 2-3 persons as advocates" [NGO3, 24 August 2017]. Such encounters would shift the possibility from engaging with imbalances and injustices that are a challenge in current co-production processes, to help create balances through the most basic common denominator we can bas a relationship with anyone on.

Figure 2: Visualisation of the pluriverses envisioned by Zapatista leader Subcomandante Marcos (Desinformémonos, 2017). The text translates to: "'It is necessary to make a new world. A world where many worlds fit. Where all the worlds fit.' Sub. Marcos".

Walking with requires the generalist ontology, that the aim of 'improving understandings of climate change' conveys, to be questioned and re-constructed in an inclusive way. Instead of centring the envisioned impact on helping people understand climate and climate change better, building on the idea that they are better informed on the 'facts', it would seek to build an understanding of climate that

incorporates the lived realities and acknowledges the cultural, political, gendered and racial dimensions of climate. It would centre the question of understanding the burning issues of people's everyday lives with the intention to understand connections to cultural, political and physical climates. It would, in fact, deconstruct the necessity of a statistical concept such as climate, which is therefore so abstract and separate from our everyday lives. Such a deconstruction would especially challenge us to envision climate on different terms. Mike Hulme proposes to envision plural climates that are political, intellectual, economic, cultural and moral as 'weathercultures' and our own understanding as active 'weatherculturalists' (Hulme, 2016: 153). *Walking with* climate knowledge as 'weatherculturalists', then, would open up the concept of climate to every person's lived reality. 'Weathercultures', then, would reflect a personal experience and a personal story. As an experience to relate to, it would inherently convey values, perspectives and norms that connect it to the environment that people live in, placing it firmly inside the system instead of creating an abstract representation that is stripped of its cultured context when it is defined.

The potential for such new comprehensions of climate entrenched in a personal, lived experience were indicated in two reflections from the participant interviews, in which a youth activist shares his experience of engaging with different people on the topic of climate change. He notes that people "are very curious […] because they want to understand exactly why is climate change a problem. […] But then the more I speak to them, the more I realize people are actually very familiar with this stuff, it's just that they don't have the same terms we have" [NGO2, 21 August 2017]. Another NGO representative echoed this perspective when he said that "most of the elders and people that go way back, they are able to tell that the previous rainfalls and the current rainfalls are not the same and that every time it's getting drier and drier" [NGO1, 21 August 2017]. Cultural understandings of climate have the potential to engage with a shortcoming of weather forecasts, which already creates barriers through mistrust because of its universalist claim for accuracy. 'Weathercultures' could create a connection to the entrenched notions of *Ubuntu* where statistical climate falls short. It already is a part of people's lived reality in the sense that

> many people have their way of predicting for instance rainfall, they don't trust forecasts. For instance, looking at various animal behaviours. Yes, that's what most people use here in Namibia. In the informal settlements or in the North there is no television and weather forecast, they have their own signs“ [NGO1, 21 August 2017].

As shared by a participant in a workshop about the practical experiences with building resilience in southern African cities, it is necessary to understand that “[i]nformality is part of the African city-region system. This informality contributes to both the resilience and vulnerability of these city systems and should therefore be embraced and integrated into resilience building initiatives” (FRACTAL, 2017). In this context, ‘weathercultures’ in Windhoek would not require integrating informality into the vision of a just future city because it would need to build from a place that informality is inherently part of.

Walking with climate knowledge in Windhoek allows to build a vision of what a just city would look like in an African context. Based on an inclusive ontology, it has the potential to deconstruct barriers and create platforms where current understandings of climate based on scientific climate information create barriers that require a bridging mechanism. By building from the perspective of the people who are typically not included in an active way, recognising their agency and involvement, the transformational potentials of encounters that embrace spaces such as evoked in the concept of the Third Space become apparent. *Walking with* climate knowledge shows great potential for connection and speak with the voices of deconstruction that have been emerging from within the transdisciplinary encounters in FRACTAL.

The limitations of *walking with* are in the limitations that participants set themselves in their engagements in transdisciplinarity. It requires a willingness to get very comfortable with being uncomfortable, especially for the actors who have are used to inhabit spaces that award their function a prescribed authority. The transformative potential of transdisciplinary collaboration and knowledge generated in these spaces boils down to the participant’s willingness to engage and share the vision that is evoked (see figure 2).

FRACTAL participants have shared the different levels of challenges they had to work through in the transdisciplinary processes. But they have already created momentum towards daring to embrace a true transformative vision of a just city, built from the perspectives of space, place and people that shape its future every day.

7. Conclusion

The central aim of this study is to examine the power dynamics that underly new modes of knowledge generation in the transdisciplinary research space. Recent trends in research have particularly propagated a transdisciplinary approach that exchanges the positivist principle with the reliance on diversity of knowledges, and their epistemologies and ontologies to be incorporated into the research design. Such a drastic shift in the mode of conducting research inevitably creates challenges for all those who engage in this new mode of knowledge production. It is therefore necessary to examine these challenges and reveal both the enabling and limiting dimensions that transdisciplinary research practice is experiencing at present.

To examine the power dynamics, a decolonial perspective was applied towards examining a transdisciplinary research space in a southern African context. Decolonial theory builds on a deconstructionist approach towards knowledge generation, with the aim to de-link principles, epistemologies and ontologies that are rooted in colonialism (Mignolo, 2007: 494). While the criticism departs from a contestation of knowledge production, the premise of the decolonial project is that the ‘coloniality of power’ is replicated in politics, economy, society and culture in the geopolitics that shape knowledge production (Asher, 2013: 832). This study centres decolonial theory as the necessary theoretical vantage point to penetrate deeper layers of critical engagement. Additionally, decolonial criticism links to activist traditions in its theoretical approach, making it accessible for creating new narratives in a complex geopolitical environment such as climate change. For the analysis in this study, a theoretical framework was derived from different literary discourses engaging in similar contestations. The

dimension of analysis that resulted from this framework were based in the analytical themes of the modernity/coloniality/decoloniality project: (1) contesting the geopolitical space, (2) contesting subjectivities, and (3) contesting knowledge politics.

These analytical themes were used to structure the analysis of the collected data, which included a diverse range of FRACTAL publications, such as working papers, briefing notes, academic publications and reflections from team meetings as well as participant interviews. The first phase of the research comprised of a qualitative thematic analysis of the sourced documents. Additionally, interviews were conducted with participants of FRACTAL in Windhoek to gain further insights into the lived experiences of the project and its participants. In the thematic analysis, predefined themes were traced and consolidated into foundational concepts that are operationalised in the FRACTAL research approach and implementation. The identified concepts were past, present and future climates, transdisciplinarity and the Third Space, transformation, reflexivity, learning and knowledge. These concepts fundamentally shape the research experience and were identified to be partly formalised in working papers and frameworks but with notable exceptions of the concepts of the Third Space, transformation and climates. The subsequent analysis identified assumptions that were evident in the operationalisation of these concepts and which create imaginaries of the collaborative engagements, the knowledge production in FRACTAL and the geopolitical space in Windhoek.

In the analysis, power dynamics were traceable through imaginaries. Two overarching imaginaries could be traced which are based in the construction of and engagement with the geopolitical space in Windhoek. The first one establishes the imaginary of the social impact. It is closely connected to assumptions and visions created around the desired future in the project, which in turn is underpinned by the vision of transformational change. The reflexive learning process in the project together is a central mechanism applied to question and deconstruct prescribed authorities. It is connected to the assumption that this deconstruction is possible through addressing the existing structures and power dynamics. While a deconstructive process was evidenced for vertical power dynamics within the spaces of FRACTAL, prescribed authorities

based on function and position of participants from the sectors science, policy and society were not evidenced to have been critically engaged in. This, in turn, was identified to enable a replication of epistemic authorities and power dynamics in the practice of the research.

