Developing a framework for assessing equity in contributions to the global goal on adaptation as part of the global stocktake

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Abstract

The global stocktake (GST) aims to assess collective progress in mitigation, adaptation, and the means of implementation and support as outlined in Article 14 of the Paris Agreement. The stocktake will be undertaken considering equity and the best available science. As a result, the GST requires a framework for assessing equity in mitigation, adaptation, and support. While mitigation has been more frequently defined based on allocations of "fair shares" in terms of emissions responsibility and targets, it is less clear how equity can be assessed in contributions to the global goal on adaptation (GGA). This is due to the diversity of pathways for enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change.

Equity in the GGA is highly intertwined with issues of justice as those least responsible for climate change are most vulnerable to its impacts and have little to no resources for adaptation. Moreover, although adaptation actions are taken on the local level, the GGA is a collective goal. An effective framework for an equity assessment in the GST would have further benefits, including: guiding equity-driven approaches to National Adaptation Plans (NAPs), acting as an ambition enabler for the Parties who believe that climate change efforts are fairly shared, and highlighting how equity considerations can be improved between the GSTs. This thesis raises and investigates the following questions: what metrics exist for assessing equity in national contributions to the GGA? how appropriate are existing indicators for assessing equity in national contributions to the GGA? and what could an effective framework for assessing equity in national contributions to the GGA look like?

This research aims to answer these questions through a systematic review of literature on equity metrics in adaptation programmes on the national and international scale. Building from a narrative synthesis and keyword analysis of the references collected, this research develops a rubrics-based framework for assessing equity in the GGA as part of the GST. The framework is founded on four dimensions of equity: distributive, procedural, recognitional, and intergenerational justice. To test the framework's applicability to a specific contribution to the GGA, and to inform the framework's effectiveness for collective assessment in the GST, it is applied to the South African National Climate Change Adaptation Strategy (NCCAS). A summary diagram is developed which demonstrates that whilst South Africa's NCCAS shows some promise to mainstreaming equity in the distributive justice dimension, it could still be more comprehensive about the plans relating to procedural and recognitional justice, and fails to achieve equity in intergenerational justice.

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List of abbreviations

CAMELS	Climate adaptation monitoring, evaluation and learning systems
CBDR&RC	Common but differentiated responsibilities and respective capabilities
CO_2	Carbon dioxide
CO_2-eq	Carbon dioxide equivalent
DEFF	Department of the Environment, Forestry and Fisheries
DFFE	Department of Forestry, Fisheries and the Environment
EF	Equity Framework, framework proposed in this thesis for assessing equity in national contributions to the GGA
GDP	Gross Domestic Product
GGA	Global goal on adaptation
GHG	Greenhouse gases
GST	Global stocktake
iied	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least developed countries
M&E	Monitoring and evaluation
MEL	Monitoring, evaluation, and learning
NAPs	National Adaptation Plans
NCCAS	South Africa's National Climate Change Adaptation Strategy
NDCs	Nationally Determined Contributions
NTP	Non-traditional publications
ODCs	Other developing countries (developing countries excluding LDCs and SIDS)
OECD	Organisation for Economic Co-operation and Development
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
ROSES	Reporting standards for systematic evidence syntheses in environmental research
SIDS	Small island developing states
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VMPs	Vulnerable and marginalised populations
WCED	World Commission on Environment and Development

Chapter 1: Introduction

1.1 Background and rationale

Above a moral imperative to ensure equitable adaptation to climate change, the United Nations Framework Convention on Climate Change (UNFCCC) calls for the pursuance of its objectives to be guided by the principle of equity (UNFCCC, 2015). The Paris Agreement considers equity as a key component for its implementation alongside "the principle of common but differentiated responsibilities and respective capabilities [CBDR&RC], in the light of different national circumstances" (UNFCCC, 2015:art2.2). Article 7.1 establishes the global goal on adaptation (GGA) "of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change" (UNFCCC, 2015) in a manner that aligns with the temperature goals set out in the Paris Agreement and in the context of sustainable development. As a result, equity in implementation is required for adequate achievement of the GGA.

By establishing the GGA, the Paris Agreement shifts adaptation from a contingency plan of failed mitigation to an equal long-term goal of the international climate change regime (Craft & Fisher, 2018:1203). The Paris Agreement recognises the GGA as "a global challenge faced by all with local, sub-national, national, regional and international dimensions" (UNFCCC, 2015:art7.2). Thus, the GGA is both a cross-disciplinary and multiscalar goal. However, the Paris Agreement falls short of describing how to measure and aggregate adaptation actions across disciplines and multiple scales (Persson & Dzebo, 2019:358).

In order to assess the collective progress of the Paris Agreement objectives, Parties will also take part in the first global stocktake (GST), commencing in 2022 and ending in 2023 (UNFCCC, 2015:art14). The GST is a periodic assessment of the collective progress of the implementation of the long-term goals of the Paris Agreement. It aims to inform nationally determined contributions (NDCs) of the Parties and enhance "international cooperation for climate action" (UNFCCC, 2015:art14.3). The GST will be undertaken in a "comprehensive and facilitative manner" (UNFCCC, 2018a: sI.1). It is conducted by a joint group of "the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice" (UNFCCC, 2018: sI.4) which consider inputs from both Party and non-Party stakeholders (UNFCCC, 2018a: sII), whilst facilitating Party participation throughout the GST process (UNFCCC, 2018a: sI.11).

According to the modalities of the GST: "equity and the best available science will be considered in a Party-driven and cross-cutting manner, throughout the global stocktake" (UNFCCC, 2018a: sI.2). However, the GST lacks an existing framework for assessing equity despite its potential usefulness in ensuring the equitable implementation of the Paris Agreement's long-term goals. In particular, equity should be considered across "mitigation, adaptation and the means of implementation and support" (UNFCCC, 2018a: sI.1).

Despite this, in an analysis of 163 intended NDCs, Winkler et al. (2018) found that while a diversity of indicators existed for assessing equity in mitigation, only one was found for adaptation. Additionally, the metrics for mitigation tend to rely on quantitative measures of "burden-sharing" and "fair share" responsibility and contribution as measured by current emissions. Such an approach is potentially insufficient for assessing equity in contributions to the GGA due to the ambiguity of achieving the GGA, as defined above.

Furthermore, while the GGA is a *global* goal, and will be assessed as such in the GST, adaptation initiatives are inherently localised which means that a global framework for assessing adaptation progress has to overcome the challenge of aggregating adaptation outcomes, such as equity, from different contexts and scales (Craft & Fisher, 2018:1204).

Finally, the GGA raises a distinct question surrounding equity and justice, where, as highlighted by Winkler (2020), vulnerable communities which are least responsible for climate change bear the greatest burden of its impacts. To fill this gap in knowledge, this dissertation develops an assessment of equity in national contributions to the GGA, as part of the GST, that accounts for the disproportionate and unfair impact of climate change.

Thus, this research attempts to answer the following questions: What metrics exist for assessing equity in national contributions to the GGA? how appropriate are existing indicators for assessing equity in national contributions to the GGA? and, what could an effective framework for assessing equity in national contributions to the GGA look like? In order to inform future progress towards the GGA, the framework should highlight the equity challenges and opportunities in national contributions.

1.2 Research aims

This research explores the integration of equity in the climate change GGA via the following three aims: 1) to investigate existing metrics for assessing equity in national contributions to the GGA through a systematic and narrative literature review, 2) to develop a framework to assess equity in national contributions to the GGA as part of the GST, and 3) to apply the framework to South Africa's National Climate Change Adaptation Strategy (NCCAS) to evaluate its national contribution to the GGA.

1.3 Outline of thesis

The thesis proceeds as follows; chapter two is the narrative literature review which further establishes the need for this research and places this research within context. In chapter three, I describe the methodology used to conduct the systematic review and accompanying narrative synthesis, as well as present, analyse, and discuss the results. In chapter four I present a framework for assessing equity in national contributions to the GGA, based on the learnings from chapter three. Chapter four also reports results applying the framework to South Africa's NCCAS. In the final chapter, I conclude the thesis by summarising the key findings and proposing future research directions.

Chapter 2: Narrative literature review

2.1 Introduction

The GST calls for an equity- and science-driven review of collective progress towards its long-term goals, including the GGA (UNFCCC, 2018a:sI.2). Yet, a formal definition of equity is absent from the Paris Agreement (Breakey, 2019:107), resulting in various interpretations of equity within the climate change regime (Al-Zahrani et al., 2019; Breakey, 2019; Pathak & Pathak, 2019; Okereke et al., 2018; Boran, 2016; Fleurbaey, 2014).

This narrative literature review aims to reveal the gap that my research addresses in relation to assessing national contributions to equity in the GGA, as part of the GST. This chapter will show that there is minimal consistency and no internationally recognised agreement on how the GST should assess equity in national contributions to the GGA.

To show the complexity and range of perspectives related to these topics, the following sections look at how equity has been framed within the climate change regime (2.2), how equity could be incorporated into the GST (2.3), and how we should define metrics for the GGA, when measuring adaptation faces many unique challenges (2.4).

Before delving into the literature review, I would like to reiterate that the aims of this thesis do not include a theoretical contribution, but rather an investigation of a complex issue through a systematic literature review. Thus, the development of the equity framework will be founded on the analysis and results of the review (chapter three) – which refer to varying theoretical frameworks – rather than establishing a predefined theoretical framework for equity and justice in the current chapter.

2.2 Equity frameworks in studies of the climate change regime

The necessity for a consistent and universally accepted framework for assessing equity in climate change efforts has been justified by a number of scholars (Rajamani et al., 2021; Pathak & Pathak, 2019; Fleurbaey et al., 2014). Rajamani et al. (2021:2) maintain that equity is "[a] key component in determining the adequacy of an individual state's contribution in the context of a collective action problem." Additionally, equity frameworks can be used to guide decision-making of climate change responses which often deal with inherent trade-offs (Fleurbaey et al., 2014:290).

Fleurbaey et al. (2014) distinguish between three further justifications for assessing equity in the climate change regime. These are: a *moral justification* based on the normative principles of equity and justice; a *legal justification* based on the legal agreement of international treaties "to cooperate on the basis of stated equity principles;" and an *effectiveness justification* which claims that the belief that climate change efforts are conducted and allocated fairly will lead to greater international agreement and domestic implementation (Fleurbaey et al., 2014:287). The *effectiveness justification* is extended by Winkler (2020) to argue that a belief in fair share efforts could also drive ambition across countries.

Fleurbaey et al. (2014:317) also raise the concern that the absence of an accepted equity framework could have negative consequences when interpretations of equity are left up to the individual countries, allowing countries "to favour their (often short term) interests".

Whilst the need for an equity framework is clear, there has been little agreement in international negotiations on what such a framework should prioritise. One recurring tension in equity discussions is the trade-off between political feasibility and ethical principles of equity (Pathak & Pathak, 2019; Caney, 2014). Advocates of political feasibility argue that there exists a pragmatic constraint on treaties whereby climate treaties must ensure that they advance the interests of involved Parties and, in doing so, make sure that no Party is worse-off for joining the treaty (Weisbach & Posner, 2012:347). Weisbach and Posner (2012) term this constraint as International Paretianism and call for dismissal of normative approaches to equity in the climate change regime, such as distributive and restorative justice, in light of the need to reach political agreement.

Caney (2014) critiques International Paretianism by arguing that this approach assumes a certain expected behaviour from Parties and concerns the willingness and compliance of Parties, rather than the feasibility of the treaty, as claimed by Weisbach and Posner. Further, Pathak and Pathak (2019:130) also offer a critique on International Paretianism, and arguments of political feasibility more generally, by maintaining that without an assessment of equity, we will risk overlooking how far such agreements depart from normative principles of equity.

Amongst those that support an equity framework, there exist a variety of approaches and elements that such a framework could involve. Boran (2016) criticises the top-down approach of the Kyoto Protocol where allocation of responsibility was divided based on Annex I, Annex II, and non-Annex I country classifications. The former two classifications had differing binding emission targets in order to abide by the Protocol. Boran (2016) asserts that this top-down approach was not conducive to the changing circumstances of nations and was arbitrarily binary in its allocation of responsibility.

The UNFCCC has since shifted from this purely top-down approach with its Paris Agreement, where the principle of CBDR&RC in light of national circumstances, and the use of undefined *developing* and *developed* nations in the text is often referred to as allowing for bottom-up flexibility of changing capacities and responsibilities (Mbeva & Pauw, 2016). The Paris Agreement is sometimes seen as a 'hybrid' approach, containing top-down processes, such as the GST, as well as bottom-up elements, including the NDCs (Kuyper, Linnér & Schroeder, 2018). However, as will be considered further in the following section (2.3) the bottom-up approach also faces significant outcome challenges (Breakey, 2019).

Mbeva and Pauw (2016:7) proceed to break down CBDR&RC into three guiding principles for an equity framework: the need for broad cooperation; the recognition that all countries bear responsibility to act on climate change; and that the extent of these actions is based on national circumstances and capabilities.

Breakey (2019) extends on the framing provided by the principle of CBDR&RC to include more normative approaches to equity. These include intergenerational equity, intra-generational equity, needs-based equity, capacity-based equity, and equity based on historical responsibility (Breakey, 2019:108).

These elements of an equity framework presented by Mbeva and Pauw (2016) and Breakey (2019) serve as possible guiding principles, but lack clarity on how such principles should be evaluated in national communications. Rajamani et al. (2021) provide an approach to assessing equity in NDCs which is situated within principles of environmental law. The authors rely on mentions of responsibility, cumulative GHG emissions, emissions per capita, GDP per capita, and Small Island Developing State (SIDS) or Least Developed Country (LDC) classifications to assess how closely NDCs align with the equity considerations of environmental law (Rajamani et al., 2021:13). While offering clearer equity indicators, this study focused on equity in relation to mitigation targets, and was limited by the equity information presented by countries in their NDCs.

Some scholars have proposed alternative approaches to assessing equity that are not founded on one set of normative principles, but rather allow for bottom-up interpretations of equity (Breakey 2019; Winkler et al., 2018; Boran, 2016). Boran (2016) advocates for a *public reason* approach which is based on the idea of reasonable pluralism, where, as long as the equity outcomes are agreed upon, the normative foundations of establishing equitable climate change responses can differ. Additional elements of the *public reason* approach to equity are an enabling environment of transparency and accountability, and adaptability of the approach to changing circumstances and information (Boran, 2016). While Boran (2016) does not provide clear guidelines on how to achieve a *public reason* approach, this approach does align with a suggested framework by Winkler et al. (2018) that calls for a menu of equity indicators that Parties can choose from to create greater consistency across Parties, but also allow for national sovereignty in equity decision-making.

As shown in this section, inconsistencies in how to address assessing equity start with the underlying normative principles of equity and continue throughout the recommendations for structuring the framework and choosing specific indicators. Although such inconsistencies indicate a lack of agreement, they also demonstrate that much research has attempted to tackle the challenge of an equity framework. Nonetheless, there is still a focus on equity in relation to mitigation targets in NDCs, rather than adaptation. Therefore, a natural next step is to further investigate equity for adaptation and consolidate this research into a comprehensive and more consistent equity framework.

2.3 Literature on equity in relation to the global stocktake and adaptation

Focusing on equity within the GST, it is helpful to work backwards from what would define a successful GST in order to evaluate different frameworks for equity within the GST. According to the Paris Agreement, the aim of the GST is to assess global progress of the long-term goals of the Paris Agreement, inform NDCs of the Parties, and enhance "international cooperation for climate action" (UNFCCC, 2015:art14.3).

Breakey (2019:111) provides further requirements for a successful equity stocktake that include: (1) *improved ambition* and effort towards the long-term goals of the Paris Agreement; (2) *improved ethics* through ensuring the application of procedural and distributive justice throughout the GST and its outcomes; and (3) *increased subjective legitimacy*, meaning greater belief in the fairness of the climate change regime. In order to be defined as successful, the equity stocktake would need to fulfil all of Breakey's (2019) above desiderata,

otherwise the stocktake is at risk of being destructive, if it leads to unproductive blame and shame, or irrelevant, if it fails to have any impact on the climate change regime.

From a technical standpoint, Pauw et al. (2017) call for greater transparency and comparability across national communications, such as NDCs, to better understand the relative priorities and ambitions of each nation during the GST assessment. While the GST aims to assess collective progress, Breakey (2019:110) also highlights that the gaps in achieving the equity considerations of the Paris Agreement could be presented in the GST based on which nations could do more to help other nations.

In this way, the GST has the potential to combine the bottom-up contributions of each nation and encourage the use of a top-down framework for assessing equity. A dual approach is supported by a number of scholars (Breaky, 2019; Pauw et al., 2017; Boran, 2016), who find benefits and disadvantages in a purely bottom-up approach.

While the principle of CBDR&RC in the Paris Agreement has encouraged a more nuanced (Mbeva & Pauw, 2016) and pluralistic (Boran, 2016) approach by allowing countries to recognise and convey their own responsibility and capacity, this has also resulted in inconsistencies and loose interpretations of equity which are incomparable (Boran, 2016). Further, Breakey (2019:113) highlights that the bottom-up approach allows some nations to act as free-riders on the ambition of other nations.

Breakey (2019) believes that the perceived binary between bottom-up or top-down approaches could be blurred to allow for the benefits of both by encouraging a pluralistic and inclusive framework for assessing equity in the GST. Here, equity principles would be decided upon in a facilitative manner and consistency could be created by ensuring national communications refer to the chosen equity principles, while flexibility is maintained by allowing countries to weight these principles differently (Breakey, 2019:121). A narrower pluralism could also be implored by attaching narrower bounds for the weights of each equity principle, in order to prioritise specific equity concerns (Breakey, 2019:121).

Similarly to Breakey's (2019) second desiderata, Al-Zahrani et al. (2019) also call for equity to be operationalised in all GST activities, from process to outcomes. This is reiterated by Winkler (2020) who advocates for equity to be considered across the three components of the GST; information collection and preparation, technical assessment, and consideration of outputs.

Ross (2020) provides a framework for tracking the effectiveness of NDCs, which could be repurposed for an equity stocktake to account for the procedural justice dimensions purported by Al-Zahrani et al., (2019), Winkler (2020) and Breakey (2019). Ross' (2020) framework assesses NDC effectiveness through a matrix that assigns indicators to be measured at each stage of tracking (inputs, processes, outputs, outcomes, and performance management) based on the objectives of each stage, and occurring within an enabling environment, i.e. shared climate change vision and good governance practices.

Thus far, this section has provided an overview of the requirements and objectives of the equity assessment in the GST, as well as reviewed recommendations for the approach of such an assessment. At this point, it is useful to briefly look at some suggested indicators for equity in the GST. However, it should be noted that there has been greater emphasis on equity indicators and methodologies for mitigation in the climate

change regime, than there has been for the GGA (Winkler & Marquard, 2021:14; Winkler et al., 2018), which is the focus of my research. Before providing some examples of equity assessments focused solely on adaptation, I will briefly cover some proposed frameworks aimed at measuring equity across both mitigation and adaptation.

The African Group of Nations have proposed a principles-based reference framework for equity which considers historic responsibility, current capability, and the development needs of Parties based on the best available science (UNFCCC, 2013). Ngwadla and Rajamani (2014) built upon this proposal in their Equity Reference Framework where they rely on cumulative emissions since 1960 to measure historic responsibility, gross domestic product (GDP) per capita (as a metric for current capability), the human development index (HDI), and lastly electrification rates as an indicator for development needs. However, their final assessment considers only financial contributions for equity in the GGA (Ngwadla & Rajamani, 2014), despite the Paris Agreement outlining additional methods of support for the GGA which include the development and transfer of technology, and capacity building support (UNFCCC, 2015).

This is similarly the case in Massawa et al.'s (2009) paper where average historic emissions per capita are used to measure the financial responsibility of developed countries in the GGA. Historic responsibility in these studies is isolated to past emissions, with little consideration on the impact of colonialism and extractivism on the vulnerability and natural resource use of developing countries (Newell et al., 2021:7; Sowman & Wynberg, 2014).

Al-Zahrani et al. (2019) consider four ways in which equity could be factored into the GST that encompass both adaptation and mitigation goals. These include leveraging the HDI to measure development needs, ensuring that developing countries have the space and time to achieve sustainable development, relying on historical responsibility to distribute climate change efforts, and assessing technical and financial capacity, as well as socio-political advantages, to contribute to climate change efforts (Al-Zahrani et al., 2019:9-110).

Whilst applying the same equity framework for mitigation and adaptation would reduce the resources required to complete an equity assessment, as discussed in chapter one, adaptation faces unique equity and evaluation challenges in terms of the unjust distribution of climate change impacts and the difficulty in attaching purely quantitative metrics to adaptation outcomes.

Coggins et al. (2021) claim that the approach to equity and justice in mitigation is unsuitable for adaptation. Specifically, they maintain that equity assessments are particularly vital for adaptation, as adaptation initiatives have the potential to result in "unjust and inequitable outcomes", such as exclusion (Coggins et al., 2021:2). Consequently, the authors conducted a systematic map of scientific literature to explore the varying definitions and assessments of equity and justice in climate change adaptation at multiple scales.

They found that there was limited literature related to equity and justice in adaptation, and within this literature great variations exist in the interpretation of equity and justice, most are concerned with adaptation finance, and focus on the distributive and procedural aspects of justice at a single scale, mostly the "individual/household and community/city level" (Coggins et al., 2021:8-11).

Juhola et al. (2022) propose their own assessment for equity in adaptation, the Adaptation Justice Index (ADJ). The AJI aims at assessing equity and justice *ex ante* in adaptation planning, in the hopes of informing the planning process and ensuring more equitable outcomes in adaptation implementation (Juhola et al., 2022).

The index is composed of multiple qualitative indicators on a rating scale to assess national and subnational adaptation planning documents (Juhola et al., 2022). The indicators are derived from four justice principles (Table 2.1), namely recognitional, distributive, procedural and restorative justice which are expanded upon in the authors' definition for just climate adaptation:

> "adaptation planning and implementation, which 1) recognises past and current disadvantages in society, 2) identifies the potential unequal way in which climate impacts and costs and benefits of adaptation measures are distributed, 3) is based on inclusive processes throughout planning, implementation, monitoring and evaluation, and 4) restores past inequalities through adaptation" (Juhola et al., 2022:609)

Juhola et al. (2022) apply the AJI to four Global North case studies, looking at one national and one city-level adaptation planning document for England, Finland, Canada and Sweden. Whilst the authors present the results of their AJI evaluation on spider charts showing the rating for each indicator, they also aggregate the indicators into a final index for each document which hides the specific equity challenges and opportunities in adaptation planning.

Table 2.1 Principles and accompanying indicators proposed in Juhola et al.'s (2022) Adaptation Justice Index. *Source: Author's own analysis reorganising text from Juhola et al. (2022:612-614)*

Principle	Indicators
1. Recognitional justice	**1.1** The strategy acknowledges that adaptation needs are different across groups in society **1.2** The strategy acknowledges the impact of existing societal structures on vulnerable groups in adapting to the impacts of climate change **1.3** The strategy acknowledges adaptation as a way to secure basic human rights
2. Distributive justice	**2.1** A risk mapping/assessment is conducted **2.2** There is a process for identifying vulnerable groups **2.3** There is a process that assesses the distribution of benefits from adaptation **2.4** There is a process that assesses how costs of adaptation are divided **2.5** The strategy identifies the possibility of the distribution of negative impacts
3. Procedural justice	**3.1** Adaptation strategy details who participates in the strategy process **3.2** The adaptation strategy has involved participation during different phases of the process **3.3** The strategy allocates responsibilities related to adaptation **3.4** The adaptation strategy has a structured plan for participation in the implementation **3.5** The adaptation strategy has a plan for updating and evaluating the strategy
4. Restorative justice	**4.1** The strategy acknowledges the need to compensate for the diverging impacts of climate change **4.2** The strategy has compensation measures to deal with maladaptation

	4.3 The unequal distribution of resources for adaptation is compensated by redistribution

Juhola et al. (2022) provide one example of a potential framework for assessing equity in adaptation based on the authors' chosen normative principles of recognitional, distributive, procedural and restorative justice. However, the framework's purpose is to inform adaptation planning, rather than be used to assess collective progress of the GGA in the GST. As a result, part of this thesis is to explore such examples of equity frameworks with the aim of extracting learnings (chapter three) and developing a framework appropriate for the GGA, as part of the GST (chapter four).

The emerging themes on how to achieve the goals of the GST and the benefits of an equity framework show that equity needs to be considered throughout the GST process and outcomes, and that a hybrid bottom-up and top-down approach should be implemented. Correspondingly, the GST could result in building confidence in the fair share of climate change efforts which can improve ambition, as well as allow for flexibility, adaptability, and a nuanced organisation of equity that is still mediated by consistent and comparable equity principles.

However, there is still great debate on what should be incorporated in an equity framework, how to develop a framework fitted for adaptation that can be applied to the GGA, and which equity indicators and specific principles should be implored in the GST.

2.4 Adaptation metrics and challenges

This final section of the literature review, before my concluding remarks (2.5), focuses on frameworks and metrics for assessing adaptation in general. Since an aim of this thesis is the development of a framework for assessing equity in national contributions to the GGA, the following literature reveals different approaches and structures the framework could take, and challenges therein, for evaluating information related to adaptation.

According to Leiter et al. (2019:4), the GST's mandate to assess collective progress towards meeting the GGA (UNFCCC, 2018) could benefit from three applications of adaptation metrics proposed by the Intergovernmental Panel on Climate Change (IPCC): to "identify adaptation needs", track adaptation implementation, and assess adaptation effectiveness.

These three applications are explored in the Global Adaptation Mapping Initiative (GAMI) which conducted a systematic review of adaptation responses in academic literature (Berrang-Ford et al., 2020). As part of the GAMI process, researchers coded the resulting 1,682 articles (Berrang-Ford et al., 2021), with the aim of answering the following questions: "Who is responding? What responses are documented? What is the extent of the adaptation-related response? What is the evidence that adaptation-related responses reduce risk, exposure and/or vulnerability?" (Berrang-Ford et al., 2020:4). They found that the majority of adaptation applications were incremental in scope, had limited information on risk reduction, and took place on the local level (Berrang-Ford et al., 2021).

