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Connecting climate justice and adaptation planning: An adaptation justice index

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ABSTRACT

Considerations of justice with regards to climate change adaptation are increasingly called for in the academic literature, but little attention has been paid to the dimensions of justice regarding the development of adaptation policy and instruments used. Thus, there is a gap when it comes to connecting the dimensions of justice to different types of adaptation strategies and plans. Here, we synthesise the findings of previous studies to create an adaptation justice index for the four dimensions of climate justice in the context of adaptation: recognitional, distributive, procedural and restorative justice. This index can be used *ex ante* to analyse and compare climate adaptation strategies and plans in different societal contexts as well as at different levels of governance, and we illustrate this by analysing four national and four city-level strategies. As adaptation planning is still a relatively new area of climate governance, the results offer potential for justice informed evaluation of adaptation plans and strategies.

1. Introduction

As implementation of adaptation is advancing (Berrang-Ford et al., 2021; Reckien et al., 2018), it has been argued that adaptation planning is biased towards technocratic and managerial approaches that overlook questions of equity and justice (Araos et al., 2021; Shi et al., 2016; Meerow and Newell, 2019; Chu and Cannon, 2021). Evidence has shown that there are questions related to the unequal participation of different groups in adaptation planning (Klein et al., 2018), and some groups bearing a disproportionate burden of the impacts of climate change (Yang et al., 2021). While there is early evidence of improvement, especially in certain urban areas (Araos et al., 2021; Chu and Cannon, 2021; Granberg and Glover, 2021), there is a pressing need to examine how justice could be considered in the different phases of the planning process, as little is known about how justice considerations are connected to adaptation strategies and planning (Mohtat and Khirfan, 2021).

Numerous strands of academic literature have intertwined, creating a fusion between climate action and justice debates (Hughes and Hoffmann, 2020, Jenkins, 2018). It has become commonplace to consider three dimensions of justice through which climate change impacts, vulnerability and adaptation are viewed. These dimensions include recognitional, distributive, and procedural justice. Increasingly, restorative justice as a fourth dimension is considered to complement the existing typology. As the conceptual debate advances, it is pertinent to note that we lack common understanding of how to identify these aspects of justice in practice. This is supported by a call for metrics and indicators to evaluate the progress in achieving justice in the context of climate adaptation (Chu and Cannon, 2021).

In this paper, we propose a definition of **just climate change adaptation** as *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.* To further connect adaptation planning and considerations of justice, we develop an *Adaptation Justice Index* (AJI) by synthesising the conceptual literature and the findings of previous studies. The AJI can be used to analyse and compare climate adaptation plans in different societal contexts, as well as at different levels of governance, and we demonstrate this with examples from four countries and four cities. As adaptation planning is still a relatively new area of climate governance, the information produced offers valuable feedback for the development of *ex ante* analyses of climate justice in the planning phase.

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2. Adaptation policy and planning: assessing justice dimensions

The current focus in much of adaptation research and policy is either on developing approaches to implementation of, or ways to empirically document, adaptation (Ford et al., 2016), and also in terms of justice dimensions (Araos et al., 2021). The challenges of assessing adaptation outcomes are well acknowledged in the literature (Berrang-Ford et al., 2019). These include agreeing on a definition, identifying a meaningful unit of analysis for comparison over time, and acknowledging the context specificity of vulnerability, as well as the resulting burden of reporting. Thus, the challenge in assessing how justice dimensions play out in the implementation of adaptation is hampered by the broader issue of lack of empirical evidence of adaptation progress on the ground (Leiter, 2021).

However, there are *ex ante* approaches, which have been developed to assess how strategic plans account for different issues. Examples of these types of approaches include assessments of the credibility of climate policy (Olazabal et al., 2019), degrees of transformative changes suggested in climate policy (Heikkinen et al., 2019), and advances in adaptation policy in general (Lesnikowski et al., 2016). While these types of analyses are not a substitute to *ex post* empirical assessments, use of policy documents as data allows one to examine what is included in the official planning of adaptation and what is not. Naturally, it is important to keep in mind that not all policies will be implemented as stated in strategic policy documents. However, plans and strategies still create the basis for actions and guide e.g., who has access to the adaptation planning. We assume that if different dimensions of justice are considered in plans and strategies, taking them into account in implementation is more probable than if they are already absent in the planning phase.