The second one is the imaginary of the science-policy interface, which drives conceptualisations of the space of engagement for the transdisciplinary research. It was identified to be driven by underlying assumptions regarding the power of the actors in the political sphere and the potential to enable transformative change. The vision for transformation at the science-policy-interface showed to be constructed based on the assumption that mutual understanding and collaboration between these sectors would create pathways of resilience.

The analysis further revealed traceable power dynamics through replications of epistemic authority. An uncontested prescribed authority was especially evident in connection with the climate information that was generated to inform the knowledge co-production that aimed to produce ‘relevant’ and ‘actionable’ knowledge products. While a contestation of authoritative knowledge was evident with regards to contextualising the information for present and future climates in Windhoek, the scientific information itself was not questioned for its authority. The generation of climate information was firmly located in the scientific sector. The conceptualisations of the physical processes that climate science seeks to understand and project into the future build exclusively on parameters defined in natural sciences. Conceptualisations of climate that were not based in scientific parameters could not be identified. Epistemic authorities and the universalist ontology of scientific information are thus not sufficiently engaged with to deconstruct the power dynamics they create, which are cemented in the authority of ‘expert’ voices. This provides evidence of a shortfall in academic discourse in engaging with more deconstructive criticisms and mainstreaming them into all areas that shape the practice of the research.

The conceptualisation of stakeholder engagement in the programmatic research design revealed to be the main mechanism that created subjectivity. Actors from the sectors of policy and practice were invited to participate in the transdisciplinary space of FRACTAL based on the assumption of relevance and the authority to represent. This created an exclusionary mechanism for individuals within these sectors without this prescribed authority. It also created authority for the participants in the knowledge processes to engage the excluded individuals and communities with the outcome of the knowledge generation processes. The mechanism in stakeholder engagement was driven by the underlying assumption that the presence of representatives of organisations from the different sectors created the necessary platform to give agency to the individuals in the sector. It is therefore through the conceptual design of the project that defines the collaborative learning spaces and in which mechanisms of subjectivities are evident, which get replicated in the collaborative processes in the project.

Transformation as a concept is continuously evoked either directly or as a conditioning principle, but it is also the concept that revealed the most indications for problematic implementation. It is frequently referenced in a non-radical, non-deconstructive context, which indicate limiting factors on enabling the change processes that it was expected to enable (FRACTAL proposal, n.d.). It is frequently referenced in a non-radical, non-deconstructive context, which indicate limiting factors on enabling the change processes that it was expected to enable. Transformation as a radical shift and departure from preconceived ways is not evidenced in the research design. The conceptualisation of transformation as a process that rather engages than disrupts established systematic power dynamics was therefore identified as a limiting factor towards the project's outcome of enhancing climate resilience in a southern African context.

Many of the challenges of implementing concepts for transdisciplinary knowledge generation have also been addressed and problematised in the reflective platforms of the project. The analysis evidenced that FRACTAL incorporates and builds on critical engagement philosophies and concepts that reflect the current discourse in academia. Especially the reflexive mechanisms in FRACTAL were traceable to incorporate

dimensions of postcolonial criticism. More so, the practical engagement with these concept and philosophies are exemplary in the project, especially in comparison to transdisciplinary research practices in other regions of the world (McClure, A. 2018c).

Tracing the limitations and potentials of current engagements with contestations of power in FRACTAL are indicative of the shortfalls of critical academic engagements in transdisciplinarity. Transdisciplinary science and the academic discourse concerned with the complex issue of climate change and sustainable development need to engage with critical voices that question and deconstruct systems not only horizontally but crossing established systemic boundaries. Voices of deconstruction have also been emerging in the reflexive platforms of the FRACTAL research project. They echo the need to penetrate deeper levels of contesting prescribed authorities and of building a southern African understanding of the challenges that cities in these regions face.

These epistemic breaks emerging from within the research space point towards “how Euro-North American-centric modernity has created modern problems of which it has no modern solutions and how theories/knowledges generated from a Euro-North American-centric context have become exhausted if not obstacles to the understanding of contemporary human issues” (Ndlovu-Gathseni, 2015: 485). An envisioning of a transformed city that is entrenched in the local place, space and people, needs to engage these deconstructive principles to rebuild a new epistemology from a decolonial perspective. It needs to consciously question systems and institutions across scales to enable systemic change. This will require for participants to get comfortable with getting even more uncomfortable in the ambiguous, hybrid environment of the Third Space.

The experimental section engaging an indigenous principle in a city space serves both as a vision of what building new epistemologies could look like and as a space to examine the limitations that current transdisciplinary research needs to engage with to enable the change that is envisioned. The thought experiment centred on *Walking With,* used by the indigenous activist movement of the Zapatistas in Mexico, the dimension of climate knowledge generation that were deconstructed in the analysis and used the

principle to reconstruct and to envision a new epistemology for climate knowledge in Windhoek. It applied the principle of *Walking With* to build a new narrative that seeks to centre justice and the fight for a common cause to create unity. It used the vision of 'oneness' of the *Ubuntu* concept as a cultural basing of the *Walking With* principle in a southern African reality, envisioning a way to deconstruct systemic barriers and rebuild the system in more inclusive terms.

An engagement with the *Walking With* principle is a first step towards envisioning new approaches in transdisciplinarity, to identify barriers and resistances. It unveils the necessity to deconstruct the prescribed authorities and hierarchies that are being replicated in programmatic transdisciplinary research designs. It exemplifies the transformative potential of a unifying perspective, which has been the single biggest challenge that the world is facing in finding solutions for living in and preventing climate change. Further engagements with the potential of methodologies and principles that centre on inclusionary ontologies are necessary for future engagements within and without the academic space. The scope of the city lend itself well to the *Walking With* principle, because of the proximity of communities and the shared experience within the city system. Limitations for future engagements could arise for larger scale projects and international communities, where the sense of sharing the same space is more abstract. In any case, engaging with such principles not only requires reflexivity and questioning ontology on the researcher's part but a deep engagement with what the principle stands for, so as not to be complicit in colonising these methodologies.

The presented research demonstrates that transformative change in development of African cities requires a deconstruction of power dynamics on interpersonal as well as systemic levels. Current transdisciplinary sustainability research is not yet sufficiently engaging in deconstructive approaches. While concepts are frequently evoked that create a vision of deconstruction and contestation, the theoretical discourse as well as the practical application in the research field significantly lack the necessary disruptiveness. The research context itself, with its programmatic research design dependent on attracting funders in the global North, is conditioned to replicate epistemic

authorities and subjectivities in the collaborative learning processes. Decolonial criticism challenges such engagements with concepts like transformation and socio-political equity based on their seriousness. These contestations are necessary if we as part of a global community truly want to change a system that has manifested its power imbalances in global crises like climate change.

An effort that strives for complacency rather than embraces the uncomfortableness of radical change is potentially more damaging for the collaborative effort than a mere lack of engagement. A complacent engagement potentially inhibits the very process it claims to further, as dimensions of this study have indicated. Additionally, it first has to be unmasked as such an engagement in order to challenge a more sincere level. This is the space in which decolonial criticism in sustainability and climate change research needs to progress much more daringly than it has in the past. Voices that call for deconstruction are becoming louder and more widespread, in academia as well as in societal forums. There is tremendous potential in the collaborative learning processes when they are seriously engaged in. It is now the call for action towards academic institutions to not resist but be at the forefront of these spaces where actors from different sectors come together, to develop the mechanisms of reflexivity into a productive and most importantly impactful engagement that does not contend itself with merely participating.