Whilst adaptation actions occur on the local level, the GGA requires a framework for assessing adaptation on the international and collective level. Newell et al. (2021) identify this gap, highlighting the global

focus on climate mitigation, in comparison to the local focus of climate adaptation. Further, this is reiterated by Okereke et al. (2018), who find that climate adaptation has been explored nationally, sub-nationally, and by businesses. Thus, there is a need to understand how local adaptation metrics can be coalesced into the international level in order to assess collective progress on the GGA.

Leiter et al. (2019) leverage the analogy of development to emphasise the importance of tracking adaptation at an international level, despite its local focus. In particular, the authors state that:

> "no one contests the context-specificity of development, yet the usefulness of tracking development progress across contexts and scales and over time is equally universally acknowledged, as showcased by the 2030 Agenda for Sustainable Development" (Leiter et al., 2019:3)

The purpose of adaptation monitoring and evaluation (M&E) is summarised in chapter 17 ("Decision-making options for managing risk") of the latest IPCC report on "Impacts, Adaptation and Vulnerability" (New et al., 2022). These include assessing whether objectives have been achieved, informing current adaptation responses and future responses, and creating both downward and upward accountability mechanisms (New et al., 2022:2607).

However, adaptation metrics, and in particular assessing progress towards the GGA, raise a number of challenges, including the lack of a bounded and agreed upon definition for adaptation (Juhola et al., 2022:610) and, as a result, the diverse range of activities that the GGA covers. To name a few, adaptation activities encompass increasing the adaptive capacity of ecosystems and agricultural land, as well as improving economic development and health services to reduce vulnerability to climate change impacts (Okereke et al., 2018:327). As such, adaptation metrics tend to be specific to the adaptation project (Leiter et al., 2019:6).

Other challenges facing adaptation metrics, offered by Leiter et al. (2019:6-9), include the availability of data; social norms and power relations that might influence chosen adaptation metrics and their definitions; the trade-off between simple, measurable metrics and complex, but meaningful adaptation information; and the need for comparability across indicators and general frameworks of assessing adaptation. Furthermore, adaptation metrics tend to focus on the short-term outcomes of responses, which might be different to their long-term impact (New et al., 2022:2609).

According to New et al. (2022:2609), part of the challenge includes the trade-offs of context-specific metrics which are culturally and geographically sensitive to local circumstances, access to available and relevant information on adaptation, and the usefulness of an agreed upon "conceptualisation of adaptation" that can be compared across adaptation initiatives. New et al. (2022:2607) maintain that a "set of all-purpose and globally applicable standard indicators that could comprehensively measure adaptation does not exist".

Following these constraints, the Notre Dame Global Adaptation Initiative (ND-GAIN) set out to assess adaptation levels by assigning a national ND-GAIN score composed of vulnerability and readiness indicators (Chen et al., 2015). The vulnerability indicators aim to measure exposure, sensitivity and adaptive capacity in six sectors: "food, water, health, ecosystem services, human habitat and infrastructure", whilst readiness is assessed based on the economic, governance and social features of the country (Chen et al., 2015:3). Chen et al.'s (2015:5) chosen indicators are based on ensuring "transparency, reliability and

consistency", which meant focusing on data that was highly available across UN countries, that could be converted or used in time-series analyses to track trends, that was free and publicly available, "collected and maintained by reliable and authoritative organizations", and which was clear and transparent.

In terms of the assessment structure, Leiter et al. (2019) distinguish between two types of adaptation metrics: those based on indices, such as ND-GAIN, and those which rely on multiple, unaggregated, indicators. Both indices and indicators "define what is being measured, and conversely also what is being left out" (Leiter et al., 2019:9).

Indices are composed of aggregated quantitative indicators and, thus, face certain design challenges related to how to weight indicators, how to normalise indicators which are measured on different scales, and how reliant are the chosen indicators on the availability of data (Leiter et al., 2019:10).

Whilst Leiter et al. (2019) favour an indicator approach over a single index, due to the former's capacity to convey more meaningful information in relation to adaptation, the adaptation assessment is still sensitive to the chosen indicators and their underlying principles. Similarly, Winkler & Marquard (2021:13) argue that the GGA might be treated as a composite goal, composed of multiple aspects of adaptation, rather than an aggregated outcome. This is further supported by New et al. (2022:2607) which propose "surveys, scorecards, interviews and focus groups" to assess adaptation progress, in addition to or as alternatives to indicators.

Pelling and Garschagen (2019) also encourage a composite approach to assessing equity in adaptation. The authors maintain that a focus on the most vulnerable populations is the only way to achieve equity in the GGA (Pelling & Garschagen, 2019). They propose three axioms for this goal: investing in relationships with the most vulnerable; supporting local innovation; and measuring success in adaptation based on reducing social vulnerability in those that will suffer most from climate change impacts. These axioms are similar to the adaptation success enablers identified by New et al. (2022:2606) which include recognitional, procedural and distributive justice, alongside "flexible and strong institutions".

Lastly, Leiter et al. (2019) summarise five learnings and criteria required for effective adaptation metrics. These include: ensuring a purpose-driven design; leveraging multiple indicators; working from both an interdisciplinary and multidisciplinary perspective; creating opportunity for new technology and data sources that can contribute to assessing adaptation; and combining qualitative and quantitative information, while building a flexible framework.

The literature in this section has highlighted the particular challenges of creating adaptation metrics. With relevance to my research, the following challenges will need to be overcome in order to create a comprehensive equity framework: data availability issues, competing normative principles, scalability, and the complexity versus simplicity trade-off. Additionally, my research will need address whether equity can be measured consistently in the GGA, despite context-specific adaptation activities.

2.5 Conclusion

The literature review focused on the implementation of an equity assessment for the GGA, by evaluating current trends in equity frameworks, approaches to equity in the GST, and adaptation metrics. The review showed that the diversity in metrics and approaches to assessing equity in contributions to the GGA, as

well as the lack of current clarity for its assessment in the GST, calls for a consolidation of equity metrics that can overcome the challenges raised, alongside a justification of any chosen approach based on normative principles of equity and justice. As such, my research attempts to address this gap by investigating existing metrics and leveraging the subsequent learnings to develop a framework for assessing equity in national contributions to the GGA as part of the GST.

To better understand the diversity of existing metrics, the next chapter describes the systematic literature review of metrics for assessing equity in adaptation at the national and international level.

Chapter 3: Methodological analysis of systematic literature review

3.1 Introduction

As highlighted in the narrative literature review in the previous chapter, a diversity of principles and indicators exist to assess equity in contributions of the Paris Agreement's long-term goals. However, when it comes to the GGA, there is little agreement on the appropriate metrics for assessing equity in national contributions. Metrics for mitigation tend to rely on quantitative measures of national "fair share" responsibility and contribution as measured by current emissions. Such an approach is potentially insufficient for assessing equity in national contributions to the GGA due to the ambiguity of achieving the GGA which is defined as "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change" (UNFCCC, 2015:art7.1)

This chapter attempts to answer the first two research questions: what metrics exist for assessing equity in national contributions to the GGA? and, how appropriate are existing metrics for assessing equity in national contributions to the GGA? These questions are addressed through a systematic literature review of existing metrics in academic literature and a narrative synthesis of non-traditional publications (NTPs). Here, NTP refers to literature which has not been published in traditional journals, and thus would not appear in a systematic search through journal databases. The aim of the chapter is to better understand existing metrics and extract learnings that will inform the development of a usable framework for the GST in the next chapter.

The methodological analysis in this chapter is built around a systematic literature review and proceeds as follows: the next section describes the methods used, including the design, data collection, analysis, and limitations of the methods. Section 3.3 provides an overview of the results from the systematic literature review, focusing on what sources were collected and the emerging thematic and keyword clusters. Section 3.4 responds to the questions posed above by discussing how the academic literature and NTPs consider equity and justice, summarising the proposed metrics, and synthesising the trends, challenges, and remaining gaps from the review. Finally, section 3.5 summarises and concludes the chapter.

3.2 Methods

3.2.1 Review protocol and consultations

The review was completed through an iterative process to ensure comprehensiveness and relevance in the results and findings. Firstly, a systematic review protocol (see Appendix A) was developed based on the latest Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2020).

Following this, the protocol was updated based on consultations with two university librarians specialising in the Environmental and Geographical Sciences, and six experts with research experience in climate change adaptation, equity in the climate regime, or both.

The consultations were used to inform the choice of electronic databases, the search terms and strategy, the data extraction process, and the methods of analysis for the collected references. Following

consultations with subject experts, there was a decision to remove NTPs from the systematic search and, rather supplement the systematic search of academic sources with a narrative synthesis of the NTP sources. This involves a synthesis of knowledge related to the research topic from relevant sources (Bangert-Drowns, 2005:231). This shift in methodology was implemented such that metrics proposed in NTPs would not be overlooked, whilst still accommodating the scope of the research and ensuring that the systematic review methods remained replicable. The consultations with subject experts focused on method and are not interviews, nor are their comments cited in this thesis.

3.2.2 Data selection process

The following search terms were used in three electronic databases, EBSCOhost, Scopus, and Web of Science:

> **(equity OR justice OR fairness) AND (metric* OR indicator* OR framework* OR measure*) AND adaptation AND "climate change"**

The search was restricted to articles published in 1992 or later and the terms were searched within article titles, keywords, and abstracts. Further, the relevance of these results was validated by cross-checking against references suggested by experts during consultations to ensure that the search terms were identifying the expected literature. The timeframe chosen represents the period within which there has been a multilateral commitment to climate action, starting with the launch of the UNFCCC, the Convention on Biological Diversity, and the United Nations Convention to Combat Desertification at the 1992 Rio Earth Summit.

Whilst this research focuses on metrics assessing equity in the GGA, the terms "justice" and "fairness" were included to ensure that the results encompassed the breadth of literature related to issues of equity. Further, this paper uses the word "metric" to loosely refer to principles, frameworks, indices, and qualitative and quantitative indicators, as such, the search included the following terms: "metric", "indicator", "framework" or "measure". Finally, to restrict results to the relevant research topic, the results search options (title, abstract, or keywords) had to include both "adaptation" and "climate change".

A software for systematic review, Rayyan (Ouzzani et al., 2016), was used for the title and abstract screening based on the inclusion/exclusion criteria in Table 3.1. As a result, a total of 1,253 articles were identified through this search (Figure 3.1.), with 490 duplicates removed in the first stage of screening.

The GST aims to assess collective progress in achieving the Paris Agreement's long-term goals by consolidating inputs from national, regional, and international sources (UNFCCC, 2018:p37). Thus, to ensure applicability to the GST as a global assessment, articles and studies with context-specific metrics which are less globally generalisable were excluded, such as metrics focused on the local, sub-national or sectoral scale. Similarly, articles or studies which were solely concerned with one element of adaptation were also excluded. Additionally, articles which were explicitly unrelated to adaptation in climate change were excluded.

Table 3.1 Inclusion and exclusion criteria of reference collection for systematic review. The criteria were used throughout the search protocol strategy: initial electronic database search [1], title/abstract screening [2], and full-text eligibility screening [3]. *Source: Author's own analysis*

Inclusion criteria	**Exclusion criteria**	**Search protocol**
Published in 1992 to present (2021)	Published before 1992	[1]
Qualitative research including theoretical papers, reviews, impact assessments, process evaluations, surveys, case studies, and book section	Entire book, editorial, or introduction to journal issue	[1, 2, 3]
National, regional, or international level of analysis	Local, sub-national, sectoral scale or context-specific level of analysis	[2, 3]
Literature in English language	Any non-English literature	[2, 3]
The literature is concerned with adaptation to climate change	The literature does not refer to adaptation (e.g., exclusively focused on mitigation, resilience, sustainability, risk analysis, disaster management, etc.)	[2, 3]
The literature is concerned with multiple elements of adaptation	The literature focuses on only one element of adaptation (e.g., flooding, sea level rise, conservation, health impacts, etc.)	[2, 3]
Proposes or recommends principles, metrics, indicators, and/or indices on assessing equity in adaptation	Does not include guidelines for measuring equity in adaptation or only reviews existing guidelines with no recommendations	[3]

Full-text eligibility screening was conducted on the remaining 139 articles, as shown in the bottom panels of Figure 3.1 (the full-text of 11 articles were unretrievable due to limited access). At this final screening stage, a similar inclusion/exclusion criteria was used to further assess the relevance of each article. The full-text screening only included articles which proposed equity metrics for assessing equity in adaptation. These included metrics in the form of indicators or indices, and/or in the form of principles (i.e. best practices or guidelines for equity in adaptation). Articles which proposed and implemented an analytical framework for discussing equity in adaptation were excluded, due to the absence of an equity-based evaluation. 40 articles were included after the full-text screening, as shown in Figure 3.1., which summarises the search and screening process, based on the Reporting standards for systematic evidence syntheses in environmental research (ROSES) (Haddaway et al., 2017).

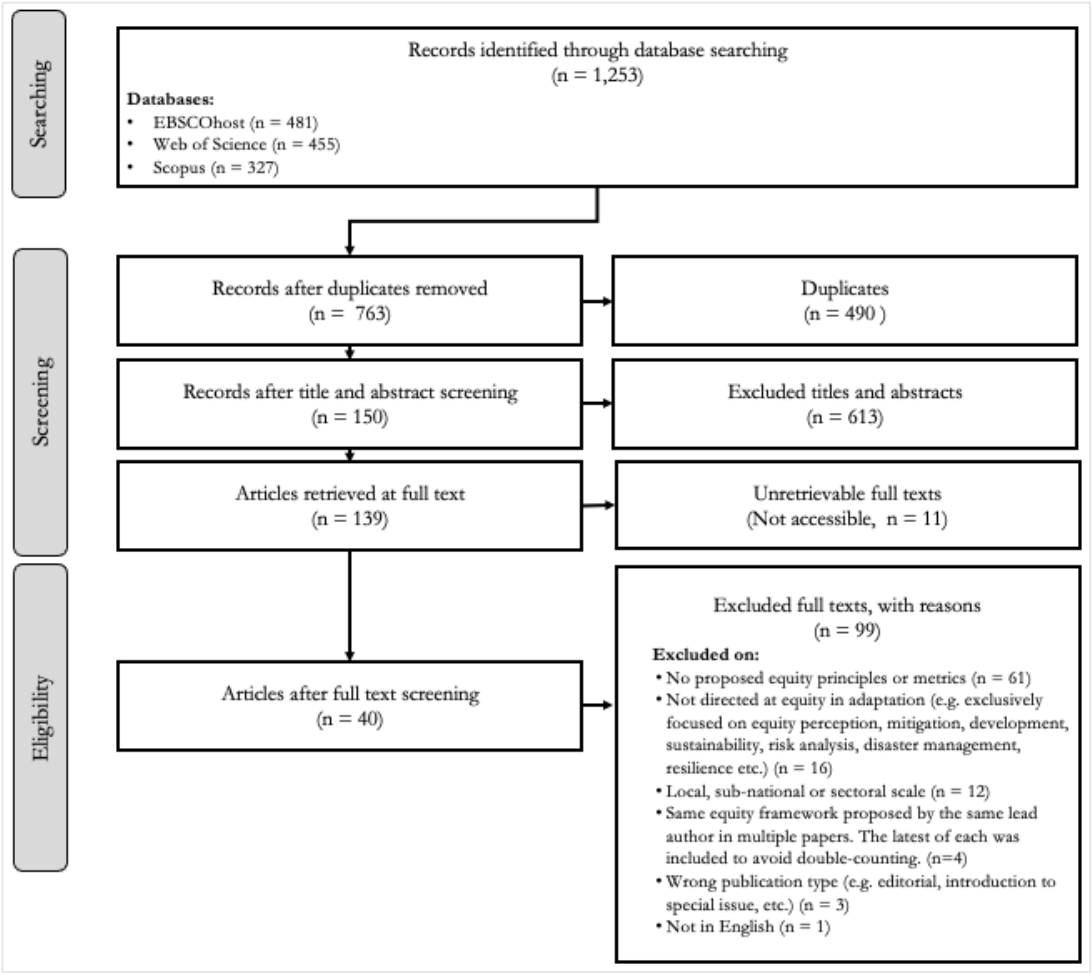

Figure 3.1 Summary flow diagram of the systematic review literature searching, screening, and eligibility process. Adapted from the ROSES flow diagram for systematic reviews (Haddaway et al., 2017). *Source: Author's own analysis*

Table 3.2. is the list of NTPs which were collected based on recommendations from the subject-expert consultations. Recommended publications were screened to ensure the sources included metrics for assessing equity in adaptation at the national, regional, and/or international level.

Table 3.2 Non-traditional publications (NTPs), reviewed in 3.4 in addition to the academic articles in the systematic review. NTPs was sourced through recommendations from the subject-expert consultations. *Source: Author's own analysis*

Title	Relevant chapter(s)	Year	Organisation
1. "Climate Change 2022: Impacts, Adaptation and Vulnerability"	"Chapter 1: Point of Departure and Key Concepts" and "Chapter 17: Decision Making Options for Managing Risk"	2022	Intergovernmental Panel on Climate Change (IPCC) Working Group II
2. "Adaptation Gap Report 2021: The gathering storm – Adapting to climate change in a post-pandemic world"	-	2019`	United Nations Environment Programme (UNEP)
3. "Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World"	"Chapter 1: Equity and Vulnerability in a Warming World: Introduction and Overview"	2010	The World Bank

4. "Framing and tracking 21st century climate adaptation: Monitoring, evaluation and learning for Paris, the SDGs and beyond"	-	2019	International Institute for Environment and Development (iied)

3.2.3 Analysis for a narrative synthesis of systematic review literature

The selected academic articles were then critically appraised using an adapted Spencer et al.'s (2003) guide on "Quality in qualitative evaluation: A framework for assessing research evidence." Further, the proposed equity metrics were separately evaluated using a combination of Leiter et al.'s (2019) "[d]esirable criteria for a global framework for assessing progress on adaptation" based on the United Nation's (UN) Environment Adaptation Gap Report (2017) and Leiter et al.'s (2019) lessons for adaptation metrics (see Appendix B).

Each academic article was coded in NVivo 12 Pro software (QSR International Pty Ltd, 2018) and a questionnaire was used to record the critical appraisal findings and data items coded in NVivo. The data items coded and extracted from each article are summarised in Table 3.3. and were aimed at exploring the geographical and theoretical scope of the frameworks and their appropriateness for the GST (the detailed codebook and questionnaire can be found in Appendix C).

Table 3.3 Data items coded in NVivo 12 Pro and extracted from each academic article in order to explore the geographical and theoretical scope of the frameworks and their appropriateness for the GST. *Source: Author's own analysis*

Coded and extracted data items from each article	
• All citation data including abstract • Nature of metric (qualitative, quantitative or both) • Type of metric (indicators, index, framework, principles) • Climate action (adaptation, mitigation, loss and damage) • Scale (national, regional, continental, international) • Discussion related to the climate regime	• Population location • Metric details, including self-identified limitations • Elements related to justice and equity • Supporting themes, disciplines and/or theories • Critical appraisal findings

NVivo 12 Pro matrix coding was used to analyse the co-occurrence of coded keywords related to elements of equity and justice, and supporting themes, disciplines and/or theories. Keywords which were coded in only one article or counts of keywords with less than two references in an article were excluded from the matrix to reduce the noise of less prevalent keywords. The co-occurrence matrix was then analysed with Gephi software (Bastian, Heymann & Jacomy, 2009) to create keyword network graphs and calculate keyword clusters (Figure 3.4.).

3.2.4 Limitations of methods

The main limitations of the research are related to the comprehensiveness of the data collection process and the influence of only one researcher reviewing and coding articles. Whilst the search terms and

strategy were iterated upon through testing and expert consultations, there still might have been relevant papers missed during the search. This is particularly true for the NTPs, which were chosen based on consultations and for literature not in the English language. A search protocol which included the references in the selected articles, more NTPs, and non-English language papers would have been more comprehensive, but the scope of this thesis was limited due to time and resources.

Additionally, as a result of this research conducted by one researcher, there is inherent bias in the review of collected articles and the critical appraisal and coding of selected articles which could not be corroborated by multiple judgements. Thus, there is space for, and it is recommended that, a research team conduct a replication study.

3.3 Presentation of systematic review results

3.3.1 Description of the included literature in systematic review

Despite the search protocol including articles published from 1992 to 2021, no eligible articles after full screening were published earlier than 2006. Figure 3.2 shows the spread of 40 articles by publishing year. There is no major variation over this time period.

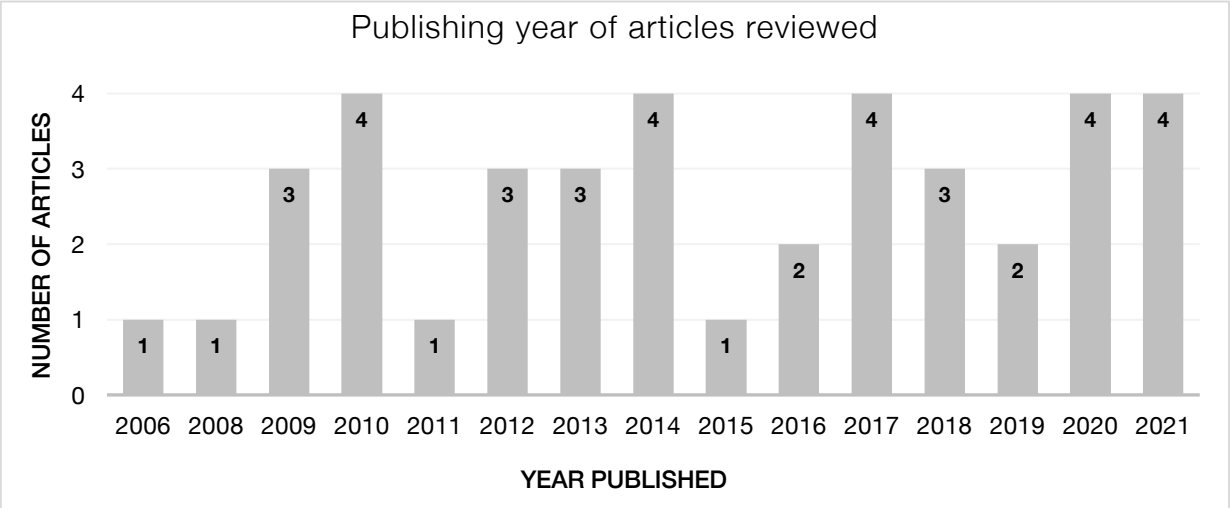

Figure 3.2 Bar chart showing the number of articles reviewed by year published; total = 40. *Source: Author's own analysis*

Figure 3.3 shows the predominance of Global North corresponding authors (33 out of the total 40), with only five based in the Global South, and two where the affiliations were from both the Global South and North. A quarter of the corresponding author affiliations are based in the United States of America (USA).

Most of the papers focused on equity assessments at the international scale (17), with 11 papers not referring to any scale, and 11 papers focusing on a specific location, eight of which refer to a national context (Figure 3.4 and Table E.1 in Appendix E).

Whilst the majority of papers (23) only referred to adaptation, 17 papers applied their equity metrics to both mitigation and adaptation, and four papers also included equity assessments in relation to loss and damage.

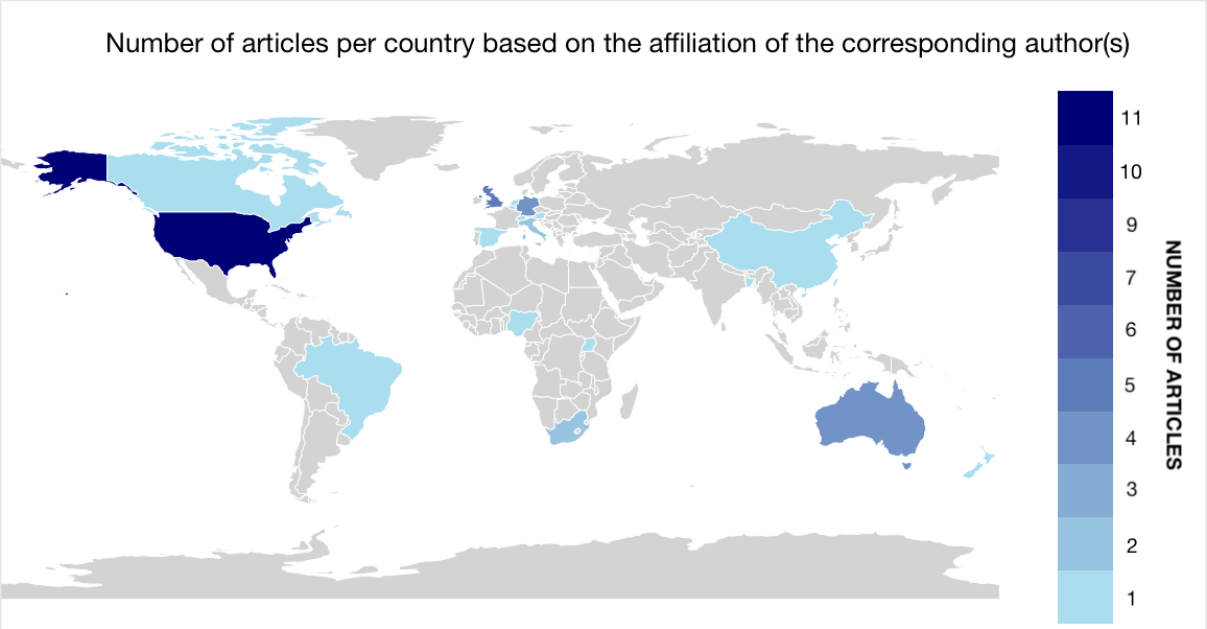

Figure 3.3 Map chart showing the number of articles reviewed by country based on the affiliation of the corresponding author(s). *Source: Author's own analysis*

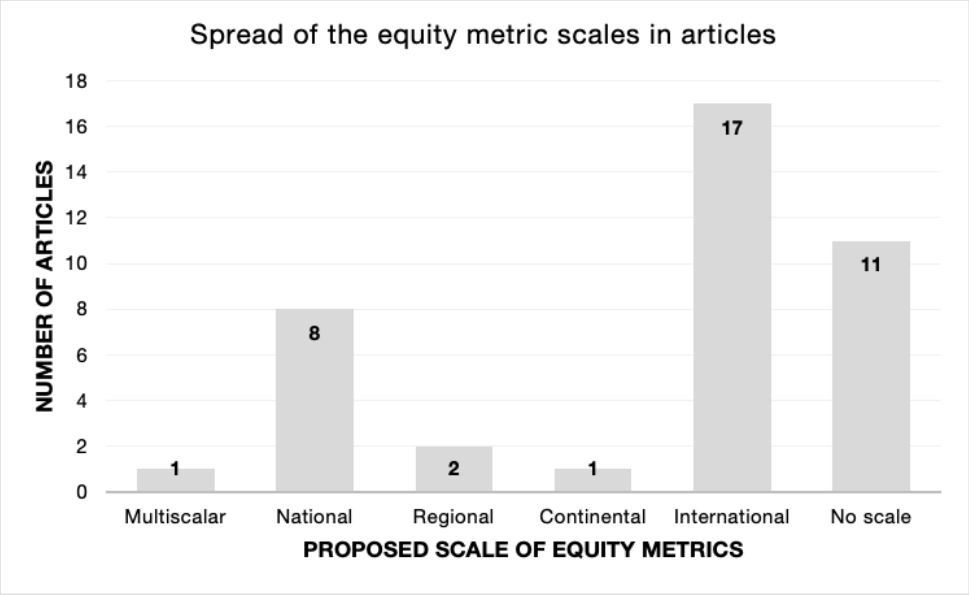

Figure 3.4 Bar chart showing the spread of equity metric scales across the included articles. *Source: Author's own analysis*

3.3.2 Keyword network analysis and thematic clusters in systematic review

Two main thematic clusters emerge from the analysis of keywords related to equity, justice, and other themes, disciplines and/or theories coded in the papers. Figure 3.5 visualises these two clusters, where the most central keywords in Cluster 1 (blue) are "procedural justice", "vulnerability" and "inequality". In Cluster 2 (green), the most connected keyword is "distributive justice", followed by "climate finance", "international law" and "CBDR&RC". The difference between these two clusters is categorised as Intangible and Tangible, respectively. In this dissertation, Intangible is used to describe the themes which focus on social dynamics. For example, procedural justice is concerned with fair processes, thus dealing with social interactions, while

vulnerability and inequality can be considered social characteristics. In contrast, Tangible is more closely related to answering questions specific to allocation, including distributive justice and its varying principles, such as CBDR&RC or the polluter-pays principle, which aim to guide the allocation of climate finance, responsibilities, burdens, and so on.