To apprehend the ways in which aspects of justice play out in adaptation, there is a need to sketch out the conceptual dimensions of climate justice, which in turn are largely based on environmental justice (Schlosberg and Collins, 2014) and classic texts on distributive justice (Rawls, 1971). The understanding of environmental justice has slowly evolved, bringing to fore arguments that an unjust distribution of environmental harm and benefits in itself has root causes and therefore is not a given. Hence, three dimensions that are central to justice are readily identified and interconnected, namely recognitional, procedural and distributive, all of which should be addressed to make society more just (Schlosberg, 2007). While distributive aspects of justice can be seen as an indication of injustices, i.e., environmental harm is disproportionally suffered by certain groups in society, Schlosberg (2007) points out that these groups or individuals need to be recognised before any redistribution can happen. This also applies to procedural justice: to support the inclusion of a group or individual, they need to be recognised first. Additionally, restorative justice has emerged as a fourth dimension to highlight how policy and planning can be used to correct these existing injustices (McCauley and Heffron, 2018).

The climate justice dimensions have also emerged in the climate adaptation literature as more focus has been placed on analysis of historical developments and power (Bulkeley et al., 2013; Holland, 2017). Empirical cases from the local level have already demonstrated how historical trends influence current adaptation practices, resulting in reaffirmation of those injustices (Bordner et al., 2020; Yang et al., 2021). Unfair representation and power politics between local institutions and vulnerable groups restrict access to adaptation decision-making for these groups (Omukuti, 2020), further exacerbating low levels of engagement (McManus et al., 2014). These local level findings are supported by studies which analyse adaptation strategies with larger sample sizes. For example, a study of 31 city level strategies states that adaptation strategies do not account for justice in a cohesive way, and that some of them may even contribute to further inequity among the cities' population (Fitzgibbons and Mitchell, 2019).

Of the four dimensions, recognitional justice focuses on the existence of societal structures that reinforce unjust outcomes in society by acknowledging that some cultural and institutional norms and practices may inherently give unequal representation to certain groups (Hughes and Hoffmann, 2020). Second, distributive justice considers the fair and equal distribution of environmental goods and benefits to all in society (Hughes and Hoffmann, 2020), with the aim to understand how environmental harm or benefits are experienced in society. When it comes to climate change adaptation, it mainly refers to the distribution of climate impacts in the physical environment. Third, procedural justice focuses on the fact that participation in decision-making is not always equal, and some groups and individuals can be excluded. Thus, there is a need to examine the processes involved (Hughes and Hoffmann, 2020). For example, within adaptation, it has already been shown that many processes are driven by external projects and networks (Juhola and Westerhoff, 2011), which may not have legitimate representation from all groups of society. Finally, there may be historical development trajectories that create structural forms of injustices, and restorative justice has been proposed to restore dignity and agency to those who have lost it (Thompson and Otto, 2015), as well as an alternative to loss and damage related climate litigation (Robinson and Carlson, 2021). The four dimensions have previously been operationalised in justice assessments separately or in ways that have not always made clear distinction between them, and our intention is to consider all four in adaptation planning.

3. An adaptation justice index

Based on the four dimensions of justice, we develop the AJI that operationalises the four different dimensions as distinct from each other, thus collectively contributing to a comprehensive view of how just the adaptation plans are. The AJI is developed in four partly overlapping steps, which are detailed below.

First, based on existing literature, we identified different adaptation and justice related attributes of the four justice dimensions, from which we formulated a set of indicators (see Sections 3.2–3.5). We used purposive sampling (Robinson, 2014)[1] to search literature using "climate adaptation" or "climate change adaptation" and justice and different categories of justice. The search was limited to peer-reviewed academic literature and did not include grey literature. We included articles that offered definitions or examples for one or more categories. After collecting the definitions and examples, we formulated the first set of indicators, which was then developed further after the first test coding round. We use the terms indicator and index as defined by OECD (2002)[2] and commonly used (e.g., Mayer, 2008; Dizdaroglu, 2015).

Second, we used qualitative content analysis (Creswell and Poth, 2016) to assess which attributes of the four justice dimensions are included in adaptation planning documents of four cities and four countries (see Section 4). During a content analysis (Krippendorff, 2004), a body of text is transformed into codes to reveal the frequencies of trends, themes, and intent in terminology. For each case example, we coded the documents for justice related policy actions and processes. The coding was done by two researchers independently to ensure intercoder reliability (O'Connor and Joffe, 2020). For coding examples, please see the supplement, part 2.