8. References

Arrighi, J., Koelle, B., Coll Besa, M., Spires, M., Kavonic, J., Scott, D., Kadihasanoglu, A., Bharwani, S., Jack., C. 2016. *Dialogue for decision-making: unpacking the 'City Learning Lab' approach. FRACTAL Working Paper 2.* Oxford, UK: Stockholm Environment Institute Oxford Centre.

Asher, K. 2013. Latin American Decolonial Thought, or Making the Subaltern Speak. *Geography Compass.* 7(12):832-842.
Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/gec3.12102 [2019, 17 September].

Austin, W., Park, C. & Goble, E. 2008. From Interdisciplinary to Transdisciplinary Research: A Case Study. *Qualitative Health Research.* 18(4):557-564.
Available: http://journals.sagepub.com/doi/full/10.1177/1049732307308514 [2019, 17 September].

Barker, C. and Pistrang, N., 2015. *Research methods in clinical psychology: An introduction for students and practitioners*. John Wiley & Sons.

Bertelsmann Stiftung (BTI). 2016. *Bertelsmann Stiftung Transformation Index. Namibia Country Report.* Gütersloh: Bertelsmann Stiftung.

Bhabha, H.K., 1994. *The location of culture*. Routledge.

Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2):77-101.

Bhambra, G.K. 2014. Postcolonial and decolonial dialogues. *Postcolonial Studies.* 17(2):115-121.
Available: http://www.tandfonline.com/doi/abs/10.1080/13688790.2014.966414 [2019, 17 September].

Bhattacherjee, A. 2012. *Social science research.* Tampa, Florida: Scholar Commons.
Available: https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=79 [2019, 17 September].

Biraimah, K. L. 2016. Moving beyond a destructive past to a decolonised and inclusive future: The role of ubuntu-style education in providing culturally relevant pedagogy for Namibia. *International Review of Education*, *62*(1), 45-62.

Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D.J., Newig, J., Reinert, F., Abson, D.J. et al. 2013. A review of transdisciplinary research in sustainability

science. *Ecological Economics.* 92:1-15.
Available: https://www.sciencedirect.com/science/article/pii/S0921800913001377 [2019, 17 September].

Buizer, J., Jacobs, K. and Cash, D., 2016. Making short-term climate forecasts useful: Linking science and action. *Proceedings of the National Academy of Sciences*, *113*(17):4597-4602.

Butterfield, R.E., Coll Besa, M., Burmeister, H., Blair, K., Kavonic, J., Bharwani, S., Cullis, J., Spires, M. and Mwalukanga, B. 2017. *Inspiring Climate Action in African Cities: Practical Options for Resilient Pathways. FRACTAL Working Paper 4.* Oxford, UK: Stockholm Environment Institute Oxford Centre.

Cash, D.W., Clark, W.C., Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jäger, J. and Mitchell, R.B., 2003. Knowledge systems for sustainable development. *Proceedings of the national academy of sciences*, *100*(14):8086-8091. Derickson, K.D. 2017. Urban geography II. *Progress in Human Geography.* 41(2):230-244.
Available: http://journals.sagepub.com/doi/full/10.1177/0309132515624315 [2019, 17 September].

Castree, N., Adams, W.M., Barry, J., Brockington, D., Büscher, B., Corbera, E., Demeritt, D., Duffy, R. et al. 2014. Changing the intellectual climate. *Nature Climate Change.* 4(9):763-768. Available: https://search.proquest.com/docview/1651525110 [2019, 17 September].

Chakrabarty, D. 2000. *Provincializing Europe: Postcolonial Thought and Historical Difference.* Princeton: Princeton University Press.

Chu, E., Anguelovski, I. & Carmin, J. 2016. Inclusive approaches to urban climate adaptation planning and implementation in the Global South. *Climate Policy.* 16(3):372-392. Available: http://www.tandfonline.com/doi/abs/10.1080/14693062.2015.1019822 [2019, 28 September].

City of Windhoek. 2016. *City of Windhoek participation in FRACTAL Project*. (Unpublished).

Clark, W.C., van Kerkhoff, L., Lebel, L. and Gallopin, G.C., 2016. Crafting usable knowledge for sustainable development. *Proceedings of the National Academy of Sciences*, *113*(17):4570-4578.

Climate & Development Knowledge Network ("CDKN"), n.d. *PROJECT: Future Climate for Africa*. Available: https://cdkn.org/project/project-future-climate-for-africa/?loclang=en_gb [2019, 17 September].

Cloutier, G., Joerin, F., Dubois, C., Labarthe, M., Legay, C. and Viens, D., 2015. Planning adaptation based on local actors' knowledge and participation: A climate governance experiment. *Climate Policy*, *15*(4):458-474.

Corburn, J. (2003) 'Bringing Local Knowledge into Environmental Decision Making: Improving Urban Planning for Communities at Risk'. *Journal of Planning Education and Research*, 22(4):420–433. doi: 10.1177/0739456X03022004008.

Darbellay, F. 2015. Rethinking inter- and transdisciplinarity: Undisciplined knowledge and the emergence of a new thought style. *Futures.* 65:163-174. Available: https://www.sciencedirect.com/science/article/pii/S0016328714001700 [2019, 28 September].

Daron, J., Janes, T., Jack, C., Jones, R. 2016. *Framework for needs-informed research: assessing climate processes. FRACTAL Working Paper 1.* Oxford, UK: Stockholm Environment Institute Oxford Centre. Available: http://www.fractal.org.za/wp-content/uploads/2017/01/Framework-for-needs-informed-research.pdf [2018, 18 April].

Department for International Development. 1997. *Eliminating world poverty: a challenge for the 21st century. White Paper on International Development.* London: Her Majesty's Stationery Office.

Elliott, R. and Timulak, L., 2005. Descriptive and interpretive approaches to qualitative research. *A handbook of research methods for clinical and health psychology*, *1*(7):147-159.

Endfield, G. & Morris, C. 2012. Cultural spaces of climate. *Climatic Change.* 113(1):1-4. Available: https://search.proquest.com/docview/1018621081 [2019, 28 September].

Eriksen, S.H., Nightingale, A.J. & Eakin, H. 2015. Reframing adaptation: The political nature of climate change adaptation. *Global Environmental Change.* 35:523-533. Available: https://www.sciencedirect.com/science/article/pii/S0959378015300509 [2019, 28 September].

Esson, J., Noxolo, P., Baxter, R., Daley, P. & Byron, M. 2017. The 2017 RGS-IBG chair's theme: decolonising geographical knowledges, or reproducing coloniality? *Area.* 49(3):384-388.

Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/area.12371 [2019, 28 September].

Felt, U., Igelsböck, J., Schikowitz, A. & Völker, T. 2016. Transdisciplinary Sustainability Research in Practice. *Science, Technology, & Human Values.* 41(4):732-761. Available: http://journals.sagepub.com/doi/full/10.1177/0162243915626989 [2019, 28 September].

Felt, U., Fouché, R., Miller, C.A. and Smith-Doerr, L. eds., 2017. *The handbook of science and technology studies*. MIT Press.

FRACTAL Brochure. n.d. *FRACTAL Future Resilience for African Cities and Lands*. Available: http://www.fractal.org.za/wp-content/uploads/2018/05/FRACTAL-Brochure.pdf [2019, 28 September].