Figure 3.6 is a visualisation of the four most connected keywords[1] in each cluster and their use over time. No discernible trends or patterns emerge from this visualisation, however the majority of coding (59%) falls within the Intangible Cluster of keywords. This cluster is equally represented before 2015 and after (inclusive of) 2015. The Paris Agreement was adopted in 2015, and therefore so was the GST and its objective to assess collective progress in light of equity. In contrast, the Tangible Cluster is more prevalent prior to 2015 (59%) than after (41%).

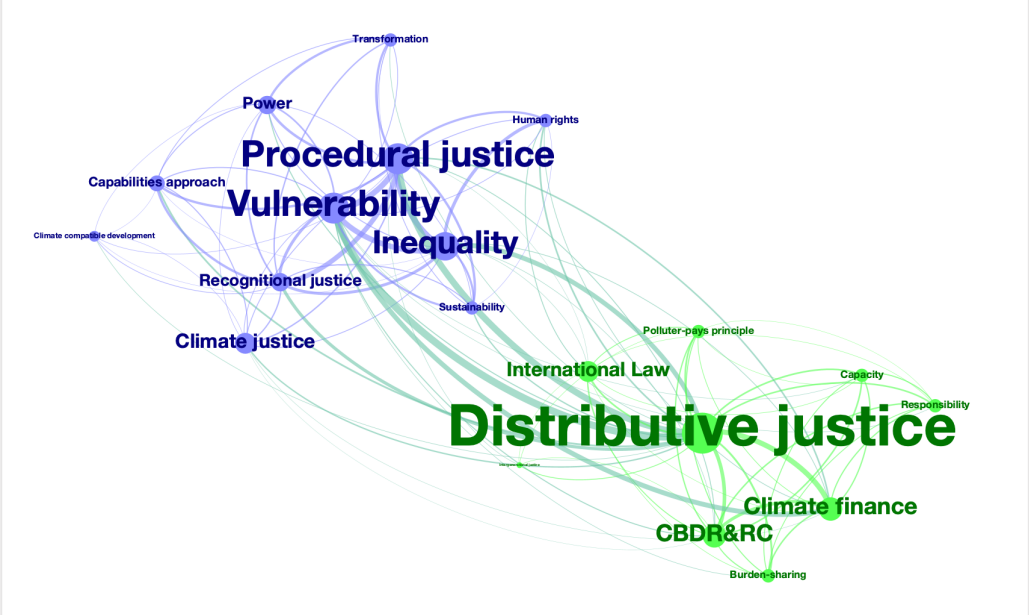

Figure 3.5 Keyword network graph created on Gephi software (Bastian, Heymann & Jacomy, 2009) based on keyword coding and analysis of keyword codes on Nvivo 12 Pro. Communities of keywords (Cluster 1 coloured in blue and Cluster 2 coloured in green) produced using Blondel et al.'s (2008) modularity algorithm in Gephi. Text and node sizes are proportional to the number of degrees of each node. "CBDR&RC" stands for the principle of "common but differentiated responsibilities and respective capabilities". *Source: Author's own analysis*

[1] The larger the text in Figure 3.5, the more frequently the keyword is considered in conjunction with other keywords.

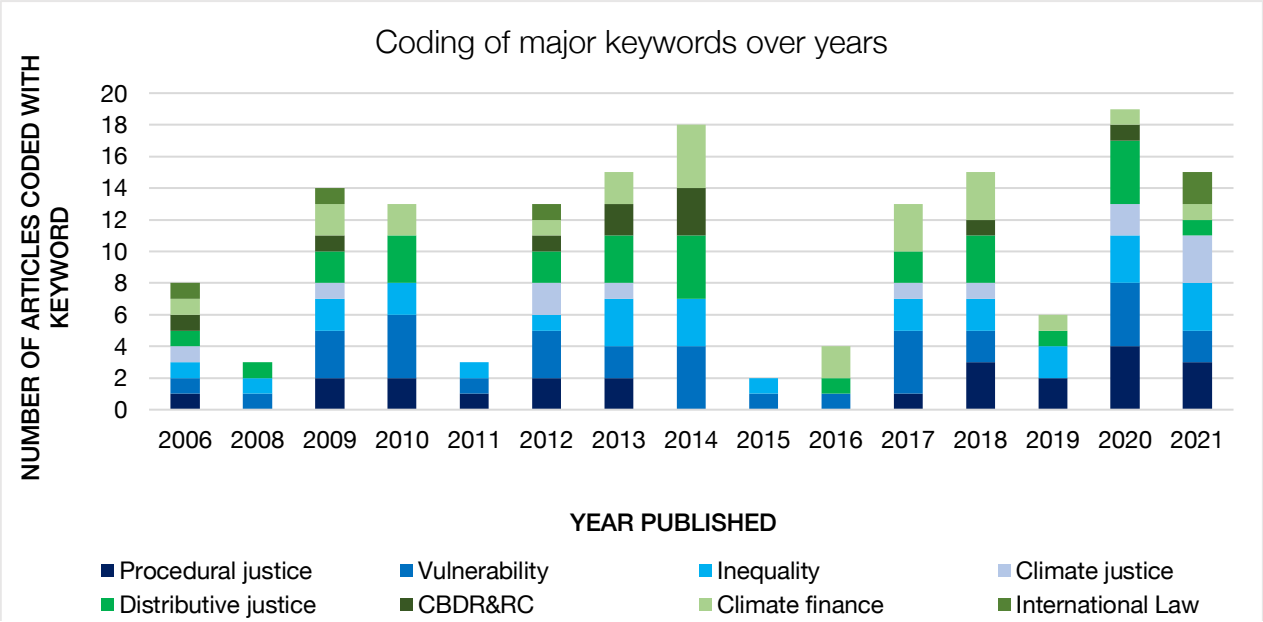

Figure 3.6 Stacked bar chart showing the number of articles coded with the four most central keywords from the Intangible and Tangible keyword communities, over the years the articles were published. "CBDR&RC" stands for the principle of "common but differentiated responsibilities and respective capabilities". *Source: Author's own analysis*

Whilst the information presented here related to affiliation and publishing years does not directly contribute to the following analysis, it is included for the sake of transparency around the attributes of the papers reviewed. The more relevant results relate to that of the underlying themes of the proposed metrics which are captured in the keyword analysis. The results here focus on the frequency and connections of these themes throughout the papers. This lays the basis for the next section, which discusses the most prevalent ones in greater depth in order to better understand their influence on the equity metrics.

3.4 Discussion of results

This section includes the narrative synthesis of NTPs with an analysis of the results from the systematic review. It first answers the question: "what metrics exist for assessing equity in contributions to the GGA?" by discussing how the academic literature and NTPs consider equity and justice (3.4.1) and by synthesising the proposed metrics (3.4.2).

The second question that this chapter explores is "how appropriate are existing metrics for assessing equity in contributions to the GGA?" As such, this section proceeds to further interpret the literature by highlighting the emerging trends in 3.4.3, and discussing some of the main challenges (3.4.4) and remaining gaps (3.4.5) for assessing equity in the GGA.

3.4.1 Considerations of equity and justice

Before presenting and discussing the types of metrics proposed in the academic papers and NTPs, it is helpful to understand how the literature defines and interprets equity and justice. Any metric for assessing equity in adaptation presupposes what it means for adaptation actions to be equitable and just. Thus, by exploring the varying approaches to equity and justice, we can begin to identify the reasons and justifications for chosen metrics. In this way, similarities and differences between the metrics can be revealed through their

underlying motivations and this can be used to inform how equity and justice should be interpreted in the framework developed in this thesis and presented in chapter four.

Equity. The most common justification for the need for equity in climate change adaptation efforts is the disproportionate impact of climate change on the Global South (Paavola & Adger, 2006; Klepp & Fünfgeld, 2021) or already vulnerable populations (Mitchell & Tanner, 2008; Terry, 2009; Whyte, 2013; Levy & Patz, 2015; Lyster, 2017; Malloy & Ashcraft, 2020), who are also least responsible for climate change (Dulal, Shah & Ahmad, 2009; Fussel, 2010; Mearns & Norton, 2010; Weiler, Klock & Dornan, 2018; Wood et al., 2018; Campello Torres et al., 2020; Fünfgeld & Schmid, 2020).

However, strict definitions for equity are scarce throughout the papers and included definitions are quite varied. The majority of papers rely on existing theories and principles to infer what equitable adaptation entails.

Lyster (2017:441) defines equity in adaptation as actions which reduce vulnerability, and protect and improve capabilities. Capabilities, based on both Amaryta Sen's and Martha Nussbaum's work on the capabilities approach, include "resources, opportunities, freedoms, and institutions necessary for individuals and groups to exist as full members in a given society" (Malloy & Ashcraft, 2020:4). A number of papers rely on the capabilities approach to understand equity and justice in adaptation (Schlosberg, 2012; Ciplet, Roberts & Khan, 2013; Lyster, 2017; Wood et al., 2018; Fünfgeld & Schmid, 2020; Malloy & Ashcraft, 2020; Hughes, 2021) as it encompasses both distributive dimensions of access to goods and services, as well as procedural dimensions through empowering individuals to have a voice in decision-making processes (Fünfgeld & Schmid, 2020:445).

Other strict definitions of equity are provided by Stadelmann et al. (2014:104) who define equity as a relational quality, where the distribution of resources is perceived as fair by the parties involved, and Chuku (2010:45) who defines equity as the enhancement of public socio-economic welfare "across societal clusters and generations", in contrast to only individual gains. Similarly, Dulal, Shah and Ahmad (2009:365) focus on the public sector, defining social equity as:

> "fair, just and equitable management of all institutions serving the public directly or by contract, and the fair, just and equitable distribution of public services, and implementation of public policy, and the commitment to promote fairness, justice and equity in the formation of public policy"

Equitable adaptation is also understood in terms of international law (Maguire, 2012) and the UNFCCC's principle of CBDR&RC (Paavola & Adger, 2006; Dellink et al., 2009; Baer, 2012; Ciplet, Roberts & Khan, 2013; Ngwadla, 2014; Winkler & Rajamani, 2014; Khan et al., 2020; Begum et al., 2022).

Maguire (2012:101) argues that principles derived from international law "were developed according to notions of equity", and thus such principles can be used to operationalise equity in adaptation. These include the principle of common but differentiated responsibilities, intra- and intergenerational equity, the precautionary principle (activities with uncertain outcomes should be avoided until there is more certainty in their consequences), the polluter-pays principle (those who caused the harm are responsible for its costs), and state responsibility and prevention (Maguire, 2012:104).

The duties derived from CBDR&RC are understood by both Winkler and Rajamani (2014) and Dellink et al. (2009) as inclusive of historic responsibility for the environmental harm caused and capacity to contribute to response measures. Dellink et al. (2009) frame these duties as consequentialist and non-consequentialist, respectively. From a consequentialist perspective, the morality of an action is dependent on its outcomes, therefore there is a duty to right the wrongs produced from an action, in this case historic responsibility for climate change (Dellink et al., 2009). The non-consequentialist view argues that irrespective of direct or indirect evidence that an action caused a harm, states have a duty to do what is right, such as implement climate change response measures because they have the capacity to do so (Dellink et al., 2009).

Several authors consider equity in adaptation through a human rights lens (Mearns & Norton, 2010; Whyte, 2013; Levy & Patz, 2015; Shih, 2019; Campello Torres et al., 2020; Hughes, 2021; Jodoin, Savaresi & Wewerinke-Singh, 2021). Jodoin, Savaresi and Wewerinke-Singh (2021:48) argue that a rights-based approach is legitimised by national and international obligations to protecting rights. Shih (2019:497) calls attention to specific human rights at risk of infringement due to climate change impacts, such as "the rights to life, health, food and an adequate standard of living". For some scholars, a human rights approach ensures vulnerable and marginalised populations are protected from climate change impacts by first safeguarding their rights (Whyte, 2013; Levy & Patz, 2015; Hughes, 2021).

Climate justice. The most common justice considerations raised by papers in the systematic review relate to distributive and procedural justice (Figure 3.7). Similarly, the IPCC AR6 WGII report (Begum et al. 2022) and the World Bank literature (Mearns & Norton, 2010) consider equitable adaptation in terms of both distributive and procedural justice, with the former also suggesting recognitional justice as a third dimension.

According to the IPCC report, distributive justice deals with the fair allocation of burdens and benefits (Begum et al., 2022:50). Khan, Robinson & Welkmans (2020:252) rely on Rawlsian justice to further define what is meant by a *fair* allocation:

> "a situation where all primary social goods, e.g., opportunity, income, and wealth, are distributed equally unless an unequal distribution of any or all of these goods is to the advantage of the least favored, which guarantees a fair deal for the most disadvantaged"

When it comes to adaptation planning, Fünfgeld & Schmid (2020:444) characterise distributive justice from a spatio-temporal perspective, considering the distribution of climate change impacts and adaptive capacity across geographic regions, as well as the distribution of harms and benefits from climate change both intra- and intergenerationally, and the historic "trajectories of marginalization that have led to socially unequal distribution of vulnerabilities".

These relational considerations are reinforced in the first chapter of the IPCC report which categorises distributive justice concerns into three types of relationships: 1) "fairness between individuals", 2) "fairness between states", and 3) "fairness between generations" (Begum et al., 2022:50). The first consideration advocates for adaptation which does not arbitrarily protect some people, while increasing the vulnerability of or creating risks for others (Begum et al., 2022:50). Additionally, drawing on the capabilities approach, the report maintains that to ensure "equitable risk or equitable risk reduction" the impacts of climate change and

adaptation policies should be measured not only by their effect on economic assets, but also on wellbeing, defined as "the ability of a person to pursue and realize the goals that they value" (Begum et al., 2022:52). Context-specific considerations are also supported by Wood et al. (2018:10) who maintain that distributive justice mechanisms should be defined based on local values and needs.

Begum et al. (2022:50) understand fairness between states through the UNFCCC's CBDR&RC, where all countries have a responsibility to address climate change, whilst being sensitive to national circumstances and capacities.

Begum et al.'s (2022:51) third distributive consideration speaks towards intergenerational justice through "the obligation to ensure that future generations are guaranteed at least a minimally decent life". Intergenerational justice is also understood in terms of distributional justice in the systematic search papers as it relates "to fairness in allocating resources between current and future generations" (Eizenberg & Jabareen, 2017:8). Other papers consider intergenerational justice more directly in terms of achieving sustainability and sustainable development goals (Chuku, 2010; Eriksen et al., 2011, Schloshberg, 2012; Eizenberg & Jabareen, 2017).

Overall, most of the literature attempts to address two main distributive justice challenges related to adaptation: 1) fair burden-sharing for managing the impacts of climate change (Dellink et al., 2009; Mitchell & Tanner, 2009; Baer, 2012; Cui et al., 2014; Boston & Lawrence, 2018), and 2) fair allocation of funds and resources to vulnerable populations (Betzold & Weiler, 2017; Eizenberg & Jabareen, 2017; Ajibade & Adams, 2019; Campello Torres et al., 2020; Fünfgeld & Schmid; 2020), with some considering these two challenges in tandem (Aarke & Rübbelke, 2010; Mearns & Norton, 2010; Maguire, 2012; Ciplet, Roberts & Khan, 2013; De Cian et al., 2016; Grasso, 2017; Begum et al., 2022). Over half the papers in the systematic review focus on addressing these challenges through the fair contribution and allocation of climate finances for adaptation (such as Aarke & Rübbelke, 2010; Meyer & Roser; 2010; Ciplet, Roberts & Khan, 2013; Chen et al., 2018).

In the chapter "Equity and Vulnerability in a Warming World: Introduction and Overview", Mearns and Norton (2010:5) provide categories for particularly vulnerable populations, which include "the poor, women, young children, and the elderly".

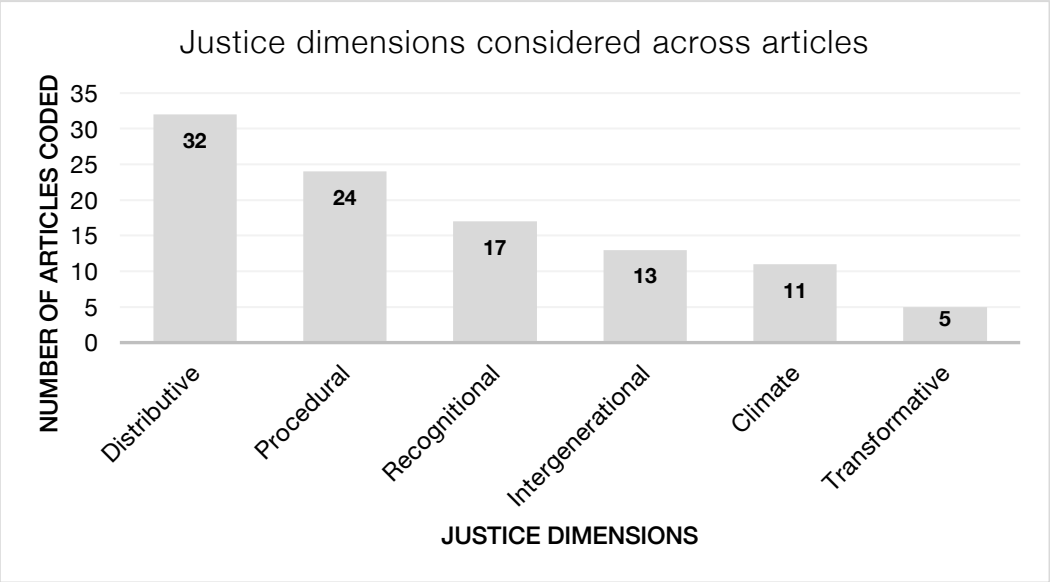

Figure 3.7 Number of articles in the systematic review coded with justice dimensions of distributive, procedural, recognitional, intergenerational, climate or transformative justice in Nvivo 12 Pro. *Source: Author's own analysis*

According to the literature reviewed, procedural justice is concerned with the fair processes related to adaptation, such as participatory planning, decision-making and oversight which includes marginalised and vulnerable populations (Paavola & Adger, 2006; Dulal, Shah & Ahmad, 2009; Terry, 2009; Mearns & Norton, 2010; Kaswan, 2012; Eizenberg & Jabareen, 2017; Wood et al., 2018; Ajibade & Adams, 2019; Campello Torres et al., 2020; Khan, Robinson & Welkmans, 2020; Jodoin, Savaresi & Wewerinke-Singh, 2021; Klepp & Fünfgeld, 2021; Begum et al., 2022), inclusive representation in formal government (Mearns & Norton, 2010; Eriksen et al., 2011), recognising and including plural knowledge systems (Chuku, 2010; Whyte, 2013), and transparency and accountability in the managing of climate finance for adaptation (Mearns & Norton, 2010; Ciplet, Roberts & Khan, 2013; Grasso, 2017; Boston & Lawrence, 2018; Shih, 2019; Begum et al., 2022).

Both the capabilities approach and human rights frameworks have been used to support procedural justice in adaptation. Schlosberg (2012:458) understands procedural justice from a capabilities lens, supporting the democratisation of and achievement of local empowerment during decision-making processes, to uphold basic capabilities related to agency. In contrast, Jodoin, Savaresi and Wewerinke-Singh (2021:48) rely on a rights-based approach to advocate for procedural justice through "public participation, access to information, and access to justice to ensure that climate governance processes are fair, transparent, and inclusive".

Mearns and Norton (2010) maintain that a rights-based approach can be leveraged to operationalise and assess social justice in climate change adaptation by ensuring that human rights are fulfilled, respected and protected. The authors argue that such an approach identifies both duties and obligations for adaptation and is legitimised by existing international obligations (Mearns & Norton, 2010:12) Thus, the approach can act as a moral and authoritative grounding for adaptation (Mearns & Norton, 2010:12). The authors propose a social development agenda that prioritises social justice in climate actions, which includes taking a "no regrets" approach (ensuring that actions have positive outcomes, irrespective of future climate uncertainty), "[i]mproving the adaptive capacity of the poor", and inclusive collaboration across stakeholders (Mearns & Norton, 2010:36-39).

Power dynamics are addressed in procedural, recognitional and transformative justice concerns. In chapter 17 of the IPCC report, which looks at monitoring, evaluation and learning (MEL) options for adaptation, the application of procedural justice is extended to include procedures which challenge power imbalances to address structural vulnerability (New et al., 2022:88).

Additionally, Terry (2009:13) highlights how gender inequalities related to "lack of assets", "lower education levels" and "exclusion from decision-making at all levels" perpetuate women's vulnerability to climate change. Fünfgeld and Schmid (2020:440) maintain that transformative procedural justice requires challenging assumptions around "who should be in charge of, and involved in, a given adaptation planning process". Similarly, Ajibade and Adams (2019:856) see establishing equity in power relations as fundamental to transformative adaptation, requiring:

> "questioning and challenging fixed beliefs, values, stereotypes, identities and assumptions especially about who is able to participate in adaptation planning, whose knowledge counts and who suffers the consequences of specific choices"

Several scholars maintain that recognitional justice and procedural justice are intertwined, where the recognition of structural inequalities, and diverse values, cultures, identities and knowledge systems is required to ensure fair and inclusive processes (Paavola & Adger, 2006; Schlosberg, 2012; Eizenberg & Jabareen, 2017; Wood et al., 2018; Mallow & Ashcraft, 2020). Similarly, Begum et al. (2022:50) argue that recognitional justice "entails basic respect and robust engagement with fair consideration of diverse values, cultures, perspectives, and worldviews".

Finally, climate justice in general is defined by Hughes (2021:204) as

> "an environmental movement that ensures social, ecological, and economic justice for everyone who contributed least to causing global warming but are likely to suffer the most from it"

This definition is reinforced by Schlosberg (2012:445), who claims models for assessing equity and fairness in global climate policies, such as the polluter-pays principle and fair share frameworks, are built upon normative climate justice theories, and Wood et al. (2018:6) who tie climate justice to the relationship between the climate and "uneven development processes". In contrast, Kaswan (2012) and Lyster (2017) relate climate justice solely to reducing vulnerability to climate change and addressing structural inequalities, without referring to responsibility for climate change.

3.4.2 Overview of proposed metrics

Principles. The majority of equity metrics proposed in the systematic review papers were in the form of principles (Figure 3.8).

Maguire (2012:103) defines principles as higher-level propositions or rules that serve as a theoretical foundation and guidance for action. Table 3.4. summarises the proposed principles from the systematic review into eight clusters, with most scholars arguing for equitable adaptation through participatory approaches with at risk populations and/or centred on the most vulnerable populations.