Third, to build the AJI, we created an ordinal scale scoring method that enabled a scale to compare how well justice is integrated. The

[1] According to Robinson, purposive sampling is a sampling design that is not intended to offer a representative sample but rather to focus on particular phenomena and/or processes (Robinson, 2014), and we use this method here to develop the indicators for each dimension.

[2] "Indicator: parameter, or a value derived from parameters, which points to, provides information about, and/or describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value. Index: a set of aggregated or weighted indicators or parameters" (OECD, 1993; 2002).

scoring system was applied as follows. If there were limited information or only a mention of the attributes in the document, the score was 0. For score 1, the attribute needed to be at least partially discussed in the document. For some attributes, there was a distinguishable form of incompleteness or lowest level of development that scored 1. For score 2, the document needed to describe measures to address the dimension, and in some cases, account for the measures partially or in mid-level terms. For score 3, the measures with which to address the dimension needed to be fully accounted for. The obtained scores reflect how comprehensively and ambitiously the different dimensions of justice are considered in the policy documents. The use of an ordinal scale from 0 to 3 allows for subsequent studies to identify changes to the studied variables (Shen et al., 2011).

For each indicator, an individual scoring scheme was developed to reflect the level of inclusion of justice in the documents, see each of the tables in the following sections for details. The scores of the individual indicators were summed up for all four dimensions and equally weighted. Since we did not rely on primary data and used an ordinal scale scoring scheme, standardisation of the indicators was unnecessary. It should be noted that the value of the AJI is not in the comparison of overall scores but in the scores of the dimensions.

Fourth, the results of the scoring were visualised in spider charts to allow the comparison of the scores between the justice dimensions. Due to a different number of indicators in each dimension, the maximum score is not the same across the dimensions (15 for distributional and procedural justice and 9 for recognitional and restorative). In the spider charts, the scores are presented as percentages of the maximum to highlight the total score.

3.1. Case selection

To test the AJI, we used the extreme case sampling method (Jahnukainen, 2009) and selected four city and four country examples that have been active in climate adaptation planning at the national or city level. We selected cases from Europe and North America to show that the index is sensitive enough to capture difference between cases in similar context. We selected an older case (Finland) and a recent case (Canada) to be able to compare cases before and after justice became a major topic in adaptation research. For each case example, we identified the latest available climate change adaptation strategy or similar document. The analysed documents were published between 2014 and 2021. The cases and selected documents are presented in Table 1. When needed, we also consulted background documents, such as external vulnerability assessments that the adaptation strategy was based upon.

3.2. Recognitional justice

Recognitional justice refers to the acknowledgement of plurality of societal actors, and their differing needs, desires, and abilities for adaptation. According to Hughes and Hoffmann (2020), justice as recognition is the recognition (or non-recognition) of the pluralist needs and desires of various groups. Chu and Cannon (2021) define recognitional justice as the recognition of structural vulnerability and intergenerational disadvantaged positions of minority groups, in terms of their cultural, socioeconomic, and political rights. Moreover, Meerow et al. (2019) propose that recognitional justice, or equity in their case, includes: (1) acknowledging community members' different intersecting identities (e.g., race, gender, social class, and age), (2) recognising that these identities are shaped by historical injustices that can affect individual vulnerability to shocks and stresses, the ability to access resources, and the capacity to participate in decision-making, and (3) promoting respect for different groups. Bulkeley et al. (2014) suggest that recognition serves as the entry point or precondition to the other dimensions of climate justice. We identified three indicators for this dimension (Table 2).

First, because vulnerabilities to climate risks are contextual, it is critical to recognise the plurality of adaptation needs across societal groups, to minimise social costs related to adaptation. Expert reviews can be used for identifying different adaptation needs, but to foster empowerment of disadvantaged communities, it is important to recognise the capability of communities to define their own necessities for climate adaptation (Fitzgibbons and Mitchell, 2021). Additionally, moving from a top-down to a bottom-up approach for climate adaptation can address power imbalances experienced amongst stakeholders (Shaw, 2015; Chu and Michael, 2019). Hence, an indicator can examine whether an adaptation strategy acknowledges that adaptation needs differ across groups in society, and on what basis.