FRACTAL Climate Information Distillation Framework ("Climate Information Distillation"). n.d. (Unpublished).

FRACTAL proposal, n.d. Available: http://www.fractal.org.za/proposed-research [2018, 18 April].

FRACTAL Scientific Capacity Development Framework ("Scientific Capacity Development"). n.d. (Unpublished).

FRACTAL Theory of Change (ToC). n.d. Available: http://www.fractal.org.za/fractal-theory-of-change [2018, 18 April].

FRACTAL. 2017. *Building city-region resilience in Africa: lessons from practice*. Available: http://www.fractal.org.za/wp-content/uploads/2017/06/ResDev-colloquium_think-piece_June2017.pdf [2019, 28 September].

FRACTAL. 2018a. *Learning Framework*. (Unpublished).

FRACTAL, 2018b. Report draft: *Third Windhoek Learning Lab 14-15 August 2018*. (Unpublished).

Freire, P., 1970. *Pedagogy of the oppressed.* Bloomsbury Publishing USA.

Future Climate for Africa ("FCFA"), n.d. About FCFA. Available: https://futureclimateafrica.org/what-fcfa-does [2019, 17 September].

Gibbons, M. 2000. Mode 2 society and the emergence of context-sensitive science. *Science and Public Policy,* 27(3):159-163.

Gibbons, M. and Nowotny, H., 2001. The potential of transdisciplinarity. In *Transdisciplinarity: joint problem solving among science, technology, and society*. 67-80.

Goonatilake, S., 1998. *Toward a Global Science: mining civilizational knowledge*. Indiana University Press.

Grosfoguel, R. 2008. 'Transmodernity, Border Thinking, and Global Coloniality: Decolonizing Political Economy and Postcolonial Studies', *Eurozine*. Available: http://www.eurozine.com/articles/2008-07-04-grosfoguel-en.html [2018, 18 April].

Grosfoguel, R. 2012. Decolonizing Western uni-versalisms: decolonial pluri-versalism from Aimé Césaire to the Zapatistas. *Transmodernity*, 1: 88–104.

Guest, G., MacQueen, K.M, and Namey, E.E. 2012. *Applied thematic analysis*, SAGE Publications, Inc., Thousand Oaks, California. DOI: 10.4135/9781483384436.

Harding, S. ed., 2011. *The postcolonial science and technology studies reader*. Duke University Press.

Harding, S. 2016. Latin American Decolonial Social Studies of Scientific Knowledge. *Science, Technology, & Human Values.* 41(6):1063-1087. Available: http://journals.sagepub.com/doi/full/10.1177/0162243916656465 [2019, 28 September].

Hiwasaki, L., Luna, E. and Shaw, R., 2014. Process for integrating local and indigenous knowledge with science for hydro-meteorological disaster risk reduction and climate change adaptation in coastal and small island communities. *International journal of disaster risk reduction*, *10*:15-27.

HM Treasury & Department for International Development. 2015. *UK aid: tackling global challenges in the national interest.* London: HM Treasury.

Hulme, M. 2008. Geographical work at the boundaries of climate change. *Transactions of the Institute of British Geographers.* 33(1):5-11.

Hulme, M., 2010. Problems with making and governing global kinds of knowledge. *Global Environmental Change*, *20*(4):558-564.

Hulme, M. 2011. Reducing the Future to Climate: A Story of Climate Determinism and Reductionism. *Osiris.* 26(1):245-266. Available: https://www.jstor.org/stable/10.1086/661274 [2019, 3 October].

Hulme, M. 2015. Climate and its changes: a cultural appraisal. *Geo: Geography and Environment.* 2(1):1-11.
Available: https://onlinelibrary.wiley.com/doi/abs/10.1002/geo2.5 [2019, 3 October].

Iipinge, K.2017a. *Windhoek City Learning Lab Report*. Available: http://www.fractal.org.za/wp-content/uploads/2017/06/First-Windhoek-Learning-Lab_Report.pdf [2019, 18 April].

Iipinge, K. 2017b. *Windhoek Second Learning Lab Report*. Available: http://www.fractal.org.za/wp-content/uploads/2018/08/Second-Windhoek-Learning-Lab-Report.pdf [2019, 18 April].

Iipinge, K. 2018a. *UNAM and City of Windhoek run joint workshop for Windhoek Councillors* [Blog, 19 January]. Available: http://www.fractal.org.za/2018/01/19/unam-and-city-of-windhoek-run-joint-climate-change-and-decision-making-awareness-workshop-for-windhoek-councillors/ [2019, 18 April].

Iipinge, K. 2018b. *Windhoek City engages in National Adaptation Planning Process* [Blog, 12 June]. Available: http://www.fractal.org.za/2018/06/12/windhoek-city-engages-in-national-adaptation-planning-process/ [2019, 18 April].

Iipinge, K. and Haukelo, S.N. 2018. *Windhoek Transformational Leadership on Climate Change Training*. Available: http://www.fractal.org.za/wp-content/uploads/2018/08/Windhoek-TLCC-Report.pdf [2019, 18 April].

Jahn, T., Bergmann, M. & Keil, F. 2012. Transdisciplinarity: Between mainstreaming and marginalization. *Ecological Economics.* 79(1):1-10.
Available: https://www.sciencedirect.com/science/article/pii/S0921800912001681 [2019, 3 October].

Jasanoff, S. 2007. Technologies of humility. *Nature*, *450*(7166), 33.

Jasanoff, S. 2010. A New Climate for Society. *Theory, Culture & Society.* 27(2-3):233-253. Available: http://journals.sagepub.com/doi/full/10.1177/0263276409361497 [2019, 3 October].

Jasanoff, S. 2011. Cosmopolitan knowledge: Climate science and global civic epistemology. *The Oxford handbook of climate change and society*.

Jasanoff, S., & Kim, S. H. 2013. Sociotechnical imaginaries and national energy policies. *Science as culture*, *22*(2), 189-196.

Jazeel, T. 2017. Mainstreaming geography's decolonial imperative. *Transactions of the Institute of British Geographers.* 42(3):334-337.
Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/tran.12200 [2019, 3 October].

Kaika, M. 2017. 'Don't call me resilient again!' The New Urban Agenda as immunology … or ... what happens when communities refuse to be vaccinated with 'smart cities' and indicators. *Environment and Urbanization.* 29(1):89-102.
Available: http://www.narcis.nl/publication/RecordID/oai:dare.uva.nl:publications%2Fef6ddd9d-3c28-428f-bdbf-54867ebdac7b [2019, 3 October].

Keet, A. 2014. Epistemic 'othering' and the decolonisation of knowledge. *Africa Insight.* 44(1):23-37.
Available: http://reference.sabinet.co.za/sa_epublication_article/afrins_v44_n1_a3 [2019, 3 October].

Kirchhoff, C.J., Carmen Lemos, M. & Dessai, S. 2013. Actionable Knowledge for Environmental Decision Making: Broadening the Usability of Climate Science. *Annual Review of Environment and Resources.* 38(1):393-414.

Kläy, A., Zimmermann, A.B. & Schneider, F. 2015. Rethinking science for sustainable development: Reflexive interaction for a paradigm transformation. *Futures.* 65:72-85.
Available: https://www.sciencedirect.com/science/article/pii/S0016328714001736 [2019, 3 October].

Klein, J.T. 2013. The Transdisciplinary Moment(um). *Integral Review.* 9(2):189-199.

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M. and Thomas, C.J., 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability science*, 7(1):25-43.

Lawrence, R.J. 2015. Advances in transdisciplinarity: Epistemologies, methodologies and processes. *Futures.* 65:1-9.
Available: https://www.sciencedirect.com/science/article/pii/S001632871400192X [2019, 3 October].