Table 3.4 Principle clusters based on the trends in principle metrics proposed by papers in the systematic review. *Source: Author's own analysis*

Principle cluster	References
1. Equitable adaptation must consider distributive, procedural and recognitional dimensions of justice	(Chuku, 2010; Eizenberg & Jabareen, 2017; Wood et al., 2018; Fünfgeld & Schmid, 2020; Khan et al., 2020; Klepp & Fünfgeld, 2021)
2. Equitable adaptation is assessed upon and improves capabilities, ensuring agency and the ability to achieve a desired quality of life	(Schlosberg, 2012; Lyster, 2017; Wood et al., 2018 Fünfgeld & Schmid, 2020)
3. Equitable adaptation involves participatory approaches with at-risk populations in the planning, decision-making, and/or monitoring of response measures or distribution of adaptation finance	(Paavola & Adger, 2006; Dulal, Shah & Ahmad, 2009; Terry; 2009; Chuku, 2010; Kaswan, 2012; Eizenberg & Jabareen, 2017; Wood et al., 2018; Ajibade & Adams, 2019; Shih, 2019; Campello Torres et al., 2020; Fünfgeld & Schmid, 2020; Khan et al., 2020; Malloy & Ashcraft, 2020; Hughes, 2021; Klepp & Fünfgeld, 2021; McDonald & McCormack, 2021)
4. Equitable adaptation is centred on the most vulnerable and/or marginalised populations	(Paavola & Adger, 2006; Dulal, Shah & Ahmad, 2009; Meyer & Roser, 2010; Ciplet, Roberts & Khan, 2013; Fünfgeld & Schmid, 2020; Khan et al., 2020; Klepp & Fünfgeld, 2021; McDonald & McCormack, 2021)
5. Equitable adaptation recognises and addresses existing inequalities or vulnerabilities	(Terry, 2009; Mitchell & Tanner, 2008; Eriksen et al., 2011; Kaswan, 2012)
6. Equitable adaptation protects human rights	(Levy & Patz, 2015; Eizenberg & Jabareen, 2017; Shih, 2019; Jodoin, Savaresi & Wewerinke-Singh, 2021)
7. Equitable adaptation abides by the precautionary principle, avoiding actions with uncertain harms or potential maladaptive consequences	(Maguire, 2012; Ciplet, Roberts & Khan, 2013; Ajibade & Adams, 2019; Shih, 2019)
8. Equitable adaptation recognises inequalities by using monitoring and evaluation tools that disaggregate data by population and demographic information	(Mitchell & Tanner, 2008; Dulal, Shah & Ahmad, 2009; Terry, 2009; Schlosberg, 2012)

In contrast to the principles revealed in the traditional academic literature, the iied report proposes a framework for developing "Climate adaptation monitoring, evaluation and learning systems" (CAMELS) based on six specific principles inferred from Article 7 of the Paris Agreement (Brooks et al., 2019), which states that:

> "adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate" (UNFCCC, 2015:art7.5)

As such, Brooks et al. (2019) set four criteria for adaptation: 1) relevance, 2) quality, 3) effectiveness, and 4) adequacy, in which they place the principles from Article 7.5 (Table 3.5). In particular, the authors maintain that adequate adaptation relates to equity and justice, referring to the distribution of risks and impacts from climate change (Brooks et al., 2019:15).

The equity dimensions of the authors' framework include addressing vulnerabilities, establishing gender-responsive actions, recognising and including indigenous knowledge systems, ensuring transparency,

and implementing meaningful participation (Brooks et al., 2019). According to Brooks et al. (2019:16), meaningful participation means the active involvement of stakeholders on which the success of adaptation is reliant, as well as those who will be affected by adaptation measures throughout the planning, decision-making, implementation and MEL processes.

Table 3.5 National level framework for applying "Climate adaptation monitoring, evaluation and learning systems" (CAMELS) based on Article 7, Paragraph 5 of the Paris Agreement. The text in this table is quoted from Figure 1. of the iied report: "Framing and tracking 21st century climate adaptation" *Source: Author's own analysis reorganising text from Brooks et al. (2019:28)*

Article 7 principles	Dimensions	Relevant criteria
1. Country-driven	Supports national priorities	Relevance
2. Gender-responsive	Addresses needs of women and girls Delivering results for women and girls	Quality Effectiveness
3. Participatory & transparent	Design, implementation, MEL	Quality
4. Addressing vulnerabilities	Targets support where needed most Delivering results for most vulnerable Sufficient to support most vulnerable	Quality Effectiveness Adequacy
5. Science & knowledge	Addresses relevant risks for country Evidence-driven; drives learning Appropriate MEL methods/data Addressing actual warming/impacts	Relevance Quality Effectiveness Adequacy
6. Integration	Delivering Sustainable Development Goals, etc Systemic across sectors, etc	Effectiveness Adequacy

Few articles apply the principles which they identify by taking the next step to assess equity in adaptation. Campello Torres et al. (2020) conduct a qualitative review of Brazil's National Adaptation Plan (NAP), while Ciplet, Roberts and Khan (2013), Wood et al. (2018) and Khan et al. (2020) undertake a qualitative discourse review of the UNFCCC's climate regime. In contrast, Klepp and Fünfgeld (2021:2) evaluated knowledge and power dynamics in the Kiribati Adaptation Project from an environmental justice lens through four months of field work with "investigations grounded in ethnographic, qualitative empirical research methods". In this case study, the authors focused on assessing actions and processes which were unjust (Klepp & Fünfgeld, 2021).

Indices. All the metrics which result in an index focus on burden-sharing for implementing climate adaptation through a combined index of indicators that measure historic responsibility and capacity (Dellink et al., 2009; Baer, 2013), the allocation of climate adaptation assistance through an index for vulnerability (Aakre & Rübbelke, 2010; Meyer & Roser, 2010; De Cian et al., 2016; Chen et al., 2018), or a combined index of historic responsibility and capacity, and an index for vulnerability (Fussel, 2010, Cui et al., 2014). Thus, proposed indices are concerned with distributive justice and the fair allocation of burdens and benefits.

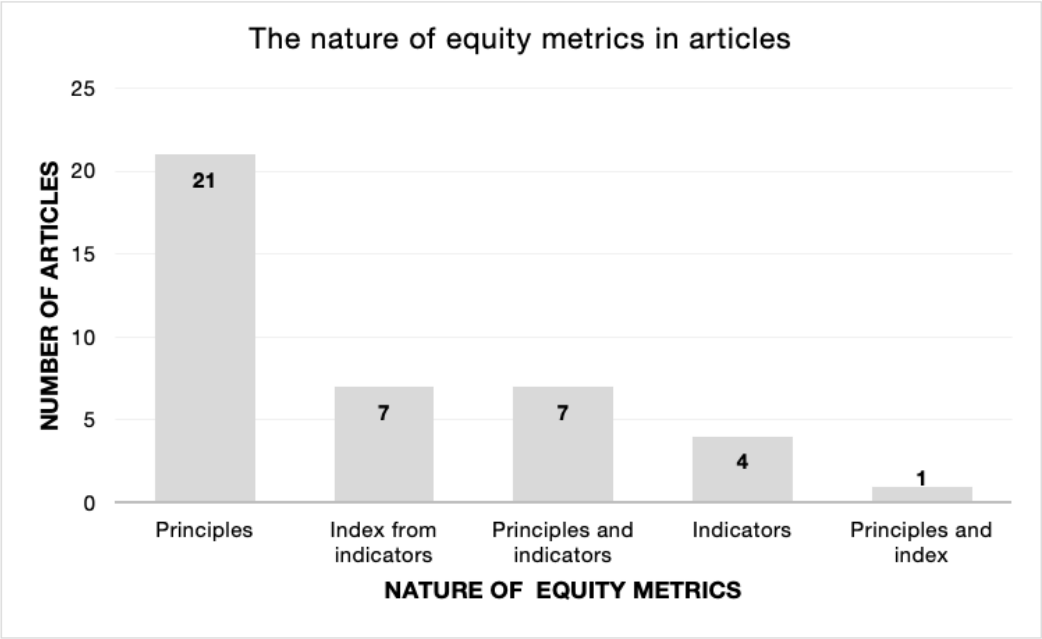

Figure 3.8 Nature of equity metrics (whether an index, indicators, principles, or a combination) across the included articles. *Source: Author's own analysis*

Indicators. Across the indicators proposed, four papers rely solely on quantitative measures (Ngwadla, 2014, Stadelmann et al., 2014; Betzold & Weiler, 2017; Weiler, Klock & Dornan, 2018), an additional four propose a combination of quantitative and qualitative indicators (Paavola & Adger, 2006; Grasso, 2017; Shih, 2019; Hughes, 2021), and the remaining papers, along with the UNEP report, leverage only qualitative metrics (Schlosberg, 2012, Winkler & Rajamani, 2014; UNEP, 2021).

The indicators proposed in the traditional academic papers can be synthesised into four main groups: 1) indicators for burden-sharing of adaptation finance (Grasso, 2017; Shih, 2019) and adaptation support (Ngwadla, 2014; Winkler & Rajamani, 2014); 2) indicators for fair governance processes in the mobilisation and distribution of adaptation finance (Grasso, 2017; Shih, 2019); 3) indicators for fair processes of participation, representation, and/or recognising existing inequalities (Paavola & Adger, 2006; Hughes, 2021); and 4) indicators for vulnerability to allocate adaptation support (Paavola & Adger, 2006; Schlosberg, 2012; Ngwadla, 2014; Stadelmann et al., 2014; Betzold & Weiler, 2017; Weiler, Klock & Dornan, 2018; Shih; 2019).

Focusing on fair governance processes, the "Adaptation Gap Report" (UNEP, 2021) proposes a framework of indicators for qualitatively assessing inclusivity in global adaptation progress across planning, finance, and implementation (UNEP, 2021). It highlights the progress made thus far, the remaining gaps, and any constraints to interpreting the findings, such as data availability (UNEP, 2021:12).

For adaptation finance and implementation, inclusivity was investigated broadly with the authors synthesising relevant evidence of inclusivity from their sources[2]. In contrast, adaptation planning assessed inclusivity in NAPs, national adaptation communications, and NDCs based on two indicators: "[d]edicated

[2] The adaptation finance review was based on studies and reports estimating adaptation costs and adaptation finance flows. The adaptation implementation review included adaptation project documents (from the Adaptation Fund, Green Climate Fund and Global Environment Facility), statistics on aid activities for adaptation from the Organisation for Economic Co-operation and Development (OECD), and studies documenting implemented adaptation (UNEP, 2021:39)

stakeholder engagement process in place" and "[c]onsideration for gender" (UNEP, 2021:17). Although each indicator was only "scored as present, absent or in progress/partial" (UNEP, 2021:18), the authors highlight distinct types of gender considerations, including

> "using gender-disaggregated data and gender analysis to identify gaps and needs, as well as developing targets and measures to enhance gender equality and monitoring progress in gender-responsive budgeting, planning and implementation." (UNEP, 2021:24)

A key limitation of this approach, identified in the report, is that aggregated assessments of global adaptation inequalities between countries ignores and fails to reveal unique national circumstances (UNEP, 2021:18).

Further limitations of assessing adaptation in general are raised in chapter 17 of the IPCC report. Whilst the report recognises the importance of assessing adaptation at a global level to understand the progress made and the remaining gaps in addressing climate change risks, it also highlights key challenges in assessing adaptation (New et al., 2022). These include the high sensitivity of assessment outcomes to the indicators and/or indices chosen, the differentiated impact of adaptation on different population groups (even in the same area), the uncertainty in the sustainability of adaptation interventions, and comparing and aggregating adaptation outcomes across levels and sectors which have varying adaptation needs (New et al., 2022:95).

3.4.3 Trends in metrics assessing equity in adaptation

There is agreement across the metrics that aim to answer who deserves adaptation support that the most vulnerable should be protected and prioritised. Here, the assumption is that vulnerability should be the starting point for measuring and evaluating equity in adaptation. However, a variety of metrics have been proposed for how to measure vulnerability. For example, vulnerability indices based on two measurements, such as income per capita and rate of unemployment (Aakre & Rübbelke, 2010), differentiating vulnerability based on country groupings which are particularly vulnerable, LDCs, SIDS, and/or African countries (Weiler, Klock & Dornan, 2018), or a combination of indicators that attempt to measure exposure (risk of climate change impacts), sensitivity (intensity of climate change impacts), and adaptive capacity (ability to manage climate change impacts) (Chen et al., 2018). The former two methods prioritise simplicity and the ability to compare vulnerability across countries and regions. In contrast, using multiple indicators is more time and resource intensive, and potentially less feasible due to limited data availability, but such metrics manage to capture more varied vulnerability information that can take into account context-specific information. Further, country vulnerability rankings are sensitive to the metrics chosen (New et al., 2022), and, thus, to ensure transparency, the assumptions and limitations of chosen metrics should be explored and addressed when possible.

On the international scale, burden-sharing frameworks for adaptation actions, which aim to share the burden of implementing the GGA, tend to rely on a combined metric of historic responsibility for emissions and capacity to support adaptation efforts. Whilst capacity is measured either through GDP per capita (Cui et al., 2014), income per capita (Baer, 2013), or country groupings, such as the UNFCCC's Annex I countries or

membership to other country groupings (e.g. G20, the European Union etc.) (Winkler & Rajamani, 2014), there is less consensus on how to measure historic responsibility. Responsibility for climate change requires choosing a date from which to start measuring impacts, as well as choosing the type of impact measured, such as all greenhouse gas emissions, all emissions other than those from land use change[3], and/or global temperature increase (Dellink et al., 2009).

These metrics which aim to answer where adaptation support should go and who should provide it, do not always answer the question of how much total support should be provided and in what form. Indices from burden-sharing frameworks can result in a percentage of total adaptation finance (Baer, 2013; Cui et al., 2014), however, such a metric is not easily transferrable to other types of adaptation support, such as technology transfer and capacity building on the international level, and other adaptation initiatives on the national level.

Another common metric for equitable adaptation relates to procedural justice and, in particular, participatory approaches. Metrics range from including consultations with at-risk populations in planning adaptation responses (McDonald & McCormack, 2021), to the empowerment of vulnerable populations and their inclusion in decision-making processes (Mearns & Norton, 2010; Fünfgeld & Schmid, 2020), and ensuring equitable and inclusive representation in national (Hughes, 2021) or international policy negotiations around adaptation (Paavola & Adger, 2006).

To ensure that participation is meaningful, it is important to recognise structural inequalities, empower marginalised populations to disrupt power imbalances (New et al., 2022), ensure inclusivity throughout the adaptation process (Brooks et al., 2019), and leverage M&E tools which disaggregate adaptation outcomes by different population groups (Schlosberg, 2012). While the UNEP (2021) report considers elements of the gender-responsiveness indicator such as gender-disaggregated data and analysis, and targets that enhance gender equality, these measures could be extended to include other vulnerable populations, related to age, ethnicity, caste, livelihood sources, and ability to access public goods and services (Mearns & Norton, 2010).

Further, part of ensuring fair processes in climate finance, is ensuring transparency and accountability in the mobilisation, distribution, and governance of adaptation finance on the national (Shih, 2019) and international (Paavola & Adger, 2006) levels.

Finally, the metrics from the systematic search with the highest critical appraisal (see Appendix D) were those that included both principles and indicators. Paavola and Adger (2006:595) offer indicators that measure mitigation, adaptation costs, and participation based on their principles of "avoiding dangerous climate change", responsibility, prioritising the most vulnerable, and equal participation. Shih (2019) focuses on equity in climate finance according human rights principles for assessing the mobilisation, distribution, and governance of climate finance. Hughes (2021) relies on principles of gender and procedural justice to propose several indicators which assess the level of participation, capacity and economic access of women in climate change responses. In these examples, the principles provided the underlying justification and guidance for the indicators, while the indicators were used to operationalise the principles. Using indicators, over an index, also

[3] Dellink et al. (2009) argue that including responsibility for emissions from land use change is complicated by the impact of colonialism on historic land use.

ensures that the information gathered to assess equity is not lost in one quantitative number, but rather a composite of both qualitative and quantitative indicators for equity.

3.4.4 Challenges in assessing equity in adaptation

The reviews revealed two main challenges: balancing complexity and simplicity in assessing equity in adaptation, and accounting for the multiscalar nature of adaptation at national, regional, and international levels.

Complex metrics composed of multiple indicators and with high flexibility are able to capture more characteristics of equity, and are more sensitive to context-specific circumstances. However, the increased complexity requires more resources and time to conduct assessments, and is not always feasible when data is missing. It is relevant to note that missing data is in of itself an assessment of lack of transparency and minimises the ability for civil society members to hold authority bodies accountable. As such, in Shih's (2019) assessment of equity in climate finance in Taiwan, the author counts missing data as a barrier to achieving equity and the UNEP report (2021) highlights constraints to interpreting the findings in order to reveal what is unmeasured and/or undisclosed.

The increased flexibility allows for more bottom-up processes. These include taking into consideration context-specific values and needs to realise distributive justice (Wood et al., 2018) or the ability for countries to strengthen duties by moving between country groupings, especially voluntarily (Winkler & Rajamani, 2014). However, these methods are more difficult to aggregate at a global scale, could impact the perception of equity (if countries set their own standards), and could hinder ambition if contributions to adaptation do not attempt to reach an equity target.

In contrast, the simpler metrics address these concerns as they are easier to collect, to aggregate, and to understand. The trade-off is omitting potentially important dimensions of equity and disregarding context-specific circumstances. Thus, simple metrics risk applying a one-size-fits-all definition and assessment of equity across varying conditions.

The second challenge is related to the multiscalar nature of adaptation. Whilst the GST requires that adaptation be measured at a collective level, adaptation initiatives are inherently localised which means that a global framework for assessing adaptation progress must overcome the challenge of aggregating adaptation outcomes, such as equity, from different contexts and scales (New et al., 2022). From the systematic review, only Wood et al. (2018) provide different indicators across distributive, procedural, and recognitional justice, for assessing equity at both the national and international level.

Further, measuring equity solely from the transfer of funds to vulnerable countries on the international level, does not ensure that climate finance is directed at vulnerable populations within the recipient country. Similarly, measuring burden-sharing at the national level does not ensure that vulnerable populations within countries are excluded from sharing the burden (Baer, 2013).

The GST will require a framework for assessing equity contributions to the GGA which is able to overcome these challenges by properly balancing complexity and simplicity in the chosen principles and

indicators, whilst being clear about any assumptions and limitations, and by appropriately differentiating and understanding equity within countries and across countries, so as to sufficiently capture equity in the GGA.

3.4.5 Gaps in assessing equity for the global goal on adaptation

The first main gap in the review relates to the dominant focus on equitable adaptation finance, over other forms of adaptation support. For example, the Paris Agreement refers to technology transfer and capacity building as other forms of support (UNFCCC, 2015). Further, on the national level, equitable adaptation can only be indirectly assessed by tracking financial flows. A direct assessment requires consideration of the just distribution of non-financial responsibilities, harms, and benefits in adaptation measures.

Secondly, most metrics were composed of either quantitative or qualitative dimensions, rather than a combination of both. As such, there is less clarity on how quantitative and qualitative metrics can work in conjunction in a way which is both feasible and comprehensive.

Thirdly, intergenerational justice was considered by 13 papers (Figure 3.6) in the systematic review in their understanding of justice, this was mostly a shallow engagement, with this dimension rarely being included in the proposed metrics for assessing equity. The clearest target for achieving intergenerational justice is raised in Begum et al. (2022:51) as "the obligation to ensure that future generations are guaranteed at least a minimally decent life", but what a *minimally decent life* entails is left unaddressed.

Furthermore, there is a gap in the literature in how to account for the temporal lag in adaptation interventions prior to their predicted benefits being realised. Measurements of equity in NAPs and other adaptation planning documents do not measure whether equity is achieved in the outcomes of the plans.

3.5 Conclusion

This systematic literature review and narrative synthesis set out to answer the following questions: what metrics exist for assessing equity in contributions to the GGA? and, how appropriate are existing metrics for assessing equity in contributions to the GGA?

Through the analysis of 40 academic papers and four NTP sources, the review shows that there is great variation in potential metrics for assessing equity in adaptation, with guiding principles relying on underlying theories of justice, human rights, vulnerability, and/or the capabilities approach. Thus, there are no shortages of potential metrics, but there is a need to consolidate existing approaches and develop a framework that is comprehensive in its scope, while feasible in its application (the focus of chapter four).

Thus far, the metrics reviewed provide some guidance on best practices for such a framework. These include:

1. Metrics composed of indicators serve to operationalise equity principles,
2. equity principles guide, legitimise, and frame the chosen indicators,
3. metrics should be multiscalar to account for equity both within and across nations,
4. comprehensive metrics should include both quantitative and qualitative indicators,
5. metrics should take into consideration data limitations and be transparent about missing data and assumptions,

6. metrics should be flexible to take into account national circumstances, and
7. metrics should have a defined standard to drive global ambition.

As such, the reviewed literature in combination reveal relevant elements, including metrics, for constructing a framework for assessing equity in contributions to the GGA. However, no one metric reviewed follows all the best practices outlined above and overcomes the challenges related to the inherent local nature of adaptation with the need to assess collective progress on a global level, and the need to balance simplicity and complexity.

The next chapter filters, consolidates, and adjusts the metrics proposed in the literature reviewed in order to develop a framework for assessing equity in national contributions to the GGA for the GST.

Chapter 4: The framework and its application

4.1 Introduction

This chapter develops a framework for assessing equity in national contributions to the GGA which could form part of the GST. This equity framework (EF) was developed from the learnings of chapter three and with consideration towards the modalities of the GST, as laid out in Decision 19/CMA.1 (UNFCCC, 2018a). The chapter aims to answer the third research question: what could an effective framework for assessing equity in national contributions to the GGA look like?

Recalling chapter one, the purpose of the EF is to highlight equity challenges and opportunities in national contributions to the GGA. Here, national contributions refers to two types of adaptation efforts: 1) adaptation actions which occur intra-nationally, and 2) adaptation support which is provided inter-nationally. In order to achieve its purpose, the EF must be able to identify equity considerations in the actions of and support for the GGA and be able to measure progress in ensuring that the actions of and support for the GGA are being undertaken in light of equity.

To meet these requirements, the EF is developed based on the learnings revealed in chapter three, including balancing complexity and simplicity. As such, the EF does not claim to provide an entirely comprehensive picture of equity in contributions to the GGA. This would not be possible due to the great diversity in understandings of how to define equity, as well as the technical and data limitations for gathering and analysing all possible information related to equity. Rather, the EF aims to act as an equity compass: pointing us in the general direction of equity, but not necessarily towards *perfect* equity – a state whereby we have an omniscient understanding of equity in adaptation and all people perceive national contributions to the GGA as equitable. Here, "we" refers to those involved in the GST process, as well as the ratified Parties of the Paris Agreement, who are involved in the equity assessment. The outputs from the EF should provide us with an indication of where we seem to be on track, in terms of equity, and where more attention is needed. Thus, as set out in the modalities of the GST, the EF should reveal the equity-related opportunities and challenges of achieving the GGA (UNFCCC, 2018a).

One of the other key take aways from the previous chapter is the importance of equity principles to legitimise indicators, and indicators to operationalise the principles. As such, the development of the EF took a stepwise approach:

1. defining equity in national contributions to the GGA,
2. defining principles of equitable adaptation,
3. creating rubric questions for each principle whilst considering the intra- and inter-national levels,
4. developing and choosing indicators which answer the rubric questions, and
5. iterating on the EF based on a South African case study[4] (included in this chapter).

[4] Appendix F includes the first version of the EF, prior to the iterations made based on the case study results. Appendix G includes the case study results from the application of the first version of the EF (section G.1), as well as text highlighting the specific iterations made (section G.2). The rubric and case study application in this chapter are based on the final version of the EF.

Due to this approach, the EF takes the form of multiple rubrics: it defines equity and its underlying principles, and then breaks the principles down into questions with assessable indicators that aim to show how close the contribution is to achieving the equity principle.

In the following section, I present the EF, before applying it, in section 4.3, to South Africa's NCCAS to evaluate its applicability for assessing national contributions. In section 4.4, I describe any assumptions and limitations of the EF. Section 4.5 concludes the chapter by summarising the EF, its applicability, and next steps.

4.2 Developing the framework

4.2.1 Overview of the Equity Framework

Before delving into the underlying definitions and principles of the EF, I will briefly discuss the inputs, process, and outputs of the assessment.

Inputs. The EF can be answered using a combination of the following inputs to the GST: NAPs, national adaptation communications, adaptation efforts in NDCs, inputs about support mechanisms, including financial flows, technology transfer, and capacity building activities, and other equity considerations communicated by the Parties and/or non-Party stakeholders and UNFCCC observer organisations (UNFCCC, 2018a:Decision 19/CMA.1 para 36).

For some aspects of the EF, such as review comments and questions related to national laws, it might be helpful to refer to other socio-political context analyses, adaptation project documents, and/or national legislation relating to climate change.

Process. Building on the best practices from chapter three, the EF is conducted on two levels: intra-national and the inter-national. Since the EF focuses on national contributions, the former looks at the adaptation contribution occurring through adaptation actions within the country, whilst the latter focuses on whether and how a developed country supports adaptation in developing countries.

The inter-national level is only included in the distributive justice principle (Table 4.1) due to the lack of inter-national level metrics revealed in chapter three for procedural, recognitional, and intergenerational justice which could be used to assess equity in national contributions, i.e. adaptation support provided by one country to another. Thus including such metrics would be outside the scope of this thesis which does not aim to create and provide evidence for new metrics, only consolidate and adjust existing metrics.

Additionally, the EF is composed of both quantitative and qualitative indicators, and aims to reveal any data limitations by being transparent about missing or unavailable information. Each question is accompanied by a comment section, where the reviewer can expand on technical limitations or other pertinent considerations.

Following from the Paris Agreement's bottom-up approach to setting national actions and ambitions, the EF should be undertaken by a team composed of mostly members of the nation being reviewed. Consequently, the areas of flexibility in the review (such as the comments) can be informed by national concerns and maintain national agency.

Outputs. The outputs from the EF are the rubrics for each equity principle and a summary diagram of the country's assessment results. The indicators are not reduced to a single index to avoid information loss and

to ensure clarity on where effort should be placed to better achieve equity in the GGA. The summary diagrams provide succinct information on a large number of elements of equity being achieved, or not. They can also be used to compare equity assessments across countries, and aggregated in order to assess regional and/or global progress towards equity in the GGA.

4.2.2 The conceptual foundation of the EF

Definition and principles. For the EF, equity in national contributions to the GGA is defined as an inclusive and pluralistic adaptation process that results in the fair allocation of responsibility for, and benefits from, adaptation actions and support, whilst reducing unfair harms within and across generations. Here, pluralism refers to the recognition of and integration of plural knowledge systems, values, cultures, and perspectives.

Expanding on this definition, the EF is founded on four principles of climate justice: distributive, procedural, recognitional, and intergenerational justice. The equitable adaptation definition and accompanying principles make normative assumptions about what equity looks like in adaptation. Such assumptions include the choice to focus on vulnerable and marginalised populations (VMPs) and the impact of adaptation on these groups, as well as the incorporation of inclusive, pluralistic, and representative adaptation processes. This thesis does not attempt to build arguments for these assumptions, but rather builds on the analysis and results of the previous chapter by adopting the consensus revealed in the reviews around what equity in adaptation entails.