Second, recognising the importance of underlying social structures is essential in identifying the drivers that contribute to social injustices experienced in societies (Schlosberg, 2004), as pre-existing societal structures influence e.g., how the impacts of climate change will be experienced among the most vulnerable groups (Shi et al., 2016). This means acknowledging that the capabilities to access resources and information related to climate adaptation vary due to structural causes. Hence, an indicator can examine the extent to which an adaptation strategy recognises the influence that societal structures have on disadvantaged communities' ability to adapt.

Third, addressing climate change has recently been considered from the perspective of securing basic human rights (Peel and Osofsky, 2018). This is also increasingly pointed out through cases of climate litigation. Organisations and groups of individuals have claimed in national and international courts that states are violating their fundamental human rights through inadequate mitigation actions, as worsening climate change threatens their safety and income (Parling, 2021). The success of these cases (Parling, 2021) suggests that similar claims about inadequate adaptation action could be validated, since securing the right to a safe life and a protected future in a changing climate, in terms of e.g., housing or employment, requires adaptation. Some examples already exist in USA, where litigation has also had significant role in developing mitigation policies (Peel & Osofsky 2015). Hence, an indicator can examine whether an adaptation strategy acknowledges adaptation as a way to secure basic human rights into the future.

3.3. Distributive justice

Distributive justice is considered in terms of how climate impacts are

Table 1
Case examples and data.

Country	Document	Publication year	City	Document	Publication year
England	The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting. Making the country resilient to a changing climate	2018	**London**	London Environment Strategy, Chapter 8: Adapting to climate change	2018
Finland	Kansallinen ilmastonmuutokseen sopeutumissuunnitelma 2022	2014	**Helsinki**	Helsingin ilmastonmuutokseen sopeutumisen linjaukset 2019–2025	2019
Canada	Adapting to the Impacts of Climate Change in Canada: An Update on the National Adaptation Strategy	2021	**Vancouver**	Climate Change Adaptation Strategy. 2018 Update and Action plan	2018
Sweden	Nationell strategi för klimatanpassning	2018	**Stockholm**	Handlingsplan för klimatanpassning 2021–2024	2020

Table 2
Indicators for recognitional justice.

Dimensions of justice	Indicator	Scale	Value	References
1. Recognitional justice	1.1. The strategy acknowledges that adaptation needs are different across groups in society	No acknowledgement	0	Shaw (2015),Chu and Michael (2019),Chu and Cannon (2021),Fitzgibbons and Mitchell (2021)
		The strategy states that adaptation needs are different	1	
		The strategy takes into account different adaptation needs based on expert review	2	
		The strategy is built on different groups identifying their adaptation needs	3	
	1.2. The strategy acknowledges the impact of existing societal structures on vulnerable groups in adapting to the impacts of climate change	No acknowledgement	0	Shi et al. (2016),Chu and Cannon (2021)
		The existence of structures is mentioned in a general manner	1	
		There are measures to decrease the impact of structures.	2	
		There is a structured plan to assess the impact of societal structures on vulnerability	3	
	1.3. The strategy acknowledges adaptation as a way to secure basic human rights	No acknowledgement	0	Bulkeley et al. (2014),Peel and Osofsky (2018)
		Adaptation as a way to secure basic rights is mentioned	1	
		The strategy describes how adaptation can secure basic rights in general	2	
		The strategy has measures to secure basic rights	3	

distributed in society, or how adaptation measures and their impacts, both negative and positive, are distributed across society. For example, Chu and Cannon (2021) use the term equity as equivalent to what is called distributive justice in environmental justice theory. They define it as a situation in which resources, opportunities and the avoidance of climate hazards or risks are equally and fairly distributed, independently of the background or identity of the group or individual. Colenbrander et al. (2018) stress that costs and benefits of adaptation are unequally distributed on a local vs. national level. We identified five indicators to assess how an adaptation strategy considers the distributive dimension (Table 3).

First, risk and vulnerability assessments, with the latter often being incorporated into the former, have become commonplace at the national, regional, or local level (Miller and Bowen, 2013). A climate risk assessment is generally composed of an assessment of climate change related hazards with an explicit methodology, the data of which may be analysed in the light of exposure and vulnerability variables (Tonmoy et al., 2014), though not always. The risk assessments may also include analysis of the costs of the impacts and 'not adapting'. The results of the assessment are most often displayed in a spatially explicit form, illustrating the geographical distribution of risks. An indicator can examine whether a strategy includes an assessment of the distribution of climate risks, and to what extent.