Lemos, M.C., 2015. Usable climate knowledge for adaptive and co-managed water governance. *Current Opinion in Environmental Sustainability*, 12:48-52.

Livingstone, D. 2012. Reflections on the cultural spaces of climate. *Climatic Change,* 113(1):91-93. Available: https://search.proquest.com/docview/1018621078 [2019, 3 October].

Mack, N., Woodsong, C., MacQueen, K.M., Guest, G. and Namey, E., 2005. *Qualitative research methods: a data collectors field guide*. Family Health International. Available: https://www.fhi360.org/sites/default/files/media/documents/Qualitative%20Research%20Methods%20-%20A%20Data%20Collector's%20Field%20Guide.pdf [2019, 3 October].

Maldonado-Torres, N., 2007. On the Coloniality of Being: Contributions to the Development of a Concept. *Cultural studies*, *21*(2-3):240-270.

Mahony, M. & Hulme, M. 2018. Epistemic geographies of climate change. *Progress in Human Geography.* 42(3):395-424.
Available: http://journals.sagepub.com/doi/full/10.1177/0309132516681485 [2019, 3 October].

McClure, A. 2018a. *City government-research partnerships: reflections from Cape Town and Johannesburg. FRACTAL Briefing Note.* Available: http://www.fractal.org.za/wp-content/uploads/2018/09/Learning_government-research-partnerships.pdf [2019, 3 October].

McClure, A. 2018b. *Climate narratives: what have we tried? What have we learned? What does this mean going forward? FRACTAL Briefing Note.* Available: http://www.fractal.org.za/wp-content/uploads/2018/09/Learning_climate-narratives-briefing-note.pdf [2019, 18 April].

McClure, A. 2018c. *Cities and Climate: What's our next step?* [Blog, 14 March]. Available: http://www.fractal.org.za/2018/03/14/cities-and-climate-whats-our-next-step/ [2019, 18 April].

McClure, A. 2018d. *Transformational Leadership on Climate Change Training for Windhoek Decision Makers* [Blog, 21 May]. Available: http://www.fractal.org.za/2018/05/21/transformational-leadership-on-climate-change-training-for-windhoek-decision-makers/ [2019, 18 April].

McClure, A. 2018e. *FRACTAL at the ACC seminar series on cities and climate change* [Blog, 23 June]. Available: http://www.fractal.org.za/2018/06/23/fractal-at-the-acc-seminar-series-on-cities-and-climate-change [2019, 18 April].

McClure, A. 2018f. *Growing climate knowledge through narratives of the future.* [Blog, 31 July]. Available: http://www.fractal.org.za/2018/07/31/growing-climate-knowledge-through-narratives-of-the-future/ [2019, 18 April].

Meehan, K., Klenk, N. L. and Mendez, F. 2018. The Geopolitics of Climate Knowledge Mobilization: Transdisciplinary Research at the Science–Policy Interface(s) in the

Americas. *Science, Technology, & Human Values.* 43(5):759–784. doi: 10.1177/0162243917745601.

Meadow, A.M., Ferguson, D.B., Guido, Z., Horangic, A., Owen, G. and Wall, T., 2015. Moving toward the deliberate coproduction of climate science knowledge. *Weather, Climate, and Society.* 7(2):179-191.

Mfune, J.K., Iipinge, K., Mokanya, E., Nghalipo, E. 2017. *Awareness on Climate Change and Decision Making Workshop for City Of Windhoek and Windhoek Constituency Councillors.* (Unpublished).

Mignolo, W., 2000. On Gnosis and the Imaginary of the Modern/Colonial World System. In: *Local Histories/Global Designs: Coloniality, Subaltern Knowledge, and Border Thinking*, 3-45.

Mignolo, W. 2005. *The idea of Latin America*. Malden, MA, Blackwell Pub.

Mignolo, W. 2007. Delinking: The rhetoric of modernity, the logic of coloniality and the grammar of de-coloniality. *Cultural studies*, *21*(2-3):449-514.

Mignolo, W. 2009. Epistemic Disobedience, Independent Thought and Decolonial Freedom. *Theory, Culture & Society.* 26(7-8):159-181. Available: http://journals.sagepub.com/doi/full/10.1177/0263276409349275. [2019, 18 September].

Mignolo, W. 2010. Cosmopolitanism and the De-colonial Option. *Studies in Philosophy and Education.* 29(2):111-127. Available: https://search.proquest.com/docview/204099736 [2019, 18 September].

Miranda Sara, L. and Baud, I.S.A., 2014. Knowledge-building in adaptation management: concertación processes in transforming Lima water and climate change governance. *Environment and Urbanization*. 26(2): 505-524.

Muñoz-Erickson, T., Miller, C. & Miller, T. 2017. How Cities Think: Knowledge Co-Production for Urban Sustainability and Resilience. *Forests.* 8(6):203. Available: https://doaj.org/article/2a573fc736de415dacee814f338120ae [2019, 18 September].

Mushi, P. A. K. 2009. *History and development of education in Tanzania*. African books collective.

Naess, L.O., 2013. The role of local knowledge in adaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change*. *4*(2):99-106

Negev, M. and Teschner, N., 2013. Rethinking the relationship between technical and local knowledge: Toward a multi-type approach. *Environmental science & policy*, 30:50-59.

Ndlovu-Gatsheni, S.J. 2015. Decoloniality as the Future of Africa. *History Compass.* 13(10):485-496.
Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/hic3.12264 [2019, 18 September].

Nowotny, H., Scott, P. and Gibbons, M., 2003. Introduction: 'Mode 2' Revisited: The New Production of Knowledge. *Minerva*, 41(3), p.179-194. DOI: 10.1023/A:1025505528250.

Noxolo, P. 2012. One world, big society: a discursive analysis of the conservative green paper for international development. *The Geographical Journal*, 178:31–34.

Noxolo, P. 2017. Decolonial theory in a time of the re-colonisation of UK research. *Transactions of the Institute of British Geographers.* 42(3):342-344.
Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/tran.12202 [2019, 18 September].

Obermeister, N., 2017. From dichotomy to duality: addressing interdisciplinary epistemological barriers to inclusive knowledge governance in global environmental assessments. *Environmental Science & Policy*, 68:80-86.

Odora Hoppers, C.A.. 2011. Towards the integration of knowledge systems: challenges to thought and practice. *The postcolonial science and technology studies reader*. Harding, S. (ed). Duke University Press.

Parnell, S. and Oldfield, S. eds., 2014. *The Routledge handbook on cities of the global south*. Routledge.

Pelling, M., 2010. *Adaptation to climate change: from resilience to transformation*. Routledge.

Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G.S., Schneider, F., Speranza, C.I., Kiteme, B., Boillat, S., Serrano, E. and Hadorn, G.H., 2010. Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. *Science and Public Policy*, 37(4):267-281.

Pollock, A. & Subramaniam, B. 2016. Resisting Power, Retooling Justice. *Science, Technology, & Human Values.* 41(6):951-966.

Available: http://journals.sagepub.com/doi/full/10.1177/0162243916657879 [2019, 18 September].

Popa, F., Guillermin, M. & Dedeurwaerdere, T. 2015. A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures.* 65:45-56.
Available: https://www.sciencedirect.com/science/article/pii/S0016328714000391 [2019, 18 September].

Quijano, A. 2000. Coloniality of power and Eurocentrisim in Latin America. *International Sociology.* 15(2):215-232.

Quijano, A. 2007. Coloniality and modernity/rationality. *Cultural Studies*, 21(2–3):168–178.