Table 4.1. The framework for assessing equity in national contributions to the global goal on adaptation is based on four climate justice principles. *Source: Author's own analysis, drawing on the results and analysis from chapter three.*

Principle	Application of principle to adaptation contributions
A. Distributive justice	The fair allocation of responsibility for implementing adaptation and the fair share of benefits from adaptation actions and support, whilst reducing unfair harms.
B. Procedural justice	Fair processes in adaptation actions, including meaningful participation, transparency, accountability, and representative governing bodies.
C. Recognitional justice	The recognition of existing inequalities, and the integration of plural knowledge systems, values, cultures, and perspectives in adaptation learnings and actions.
D. Intergenerational justice	The fair allocation of responsibility, benefits, and harm prevention from climate change impacts between the current and future generations, in such a way that does not compromise the quality of life of future generations.

Whilst chapter three identified an array of principles and theories for equity (such as those in Table 3.4), – including the polluter-pays principle, CBDR&RC, the precautionary principle, taking a human rights approach, or a capabilities approach, amongst others – these principles have informed the climate justice principles above and can all be established within them. For example, the polluter-pays principle is part of distributive justice, as it aims to allocate responsibility. Similarly, CBDR&RC seeks to achieve distributive justice by establishing a collective responsibility, whilst recognising that different national contexts and capacities will lead to a differentiated share of that responsibility. The precautionary principle can also be found

in distributive justice since it advocates for reducing harms. The safeguarding of human rights, including rights to life, health, and access to fair governance processes aims to protect and include VMPs (Whyte, 2013; Levy & Patz, 2015; Hughes, 2021; Jodoin, Savaresi and Wewerinke-Singh, 2021), thus calling for both distributive and procedural justice. Similarly, taking a capabilities approach relies on distributive and procedural justice elements, respectively, by creating access to basic capabilities, as well as supporting local empowerment in decision-making processes (Schlosberg, 2012; Fünfgeld & Schmid, 2020). Consequently, the four principles were chosen as the standards for achieving equity in the GGA because they encompass the spread of equity concerns raised in the literature reviews.

Questions. The principles are broken down further into questions used in the rubrics. These questions aim to understand to what extent the principles are being met in national contributions to the GGA, by focusing on more specific aspects of each principle (Figure 4.1).

The questions are the metrics of the framework, showing what is being measured for each principle. They start to hone in on the particular equity elements in national contributions to the GGA, but they could still be answered in a number of ways. The following section discusses each question further and their respective indicators. The indicators serve as the measurements for each question.

4.2.3 The rubrics

A. Distributive justice. The distributive justice principle is composed of two questions for the intra-national level: 1) are VMPs targeted in adaptation? and 2) how is responsibility for implementing adaptation delegated in government authorities and across society? And one question for the inter-national level: 3) Are the most vulnerable countries prioritised in receiving the majority of adaptation finance, technology transfers, and capacity-building activities? (Figure 4.2.)

The first question uses a rating scale from 0 to 2 to assess whether adaptation targets VMPs, with 0 representing no information on the target group, 1 signifying that the group is mentioned, and 2 that the group is mentioned in connection to a specific adaptation activity.

The VMPs in the rubric are based on the populations identified by Mearns and Norton (2010) and iterations made to the rubric after applying a first version to South Africa's NCCAS.[5] The VMPs include: women, youth, the elderly, the poor, remote populations (i.e. populations with limited access to public services and goods), populations with livelihood sources which are particularly vulnerable to the impacts of climate change (for example, fisherfolk or workers in the tourism industry), sick people, people with disabilities, and other nationally-specific marginalised populations (for example, disaggregation based on ethnicity, race and/or caste). The final group recognises that the identification of marginalised groups might be specific to national circumstances and so allows for this flexibility.

An "unspecified vulnerable group" option is also provided for cases where the adaptation activity purports to target vulnerable populations, but is not specific about which group. Preferably, the indicators are

[5] The first version of the EF and its application on South Africa's NCCAS, as well as the iterations made are available in Appendices F and G, respectively.

Equity in national contributions to the global goal on adaptation is defined as an inclusive and pluralistic adaptation process that results in the fair allocation of responsibility for, and benefits from, adaptation actions and support, whilst reducing unfair harms within and across generations.

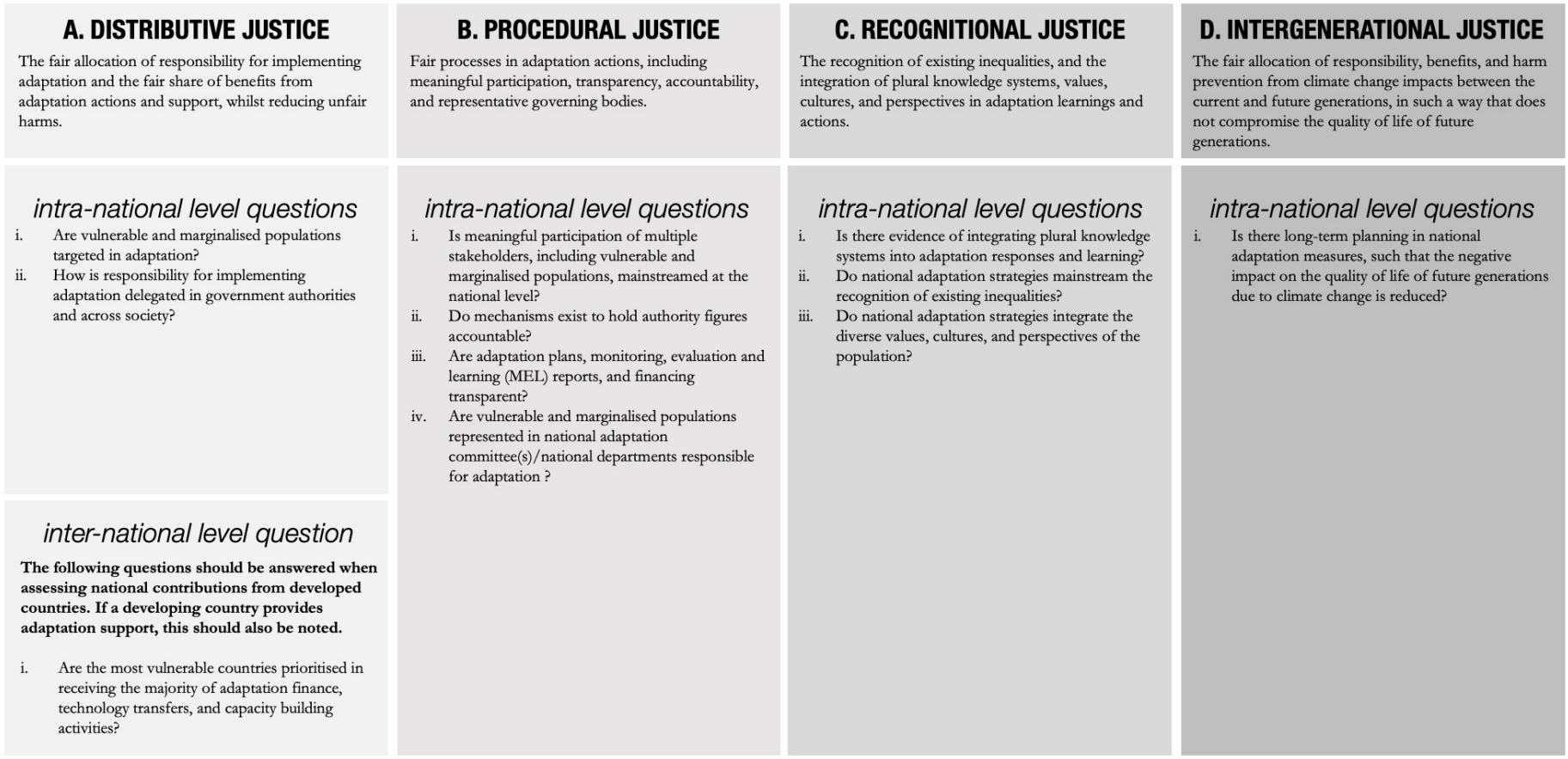

Figure 4.1. Overview of the framework for assessing equity in national contributions to the global goal on adaptation. *Source: Author's own analysis.*

A. DISTRIBUTIVE JUSTICE

intra-national level

i. Are vulnerable and marginalised populations targeted in adaptation?

0 = no information *1 = group mentioned* *2 = specific adaptation activity related to group*	
unspecified vulnerable population	
women	
youth	
the elderly	
the poor	
remote populations	
populations with vulnerable livelihood sources	
sick people	
people with disabilities	
other nationally-specific marginalised populations (e.g. based on ethnicity/race)	
Comments: …	

ii. How is responsibility for implementing adaptation delegated in government authorities and across society?

0 = no information *Y = yes* *N = no*	
Responsibility delegated to government as a whole	
Responsibility delegated to government level and/or department	
Responsibility delegated to government committee	
Government partnerships with private corporations	
Government partnerships with non-governmental organisations (NGOs)	
Government partnerships with civil society actors	
Comments: …	

inter-national level

i. Are the most vulnerable countries prioritised in receiving the majority of adaptation finance, technology transfers, and capacity building activities?

0 = no information	
% of total adaptation finance flow received by LDCs, SIDS and/or African countries	
% of total adaptation finance flow received by other Developing Countries (non-Annex I) (ODCs)	
% of total technology transfers for adaptation received by LDCs, SIDS and/or African countries	
% of total technology transfers for adaptation received by ODCs	
% of capacity building projects focused on adaptation in LDCs, SIDS and/or African countries funded or carried out by international bodies	
% of capacity building projects focused on adaptation in ODCs funded or carried out by international bodies.	
Comments: …	

Figure 4.2 Rubric to evaluate distributive justice questions and indicators in the framework for assessing equity in national contributions to the global goal on adaptation. *Source: Author's own analysis*

scored 2s on all groups with a 0 on "unspecified vulnerable group". However, a 2 on "unspecified vulnerable group" better achieves distributive justice than no information pertaining to any VMPs.

The second question attempts to ascertain where responsibility for implementing adaptation is delegated and whether it is mainstreamed throughout government, with efforts made by government to partner with civil society actors and/or organisations. A "yes" for each box implies both clarity in duty delegations and a fair distribution amongst government and society.

For the inter-national level question, it is necessary to define and identify vulnerable countries. Chapter three revealed a variety of metrics to measure vulnerability, with New et al. (2022) finding that any measure of vulnerability is sensitive to the metrics chosen. Further, the more indicators used to measure vulnerability, the more susceptible the accuracy of the measure is to data limitations and the greater the black box between indicators chosen and the final measure. Thus, since there exists little clarity on the most equitable set of indicators for vulnerability, the EF defaults to a simpler set of metrics, also adopted by Weiler, Klock and Dornan (2018), that relies on UNFCCC country groupings.

Vulnerable countries are ranked into two groups: the most vulnerable group includes LDCs, SIDs and African countries, and the next most vulnerable group is composed of other developing countries (ODCs) (excluding LDCs, SIDS and African countries). The former group is, therefore, made up of 94 countries (without double counting countries which appear across LDCs, SIDs and/or African countries) (United Nations; 2021; United Nations Educational, Scientific and Cultural Organization [UNESCO], n.d.), and the ODCs is made up of 60 countries (UNFCCC, 2018b). The rubric should show that the majority of adaptation support, in the form of adaptation finance, technology transfer, and funding capacity building activities, is directed towards LDCs, SIDs, and African countries.

Further, the inter-national level assessment is directed at national contributions by countries with historical responsibility and capacity. Similarly to the preceding line of reasoning, these countries refer to what the Paris Agreement terms developed countries (UNFCCC, 2015). The Paris Agreement calls for developed countries to support developing countries through adaptation finance (UNFCCC, 2015:art 9.1), technology transfers (UNFCCC, 2015:art 10.6), and by supporting capacity building activities (UNFCCC, 2015:art 11.3). As such, developed countries are obligated by the Paris Agreement to support adaptation efforts in developing countries. Nevertheless, it is also recommended that if a developing country provides support to other developing countries, this is recorded in the equity assessment and noted in the comments.

B. Procedural justice. The procedural justice dimension is composed of four questions: 1) is meaningful participation of multiple stakeholders, including VMPs, mainstreamed at the national level?, 2) do mechanisms exist to hold authority figures accountable?, 3) are adaptation plans, MEL reports, and financing transparent? and 4) are VMPs represented in national adaptation committee(s)/national departments responsible for adaptation? (Figure 4.3).

Question one has two parts in the rubric: the first aims to uncover at what point and to what extent in the adaptation action does participation occur. Here, comprehensive participation should occur

in each phase of the adaptation action and should also include decision-making power, rather than only consultations. The second part reveals which VMPs are targeted in participation activities, where the groups are identical to those discussed in the distributive justice dimension.

The second question focuses on accountability and verifies whether it is possible to contact those responsible for the adaptation action (low accountability) and whether the national laws allow citizens to hold government accountable for adaptation and/or maladaptation (high accountability). The comments section in this question could also be used by the reviewer to discuss the effectiveness and independence of the judiciary in the country.

The next question is about the transparency[6] of adaptation actions and demonstrates the type of information available (adaptation plans, MEL reports, or financial flows) and how accessible the information is. Accessibility is increased when the information is available online and communicated in public forums.

The final question for this dimension looks at representation of VMPs in national decision-making bodies. Equity is achieved here if there is not an over-representation of men in these bodies, and some percentage representation of the other VMPs. Sick people and people with disabilities is excluded from the indicators here due to privacy concerns related to personal health information.

C. Recognitional justice. The recognitional justice principle is broken down into three questions: 1) is there evidence of integrating plural knowledge systems into adaptation responses and learning? 2) do national adaptation strategies mainstream the recognition of existing inequalities? and 3) do national adaptation strategies integrate the diverse values, cultures, and perspectives of the population? (Figure 4.4).

The first question assesses to what extent plural knowledge systems are recognised in national documents by their integration (or lack thereof) in national adaptation principles or visions, and national adaptation practices. A rating scale is used on this question as recognition can occur on the superficial level through mentioning other knowledge systems (score=1) or it can occur in an in-depth manner through integration of other knowledge systems (score=2). It may be helpful at this point to rearticulate the assumption made by this question which is that integrating plural knowledge systems in adaptation principles and practices leads to greater equity. Whilst this thesis does not provide its own argumentation for this assumption, building on the results from chapter three, this assumption is based on recognising, and thus, respecting diverse world views (Begum, 2022:50) by considering and integrating plural knowledge systems in adaptation actions.

The second question is divided into two parts. The first part establishes whether countries recognise existing inequalities in their own understanding of their national context. The second part draws on a repeated metric for recognitional justice extracted from the systematic literature review (Mitchell & Tanner, 2008; Dulal, Shah & Ahmad, 2009; Terry, 2009; Schlosberg, 2012) and attempts to infer

[6] Transparency on the national level refers to how transparent adaptation actions are to the national population, rather than to the UNFCCC, which is covered in the transparency framework (UNFCCC, 2018a:Decision 18/CMA.1).

B. PROCEDURAL JUSTICE

i. Is meaningful participation of multiple stakeholders, including vulnerable and marginalised populations, mainstreamed at the national level?

0 = no information ***Y = yes*** ***N = no***	
In design phase	
In implementation phase	
In monitoring, evaluation, and learning phase	
Through consultations	
Includes decision-making power	
Comments: …	

0 = no information ***1 = group mentioned*** ***2 = type of participation with group mentioned***	
unspecified vulnerable population	
women	
youth	
the elderly	
the poor	
remote populations	
populations with vulnerable livelihood sources	
the sick	
people with disabilities	
other marginalised populations	
Comments: …	

ii. Do mechanisms exist to hold authority figures accountable?

0 = no information	
The contact information of the official(s) responsible for adaptation measures that is publicly available	
Comments: …	

0 = no information ***Y = yes*** ***N = no*** ***IP = in progress***	
There is a law concerning government's obligation to implement adaptation	
There is a law concerning government's obligation to protect against maladaptation	
Comments: …	

iii. Are adaptation plans, monitoring, evaluation and learning (MEL) reports, and financing transparent?

0 = no information ***Y = yes*** ***N = no*** ***IP = in progress***	
Adaptation plans accessible by request	
Adaptation plans available online	
Adaptation plans communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	
Adaptation financial flows accessible by request	
Adaptation financial flows accessible online	
Adaptation financial flows communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	
Adaptation MEL reports accessible by request	
Adaptation MEL reports accessible online	
Adaptation MEL communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	
Comments: …	

iv. Are vulnerable and marginalised populations represented in national adaptation committee(s)/national departments responsible for adaptation ?

0 = no information	
% representation of women in national adaptation committee(s)/national departments responsible for adaptation (50%)	
% representation of youth in national adaptation committee(s)/national departments responsible for adaptation (is there any)	
% representation of the elderly in national adaptation committee(s)/national departments responsible for adaptation	
% representation of the poor in national adaptation committee(s)/national departments responsible for adaptation	
% representation of remote populations in national adaptation committee(s)/national departments responsible for adaptation	
% representation of populations with vulnerable livelihood sources in national adaptation committee(s)/national departments responsible for adaptation	
% representation of other marginalised populations in national adaptation committee(s)/national departments responsible for adaptation	
Comments: …	

Figure 4.3. Rubric to evaluate procedural justice questions and indicators in the framework for assessing equity in national contributions to the global goal on adaptation. *Source: Author's own analysis.*

C. RECOGNITIONAL JUSTICE

i. Is there evidence of integrating plural knowledge systems into adaptation responses and learning?

0 = no information *1 = mention of other knowledge systems (e.g. indigenous knowledge)* *2 = detailed information on the integration of plural knowledge systems*	
Integration of adaptation practices from plural knowledge systems in national adaptation guiding principles and/or visions	
Integration of adaptation practices from plural knowledge systems in the majority of adaptation actions	
Comments: …	

ii. Do national adaptation strategies mainstream the recognition of existing inequalities?

0 = no information *1 = mention of existing inequality in national context description* *2 = detailed information on existing inequalities in national context description*	
Recognition of existing inequalities in description of national context in national documents	
Comments: …	

0 = no information *1 = monitoring and evaluation tools disaggregated by group*	
unspecified vulnerable population	
women	
youth	
the elderly	
the poor	
remote populations	
populations with vulnerable livelihood sources	
the sick	
people with disabilities	
other nationally-specific marginalised populations (e.g. based on ethnicity/race	
Comments: …	

iii. Do national adaptation strategies integrate the diverse values, cultures, and perspectives of the population?

0 = no information *Y = yes* *N = no*	
Adaptation principles are guided by multiple values, cultures, and/or perspectives of the population in national documents	
Participatory approaches aim to reveal values, cultures, and/or perspectives of the population	
Comments: …	

Figure 4.4. Rubric to evaluate recognitional justice questions and indicators in the framework for assessing equity in national contributions to the global goal on adaptation. *Source: Author's own analysis.*

D. INTERGENERATIONAL JUSTICE

i. Is there long-term planning in national adaptation measures, such that the negative impact on the quality of life of future generations due to climate change is reduced?

0 = no information ***< 10 = less than 10 years into the future*** ***11-20 = 11-20 years into the future*** ***21-50 = 21-50 years into the future*** ***51-100 = 51-100 years into the future*** ***>100 = over 100 years into the future***
Amount of years of climate change impacts that adaptation planning considers |
Comments: …

Figure 4.5. Rubric to evaluate intergenerational justice questions and indicators in the framework for assessing equity in national contributions to the global goal on adaptation. *Source: Author's own analysis.*

recognition of structural inequalities based on whether government calls for disaggregated M&E tools that look at the specific impacts of adaptation on VMPs.

The third question focuses on recognition of multiple values, cultures, and/or perspectives of the national population by exploring their consideration in national adaptation principles and whether participatory approaches aim to reveal the population's values, cultures, and/or perspectives.

D. Intergenerational justice. For the final principle, the EF poses one question: 1) is there long-term planning in national adaptation measures, such that the negative impact on the quality of life of future generations due to climate change is reduced? See rubric in Figure 4.5 above.

In essence, intergenerational justice is about the sustainability of adaptation actions (Chuku, 2010; Eriksen et al., 2011, Schloshberg, 2012; Eizenberg & Jabareen, 2017). Whilst the impacts and consequences of adaptation actions, or the lack thereof, cannot be measured *ex-ante*, it is possible to examine the proposed timeframe for adaptation planning. Therefore, the indicators under this question maintain that adaptation plans, which consider future impacts of climate change, have a greater consideration towards future generations and, thus, attempt to reduce the harms of climate change and fairly distribute responsibility for implementing adaptation actions.

Overall assessment of equity in national contributions to GGA. As previously mentioned, the EF does not reduce the equity assessment into a single index in order to avoid any information loss. As such, the rubrics remain unaggregated with the intention that they will reveal the challenges and opportunities related to achieving equity in national contributions to the GGA.

Nonetheless, the rubrics can be summarised in a visualisation which provides an overview of the progress towards each principle. The way in which a summary diagram conveys complex, qualitative assessment of a national contribution to the GGA can be seen in its application of South Africa's NCCAS (see Figure 4.10 visualising the case study assessment).

The visualisation can be used to compare national contributions across countries, as well as to assess progress across regions or globally by combining multiple visualisations. Here, each indicator could be colour-coded based on whether, and to what extent, the majority of countries being assessed have achieved each indicator. In this way, the visualisations can serve as an overview of progress on different levels, which can be better understood through the individual rubrics and the reviewer comments.

4.3 Applying the framework to South Africa's NCCAS

4.3.1 Overview and results

South Africa's NCCAS was published in November 2019 and approved by Cabinet in August 2020. The document serves as South Africa's NAP, fulfilling the county's commitment to the Paris Agreement (DEFF, 2019:10). South Africa's NDC (updated in September 2021) affirms the NCCAS as South Africa's NAP and provides a summary adaptation-NDC (A-NDC) informed by the NCCAS (Republic of South Africa [RSA], 2021). The A-NDC describes the NCCAS as "the key domestic policy instrument to guide [adaptation] implementation" (RSA, 2021:7). As such, the EF is applied to South

Africa's NCCAS as it provides the overarching guidance of the country's objectives, interventions, and outcomes for national adaptation action (DEFF, 2019), and thus is a relevant overview of South Africa's national contribution to the GGA.

The equity assessment was undertaken by first reading through the NCCAS and coding sections related to any of the EF principles: distributive, procedural, recognitional, and intergenerational justice. Following this, each rubric was completed by searching through the coded sections for information related to each question. The results were recorded for each indicator and expanded upon with references in the review comments section. The results of applying the EF to the NCCAS are shown in Figures 4.6 to 4.10 below.

4.3.2 Discussion

Distributive justice. The NCCAS makes consistent references to targeting VMPs throughout the document, in both the guiding principles of the strategy and in specific adaptation actions. Whilst the NCCAS defines vulnerable populations as "women, and especially poor and/or rural women; children, especially infants and child-headed families; the aged; the sick; and the physically challenged" (DEFF, 2019:20) it does not propose adaptation actions for each of these vulnerable groups, focusing rather on women, rural populations, and populations with vulnerable livelihood sources. Further, it excludes nationally-specific vulnerable groups based on race, despite the high correlation between inequality and race in South Africa (Statistics South Africa, 2019).

Distribution of responsibility for implementing adaptation is clearly communicated in the NCCAS through specific interventions, as well as the implementation framework. Responsibility is delegated to government as a whole, specific departments, and government committees. The NCCAS also supports and plans for partnerships with private corporations, non-governmental organisations, civil society actors, community-based organisations, labour organisations, and research institutes.

Procedural justice. The most comprehensive plans fulfilling procedural justice are those of participatory approaches, including VMPs. However, the type of participation expected by the NCCAS is unclear and is restricted to the development and implementation of adaptation actions, excluding MEL.

In terms of accountability, once the Climate Change Bill comes into effect, governments will be required to implement the climate change responses as outlined in the act and a failure to do so may be considered an offence as prescribed in the regulations made in terms of the act.

The transparency question is answered only superficially in the NCCAS, with no information on the transparency of other adaptation plans and only actions which aim to implement transparency and communication mechanisms for adaptation finance flows and M&E reports, respectively, but limited detail on the structure of these mechanisms.

Representation of the Department of Forestry, Fisheries and the Environment (DFFE) shows a large majority of the managing structure are women, but no information was available on the DFFE site about whether other VMPs are represented in the department (DFFE, 2022).

Recognitional justice. There is evidence of some integration of plural knowledge systems in the NCCAS guiding principles and, to a lesser extent, in the actions. Further, the guiding principles also support the inclusion of the populations cultural and social interests. However, there is no information on *how* it might include these considerations.

In framing the national context of South Africa, the NCCAS recognises existing inequalities and the exacerbating impact of climate change on already vulnerable populations (DEFF, 2019:13). Nonetheless, the NCCAS does not state that M&E tools should disaggregate impact assessment by VMPs and, therefore, neglects to ensure that the differentiated impact of adaptation actions is captured by M&E.

Intergenerational justice. The NCCAS is mostly limited to actions for the next ten years. Although this speaks towards a commitment for more immediate action, it also omits planning for future adaptation actions in the present. Thus, overlooking the sustainability of the adaptation actions in the longer term. Whilst the five-year iteration plan ensures that the NCCAS remains dynamic to changing conditions, it is insufficient on its own in ensuring that the burden for adaptation is not unfairly placed on future generations.

Challenges and opportunities. Overall, South Africa's NCCAS shows progress towards adaptation actions taken in light of equity for each principle of climate justice. Figure 4.10 below summarises the multiple rubrics into a single figure. The innermost circle shows the four dimensions of equity, the middle circle divides each dimension into each rubric question – summarised as the main theme of the question, for example, with the intergenerational justice question focusing on sustainability of adaptation plans – and the outer circle is colour-coded based on the evaluation of each of the indicators under the questions. In the visualisation, "grey" refers to missing information, "red" to indicators which have not been achieved, "yellow" to indicators in progress, "light green" to partial achievement, and "dark green" to achievement of the indicator. The summary diagram helps reveal the main challenges and opportunities from the equity assessment. Thus, according to the completed rubrics and Figure 4.10, the main challenges the NCCAS needs to overcome relate to being more explicit and comprehensive in their existing plans, showing progress on the indicators which are in their preliminary phases, and strengthening the intergenerational justice dimension.

The NCCAS should have greater detail about how the adaptation actions proposed aim to target specific VMPs, the level of participation of VMPs in adaptation processes, the accessibility of adaptation plans, and how government will ensure that diverse public values, cultures, and perspectives will be included in adaptation. Further, participation should also be expanded to include MEL activities.