Second, vulnerability is widely discussed as a complex phenomenon, describing several social conditions and processes that influence the extent to which different members or groups of society are affected by climate change related hazards. Both generic and hazard specific vulnerability traits and attributes have been identified in the literature and their inclusion into risk and vulnerability assessments has become common place (Fiack et al., 2021). An indicator can examine whether, and to what extent, an adaptation strategy has undertaken a vulnerability assessment that includes the identification of vulnerable groups.

Third, there are some recent analyses that assess who benefit from adaptation measures, based on the assumption that the distribution of benefits from adaptation is not equal (Anguelovski et al., 2016; Ponce Oliva et al., 2021). There is also evidence of how the difference in who coordinates actions for adaptation can lead to different levels of benefits for those involved (Nthambi et al., 2021). Hence, an indicator can examine whether the adaptation strategy includes a process for assessing the distribution of benefits from adaptation.

Fourth, the costs of implementing adaptation actions are naturally tied to the type and extent of adaptation measures (Neumann et al., 2021). There is limited literature estimating the adaptation costs and its distribution among groups. However, studies assessing different groups' values and willingness to pay for adaptation show that the willingness between groups can vary significantly (Rolfe et al., 2021). An adaptation strategy ought to assess the burden of its implementation on society. Hence, an indicator can examine whether the strategy identifies the unequal distribution of costs from adaptation measures across society.

Fifth, the issue of maladaptation (Juhola et al., 2016) can be considered separately from costs or benefits, which mainly focus on implementation itself. Maladaptation, on the other hand, includes distributional issues related to negative consequences of implemented adaptation, for instance when adaptation measures shift vulnerability to or erode sustainable development for another group or locality (Tubi and Williams 2021). Hence, a strategy ought to identify the risk of the distribution of negative impacts from adaptation measures, i.e., maladaptation, and an indicator can examine that.

3.4. Procedural justice

Procedural justice refers to the fairness in the process of climate adaptation (Schlosberg, 2007; Wenta et al., 2018; van den Berg and Keenan, 2019). This means considering who can participate in the planning process either as a decision maker or participant, how decisions are made and based on who's information or ideas (Wenta et al.,

Table 3
Indicators for distributive justice.

Dimensions of justice	Indicator	Scale	Value	References
2. Distributive justice	2.1. A risk mapping/assessment is conducted	No assessment	0	Tonmoy et al. (2014),Chu and Cannon (2021),Fiack et al. (2021)
		Yes, risk assessment is mentioned but results are not used	1	
		Yes, risk assessment is conducted, and measures are identified for some risks	2	
		Risk assessment is conducted, and measures are identified for all risks	3	
	2.2. There is a process for identifying vulnerable groups	No process	0	Chu and Cannon (2021),Fiack et al. (2021)
		Vulnerable groups are identified	1	
		There is a vulnerability assessment that will be updated.	2	
		Vulnerability assessment is connected to adaptation planning and monitoring	3	
	2.3. There is a process that assesses the distribution of benefits from adaptation	No process	0	Anguelovski et al. (2016), Chu and Cannon (2021), Colenbrander et al. (2018),Fiack et al. (2021),Ponce Oliva et al. (2021),Nthambi et al. (2021)
		The strategy identifies the distribution of benefits of adaptation measures in general	1	
		Distribution of benefits is assessed as part of the strategy process.	2	
		Distribution of benefits is monitored continuously	3	
	2.4. There is a process that assesses how costs of adaptation are divided	No process	0	Colenbrander et al. (2018);Neumann et al. (2021),Rolfe et al. (2021)
		The strategy identifies the distribution of costs of adaptation measures in general	1	
		Distribution of costs is assessed as part of the strategy process.	2	
		Distribution of costs is monitored continuously	3	
	2.5. The strategy identifies the possibility of the distribution of negative impacts, i.e., maladaptation, of adaptation measures	No identification	0	Juhola et al. (2016), Tubi & Williams (2021)
		The strategy identifies (at least implicitly) the distribution of negative impacts of adaptation measures in general	1	
		Distribution of negative impacts of some adaptation measures are identified	2	
		Distribution of negative impacts of all adaptation measures are identified	3	

2018). Decision-making processes and procedures are just when they are transparent, accountable, and include diverse voices, values, and viewpoints (Wenta et al., 2018; Chu and Cannon, 2021). Here, we identified five attributes (Table 4).