Radcliffe, S.A. 2017. Decolonising geographical knowledges. *Transactions of the Institute of British Geographers.* 42(3):329-333.
Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/tran.12195 [2019, 18 September].

Rodina, L., Baker, L.A., Galvin, M., Goldin, J., Harris, L.M., Manungufala, T., Musemwa, M., Sutherland, C. et al. 2017. Water, equity and resilience in Southern Africa: future directions for research and practice. *Current Opinion in Environmental Sustainability.* 26-27:143-151.
Available: https://www.sciencedirect.com/science/article/pii/S1877343517301884 [2019, 18 September].

Rodney, W. 1972. *How Europe Underdeveloped Africa*. Verso Trade.

Rosendahl, J., Zanella, M.A., Rist, S. & Weigelt, J. 2015. Scientists' situated knowledge: Strong objectivity in transdisciplinarity. *Futures.* 65:17-27.
Available: https://www.sciencedirect.com/science/article/pii/S0016328714001724 [2019, 18 September].

Roy, A. 2004. *The 2004 Sydney Peace Prize lecture. Sydney.* 3 November 2004.
Available: https://sydney.edu.au/news/84.html?newsstoryid=279 [2019, 18 September].

Said, E. W. 1995. *Orientalism: Western Conceptions of the Orient*. London: Penguin

Schmidt, L. and Neuburger, M., 2017. Trapped between privileges and precariousness: Tracing transdisciplinary research in a postcolonial setting. *Futures*, 93:54-67.

Schmidt, L. and Pröpper, M. 2017. Transdisciplinarity as a real-world challenge: a case study on a North–South collaboration. *Sustainability Science.* 12(3):365-379. Available: https://search.proquest.com/docview/1888879458 [2019, 18 September].

Scott, D. 2017. *Understanding urban governance entry points for climate science to inform development decisions. FRACTAL Concept Note 1.* Oxford, UK: Stockholm Environment Institute Oxford Centre.

Scott, D., Iipinge, K., Mfune, J., Muchadenyika, D., Makuti, O. and Ziervogel, G., 2018. The Story of Water in Windhoek: A Narrative Approach to Interpreting a Transdisciplinary Process. *Water*, 10(10): 1366.

Shibata, A. 2005. *The" Germanization" of Africa: White Education in German South-West Africa. CNER Discussion Paper No. 6.* Available: http://hdl.handle.net/10086/16026 [2019, 3 October].

Simon, D. & Leck, H. 2015. Understanding climate adaptation and transformation challenges in African cities. *Current Opinion in Environmental Sustainability.* 13:109. Available: http://publications.lib.chalmers.se/publication/223320-understanding-climate-adaptation-and-transformation-challenges-in-african-cities [2019, 18 September].

Spivak, G. C. 1988. ‘‘Can the Subaltern Speak?’’ In: *Marxism and the Interpretation of Culture*. C. Nelson & L. Grossberg, Eds. 271-313. Urbana: University of Illinois Press.

Sundberg, J. 2014. Decolonizing posthumanist geographies. *Cultural Geographies.* 21(1):33-47. Available: https://www.jstor.org/stable/26168540 [2019, 18 September].

Taylor, A., Scott, D., Steynor, A., McClure, A. 2017. *Transdisciplinarity, Co-production and Co-exploration: integrating knowledge across science, policy and practice in FRACTAL. FRACTAL Working Paper no.3*. Available: http://www.fractal.org.za/wp-content/uploads/2017/03/Co-co-trans_March-2017.pdf [2018, 18 April].

Tengö, M., Hill, R., Malmer, P., Raymond, C.M., Spierenburg, M., Danielsen, F., Elmqvist, T. and Folke, C., 2017. Weaving knowledge systems in IPBES, CBD and beyond—lessons learned for sustainability. *Current Opinion in Environmental Sustainability*, 26:17-25.

Thiong'o, N.W. 1986. *Decolonising the mind: The politics of language in African literature*. East African Publishers.

Uzomah, H. O. 2018. Decolonizing African educational system as a panacea for Africa’s educational advancement in the 21st century. *African Renaissance*, *15*(1), 29-43.

Vaughan, C., Buja, L., Kruczkiewicz, A. & Goddard, L. 2016. Identifying research priorities to advance climate services. *Climate Services,* 4:65-74. Available: https://www.sciencedirect.com/science/article/pii/S2405880716300358 [2019, 18 September].

Visbeck, M. 2008. From climate assessment to climate services. *Nature Geoscience.* 1(1):2-3. Available: http://dx.doi.org/10.1038/ngeo.2007.55 [2019, 18 September].

Wallace, M. 2011. *A history of Namibia: From the beginning to 1990.* New York: Columbia University Press.

West, R., Stewart, L., Foster, K. and Usher, K., 2012. Through a critical lens: Indigenist research and the Dadirri method. *Qualitative Health Research*, *22*(11):582-1590.

van Rooyen, L. 2017. *"I am who I am because of what we are" – building trust in our Transdisciplinary projects (plus some reflections on my trip to the Barcelona Training School)* [Blog, 23 March]. Available: http://www.fractal.org.za/2017/03/23/i-am-who-i-am-because-of-what-we-are-building-trust-in-our-transdisciplinary-projects-plus-some-reflections-on-my-trip-to-the-barcelona-training-school/ [2019, 18 April].

Ziai, A. 2012. *Postcolonial perspectives on 'development'*. *Working Paper No. 103.* Zentrum für Entwicklungsforschung (ZEF) Working Paper Series. Available: https://www.zef.de/fileadmin/webfiles/downloads/zef_wp/wp103.pdf [2019, 3 October].

Ziegler, J. R., & Lehner, E. 2018. Knowledge systems and the colonial legacies in African science education. *Cultural Studies of Science Education*, *13*(4), 1101-1108. Available: http://academicworks.cuny.edu/cgi/viewcontent.cgi?article=1037&context=bx_pubs [2019, 3 October].

9. Appendix 1: Interview Questionnaire

Governance interviews on Windhoek water sector

Demographics

- Can you tell me about your organisation and your role in it?
- What is your personal (educational) background?
- How long have you been working with issues related to water?
- Were you appointed to participate in the FRACTAL project? If so, by whom?

The urban water sector and its actors

Water issues and their actors (Objective 1)
How is water access regulated? What determines who has access to water? Does infrastructure play a role? Does the historic context play a role? Do economic means play a role?

Community involvement in decision-making (Objective 1, Objective 3)
Whose input is necessary for a decision and at what stage? Who determines which issues get prioritized and passed on to higher levels?

a) In what ways are non-state actors (NGOs, civil societies) involved in governance in the water sector – are they regarded as relevant stakeholders on the city level? At which stage of the process is the community consulted?

b) What are their concerns and ideas? How are they taken into consideration? Do you think the community trusts in the decisions made by government representatives?

Relationship between scientists and practitioners

Role of climate information (Objective 3)

- What do you regard as the scientists' contribution in a decision-making process? What kind of information is shared? Does the information relate to short-term or long-term decisions? Do you find the provided information useful? If so, what part is useful, what part isn't? What kind of skills do you see as crucial for working in the water sector?

- What knowledge do decision-makers need and use to make decisions in their sector? How and when do you consult experts on water and climate issues? How much do you rely on expert judgement when making a decision?

Knowledge from transdisciplinary process FRACTAL (Objective 3)
What do you/your organisation regard as possible benefits from participating in FRACTAL?
What do you regard as your contribution to FRACTAL?

a) Community: Is the scientific information relevant to the local communities that you represent? If so, how and where did you share and communicate your learnings from the City Learning Lab?

b) Future: Going forward, what changes would you like to see in the way scientific knowledge is shared and why?