In terms of accountability and transparency, there are a number of planned mechanisms which would improve these equity outcomes, but are not yet in place. These include the approval of the Climate Change Bill, an oversight mechanism for adaptation finance, and the communication format of adaptation M&E.

A. DISTRIBUTIVE JUSTICE

i. Are vulnerable and marginalised populations targeted in adaptation?

0 = no information ***1 = group mentioned*** ***2 = specific adaptation activity related to group***	
unspecified vulnerable population	2
women	2
youth	1
the elderly	1
the poor	1
remote populations	2
populations with vulnerable livelihood sources	2
sick people	1
people with disabilities	1
other nationally-specific marginalised populations (e.g. based on ethnicity/race)	2

Comments:

- The NCCAS considers the following vulnerable groups: "women, and especially poor and/or rural women; children, especially infants and child-headed families; the aged; the sick; and the physically challenged" (Department of the Environment, Forestry and Fisheries [DEFF], 2019:20).
- Specific adaptation actions are targeted towards women, vulnerable populations, and fisherfolk and farmers (DEFF, 2019:26-28).
- Nationally-specific marginalised populations include children-headed families and specific adaptation actions are targeted at rural populations and "those that cannot read and write" (DEFF, 2019:46).
- Despite the correlation between race and inequality in South Africa due to Apartheid (Statistics South Africa, 2019), race is not mentioned as a grouping for other marginalised populations.

ii. How is responsibility for implementing adaptation delegated in government authorities and across society?

0 = no information ***Y = yes*** ***N = no***	
Responsibility delegated to government as a whole	Y
Responsibility delegated to government level and/or department	Y
Responsibility delegated to government committee	Y
Government partnerships with private corporations	Y
Government partnerships with non-governmental organisations (NGOs)	Y
Government partnerships with civil society actors	Y

Comments:

- Responsibility and partnerships are clearly referenced throughout the document with Intervention 4 focused on "facilitat[ing] mainstreaming of adaptation responses into sectoral planning and implementation" (DEFF, 2019:21)
- Further, Intervention 7, "[e]stablish effective governance and legislative processes to integrate climate change in development planning" (DEFF, 2019:21), includes a breakdown of governance partnerships across national government, provincial goverments, municipalities, the private sector, civil society, labour organisations, academia and research institutes, and community leadership (DEFF, 2019:48-49)
- Intervention 7 also establishes three coordinating structures to facilitate national efforts: 1) the Inter-Ministerial Committee on Climate Change, 2) the Intergovernmental Committee on Climate Change, and 3) the National Committee on Climate Change (DEFF, 2019:50)
- The implementation framework clearly assigns a government lead and partners for each of the adaptation actions in the NCCAS (DEFF, 2019:62-73)

Figure 4.6. Completed rubric evaluating distributive justice in South Africa's National Climate Change Adaptation Strategy (NCCAS) with indicator scores and review comments. *Source: Author's own analysis.*

B. PROCEDURAL JUSTICE

i. Is meaningful participation of multiple stakeholders, including vulnerable and marginalised populations, mainstreamed at the national level?

0 = no information *Y = yes* *N = no*	
In design phase	Y
In implementation phase	Y
In monitoring, evaluation, and learning phase	N
Through consultations	Y
Includes decision-making power	0

Comments:
- One of the guiding principles of the NCCAS is "[p]articipatory, bottom up approach" which calls for participation in the development and implementation of the NCCAS (DEFF, 2019:20)
- Whilst consultation inclusion in the decision-making process is mentioned, it is unclear if the level of participation will include decision-making power.

0 = no information *1 = group mentioned* *2 = type of participation with group mentioned*	
unspecified vulnerable population	1
women	1
youth	1
the elderly	1
the poor	1
remote populations	1
populations with vulnerable livelihood sources	0
sick people	1
people with disabilities	1
other marginalised populations	1

Comments:
- Participation of the vulnerable groups (as defined by NCCAS) in development and implementation mentioned, but it is unclear what type of participation is expected.

ii. Do mechanisms exist to hold authority figures accountable?

0 = no information	
The contact information of the official(s) responsible for adaptation measures that is publicly available	0

Comments:
- Whilst this information is available if one searches online for the specific government departments, it is not present in the NCCAS document itself.

0 = no information *Y = yes* *N = no* *IP = in progress*	
There is a law concerning government's obligation to implement adaptation	IP
There is a law concerning government's obligation to protect against maladaptation	0

Comments:
- Outcome 7.1 of the NCCAS states that "[a]daptation governance defined and legislated through the Climate Change Act once approved by parliament" (DEFF, 2019:22), thus calling for legislation that obligates government to implement adaptation for climate change.

iii. Are adaptation plans, monitoring, evaluation and learning (MEL) reports, and financing transparent?

0 = no information *Y = yes* *N = no* *IP = in progress*	
Adaptation plans accessible by request	0
Adaptation plans available online	Y
Adaptation plans communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	0
Adaptation financial flows accessible by request	IP
Adaptation financial flows accessible online	IP
Adaptation financial flows communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	IP
Adaptation MEL reports accessible by request	0
Adaptation MEL reports accessible online	0
Adaptation MEL communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	Y

Comments:
- The NCCAS is available online, but it does not refer to the accessibility of other adaptation plans.
- There is a specific action in Intervention 8, "[e]nable substantial flows of climate change adaptation finance from various sources" (DEFF, 2019:54), which aims to create a public oversight mechanism for tracking adaptation finance, as such the transparency of adaptation finance is in progress (represented by a "-" above) (DEFF, 2019:56)
- Intervention 9, "[d]evelop and implement an M&E system that tracks implementation of adaptation actions and their effectiveness" (DEFF, 2019:57), calls for M&E information to be "communicated effectively at a community level in accessible format" (DEFF, 2019:61), but does not specify the specific formats.

iv. Are vulnerable and marginalised populations represented in national adaptation committee(s)/national departments responsible for adaptation ?

0 = no information	
% representation of women in national adaptation committee(s)/national departments responsible for adaptation (50%)	92%
% representation of youth in national adaptation committee(s)/national departments responsible for adaptation (is there any)	0
% representation of the elderly in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of the poor in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of remote populations in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of populations with vulnerable livelihood sources in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of other marginalised populations in national adaptation committee(s)/national departments responsible for adaptation	0

Comments:
- Representation here is based on the available information the department site about the managing structure of the Department of Forestry, Fisheries and the Environment (DFFE) of South Africa (DFFE, 2022). This department authored the NCCAS.

Figure 4.7. Completed rubric evaluating procedural justice in South Africa's National Climate Change Adaptation Strategy (NCCAS) with indicator scores and review comments. *Source: Author's own analysis.*

C. RECOGNITIONAL JUSTICE

i. Is there evidence of integrating plural knowledge systems into adaptation responses and learning?

0 = no information ***1 = mention of other knowledge systems (e.g. indigenous knowledge)*** ***2 = detailed information on the integration of plural knowledge systems***	
Integration of adaptation practices from plural knowledge systems in national adaptation guiding principles and/or visions	2
Integration of adaptation practices from plural knowledge systems in the majority of adaptation actions	1

Comments:

- The main definitions of the document are informed by the Intergovernmental Panel on Climate Change (IPCC) (DEFF, 2019: 3-4).
- In the description of the national context, the document highlights the need to take into consideration "local context and local knowledge" in adaptation (DEFF, 2019:14).
- One of the guiding principles of the NCCAS is "Based on best available science and traditional knowledge" (DEFF, 2019:20).
- The integration of indigenous knowledge in an adaptation action is only mentioned in Intervention 6, "[b]uild the necessary capacity and awareness for climate change responses" (DEFF, 2019:45), under the action to "[d]evelop and implement an effective communication and outreach programme" (DEFF, 2019:46). This action calls for the "co-creation of knowledge in the field" and "recognise[s] the importance of indigenous knowledge systems" (DEFF, 2019:46).

ii. Do national adaptation strategies mainstream the recognition of existing inequalities?

0 = no information ***1 = mention of existing inequality in national context description*** ***2 = detailed info on existing inequalities in context description***	
Recognition of existing inequalities in description of national context in national documents	2

Comments:

- The NCCAS identifies climate change as a threat multiplier to existing inequalities and specifies its differentiated impact on different vulnerable groups (DEFF:2019:9)

0 = no information ***1 = monitoring and evaluation tools disaggregated by group***	
unspecified vulnerable population	0
women	0
youth	0
the elderly	0
the poor	0
remote populations	0
populations with vulnerable livelihood sources	0
sick people	0
people with disabilities	0
other nationally-specific marginalised populations	0

Comments:

- Intervention 9 relates to M&E for each action. However, none of the actions in this intervention specifically raise the need for disaggregated information by these groups.
- Annex B of the NCCAS calls for monitoring with demographic information for Outcome 1.1. "Increased resilience and adaptive capacity achieved in human, economic, environmental, physical and ecological infrastructure" (DEFF:2019:75).

iii. Do national adaptation strategies integrate the diverse values, cultures, and perspectives of the population?

0 = no information ***Y = yes*** ***N = no***	
Adaptation principles are guided by multiple values, cultures, and/or perspectives of the population in national documents	Y
Participatory approaches aim to reveal values, cultures, and/or perspectives of the population	0

Comments:

- One of the guiding principles of the NCCAS is "[p]eople-centred" which means "[t]he development and implementation of the NCCAS will place people, their needs and their rights at the forefront and serve their physical, developmental, cultural and social interests equitably" (DEFF, 2019:20).

Figure 4.8 Completed rubric evaluating recognitional justice in South Africa's National Climate Change Adaptation Strategy (NCCAS) with indicator scores and review comments. *Source: Author's own analysis.*

D. INTERGENERATIONAL JUSTICE

i. Is there long-term planning in national adaptation measures, such that the negative impact on the quality of life of future generations due to climate change is reduced?

0 = no information ***< 10 = less than 10 years into the future*** ***11-20 = 11-20 years into the future*** ***21-50 = 21-50 years into the future*** ***51-100 = 51-100 years into the future*** ***>100 = over 100 years into the future***	
Amount of years of climate change impacts that adaptation planning considers	11-20
Comments: … • The NCCAS is specifically a 10-year plan that aims to be iterated upon every 5 years (DEFF, 2019:10). • The timeframes of the actions in the NCCAS are classified as short-term (1-3 years), medium-term (4-10 years), and long-term (over 10 years). However, the majority of actions fall within the short- and medium-term timeframes. (DEFF, 2019:62-73).	

Figure 4.9. Completed rubric evaluating intergenerational justice in South Africa's National Climate Change Adaptation Strategy (NCCAS) with indicator scores and review comments. *Source: Author's own analysis.*

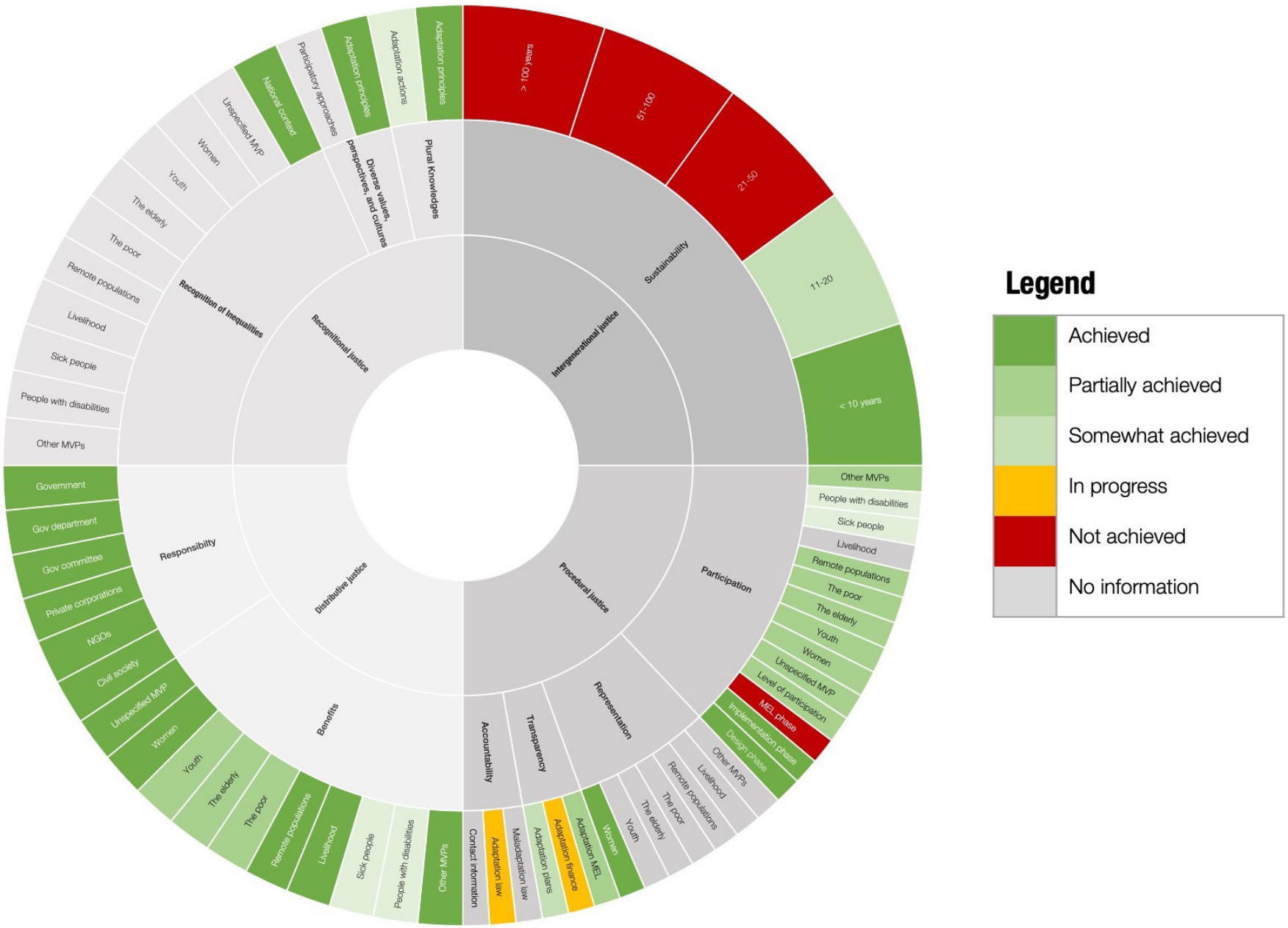

Figure 4.10. Overview of equity framework results applied to South Africa's National Climate Change Adaptation Strategy. *Source: Author's own analysis*

The weakest dimension of the NCCAS lies with intergenerational justice. Due to the limited timeframe of the document, it is unclear to what extent the planned adaptation actions take into consideration future generations and ensure sustainable development.

4.4 Limitations and assumptions

The main limitations of the EF are its scope, level of detail, and the scale at which it is applied. In terms of scope, the EF overlooks transformative justice and applying the capabilities approach to non-human life. These equity considerations appeared in the literature reviewed in chapter three, but only in five (Whyte, 2013; Ajibade & Adams, 2019; Fünfgeld and Schmid, 2020; Malloy & Ashcraft, 2020; Klepp & Fünfgeld, 2021) and two (Schlosberg, 2012; Fünfgeld and Schmid, 2020) sources, respectively. Thus, they are omitted in the current EF due to the lack of existing and accepted metrics.

Further, transformative justice, which maintains that adaptation should address existing inequalities and challenge underlying assumptions about power (Fünfgeld and Schmid, 2020), is not entirely distinct from targeting VMPs in adaptation actions in distributive justice, recognising existing inequalities in recognitional justice and empowering VMPs in procedural justice. Intergenerational justice at a transformative level might be extended to not only protecting future generations, but confronting and addressing past inequalities. As such, transformative justice can be thought of as taking ambitious steps to achieve the other climate justice dimensions.

An additional limitation in scope is related to the inputs themselves. Since the EF should be applied to sources such as NAPs, it is confined to assessing equity ambitions in adaptation plans, rather than adaptation implementation, a gap that was also revealed in the literature reviewed and raised in section 3.4.5Consequently, the EF makes the assumption that equity ambitions in plans will trickle-down to equity in actions. Whilst this assumption might not always be the case, equity in plans is a starting point for setting national expectations on adaptation actions taken in light of equity. Further, the iterations of NAPs might include more information on already undertaken adaptation actions and outcomes, and so the EF could be broadened to compare and distinguish between equity in actions taken and equity in planned actions.

Regarding level of detail, the EF leans towards simplicity in its feasibility over complexity by avoiding increasingly subjective questions related to equity, for example, in defining vulnerability and responsibility. One method to increase the level of detail in the EF is to extend the rating scale, currently ranging from zero to two. By applying the EF to contributions from other countries, the rating scale can be adjusted to better represent the range of comprehensiveness related to equity in national contributions.

With respect to scale, the EF functions on two levels: the intra-national (adaptation actions within countries) and, for distributive justice, also the inter-national (adaptation support across countries). Thus, it cannot answer whether equity in adaptation on the national level results in equity in adaptation at the local level, where the majority of adaptation actions occur. Additionally, whilst the EF measures

equity in adaptation support across countries, it does not assess equity in how this support is then used and distributed within the receiving countries.

Lastly, since the EF was developed by one researcher, it has inherent bias in the interpretation of the learnings from chapter three and how they inform the design of the framework. The EF makes certain assumptions about who deserves adaptation benefits, who is responsible for adaptation, and that inclusivity, representation, and pluralism lead to greater equity in adaptation. These assumptions are based on the learnings from the reviews (chapter three), but might also require further investigation to increase the robustness of the framework. As such, there is room to discuss and iterate on the EF in future research, as well as through interviews with VMPs, policymakers, academics, adaptation practitioners, and other relevant stakeholders.

4.5 Conclusion

This chapter introduced, applied, and iterated upon a framework for assessing equity in national contributions to the GGA. The EF was developed based on the learnings from chapter three with the aim of implementing best practices, and overcoming gaps and challenges revealed in the previous chapter.

The proposed EF is a framework on the intra- and inter-national level, consisting of both qualitative and quantitative indicators, which are guided by equity principles based on four dimensions of climate justice: distributive, procedural, recognitional, and intergenerational justice. The combination of feasible indicators with comprehensive principles attempts to balance simplicity and complexity in the framework.

Additionally, the rubrics allow for transparency in data limitations with comment sections for reviewers to expand on any assumptions or additional information which should be considered alongside the indicators. This also allows some room for flexibility for diverse national circumstances.

The application of the national level EF to South Africa's NCCAS shows its ability to reveal challenges and opportunities related to equity in adaptation actions, consistent with the modalities of the GST (UNFCCC, 2018a:Decision 19/CMA.1). The application also revealed key areas for iteration on the EF. Importantly, the iterations made to the EF based on its application could only happen at the intra-national level with one input from a developing country, as applying the EF to multiple inputs falls outside the scope of this thesis. Therefore, it is recommended that a sample of cross-country adaptation actions and support with multiple inputs is used to apply and iterate on the EF as a whole.

Although the EF has some limitations in its scope, level of detail, and scale, it can serve as a compass for progress towards equity in the GGA if used in the GST. Additionally, it has the potential to provide the following indirect benefits:

1. **The proactive benefit:** the EF could guide an equity-driven approach to NAPs;
2. **the active benefit:** if there is a belief that each country is contributing their fair share to climate action, this encourages other countries to raise their own ambition, resulting in a "virtuous cycle" between equity and ambition (Winkler, 2020); and

3. **the retroactive benefit:** according to Article 14.3 "the outcome of the GST shall inform Parties in updating and enhancing, in a nationally determined manner, their actions and support" (UNFCCC, 2015). Therefore, equity outcomes in the GST shall be used for the purpose of improving equity in the GGA.

Chapter 5: Conclusion

In this thesis, I developed and tested a framework for assessing equity in contributions to the GGA as part of the GST.

The framework (EF) was informed by the systematic review and narrative synthesis of relevant literature (chapter three) which aimed to answer the following two questions: what metrics exist for assessing equity in contributions to the GGA? and, how appropriate are existing indicators for assessing equity in contributions to the GGA? After a systematic screening process, 40 academic articles were reviewed (full list in Appendix E, Table E.1), supplemented by four NTPs (Table 3.2), following recommendations during the subject-expert consultations on methodology, including scope of literature.

Chapter three revealed that a variety of metrics exist. These range from guiding principles based on theories of justice, human rights, and the capabilities approach, to more specific quantitative and qualitative indicators used to measure vulnerability, capacity, responsibility, and/or fair processes. These evaluation tools sought to assess whether vulnerable populations make up most adaptation beneficiaries, whether populations with greater financial capacity and/or historic responsibility are contributing most to adaptation efforts, and whether adaptation processes are pluralistic, inclusive, and representative. With this information, the papers argued that adaptation efforts could be assessed as fair, equitable, or just.

However, whilst many metrics have been proposed, their applicability to national contributions to the GGA in the GST was not found in the literature. Few of the proposed metrics covered the range of equity and justice concerns raised in the reviewed papers. Many metrics relied solely on quantitative or qualitative data and neglected to consider data limitations. Most metrics focused on either the intra- or inter-national scale, with few proposing a multiscalar approach. As such, the reviews confirmed the need for a framework that could amalgamate existing equity metrics, to ensure comprehensiveness, whilst remaining feasible and appropriate for use in the GST.

In chapter four, I proposed an EF (Figures 4.1-4.5) based on the learnings from the literature in chapter three and the modalities of the GST. Founded on principles of distributive, procedural, recognitional, and intergenerational justice, the EF assesses equity by reviewing national inputs through several rubrics. To operationalise the principles, the rubrics are comprised of quantitative and qualitative indicators guided by specific questions. The indicators include binary "yes"/ "no"/ "in progress" responses, rating scales, and a few numerical responses.

The EF is applied to South Africa's NCCAS, also in chapter four. This is part of the stepwise development, outlined in 4.1, and the first version of an EF can be seen in Appendix F. Through this iterative process, the EF was refined. The NCCAS application also includes a summary diagram; which summarises the several rubrics of the EF into one diagram that highlights the main challenges and opportunities of achieving equity in the national contribution to the GGA.

The EF is mostly focused on the intra-national level, assessing national contributions within countries as actions taken towards the GGA. However, it also assesses distributive justice at the inter-national level, by evaluating support provided to assist countries with the GGA. It is transparent about

data limitations and provides a space for reviewer comments that can expand on the assessment and results, allowing reviewers to capture nuances that the indicators may struggle to accommodate. The final outputs from the assessment are the completed rubrics, as well as a visualisation of the equity assessment which can be used to make comparisons across countries and regions when indicators are aggregated.

As part of the GST, the EF could be used in assessing global progress on equity in the GGA by creating a mosaic of the assessment of national contributions or by aggregating the results for a global summary. The EF highlights equity gaps in the GGA, which, once revealed, can guide future adaptation and equity efforts. Further, the EF is transparent about missing data and other data limitations, which could influence equity M&E tools for future national plans and GST inputs.

Aside from its use in the GST, countries can use the EF rubric to assess and iterate on their NAPs and actions. This might inform their reporting, and countries can choose to request review of adaptation actions and support. Thus, the EF has the potential to encourage both national and global ambition in achieving equitable adaptation.

Whilst the EF could result in these positive equity outcomes, it is important to be aware of its scope. The EF does not claim to be an all-encompassing framework of equity, but rather a tool that provides some indication of equity, or the lack thereof, in national contributions to the GGA. Rather than make an assessment on the achievement of equity in the GGA, the EF focuses on revealing gaps, challenges to measuring equity, and opportunities for greater ambition towards equity in the GGA.

The EF could be strengthened in future research by additional studies focusing on specific indicators which explore their theoretical grounding , their ability to accurately assess equity on the ground, and how these indicators might reveal a more transformative approach to equity in adaptation. Such studies might address the assumptions made in this thesis related to who deserves adaptation, who should be responsible for adaptation, and whether pluralism, representativeness, and inclusivity are necessary elements of equity in adaptation. Furthermore, studies focusing on adaptation action could evaluate whether the proposed indicators translate to equity in practice.

To ensure greater generalisability, future research should apply the EF to a range of inputs from a case study country and apply it to a sample of both Global South and Global North countries. Learnings from these applications could be used to iterate and refine the EF based on the applications, before again applying a revised EF.

With regards to scale, additional studies might explore whether the framework can be downscaled for use in local adaptation actions. Adapting the EF for the local level would also improve the transparency and availability of information related to equity in adaptation, which could better inform the assessment of equity in national contributions to the GGA. Furthermore, there is room to explore procedural, recognitional, and intergenerational justice at the inter-national level. Here, new research might have to make the case for new indicators that can assess these equity principles in adaptation support mechanisms.

In this thesis, I have reviewed existing equity metrics and consolidated the learnings from these metrics to test and develop the EF. Whilst acknowledging the limitations of the research process and EF, the framework provides a preliminary blueprint for how equity in national contributions to the GGA might be assessed, and by doing so, ensures that equity is a crucial component to both the GST's assessment of progress of the GGA and to the achievement of the GGA.