First, adaptation strategies are prepared by the public sector or by a consulting company hired by the public sector. In the process of drafting the plan, there are several possibilities to include stakeholders, such as the private sector, NGOs, or citizens. The main approaches for stakeholder involvement are participation through invitation, where those preparing the plan decide who the participating actors are, and open participation, in which anyone can participate. The former is often connected to expert participation and the latter to citizen participation, and both can be used during the process. However, open citizen participation is considered necessary for procedural justice (O'Brien & Selboe 2015), since procedural justice requires ensuring that those affected by the decisions can participate meaningfully in the decision-making process (Anguelovski et al., 2016; Wenta et al., 2018). Open participation is especially important when it comes to including the most vulnerable groups (Innes and Booher, 2004). However, even with open participation, inclusion can be challenging if the vulnerable groups are in a marginalised position (Anguelovski et al., 2016; Chu and Michael, 2019; van den Berg and Keenan, 2019). An indicator can examine whether the strategy details who participated in the planning process.

Second, participation in preparing the plan should be meaningful (Anguelovski et al., 2016; Wenta et al., 2018; van den Berg and Keenan, 2019; IPCC, 2022). Therefore, in addition to who participates, it is important to consider how and when the participation happens, as this defines the impact the participants can have on the strategy. Participation can happen either during the preparation of the strategy, informing the process, or after completion, evaluating the outcome. However, if participation remains at the level of occasional informing and consulting, it is unlikely that the process is meaningfully inclusive and just (Innes and Booher, 2004). For procedural justice to be realised, participation should be collaborative and continuous (IPCC, 2022). Hence, an indicator can examine whether the strategy has involved participation during different phases of the process.

Third, participation also needs to be considered when it comes to implementing the strategy, as most of the strategies only involve the public sector (Klein et al., 2018). The first step is to allocate responsibilities to ensure that adaptation measures are realised. It is important to recognise that the plurality of the actors involved means that they have different capabilities, and therefore, should have different responsibilities (Bulkeley et al., 2014). When planning the adaptation actions and allocating responsibilities, the capability of different actors to make a difference, and on what scale, should be considered (Juhola, 2019). Hence, an indicator can examine whether the division of responsibilities is presented and justified in the adaptation strategy.

Fourth, different groups can, and most probably need to, participate in implementation without being responsible for it. As in the case of the strategy preparation process, the implementation process should be collaborative and continuous for procedural justice to be guaranteed (van den Berg and Keenan, 2019). Informing and consulting are not likely to be sufficient since adaptation measures most probably require actions outside of the public sector (Surminski, 2013). Hence, an indicator can examine whether the adaptation strategy has a structured plan for participation in the implementation phase.

Fifth, vulnerability to climate risks is dynamic (Jurgilevich et al., 2017), which means that the vulnerability of a group needs to be periodically re-evaluated, which should also lead to updating of the adaptation actions (van den Berg and Keenan, 2019). Hence, an indicator can examine whether the adaptation strategy has a plan for evaluating and updating the strategy.

Table 4
Indicators for procedural justice.