Personal and community perception of change

Personal perception of future changes (Objective 2)
Considering a future climate (in the next decade and decades), what do you feel are the main challenges and opportunities that Windhoek faces with regards to water?

a) How did you experience the last water crisis? Do you think this will worsen in the future? Is water scarcity a persistent issue or has this changed over the years? Have you noticed any changes in rainfall patterns? Have you changed your behaviour because of these changes?

b) Can you share a story from your personal or professional life about water?

c) What are the main risk factors for water availability today? Is climate change relevant for future water security?

Grassroot/stakeholder engagement and community perceptions (Objective 2)

a) What kind of information is communicated on climate, future changes and possible impacts? Does it relate to specific experiences of stakeholders (water scarcity, drought, etc)?

b) What is the perception of water issues in the communities? Is it a one-time disaster? Is it getting worse? Is there any connection to climate change perceived?

c) How does the local community deal with water scarcity? Do you see any changes in behaviours of people in the local communities? Are they concerned about water availability in the future? How are they preparing for this? Does religion play a role? Does gender play a role?

d) Perceptions of equity – do they feel they are sufficiently involved? Do they trust in the leaders to make the right decisions? Does historic marginalization play a role?

e) What are informal governance structures that exist in informal settlements around water? How do they link to the formal governance system?

f) What is the narrative around climate change that you hear in the community/ politics/ society/ media? How do people talk about climate change? What is their origin? Are they influencing local policy and decision-making processes?

10. Appendix 2: List of interview participants

No.	Organisation	Date	Minutes & Seconds	Description	Code
1	Division Marginalised Communities	21/08/2017	34:42	Official 1	O1
2	NEWS “Namibia Environment and Wildlife Society” & Progress Namibia	21/08/2017	27:51	NGO representative 1	NGO1
3	International Youth on Climate Movement & Namibia Youth on Renewable Energy	21/08/2017	38:44	NGO representative 2	NGO2
4	Namibia University of Science and Technology	22/08/2017	28:41	Academic 1	A1
5	Directorate of Water Resource Management, Ministry of Agriculture, Water and Forestry	22/08/2017	47:17	Official 2	O2
6	Directorate of Water Resource Management	23/08/2017	15:36	Official 3	O3
7	Multidisciplinary Research Centre at UNAM	23/08/2017	61:13	Academic 2	A2
8	Human Settlement department, City of Windhoek	23/08/2017	61:13	Official 4	O4
9	SASSCAL Project	23/08/2017	27:43	Academic 3	A 3
10	Solid Waste Management, Department of Economic Development & Community Services	24/08/2017	56:10	Official 5	O5
11	Hanns Seidel Foundation Namibia	24/08/2017	39:50	NGO representative 3	NGO3
12	Shack Dwellers Federation for Namibia and National Housing Action Group	24/08/2017	42:37	NGO representative 4	NGO4
13	NamWater	25/08/2017	55:43	Official 6	O6
14	Disaster Risk Management Division, City of Windhoek	28/08/2017	21.29	Official 7	O7
15	Development Workshop Namibia	28/08/2017	46:46	NGO representative 5	NGO5

11. Appendix 3: List of reviewed documents

No.	Title	Type	Author	Year
1	FRACTAL Brochure	Brochure	N.A.	n.d.
2	About FRACTAL	Website	N.A.	n.d.
3	FRACTAL Consortium Partners	Website	N.A.	n.d.
4	FRACTAL research approach	Website	N.A.	n.d.
5	FRACTAL Theory of Change	Website	N.A.	n.d.
6	Future Resilience for African CiTies And Lands (FRACTAL) proposal	Website	N.A.	n.d.
7	Learning Framework	Framework	N.A.	2018
8	FRACTAL collaboration protocols	FRACTAL Protocol	N.A.	2016
9	FRACTAL Programmatic engagement, uptake and communication strategy	Framework	N.A.	n.d.
10	FRACTAL Scientific Capacity Development	Framework	N.A.	n.d.
11	FRACTAL Governance Framework	Framework	N.A.	n.d.
12	City of Windhoek participation in FRACTAL Project:	MC	City of Windhoek	2016
13	The Story of Water in Windhoek: A Narrative Approach to Interpreting a Transdisciplinary Process	Academic Paper	Dianne Scott, Kornelia N. Iipinge, John K. E. Mfune, Davison Muchadenyika, Olavi V. Makuti and Gina Ziervogel	2018
14	Climate information websites: an evolving landscape	Academic Paper	Bruce Hewitson, Katinka Waagsaether, Jan Wohland, Kate Kloppers, Teizeen Kara	2017
15	Co-exploratory climate risk workshops: Experiences from urban Africa	Academic Paper	A. Steynor, J. Padghamb, C. Jack, B. Hewitson, C. Lennard	2016
16	Building city-region resilience in Africa: lessons from practice	FRACTAL Think Piece, Conference workshop output Resilience for Development: Assessment Methods and Transformation Practices Colloquium	N.A.	2017
17	Climate Data in Southern Africa: Agreements & Contradictions	Conference Poster 32nd Annual Conference of South African Society for Atmospheric Sciences	Victor S Indasi, Bruce Hewitson, Chris Jack and Piotr Wolski	2016
18	Climate Resilient Decision Making A City-Centric Approach to Water Security	Conference Poster 14th International Water Association Specialist Conference on Watershed and River Basin Management	Rebecca Ilunga*, James Cullis*, Simon Dadson**, Feyera Hirpa** and Sukaina Bharwani*** *Aurecon South Africa (Pty) Ltd.; **Oxford University School of Geography and the Environment; ***Stockholm Environment Institute (SEI)	2017
19	Integrating climate change information into long term planning and design for critical water related infrastructure in Windhoek and other African cities	Conference paper 18th WaterNet/WARFSA/GWP-SA Symposium, Namibia	N.J. Walker (a,d), K.N. Iipinge (b), J.D.S. Cullis (a), D. Scott (c), J. Mfune (b), P. Wolski (c), and C. Jack (c) a=Aurecon, Cape Town, South Africa b=Department of Biological Sciences, University of Namibia, Windhoek c=Climate Systems Analysis Group, University of Cape Town, South Africa d=Institute of Water Studies, University of the Western Cape, South Africa	2017
20	Learning within & about climate science What has transdisciplinary engagement through FRACTAL taught us?	FRACTAL Briefing Note Second FRACTAL learning webinar	Alice McClure	2018