Word count: 21,028

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Appendices

Appendix A: Systematic Review Protocol

Table A.1 Systematic review protocol. Template based on based on the latest Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2020). *Source: Author's own analysis*

Review title	A systematic review of existing equity indicators for adaptation programmes to explore how appropriate existing indicators are for assessing equity in contributions to the global goal on adaptation as part of the global stocktake
First reviewer	Kalia Barkai
Supervisor	Harald Winkler
Project title	Developing a framework for assessing equity in contributions to the global goal on adaptation as part of the global stocktake
Support	
Systematic review overview	Harald Winkler
Protocol development	Consultations with Marieke Norton, Mark New, Samantha Keen, Sheona Shackleton, Darlington Sibanda and Ian Noble
Literature searching	Awot Gebregziabher and Tamzyn Suliaman from the UCT library team
Rationale	
The Paris Agreement considers equity as a key component for its implementation alongside "the principle of common but differentiated responsibilities and respective capabilities (CBDR&RC), in the light of different national circumstances" (United Nations Framework Convention on Climate Change [UNFCCC], 2015;art2.2). Article 7.1 establishes the global goal on adaptation (GGA) "of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change" (UNFCCC, 2015:art7.1) in a manner that aligns with the temperature goals set out in the Paris Agreement and in the context of sustainable development. As a result, equity in implementation is required for adequate achievement of the GGA. To review the collective progress of the Paris Agreement objectives, Parties will take part in the first global stocktake, commencing in 2022 and ending in 2023 (UNFCCC, 2015:art14). The aim of the global stocktake is to assess global progress of the long-term goals of the Paris Agreement, inform nationally determined contributions (NDCs) of the Parties, and enhance "international cooperation for climate action" (UNFCCC, 2015:art14.3). According to the modalities of the global stocktake: "equity and the best available science will be considered in a Party-driven and cross-cutting manner, throughout the global stocktake" (UNFCCC, 2018:sI.2). In order to achieve this modality, the global stocktake requires a process or framework for assessing equity in "mitigation, adaptation and the means of implementation and support" (UNFCCC, 2018:sI.1). However, in an analysis of 163 intended NDCs (INDCs), Winkler et al. (2018) found that while a diversity of indicators existed for assessing equity in mitigation, only one was found for adaptation. Additionally, the metrics for mitigation tend to rely on quantitative measures of "fair share" responsibility and contribution as measured by current emissions. Such an approach is potentially insufficient for assessing equity in contributions to the GGA due to the ambiguity of achieving the GGA, as defined above. Furthermore, while the global stocktake requires that adaptation be measured at a global scale, adaptation initiatives are inherently localised which means that a global framework for assessing adaptation progress has to overcome the challenge of aggregating adaptation outcomes, such as equity, from different contexts and scales (Craft & Fisher, 2018:1204). Finally, the GGA has raised a distinct question surrounding equity and justice, where, as highlighted by Winkler (2020), vulnerable communities which are least responsible for climate change bear the greatest burden of its impacts. Thus, there is a need to develop an assessment of equity in contributions to the GGA, as part of the global stocktake, that accounts for the disproportionate and unfair impact of climate change. Thus, this systematic review attempts to answer the following questions: What metrics exist for assessing equity in contributions to the GGA? and, how appropriate are existing indicators for assessing equity in contributions to the GGA? With the purpose of developing a recommended framework for assessing equity in contributions to the GGA as part of the global stocktake.	

Objectives	
1. To investigate the existing metrics for assessing equity in adaptation programmes on a national and global scale. This investigation will be conducted through a systematic review of peer reviewed qualitative research, as well as grey literature from relevant governments and organisations. 2. To evaluate how appropriate existing indicators are for assessing equity in contributions to the global goal on adaptation as part of the global stocktake through a critical appraisal of the research and frameworks and an analysis of the geographical and theoretical scope of the frameworks.	
Methods	
Eligibility criteria	**Type of research:** • *qualitative research* including theoretical papers, impact assessments, process evaluations, surveys, case studies, and book section. • *grey literature* such as conference proceedings, reports, and papers from relevant governments and organisations **Scale:** *national and international* adaptation programmes (in order to ensure applicability to the global stocktake which consolidates national inputs into an international assessment of collective progress) **Start and end dates:** *1992 to present* (in 1992 the Rio Earth Summit launched the UNFCCC, the Convention on Biological Diversity, and the United Nations Convention to Combat Desertification, representing a multilateral commitment to climate action) **Language of research:** *English* (due to limitations of the main researcher, literature in other languages will not be included) **Outcomes of interest:** Metrics for assessing equity in adaptation programmes
Information sources	**Electronic databases:** • EBSCOHost (Academic Search Premier, Africa-Wide Information, Biological & Agricultural Index Plus (H.W. Wilson), General Science Abstracts (H.W. Wilson), GreenFILE, MasterFILE Premier, Environment Complete, General Science Full Text (H.W. Wilson)) • SCOPUS • Web of Science **Other methods used for identifying relevant research:** • Contacting experts in the field of climate change adaptation and equity **Non-traditional publications search:** Reviewed recommendations from subject-expert consultations: • Latest relevant chapters from the Intergovernmental Panel on Climate Change (IPCC) reports • Relevant chapter's from The World Bank's "Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World (Mearns & Norton, 2010) • The United Nation Environment Programme's (2021) "Adaptation Gap Report" • The International Institute for Environment and Development's (2019) "Framing and tracking 21st century climate adaptation: Monitoring, evaluation and learning for Paris, the SDGs and beyond"
Search strategy	**Two-step search strategy:** *Step 1:* • Search academic databases with (equity OR justice OR fairness) AND (metric* OR indicator* OR framework* OR measure*) AND (adaptation AND "climate change") • If suggested literature by experts does not appear in the search with this strategy, then the search terms will be evaluated and iterated upon to ensure they are not missing crucial keywords. • Collect references from bibliographies of included papers. • Move on to Step 2a or Step 2b based on quantity of resources found. *Step 2a: Too many references (>250 included)* If too many references, use the following strategies (in this order) to refine the search: • Remove "justice" from search terms, • Choose only national or international scale, and/or • Reduce the time period. *Step 2b: Too little references (< 40 included)* • Pivot to: What can we learn from the development world for considering equity in adaptation? • Edit systematic review with new question in mind
Details of methods	One main reviewer (myself) with supervision from Harald Winkler

Quality assessment	Critical appraisal of the research will be adapted from Spencer et al.'s (2003) "Quality in qualitative evaluation: A framework for assessing research evidence." Further, Leiter et al.'s (2019) "[d]esirable criteria for a global framework for assessing progress on adaptation" based on the UN Environment Adaptation Gap Report (2017) will be used to evaluate the adaptation metrics in the research.
Data extraction and management	• Rayyan for abstract and title screening with inclusion/exclusion criteria • Eligibility screening through Endnote • Data extraction in Nvivo exported in Excel • EndNote will be used to keep track of references • Data will be backed up monthly on OneDrive
Data items	• All citation data including abstract • Type of document (gov, academic publication, NGO report, intergovernmental (e.g. World Bank)) • Equity metrics • Type of metric (indicators or index or principles) • Nature of metric (qualitative, quantitative, or both) • Equity assessment framework/process • Justice theory or theories applied (procedural, distributive, recognitional, transformative, intergenerational, and/or other) • Population location (global South, global North, international, country, region) • Self-identified limitations and assumptions • Purpose of adaptation metric
Comparative keyword network analysis	Data visualisation and analysis of keyword relationships within and between literatures to highlight popular themes from the literature, how different themes interact, and identify equity keyword clusters Track occurrence of keywords over time.
Narrative synthesis	1. Summary of amount of research discovered, including how many met the inclusion criteria (flow chart), and a description of their designs and settings 2. Preliminary summary of the equity metrics and frameworks found and the underlying justice theories 3. Exploration of the relationships and differences between literatures 4. An assessment of the robustness of the synthesis 5. Supplementary narrative literature review of grey literature
Meta-bias(es)	An assessment of biases will be conducted based on any affiliations of the main and corresponding literature authors and aims of the literature by looking at the equity clusters by global South and global North affiliation clusters.

Appendix B: Critical Appraisal Templates

B.1 Critical Appraisal of Qualitative Studies

Table B.1 Critical appraisal of qualitative studies adapted from: Spencer et al. (2003). The original qualitative appraisal framework was adjusted by excluding sections, appraisal questions and indicators irrelevant for the type of articles collected in the systematic review. The text for the remaining appraisal items is unchanged. *Source: Author's own analysis*

Section	Appraisal Questions	Indicators
Findings	**How credible are the findings**	Findings/conclusions 'make sense'/have a coherent logic
		Findings/conclusions are resonant with other knowledge and experience (this might include peer or member review)
	How has knowledge/ understanding been extended by the research?	Literature review (where appropriate) summarising knowledge to date/key issues raised by previous research
		Aims and design of study set in the context of existing knowledge/ understanding; identifies new areas for investigation (for example, in relation to policy/practice/substantive theory)
		Credible/clear discussion of how findings have contributed to knowledge and understanding (e.g. of the policy, programme or theory being reviewed); might be applied to new policy developments, practice or theory
		Findings presented or conceptualised in a way that offers new insights/alternative ways of thinking
		Discussion of limitations of evidence and what remains unknown/unclear or what further information/research is needed
	How well does the evaluation address its original aims and purpose?	Clear statement of study aims and objectives; reasons for any changes in objectives
		Findings clearly linked to the purposes of the study – and to the initiative or policy being studied
		Summary or conclusions directed towards aims of study
		Discussion of limitations of study in meeting aims (e.g. are there limitations because of missed or unresolved areas of questioning; incomplete analysis; time constraints?)
	Scope for drawing wider inference – how well is this explained?	Discussion of how hypotheses/ propositions/findings may relate to wider theory; consideration of rival explanations
Analysis	**How well has the approach to, and formulation of, the analysis been conveyed?**	Discussion, with examples, of how any constructed analytic concepts/typologies etc. have been devised and applied
	How well has diversity of perspective and content been explored?	Examination of origins/influences on opposing or differing positions
Reporting	**How clear are the links between data, interpretation and conclusions – i.e. how well can the route to any conclusions be seen?**	Clear conceptual links between analytic commentary and presentations of original evidence/support
		Discussion of how explanations/ theories/conclusions were derived (i.e. how warranted); whether alternative explanations explored
	How clear and coherent is the reporting?	Demonstrates link to aims of study/research questions
		Provides a narrative/story or clearly constructed thematic account
		Has structure and signposting that usefully guide reader through the commentary

		Provides accessible information for intended target audience(s)
		Key messages highlighted or summarised
Reflexivity & Neutrality	**How clear are the assumptions/theoretical perspectives/values that have shaped the form and output of the evaluation?**	Discussion/evidence of the main assumptions/hypotheses/theoretical ideas on which the evaluation was based and how these affected the form, coverage or output of the evaluation (the assumption here is that no research is undertaken without some underlying assumptions or theoretical ideas)
		Discussion/evidence of the ideological perspectives/values/philosophies of research team and their impact on the methodological or substantive content of the evaluation (again, may not be explicitly stated)
		Evidence of openness to new/alternative ways of viewing subject/theories/ assumptions (e.g. discussion of learning/concepts/ constructions that have emerged from the data; refinement restatement of hypotheses/theories in light of emergent findings; evidence that alternative claims have been examined)
		Discussion of how error or bias may have arisen in design/data collection/analysis and how addressed, if at all
		Reflections on the impact of the researcher on the research process

B.2 Critical Appraisal of Adaptation Metrics, Adapted for Equity Considerations

Table B.2 Criteria for adaptation metrics based on Leiter et al. (2019). Edits made by author to B.2.i are italicised. Criteria for B.2.ii are derived from the emerging lessons in Leiter et al. (2019:1-2). The appraisal questions have been created by the author and adapted for equity considerations. B.2.i was used to appraise index and/or indicator metrics, but not principles. *Source: Author's own analysis.*

Criteria	Appraisal questions
B.2.i "Desirable criteria for a global framework for assessing progress in adaptation" based on UNEP (2017) as cited in Leiter et al. (2019:14)	
Aggregable	Does the measure reflect a consistent definition of adaptation that is comparable at the national level, and is available for a comprehensive number of countries globally, such that data could be systematically aggregated (qualitatively or quantitatively)?
Transparent	Are definitions, assumptions, and methods transparent and consistent between countries?
Longitudinal	Can the measure be tracked over time to monitor and evaluate progress?
Feasible	For global synthesis/aggregation of national assessments submitted to UNFCCC: does the measure avoid placing undue additional reporting burden on countries? For global tracking of adaptation using publically available data: is the measure reasonably available or can it be collected for all countries?
Coherent	Does the measure reflect a concept of construct that is coherent with a general understanding of what constitutes … *equitable* adaptation? Are assumptions underpinning the use of proxies empirically validated or theoretically sound?
Sensitive to national context	Is the measure sensitive to diverse national contexts (for example, different political, economic, and socio-cultural priorities and resources)? Does the measure avoid unjustified, poorly evidenced or generalized assumptions – implicit or explicit – regarding what is 'good', 'appropriate', or 'sufficient' adaptation?
B.2.ii Criteria based on emerging lessons from Leiter et al. (2019:1-2)	
Purpose-driven	Is the metric purpose-driven with reference to what it is used for and what it is meant to achieve?
Multiple criteria	Does the metric include multiple criteria to evaluate equity?
Multidisciplinary nature	Does the metric consider and include other disciplines to capture equity from multiple perspectives and fields?
Flexible	Is the metric flexible such that it can be adapted based on context or further learnings?
Quantitative and qualitative	Does the metric include both quantitative and qualitative criteria, allowing for a more comprehensive measure of equity in adaptation?

Appendix C: Codebook and questionnaire for data extraction

C.1 Codebook used in NVivo 12 Pro

Table C.1 Codebook produced in NVivo 12 Pro software of keywords coded for each article in the systematic review with the number of files with the keyword coded, and the number of coded references to the keyword in total. Note that child nodes (sub-categories of keywords) are aggregated in the count of the main keyword categories. *Source: Author's own analysis*

Node/keyword	Description	Number of articles	Number of codes
Climate action		37	73
Adaptation	The "process of adjustment to actual or expected climate and its effects" on both human and natural systems (IPCC, 2014:76)	37	46
Loss and damage	The harms caused by anthropogenic climate change	4	4
Mitigation	The reduction of greenhouse gas emissions	17	22
justice and equity	References to justice, equity, and fairness, and their different dimensions.	40	441
Equity	Explicit references to "equity" and "fairness"	39	178
Inequality	Explicit references to "inequality" of national populations or sub-groups	27	84
- Age	The disproportionate impact of adaptation and/or climate change based on age	3	4
- Class	The disproportionate impact of adaptation and/or climate change based on economic status	7	12
- Gender	The disproportionate impact of adaptation and/or climate change based on gender identity	11	22
- Race & ethnicity	The disproportionate impact of adaptation and/or climate change based on race and/or ethnicity	10	16
Justice	Explicit references to "justice"	37	261
- Distributive justice	The fair allocation of responsibilities, burdens, rights, and benefits (Caney, 2014; Dooley et al., 2018; Okereke et al., 2018)	28	81
- Intergenerational justice	A derivative of distributive justice that is centred on the distribution of climate change burdens between current and future generations (Breakey, 2019)	13	16
- Procedural justice	Achieving justice in the processes of decision-making for climate change impacts and responses. (Sowman & Wynberg, 2014; Newell et al., 2021)	23	61
- Recognitional justice	Recognising existing inequalities and differences in relation to already marginalised groups who might face cultural, political, and social discrimination. (Okereke et al., 2018; Newell et al., 2021)	17	36
- Transformative justice	An approach to climate justice that addresses the structural and root causes of inequality, such as "historical injustices, land rights, political participation, and governance" (Newell et al., 2020:7)	4	6
- Climate justice	The equity and fairness implications associated with the specific environmental issue of anthropogenic climate change	12	17
- Comparative justice	The equal treatment of similar situations (Boston & Lawrence, 2018)	1	1
- Compensatory justice	Compensation to right wrongful actions and their harmful consequences (Meyer & Roser, 2010)	1	2
- Corrective justice	The duty to bear responsibility for negative consequences because of neglecting the duty to not harm others. (Ngwadla, 2014)	1	1
- Gender justice	Fairness and equity considerations concerned with gender issues, including feminism and ecofeminism.	2	2
- Restorative justice	Righting wrongs through mediation between those responsible for the harm and those harmed by its consequences.	1	1
- Social justice	Explicit references to "social justice" which usually encompasses societal fairness and equity considerations, including distributive justice.	1	1
Scale	The scale at which the metric should be used.	19	21
National	At a country level	1	1
Regional	A group of countries from within a sub-continent	11	11
Continental	At a continent level	6	7
International	At a global level	1	1

The metric	A system of measurement or evaluation that can be quantitative, qualitative or both (Leiter et al., 2019). Used in this study as the umbrella term for assessments composed of indicator(s), index and indices, and/or principle(s).	40	386
Limitations	Self-identified limitations of the metric	20	72
Nature of metric	This node is to code any mention about the qualitative or quantitative nature of the metric proposed	3	3
- Qualitative	Non-numerical descriptor(s) that focus on qualities and characteristics	1	1
- Quantitative	Numerical descriptor(s)	2	2
Type of metric	Metric assessment types: indicators, index and indices, framework or principle	40	303
- Framework	The underlying structure in which the metric fits, that includes the process for using the metric	11	26
- Index	A single number produced from multiple quantitative indicators (Leiter et al., 2019)	8	18
- Indicator(s)	One variable that describes a characteristic and can be made up of a combination of data. Indicators can be quantitative or qualitative. (Leiter et al., 2019)	18	102
- Principle(s)	A higher-level proposition or rule which serves as a theoretical foundation and guidance for action (Maguire, 2012)	28	157
Themes, disciplines and/or theories	The themes, disciplines and/or theories discussed in the paper and those used to justify, support, or explain the proposed equity metrics.	40	443
Beneficiary-pays principle	Those who benefitted from CO2-eq emissions should pay for the benefits derived. (Newell et al., 2020)	2	2
Burden-sharing	Attempts to answer how climate change adaptation efforts and/or costs should be distributed. (Fleurbaey et al., 2014)	4	12
Capabilities	Refers to Sen's and Nussbaum's Capabilities Approach which refers to "the resources, opportunities, freedoms, and institutions necessary for individuals and groups to exist as full members in a given society" (Malloy & Ashcraft, 2020:4)	7	17
CBDR&RC	Common but differentiated responsibilities and respective capabilities principle from the 2015 Paris Agreement (UNFCCC, 2015)	10	27
Climate compatible development	The mainstreaming of climate change efforts into development policy and/or seeking "triple wins" related to mitigation, adaptation, and development.	2	4
Climate finance	Funding for adaptation (in papers which look at mitigation and adaptation, this refers to funding for both types of climate actions).	23	48
Consequentialism	Equity/justice focused on the (un)fair outcomes of an action, rather than the action itself.	2	5
Cosmopolitan egalitarianism	The theory that individuals have "equal moral standing and human rights regardless of nationality" and bear equal responsibility (Baer, 2012:63).	1	2
Deontology	The use of rules, principles, and/or axioms which determine what actions are right or wrong, unrelated to the consequences of the actions.	2	7
Disaster management	Dealing with and reacting to the consequences of extreme events.	2	2
Fiscal federalism	The term used for understanding which operations should be centralised and which should be decentralised, in terms of economic governance. (Aarke & Rübbelke, 2010)	1	1
International Law	References to international law and legal implications on an international level	5	10
Intersectionality	The consideration of multiple (and overlapping) levels of marginalisation based on unique experiences and identities.	1	1
Millennium Development Goals	Reference to the 2000 United Nation's Millennium Development Goals	1	2
No harm principle	The principle that sovereign states do not have the right to harm other states (Dellink et al., 2009)	3	4
Polluter-pays principle	Those who caused the harm should pay the costs of the consequences relative to the harm caused (Caney, 2014).	11	15
Power	References to power relations and dynamics, including decision-making	9	25

	power, power disparities, and networks of power.		
Precautionary principle	Taking necessary precautions before acting or not acting if the action might result in significant or uncertain harms.	1	2
Public good	Goods which are publicly accessible and/or deserved.	1	2
Realisation-focused comparison theory	A justice theory based on Sen's capabilities work, composed of the following: "(1) focus on advancing justice within the context of political realities, (2) focus on the actual behavior of actors in relation to institutions, and (3) recognition that there are often ambiguities between divergent approaches to organizing society that are all reasoned as just" (Ciplet, Roberts & Khan, 2013:50)	1	5
Responsibility and capacity	Distribution of adaptation efforts and/or costs based on responsibility for the impact of climate change and the capacity to address climate change impacts.	7	13
Human rights	Moral principles for protecting human rights, based off the United Nation's Universal Declaration of Human Rights and other right declarations.	12	30
Sustainability	Explicit references to sustainable development, sustainability in general, and the United Nation's Sustainable Development Goals.	8	19
Transformation	Explicit references to "transformation" in terms of a foundational or systemic change to the system to address root causes of inequity and/or power disparities.	6	16
Vulnerability	A population (or sub-group's) predisposition to climate change impacts. Sometimes composed of exposure to hazards, sensitivity to impacts, and adaptive capacity (Betzold & Weiler, 2017).	33	77
Climate regime	Analysis, discussions, and/or findings related to the international climate regime.		
Paris Agreement	Explicit references to the UNFCCC's 2015 Paris Agreement.	4	4
Policy and politics	Considerations about the political environment and/or policy surrounding adaptation and/or equity.	17	38
UNFCCC	Explicit references to the United Nation's Framework Convention on Climate Change.	2	2
Global cap-and-trade regime	The system of setting emission caps and emission allowances based on emission thresholds with the ability of countries to trade allowances.	1	2

C.2 Questionnaire for recording data and thoughts on articles in the systematic review

Section 1. Bibliometric information

1. First author [surname, first name initial]
2. Year published
3. Journal name
4. Citation
5. Abstract
6. Corresponding author(s) affiliation (separated by commas)
7. Global North or South affiliation:
    a. Global North
    b. Global South
    c. Global South and North

Section 2. Qualitative appraisal of the paper (see Appendix B.1)

Section 3. The metric structure

1. Is the metric quantitative and/or qualitative?
    a. Quantitative

b. Qualitative
c. Both

2. Type of metric (multiple choice):
    a. Index
    b. Indicator(s)
    c. Principle(s)
    d. Framework
    e. Other…
3. Metric appraisal (see Appendix B.1)

Section 4. Content questions

1. Theme(s) (multiple choice):
    a. Climate finance
    b. Burden-sharing
    c. International law
    d. Policy
    e. Transformation
    f. CBDR&RC
    g. Capabilities
    h. Vulnerability
    i. Sustainability
    j. Climate justice
    k. Human rights
    l. Polluter-pays principle
    m. No harm principle
    n. Responsibility and capacity
    o. Intersectionality
    p. Other…
2. Does the metric also apply to mitigation?
    a. Yes
    b. No
3. What scale is the metric applicable to?
    a. National
    b. Regional
    c. Continental
    d. International
    e. No scale
    f. Other…

4. What is the population location?
5. Brief summary of the metric:
6. Justice dimension(s) considered (multiple choice):
    a. Distributive
    b. Recognitional
    c. Transformative
    d. Procedural
    e. Intergenerational
    f. Other…
7. How does the paper consider justice? How does it define justice?
8. What types of inequality are mentioned in the paper? (multiple choice)
    a. Inequality in general
    b. Gender
    c. Race & ethnicity
    d. Class
    e. Age
    f. Other…
9. How is equity defined in the paper? And/or do the authors justify their metrics for equity?
10. Do the authors identify any limitations of their proposed metrics?
11. Open thoughts or summary on the paper:

Appendix D: Critical appraisal intermediate outcomes

Table D.1 Critical appraisal of articles and their metrics included in the systematic review. Articles which proposed only principles for equity metrics were only appraised on the following characteristics: 1) purpose-drive, 2) multiple criterion, 3) multidisciplinary, 4) flexible, and 5) qualitative and quantitative. Qualitative appraisal based on: Spencer et al. (2003) (see Appendix B.1) and metric appraisal based on Leiter et al. (2019) (see Appendix B.2) *Source: Author's own analysis*

Author(s), year	Qualitative appraisal (0-1)	Aggregable	Transparent	Longitudinal	Feasible	Coherent	Context sensitive	Purpose-driven	Multiple criteria	Multidisciplinary	Flexible	Qualitative and quantitative
Aakre & Rübbelke, 2010	0,61	Yes	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No
Ajibade & Adams, 2019	0,75	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Baer, 2013	0,80	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No
Betzold & Weiler, 2017	0,53	Yes	No	Yes	Yes	No	No	No	Yes	No	No	No
Boston & Lawrence, 2018	0,66	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Campello Torres et al., 2020	0,36	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Chen et al., 2018	0,60	Yes	No	Yes	No	Yes	No	Yes	Yes	No	No	Yes
Chuku, 2010	0,64	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Ciplet, Roberts & Khan, 2013	0,75	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Cui et al., 2014	0,64	Yes	No	Yes	Yes	No	No	Yes	Yes	No	No	No
De Cian et al., 2016	0,44	Yes	No	Yes	No	No	No	Yes	Yes	No	No	No
Dellink et al., 2009	0,78	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Dulal, Shah & Ahmad, 2009	0,59	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Eizenberg & Jabareen, 2017	0,59	-	-	-	-	-	-	Yes	Yes	Yes	Yes	Yes
Eriksen et al., 2011	0,63	-	-	-	-	-	-	Yes	Yes	Yes	Yes	No
Fünfgeld & Schmid, 2020	0,74	-	-	-	-	-	-	Yes	Yes	Yes	Yes	No
Fussel, 2010	0,74	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No
Grasso, 2017	0,55	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Jodoin, Savaresi & Wewerinke-Singh, 2021	0,71	-	-	-	-	-	-	Yes	Yes	No	No	No
Hughes, 2021	0,58	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Kaswan, 2012	0,61	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Khan et al., 2020	0,71	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Klepp & Fünfgeld, 2021	0,65	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Levy & Patz, 2015	0,55	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Lyster, 2017	0,47	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Maguire, 2012	0,64	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Malloy & Ashcraft, 2020	0,71	-	-	-	-	-	-	Yes	Yes	Yes	Yes	No
McDonald & McCormack, 2021	0,44	-	-	-	-	-	-	Yes	No	No	Yes	No
Meyer & Roser, 2010	0,73	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No	No
Mitchell & Tanner, 2008	0,44	-	-	-	-	-	-	Yes	Yes	Yes	Yes	No
Ngwadla, 2014	0,59	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No
Paavola & Adger, 2006	0,75	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schlosberg, 2012	0,76	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Shih, 2019	0,68	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Stadelmann et al., 2014	0,73	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	No
Terry, 2009	0,69	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Weiler, Klock & Dornan, 2018	0,53	Yes	No	Yes	No	No	No	Yes	Yes	No	No	No
Whyte, 2013	0,56	-	-	-	-	-	-	Yes	Yes	No	Yes	No
Winkler & Rajamani, 2014	0,74	-	-	-	-	-	-	Yes	Yes	No	Yes	Yes
Wood et al., 2018	0,72	-	-	-	-	-	-	Yes	Yes	Yes	Yes	No

Appendix E: Metric characteristics from included studies in systematic review

Table E.1 Characteristics of the metrics from included studies in the systematic review. *Source: Author's own analysis*

Author(s), year	Scale	Study location	Metric type	Nature of metric
Aakre & Rübbelke, 2010	Regional	European Union	Quantitative	Index from indicators
Ajibade & Adams, 2019	No scale	-	Qualitative	Principles
Baer, 2013	International	-	Quantitative	Index from indicators
Betzold & Weiler, 2017	International	-	Quantitative	Indicators
Boston & Lawrence, 2018	National	New Zealand	Qualitative	Principles
Campello Torres et al., 2020	National	Brazil	Qualitative	Principles
Chen et al., 2018	International	-	Quantitative	Index from indicators
Chuku, 2010	Continental	Africa	Qualitative	Principles
Ciplet, Roberts & Khan, 2013	International	-	Qualitative	Indicators
Cui et al., 2014	International	-	Quantitative	Index from indicators
De Cian et al., 2016	International	-	Quantitative	Index from indicators
Dellink et al., 2009	International	-	Quantitative	Index from indicators
Dulal, Shah & Ahmad, 2009	Regional	The Caribbean	Qualitative	Principles
Eizenberg & Jabareen, 2017	No scale	-	Qualitative	Principles
Eriksen et al., 2011	No scale	-	Qualitative	Principles
Fünfgeld & Schmid, 2020	No scale	-	Qualitative	Principles
Fussel, 2010	National	-	Quantitative	Index from indicators
Grasso, 2017	International	-	Both	Principles and indicators
Jodoin, Savaresi & Wewerinke-Singh, 2021	No scale	-	Qualitative	Principles
Hughes, 2021	National	South Africa, Nigeria, Mali and Rwanda	Both	Principles and indicators
Kaswan, 2012	National	USA	Qualitative	Principles
Khan et al., 2020	International	-	Qualitative	Principles
Klepp & Fünfgeld, 2021	National	Kiribati	Qualitative	Principles
Levy & Patz, 2015	No scale	-	Qualitative	Principles
Lyster, 2017	International	-	Qualitative	Principles
Maguire, 2012	International	-	Qualitative	Principles
Malloy & Ashcraft, 2020	No scale	-	Qualitative	Principles
McDonald & McCormack, 2021	No scale	-	Qualitative	Principles
Meyer & Roser, 2010	International	-	Quantitative	Principles and index
Mitchell & Tanner, 2008	No scale	-	Qualitative	Principles
Ngwadla, 2014	International	-	Quantitative	Principles and indicators
Paavola & Adger, 2006	International	-	Both	Principles and indicators
Schlosberg, 2012	No scale	-	Qualitative	Principles and indicators
Shih, 2019	National	Taiwan	Both	Principles and indicators
Stadelmann et al., 2014	International	-	Quantitative	Indicators
Terry, 2009	No scale	-	Qualitative	Principles
Weiler, Klock & Dornan, 2018	International	-	Quantitative	Indicators
Whyte, 2013	National	USA	Qualitative	Principles
Winkler & Rajamani, 2014	International	-	Qualitative	Principles and indicators
Wood et al., 2018	Multiscalar	LDCs	Qualitative	Principles

Appendix F: First version of the Equity Framework

Equity in national contributions to the global goal on adaptation is defined as an inclusive and pluralistic adaptation process that results in the fair allocation of responsibility for, and benefits from, adaptation actions and support, whilst reducing unfair harms within and across generations.