Dimensions of justice	Indicator	Scale	Value	References
3. Procedural justice	3.1. Adaptation strategy details who participates in the strategy process	No participation outside the public sector	0	Innes and Booher (2004), O'Brien & Selboe 2015, Anguelovski et al. (2016),Chu and Michael (2019),van den Berg and Keenan (2019),Chu and Cannon (2021)
		Participation through invitation for experts, private sector	1	
		Participation of experts and citizens through open invitation	2	
		Participation and measures to enable participation of vulnerable groups	3	
	3.2. The adaptation strategy has involved participation during different phases of the process	No participation	0	Innes and Booher (2004), O'Brien & Selboe 2015, Anguelovski et al. (2016),Wenta et al. (2018),Chu and Cannon (2021),IPCC (2022)
		The strategy process has involved information provision about adaptation (at least once during the process before the final output publication)	1	
		The strategy process has involved consultation.	2	
		The participation in the strategy process has been collaborative and continuous.	3	
	3.3. The strategy allocates responsibilities related to adaptation	No allocation	0	Bulkeley et al. (2014),Juhola (2019)
		Responsibilities are mentioned	1	
		Responsibilities for some adaptation measures are allocated	2	
		Responsibilities for all adaptation measures are allocated	3	
	3.4. The adaptation strategy has a structured plan for participation in the implementation.	No participation in the implementation plan	0	Innes and Booher (2004); Van den Berg & Keenan (2019)
		The implementation plan involves informing different stakeholders	1	
		The implementation plan involves stakeholder consultation	2	
		The implementation plan involves stakeholder participation in a collaborative and continuous manner	3	
	3.5. The adaptation strategy has a plan for updating and evaluating the strategy	No plan	0	Jurgilevich et al. (2017), Van den Berg & Keenan (2019)
		The strategy involves a plan for updating, but evaluation is not described	1	
		The strategy involves a plan for updating and describes how progress will be evaluated	2	
		The strategy involves an update and evaluation plan that includes stakeholder participation	3	

3.5. *Restorative justice*

Restorative justice as the fourth dimension is the least developed both in terms of theoretical writing and practical application in adaptation planning. The idea of restorative justice has previously been applied in criminal justice, where it implies a shift from the offender to the victim to restore their dignity and reconcile wrongs (Robinson and Carlson, 2021). Restorative justice in the context of adaptation has been discussed within the loss-damage debate (Boyd et al. 2017), which highlight the experienced and irreversible losses and damages attributed to climate change and felt by the most vulnerable in society (McCauley and Heffron, 2018). Measures associated with restorative justice can be used to redress negative impacts of climate change, by first acknowledging harm that has occurred, the existence of an injustice, then identifying the offenders and victims, and finally considering the types of compensation and other repairs that can be made and sustained (Robinson and Carlson, 2021). We identified three indicators here (Table 5).

First, to employ any restorative justice measures, there must be a recognition or a discovery of an occurred impact and injustice (Robinson

Table 5
Indicators for restorative justice.

Dimensions of justice	Indicator	Scale	Value	References
4. Restorative justice	4.1. The strategy acknowledges the need to compensate for the diverging impacts of climate change	No acknowledgement	0	Huggel et al. (2013),Thompson and Otto (2015),Robinson and Carlson (2021)
		The strategy acknowledges the need to compensate	1	
		The strategy has compensation measures for some impacts of climate change	2	
		The strategy has compensation measures for all relevant impacts of climate change	3	
	4.2. The strategy has compensation measures to deal with maladaptation	No mention of the need to compensate	0	Eriksen et al. (2021)
		The need to compensate is mentioned	1	
		There are compensation measures for some maladaptation	2	
		There are measures to compensate for all groups	3	
	4.3. The unequal distribution of resources for adaptation is compensated by redistribution	No mention of unequal distribution	0	Robinson and Carlson (2021)
		The need for reallocation of resources for adaptation is acknowledged (at least partially)	1	
		There are measures for reallocation of adaptation resources	2	
		There are measures for the reallocation of adaptation resources to develop adaptive capacity	3	

and Carlson, 2021). In terms of climate change impacts, this is often linked to the question of attribution, i.e., whether a particular event can be attributed to climate change (Huggel et al., 2013). This level of discussion is rarely seen in adaptation strategy and planning documents (Juhola, 2019) but may become more prevalent in the future (Thompson and Otto, 2015). Hence, an indicator can examine whether the strategy acknowledges the need to compensate for the diverging impacts of climate change that are contextually relevant within the scope of the plan.

Second, maladaptation (Juhola et al., 2016) may occur because of existing unequal structures in society (Eriksen et al., 2021). Maladaptation is considered as an outcome of implemented adaptation (see indicator 2.5). This outcome can reinforce existing inequalities and further enhance vulnerability, and it is possible, in theory, to develop adaptation measures that address these in a restorative manner. Hence, an indicator can examine whether the strategy has compensation measures to deal with maladaptation.

Third, as suggested by Robinson and Carlson (2021), a restorative justice process includes the identification of measures to compensate for the unequal distribution of resources. While there are relatively few examples of redistribution related to climate impacts and adaptation planning, there are examples of this type of measures regarding environmental harm more broadly as identified by Robinson and Carlson (2021). Existing climate litigation cases (e.g., Preston, 2016) may be an example of this type of measure emerging. Thus, an indicator can examine whether a strategy has redistribution measures in place to compensate for the unequal distribution of resources for adaptation.