21	Climate narratives: what have we tried? What have we learned? What does this mean going forward?	FRACTAL Briefing Note Third FRACTAL learning webinar	Alice McClure	2018
22	City government-research partnerships: reflections from Cape Town and Johannesburg	FRACTAL Briefing Note Fourth FRACTAL learning webinar	Alice McClure	2018
23	Framework for needs-informed research: assessing climate processes	FRACTAL Working Paper 1	Joseph Daron, Tamara Janes, Chris Jack, Richard Jones	2016
24	Dialogue for decision-making: unpacking the 'City Learning Lab' approach	FRACTAL Working Paper 2	Julie Arrighi, Bettina Koelle, Monica Coll Besa, Meggan Spires, Jess Kavonic, Dianne Scott, Aynur Kadihasanoglu, Sukaina Bharwani, Chris Jack	2016
25	Transdisciplinarity, co-production, and co-exploration: integrating knowledge across science policy and practice in FRACTAL	FRACTAL Working Paper 3	Anna Taylor, Dianne Scott, Anna Steynor, Alice McClure	2017
26	Inspiring climate action in African cities: Practical options for resilient pathways	FRACTAL Working Paper 4	Ruth Butterfield, Monica Coll Besa, Helen Burmeister, Kelly Blair, Jessica Kavonic, Sukaina Bharwani, James Cullis, Meggan Spires, Brenda Mwalukanga,	2017
27	Research methods for understanding and supporting decision processes in African Cities	FRACTAL Working Paper 5	Richard Taylor, Ruth Butterfield, Sukaina Bharwani, Anna Taylor, Tahia Devisscher	2017
28	Towards developing a common language for climate change in the City of Cape Town	FRACTAL Working Paper 6	Anna Steynor and Jessica Lee	2017
29	Inspiring climate action in African cities: practical options for resilient pathways	FRACTAL Working Paper 7	Ruth Butterfield, Monica Coll Besa, Helen Burmeister, Kelly Blair, Jessica Kavonic, James Cullis, Sukaina Bharwani, Meggan Spires, Brenda Mwalukanga	2018
30	Understanding urban governance entry points for climate science to inform development decisions	FRACTAL Concept Note 1	Dianne Scott	2017
31	Transdisciplinarity, co-production and co-exploration: integrating knowledge across science, policy and practice in FRACTAL	FRACTAL Briefing Note	N.A.	n.d.
32	Building Resilience in African Cities: a think piece	FRACTAL Think Piece	Spires, M., Kavonic, J., Cullis, J., Coll Besa, M.	2017
33	Climate Summary for Khomas Region	Summary	Laura Burgin, Kornelia Iipinge, Joseph Daron, Richard Jones, Chris Jack and Olavi Makuti	2018
34	Water Security in Windhoek: governance, water demand and supply, and livelihoods in the context of urbanization and climate change Final Project Report for 2016 START Grants for Global Change in Africa	Report	N.A.	2018
35	Windhoek Transformational Leadership on Climate Change Training	Report	Kornelia Iipinge and Saima N Haukelo	2018

36	Principles for Transformational Leaderhsip on Climate Change, co-produced by Windhoek decision-makers	Visualisation of List	N.A.	2018
37	Climate risk narratives and climate information for Windhoek	Infographic	N.A. (FRACTAL climate research team)	2018
38	Future Climate Impacts Infographic.	Infographic	N.A. (FRACTAL climate research team)	2018
39	START-Global Environmental Change (GEC) city learning exchange: Harare and Windhoek	Report	Rudo Mamombe, Kornelia Iipinge, and Mzime Ndebele-Murisa	2017
40	Windhoek City Learning Lab Report	Report	Kornelia Iipinge	2017
41	Windhoek Second Learning Lab Report	Report	Kornelia Iipinge	2017
42	Third Windhoek Learning Lab 14-15 August 2018	Report draft	N.A.	2018
43	Windhoek Task Team reflections at Third Windhoek Learning Lab (14-15 August 2018)	Reflections notes	N.A.	2018
44	Awareness on Climate Change and Decision Making Workshop for City Of Windhoek and Windhoek Constituency Councillors	Report	J.K. Mfune, K. Iipinge, E. Mokanya, E. Nghalipo	2017
45	FRACTAL embedded researchers workshop	Report	Alice McClure, Anna Taylor, Brenda Mwalu	2017
46	FRACTAL annual meeting 2016	Report	N.A.	2016
47	FRACTAL annual meeting 2017	Report	N.A.	2017
48	Future Resilience for African CiTies and Lands (FRACTAL) Imbizo report	Report	N.A.	2016
49	FRACTAL inception meeting	Report	N.A.	2015
50	Windhoek City Digest, Issue 1	Newsletter	N.A.	2018
51	Windhoek City Digest, Issue 2	Newsletter	N.A.	2018
52	How can scientists play a bigger role in shaping the future of cities?	Article (online)	Anna Taylor, Monica Coll Besa	2016
53	How African cities' residents are creating climate change solutions	Article (online)	Alice McClure, Gina Ziervogel	2018
54	How three research groups are tearing down the ivory tower	News feature (online)	Cassandra Willyard, Megan Scudellari & Linda Nordling	2018
55	The Story of Water: Windhoek	Blog post (FRACTAL website)	Alice McClure	2018, 29 October
56	Growing climate knowledge through narratives of the future	Blog post (FRACTAL website)	Alice McClure	2018, 31 July
57	Principles for Transformational Leadership on Climate Change	Blog post (FRACTAL website)	Alice McClure	2018, 17 July
58	FRACTAL at the ACC seminar series on cities and climate change	Blog post (FRACTAL website)	Alice McClure	2018, 23 June
59	Windhoek City engages in National Adaptation Planning Process	Blog post (FRACTAL website)	Kornelia Iipinge	2018, 12 June
60	Transformational Leadership on Climate Change Training for Windhoek Decision Makers	Blog post (FRACTAL website)	Alice McClure	2018, 21 May
61	Cities and Climate: What's our next step?	Blog post (FRACTAL website)	Alice McClure	2018, 14 March
62	UNAM and City of Windhoek run joint workshop for Windhoek Councillors	Blog post (FRACTAL website)	Kornelia Iipinge	2018, 19 January
63	Lusaka-Windhoek Exchange: abundance of water resources against deficit water	Blog post (FRACTAL website)	Brenda Mwalukanga and Kornelia Iipinge	2017, 27 November
64	Learning Labs in Lusaka, Maputo and Windhoek highlight water insecurity as burning issue	Blog post (FRACTAL website)	Alice McClure	2017, 8 September
65	'"Trust me, I'm an expert": weighing expert opinion in a transdisciplinary space	Blog post (FRACTAL website)	Jessica Lee	2017, 29 May
66	Cities, climate change and policies: A new and exciting road ahead	Blog post (FRACTAL website)	Kornelia Iipinge	2017, 15 May

67	"I am who I am because of what we are" – building trust in our Transdisciplinary projects (plus some reflections on my trip to the Barcelona Training School)	Blog post (FRACTAL website)	Lulu van Rooyen	2017, 23 March
68	Telling stories: A multi-disciplinary co-production device	Blog post (FRACTAL website)	Dianne Scott and Chris Jack	2017, 23 February
69	Culturing (some form of) a growth mindset for learning in FRACTAL	Blog post (FRACTAL website)	Alice McClure	2017, 14 January
70	City processes in FRACTAL and an indication of what we have learned thus far	Blog post (FRACTAL website)	Jess Kavonic	2016, 22 December
71	FRACTAL Strategic Meeting	Meeting notes	FRACTAL	2018, 19 July
72	Climate Information Distillation	Framework	FRACTAL	2018

UNIVERSITY OF CAPE TOWN
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29 August 2016

Prof B Hewitson
Climate Systems Analysis Group (CSAG), ACDI, Environmental and Geographical Sciences (EGS) and African Centre of Cities (ACC)

Future Resilience for African Cities and Lands (FRACTAL)

Dear Prof Hewitson

I am pleased to inform you that the Faculty of Science Research Ethics Committee has approved the above-named application for research ethics clearance, subject to the conditions listed below. You are required to:

- Implement the measures described in your application to ensure that the process of your research is ethically sound; and

- Uphold ethical principles throughout all stages of the research, responding appropriately to unanticipated issues: please contact me if you need advice on ethical issues that arise.

Your approval code is: **FSREC 045** – 2016

I wish you success in your research.

Yours sincerely

Signature Removed

Prof Timm Hoffman
Chair: Faculty of Science Research Ethics Committee