A. DISTRIBUTIVE JUSTICE

The fair allocation of responsibility for implementing adaptation and the fair share of benefits from adaptation actions and support, whilst reducing unfair harms.

intra-national level questions

i. Are vulnerable and marginalised populations targeted in adaptation?
ii. How is responsibility for implementing adaptation delegated in government authorities and across society?

inter-national level question

The following questions should be answered when assessing national contributions from developed countries. If a developing country provides adaptation support, this should also be noted.

i. Are the most vulnerable countries prioritised in receiving the majority of adaptation finance, technology transfers, and capacity building activities?

B. PROCEDURAL JUSTICE

Fair processes in adaptation actions, including meaningful participation, transparency, accountability, and representative governing bodies.

intra-national level questions

i. Is meaningful participation of multiple stakeholders, including vulnerable and marginalised populations, mainstreamed at the national level?
ii. Do mechanisms exist to hold authority figures accountable?
iii. Are adaptation plans, monitoring, evaluation and learning (MEL) reports, and financing transparent?
iv. Are vulnerable and marginalised populations represented in national adaptation committee(s)/national departments responsible for adaptation ?

C. RECOGNITIONAL JUSTICE

The recognition of existing inequalities, and the integration of plural knowledge systems, values, cultures, and perspectives in adaptation learnings and actions.

intra-national level questions

i. Is there evidence of integrating plural knowledge systems into adaptation responses and learning?
ii. Do national adaptation strategies mainstream the recognition of existing inequalities in monitoring and evaluation tools?
iii. Do national adaptation strategies integrate the diverse values, cultures, and perspectives of the population?

D. INTERGENERATIONAL JUSTICE

The fair allocation of responsibility, benefits, and harm prevention from climate change impacts between the current and future generations, in such a way that does not compromise the quality of life of future generations.

intra-national level questions

i. Is there long-term planning in national adaptation measures, such that the negative impact on the quality of life of future generations due to climate change is reduced?

Figure F.1 First version of overview of rubric questions for assessing equity in national contributions to the global goal on adaptation. *Source: Author's own analysis*

A. DISTRIBUTIVE JUSTICE

intra-national level

i. Are vulnerable and marginalised populations targeted in adaptation?

0 = no information *1 = group mentioned* *2 = specific adaptation activity related to group*	
unspecified vulnerable population	
women	
youth	
the elderly	
the poor	
remote populations	
populations with vulnerable livelihood sources	
other nationally-specific marginalised populations (e.g. based on ethnicity/race)	
Comments: …	

ii. How is responsibility for implementing adaptation delegated in government authorities and across society?

0 = no information *Y = yes* *N = no*	
Responsibility delegated to government as a whole	
Responsibility delegated to government level and/or department	
Responsibility delegated to government committee	
Government partnerships with private corporations	
Government partnerships with non-governmental organisations (NGOs)	
Government partnerships with civil society actors	
Comments: …	

inter-national level

i. Are the most vulnerable countries prioritised in receiving the majority of adaptation finance, technology transfers, and capacity building activities?

0 = no information	
% of total adaptation finance flow received by LDCs, SIDS and/or African countries	
% of total adaptation finance flow received by other Developing Countries (non-Annex I) (ODCs)	
% of total technology transfers for adaptation received by LDCs, SIDS and/or African countries	
% of total technology transfers for adaptation received by ODCs	
% of capacity building projects focused on adaptation in LDCs, SIDS and/or African countries funded or carried out by international bodies	
% of capacity building projects focused on adaptation in ODCs funded or carried out by international bodies.	
Comments: …	

Figure F.2 First version of the rubric for assessing distributive justice in national contributions to the global goal on adaptation. *Source: Author's own analysis*

B. PROCEDURAL JUSTICE

i. Is meaningful participation of multiple stakeholders, including vulnerable and marginalised populations, mainstreamed at the national level?

0 = no information *Y = yes* *N = no*	
In design phase	
In implementation phase	
In monitoring, evaluation, and learning phase	
Through consultations	
Includes decision-making power	
Comments: …	

0 = no information *1 = group mentioned* *2 = type of participation with group mentioned*	
unspecified vulnerable population	
women	
youth	
the elderly	
the poor	
remote populations	
populations with vulnerable livelihood sources	
other marginalised populations	
Comments: …	

ii. Do mechanisms exist to hold authority figures accountable?

0 = no information	
The contact information of the official(s) responsible for adaptation measures that is publicly available	
Comments: …	

0 = no information *Y = yes* *N = no*	
There is a law concerning government's obligation to implement adaptation	
There is a law concerning government's obligation to protect against maladaptation	
Comments: …	

iii. Are adaptation plans, monitoring, evaluation and learning (MEL) reports, and financing transparent?

0 = no information *Y = yes* *N = no*	
Adaptation plans accessible by request	
Adaptation plans available online	
Adaptation plans communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	
Adaptation financial flows accessible by request	
Adaptation financial flows accessible online	
Adaptation financial flows communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	
Adaptation MEL reports accessible by request	
Adaptation MEL reports accessible online	
Adaptation MEL communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	
Comments: …	

iv. Are vulnerable and marginalised populations represented in national adaptation committee(s)/national departments responsible for adaptation ?

0 = no information	
% representation of women in national adaptation committee(s)/national departments responsible for adaptation (50%)	
% representation of youth in national adaptation committee(s)/national departments responsible for adaptation (is there any)	
% representation of the elderly in national adaptation committee(s)/national departments responsible for adaptation	
% representation of the poor in national adaptation committee(s)/national departments responsible for adaptation	
% representation of remote populations in national adaptation committee(s)/national departments responsible for adaptation	
% representation of populations with vulnerable livelihood sources in national adaptation committee(s)/national departments responsible for adaptation	
% representation of other marginalised populations in national adaptation committee(s)/national departments responsible for adaptation	
Comments: …	

Figure F.3 First version of the rubric for assessing procedural justice in national contributions to the global goal on adaptation. *Source: Author's own analysis*

C. RECOGNITIONAL JUSTICE

i. Is there evidence of integrating plural knowledge systems into adaptation responses and learning?

0 = no information *1 = mention of other knowledge systems (e.g. indigenous knowledge)* *2 = detailed information on the integration of plural knowledge systems*	
Integration of adaptation practices from plural knowledge systems in national adaptation documents	
Integration of adaptation practices from plural knowledge systems in the majority of adaptation project documents	
Comments: …	

ii. Do national adaptation strategies mainstream the recognition of existing inequalities in monitoring and evaluation tools?

0 = no information *1 = monitoring and evaluation tools disaggregated by group*	
unspecified vulnerable population	
women	
youth	
the elderly	
the poor	
remote populations	
populations with vulnerable livelihood sources	
other nationally-specific marginalised populations (e.g. based on ethnicity/race	
Comments: …	

iii. Do national adaptation strategies integrate the diverse values, cultures, and perspectives of the population?

0 = no information *Y = yes* *N = no*	
Adaptation principles are guided by multiple values, cultures, and/or perspectives of the population in national documents	
Participatory approaches aim to reveal values, cultures, and/or perspectives of the population	
Comments: …	

Figure F.4 First version of the rubric for assessing recognitional justice in national contributions to the global goal on adaptation. *Source: Author's own analysis*

D. INTERGENERATIONAL JUSTICE

i. Is there long-term planning in national adaptation measures, such that the negative impact on the quality of life of future generations due to climate change is reduced?

0 = no information ***< 10 = less than 10 years into the future*** ***11-20 = 11-20 years into the future*** ***21-50 = 21-50 years into the future*** ***51-100 = 51-100 years into the future*** ***>100 = over 100 years into the future***
Amount of years of climate change impacts that adaptation planning considers |
Comments: …

Figure F.5 First version of the rubric for assessing intergenerational justice in national contributions to the global goal on adaptation. *Source: Author's own analysis*

Appendix G: First version of Equity Framework case study applied to South Africa's National Climate Change Adaptation Strategy

G.1 The rubrics and diagram of the application of the first version Equity Framework

A. DISTRIBUTIVE JUSTICE

i. Are vulnerable and marginalised populations targeted in adaptation?

0 = no information ***1 = group mentioned*** ***2 = specific adaptation activity related to group***	
unspecified vulnerable population	2
women	2
youth	1
the elderly	1
the poor	1
remote populations	2
populations with vulnerable livelihood sources	2
other nationally-specific marginalised populations (e.g. based on ethnicity/race)	2

Comments:

- The NCCAS considers the following vulnerable groups: "women, and especially poor and/or rural women; children, especially infants and child-headed families; the aged; the sick; and the physically challenged" (Department of the Environment, Forestry and Fisheries [DEFF], 2019:20).
- Specific adaptation actions are targeted towards women, vulnerable populations, and fisherfolk and farmers (DEFF, 2019:26-28).
- Nationally-specific marginalised populations include children-headed families and specific adaptation actions are targeted at rural populations and "those that cannot read and write" (DEFF, 2019:46).
- Despite the correlation between race and inequality in South Africa due to Apartheid (Statistics South Africa, 2019), race is not mentioned as a grouping for other marginalised populations.

ii. How is responsibility for implementing adaptation delegated in government authorities and across society?

0 = no information ***Y = yes*** ***N = no***	
Responsibility delegated to government as a whole	Y
Responsibility delegated to government level and/or department	Y
Responsibility delegated to government committee	Y
Government partnerships with private corporations	Y
Government partnerships with non-governmental organisations (NGOs)	Y
Government partnerships with civil society actors	Y

Comments:

- Responsibility and partnerships are clearly referenced throughout the document with Intervention 4 focused on "facilitat[ing] mainstreaming of adaptation responses into sectoral planning and implementation" (DEFF, 2019:21)
- Further, Intervention 7, "[e]stablish effective governance and legislative processes to integrate climate change in development planning" (DEFF, 2019:21), includes a breakdown of governance partnerships across national government, provincial goverments, municipalities, the private sector, civil society, labour organisations, academia and research institutes, and community leadership (DEFF, 2019:48-49)
- Intervention 7 also establishes three coordinating structures to facilitate national efforts: 1) the Inter-Ministerial Committee on Climate Change, 2) the Intergovernmental Committee on Climate Change, and 3) the National Committee on Climate Change (DEFF, 2019:50)
- The implementation framework clearly assigns a government lead and partners for each of the adaptation actions in the NCCAS (DEFF, 2019:62-73)

Figure G.1 First version of the distributive justice assessment applied to South Africa's National Climate Change Adaptation Strategy. *Source: Author's own analysis*

B. PROCEDURAL JUSTICE

i. Is meaningful participation of multiple stakeholders, including vulnerable and marginalised populations, mainstreamed at the national level?

0 = no information *Y = yes* *N = no*	
In design phase	Y
In implementation phase	Y
In monitoring, evaluation, and learning phase	N
Through consultations	Y
Includes decision-making power	0

Comments:
- One of the guiding principles of the NCCAS is "[p]articipatory, bottom up approach" which calls for participation in the development and implementation of the NCCAS (DEFF, 2019:20)
- Whilst consultation inclusion in the decision-making process is mentioned, it is unclear if the level of participation will include decision-making power.

0 = no information *1 = group mentioned* *2 = type of participation with group mentioned*	
unspecified vulnerable population	1
women	1
youth	1
the elderly	1
the poor	1
remote populations	1
populations with vulnerable livelihood sources	0
other marginalised populations	1

Comments:
- Participation of the vulnerable groups (as defined by NCCAS) in development and implementation mentioned, but it is unclear what type of participation is expected.

ii. Do mechanisms exist to hold authority figures accountable?

0 = no information	
The contact information of the official(s) responsible for adaptation measures that is publicly available	0

Comments:
- Whilst this information is available if one searches online for the specific government departments, it is not present in the NCCAS document itself.

0 = no information *Y = yes* *N = no*	
There is a law concerning government's obligation to implement adaptation	Y
There is a law concerning government's obligation to protect against maladaptation	0

Comments:
- Outcome 7.1 of the NCCAS states that "[a]daptation governance defined and legislated through the Climate Change Act once approved by parliament" (DEFF, 2019:22), thus calling for legislation that obligates government to implement adaptation for climate change.

iii. Are adaptation plans, monitoring, evaluation and learning (MEL) reports, and financing transparent?

0 = no information *Y = yes* *N = no*	
Adaptation plans accessible by request	0
Adaptation plans available online	Y
Adaptation plans communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	0
Adaptation financial flows accessible by request	-
Adaptation financial flows accessible online	-
Adaptation financial flows communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	-
Adaptation MEL reports accessible by request	0
Adaptation MEL reports accessible online	0
Adaptation MEL communicated in public forums (government gazette, radio, television, town halls, newspaper, …)	Y

Comments:
- The NCCAS is available online, but it does not refer to the accessibility of other adaptation plans.
- There is a specific action in Intervention 8, "[e]nable substantial flows of climate change adaptation finance from various sources" (DEFF, 2019:54), which aims to create a public oversight mechanism for tracking adaptation finance, as such the transparency of adaptation finance is in progress (represented by a "-" above) (DEFF, 2019:56)
- Intervention 9, "[d]evelop and implement an M&E system that tracks implementation of adaptation actions and their effectiveness" (DEFF, 2019:57), calls for M&E information to be "communicated effectively at a community level in accessible format" (DEFF, 2019:61), but does not specify the specific formats.

iv. Are vulnerable and marginalised populations represented in national adaptation committee(s)/national departments responsible for adaptation ?

0 = no information	
% representation of women in national adaptation committee(s)/national departments responsible for adaptation (50%)	92%
% representation of youth in national adaptation committee(s)/national departments responsible for adaptation (is there any)	0
% representation of the elderly in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of the poor in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of remote populations in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of populations with vulnerable livelihood sources in national adaptation committee(s)/national departments responsible for adaptation	0
% representation of other marginalised populations in national adaptation committee(s)/national departments responsible for adaptation	0

Comments:
- Representation here is based on the available information the department site about the managing structure of the Department of Forestry, Fisheries and the Environment (DFFE) of South Africa (DFFE, 2022). This department authored the NCCAS.

Figure G.2 First version of the procedural justice assessment applied to South Africa's National Climate Change Adaptation Strategy. *Source: Author's own analysis*

C. RECOGNITIONAL JUSTICE

i. Is there evidence of integrating plural knowledge systems into adaptation responses and learning?

0 = no information ***1 = mention of other knowledge systems (e.g. indigenous knowledge)*** ***2 = detailed information on the integration of plural knowledge systems***	
Integration of adaptation practices from plural knowledge systems in national adaptation documents	2
Integration of adaptation practices from plural knowledge systems in the majority of adaptation project documents	0

Comments:

- The main definitions of the document are informed by the Intergovernmental Panel on Climate Change (IPCC) (DEFF, 2019: 3-4).
- In the description of the national context, the document highlights the need to take into consideration "local context and local knowledge" in adaptation (DEFF, 2019:14).
- One of the guiding principles of the NCCAS is "Based on best available science and traditional knowledge" (DEFF, 2019:20).
- The integration of indigenous knowledge in an adaptation action is only mentioned in Intervention 6, "[b]uild the necessary capacity and awareness for climate change responses" (DEFF, 2019:45), under the action to "[d]evelop and implement an effective communication and outreach programme" (DEFF, 2019:46). This action calls for the "co-creation of knowledge in the field" and "recognise[s] the importance of indigenous knowledge systems" (DEFF, 2019:46).

ii. Do national adaptation strategies mainstream the recognition of existing inequalities in monitoring and evaluation tools?

0 = no information ***1 = monitoring and evaluation tools disaggregated by group***	
unspecified vulnerable population	0
women	0
youth	0
the elderly	0
the poor	0
remote populations	0
populations with vulnerable livelihood sources	0
other nationally-specific marginalised populations (e.g. based on ethnicity/race	0

Comments:

- Intervention 9 relates to monitoring and evaluation for each action, where some actions are targeted at specific vulnerable groups. However, none of the actions in this intervention specifically raise the need for disaggregated information by these groups.
- Annex B of the NCCAS calls for monitoring with demographic information for Outcome 1.1. "Increased resilience and adaptive capacity achieved in human, economic, environmental, physical and ecological infrastructure" (DEFF:2019:75).

iii. Do national adaptation strategies integrate the diverse values, cultures, and perspectives of the population?

0 = no information ***Y = yes*** ***N = no***	
Adaptation principles are guided by multiple values, cultures, and/or perspectives of the population in national documents	Y
Participatory approaches aim to reveal values, cultures, and/or perspectives of the population	0

Comments:

- One of the guiding principles of the NCCAS is "[p]eople-centred" which means "[t]he development and implementation of the NCCAS will place people, their needs and their rights at the forefront and serve their physical, developmental, cultural and social interests equitably" (DEFF, 2019:20).

Figure G.3 First version of the recognitional justice assessment applied to South Africa's National Climate Change Adaptation Strategy. *Source: Author's own analysis*

D. INTERGENERATIONAL JUSTICE

i. Is there long-term planning in national adaptation measures, such that the negative impact on the quality of life of future generations due to climate change is reduced?

0 = no information ***< 10 = less than 10 years into the future*** ***11-20 = 11-20 years into the future*** ***21-50 = 21-50 years into the future*** ***51-100 = 51-100 years into the future*** ***>100 = over 100 years into the future***	
Amount of years of climate change impacts that adaptation planning considers	11-20
Comments: … • The NCCAS is specifically a 10-year plan that aims to be iterated upon every 5 years (DEFF, 2019:10). • The timeframes of the actions in the NCCAS are classified as short-term (1-3 years), medium-term (4-10 years), and long-term (over 10 years). However, the majority of actions fall within the short- and medium-term timeframes. (DEFF, 2019:62-73).	

Figure G.4 First version of the intergenerational justice assessment applied to South Africa's National Climate Change Adaptation Strategy. *Source: Author's own analysis*

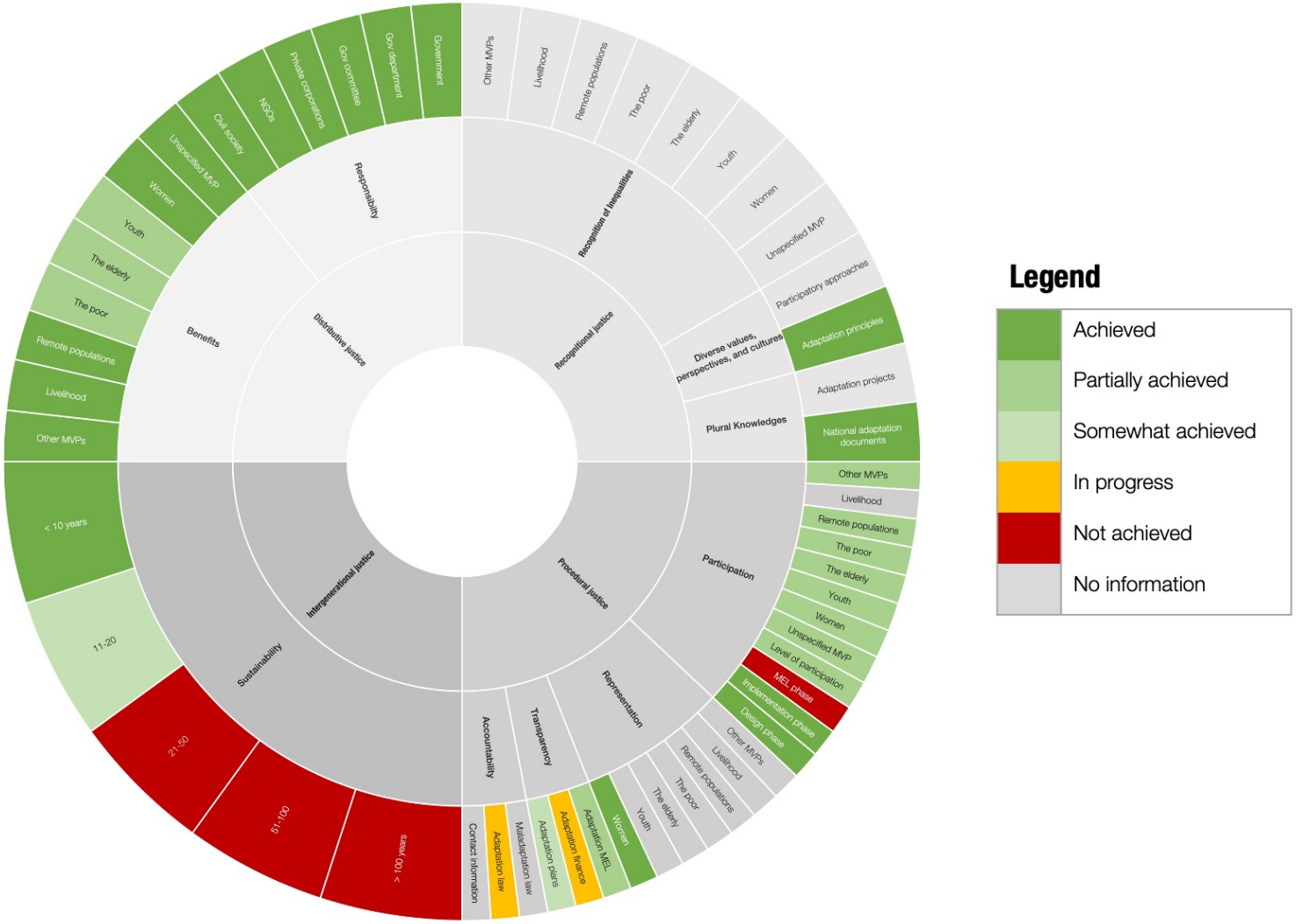

Figure G.5 First version of South Africa's National Climate Change Adaptation Strategy's summary equity assessment in its contribution to the global goal on adaptation. *Source: Author's own analysis*

G.2 Explanation of the iterations made to the Equity Framework

Based on the application of the national level EF to South Africa's NCCAS, there are five iterations. Firstly, South Africa's NCCAS identifies two further VMPs which are omitted from the EF, but are generalisable to any population group. These include the sick and the physically challenged. To be more exhaustive, the VMPs in the EF has been expanded to include these groups, adjusting the latter to "people with disabilities" so as to be inclusive of both physical and mental disabilities.

The second and third iteration relate to recognitional justice. The NCCAS referred to plural knowledge systems in both the guiding principles and in the adaptation actions. Currently, the EF separates between verifying integration of plural knowledge systems in national documents and in the majority of adaptation projects. In order to allow for the flexibility of NAP structures, the indicators have been adjusted as follows: 1) integration of adaptation practices from plural knowledge systems in national adaptation *guiding principles and/or visions*, and 2) integration of adaptation practices from plural knowledge systems in the majority of adaptation *actions*. This change also allows for greater nuance in the indicators, such as the lack of integration in the majority of adaptation actions in the NCCAS which is only revealed in the comments section in the original EF.

The second question of recognitional justice has also been expanded by adding an extra indicator to check for recognition of existing inequalities in the description of the national context. This gives countries the opportunity to show such recognition in both their understanding of their national circumstances and in the measuring of adaptation impacts.

The fourth iteration relates to the ongoing, but not yet finalised, plans proposed in the NCCAS. The original EF was lacking a system to describe a mechanism that might be in progress, for example, transparency mechanisms. Therefore, the EF has been updated to allow for an "in progress" indication for the transparency and accountability questions in procedural justice.