4. Results and discussion

There are several ways to summarise the findings of the AJI, depending on whether the aim is to examine the differences between the dimensions of justice, or to compare different cases to each other. For the purpose of illustrating its use, we discuss the results from both perspectives.

4.1. Index results

We calculated the scores for each of the national and city level documents (for detailed scoring, see supplement, part 1), and the results are presented below in alphabetical order (national/city).

The overall adaptation justice index score for Canada was 32 points out of 48, 67 % of the maximum. The individual scores for each of the dimensions were the most even among the four countries, with the highest score obtained for procedural justice (12/15, 80 %) and the lowest for restorative justice (5/9, 56 %). The development of the first national adaptation strategy in Canada is still ongoing, which restricted a full assessment of all the indicators. The development process appears to be based on research and stakeholder engagement, as it builds on a national knowledge base of climate change impacts and the state of adaptation, as well as on the continuous work of thematic 'advisory tables' involving a range of key stakeholders, which may explain the relatively high scores.

The overall adaptation justice index score for England was 20 points out of 48, 42 % of the maximum, with the highest scores obtained from the procedural (12/15, 80 %) and the lowest from the restorative dimensions (0/15, 0 %). National adaptation planning in the UK was institutionalised relatively early through the passing of the framework legislation (Climate Change Act, 2008) that prescribed the Committee on Climate Change and its Adaptation Sub-Committee, both independent advisory bodies, to prepare the knowledge-base to support decision-making, as well as stipulated statutory reporting. The statutory reporting mandate has increased the engagement of vulnerable sectors and integrated bottom-up perspectives into the national level adaptation planning (Street and Jude, 2019; Jude et al., 2017).

The overall adaptation justice index score for Finland was 20 points out of 48, 42 % of the maximum. As visualised in Fig. 1, Finland scores highest in procedural justice (12/15, 80 %) and lowest in restorative justice (1/9, 11 %). Finland launched its first national adaptation strategy relatively early, in 2005. The Finnish Climate Act (2015) prescribes monitoring and evaluation of the strategy, and the launching of a new strategy at least every ten years. The Climate Act is currently being renewed and the timeframe will most likely be shortened and the third adaptation strategy is currently being prepared by an expert group in consultation with stakeholders.

For Sweden, the total index score was 20 out of 48 points, 42 %. The highest score was obtained from the procedural dimension (13/15 = 86 %), and the lowest score from recognitional justice (0/9 = 0 %). Sweden has mainly focused on the sectoral adaptation plans and launched its first national adaptation strategy relatively late (2018). The strategy is due to be renewed every five years.

Turning to the city level, the overall adaptation justice index score for Helsinki was 17 points out of 48, 35 % of the maximum. As visualised in Fig. 1, Helsinki scored highest in procedural justice (9/15, 60 %) and lowest in restorative justice (0/9). The current adaptation strategy was produced by an adaptation working group within the wider climate change working group of Helsinki, appointed in 2016. The adaptation process will be evaluated using regional indicators, possibly adding some city specific ones. The strategy is due to be renewed in 2025.

The overall score for London was 28 points out of 48, 58 % of the maximum. London scored highest in procedural justice (13/15, 87 %) and lowest in recognitional and restorative justice (3/9, 33 % for both dimensions). London is considered a globally relevant actor when it comes to climate governance. The above-mentioned Climate Change Act (2008) and the Greater London Area Act (1999) form the legislative and policy foundation for adaptation. The first adaptation strategy was published in 2011 as a chapter in the broader environment strategy. Climate adaptation is connected to resilience thinking, meaning that the London Resilience Partnership, which brings together 170 organisations, keeps a register of the main climate risks and the ways to address them.

The city of Stockholm scored a total of 13 points out of 48 points possible, 27 %. For the individual dimensions, the highest score was obtained from procedural justice (7/15 = 47 %) and the lowest from restorative (0/9 = 0 %). Stockholm has been described as a model of sustainable urban living, being the first winner of the European Green Capital award (European Commission, 2010). However, the current climate adaptation plan for 2021–2024 is the first the city has published, which is relatively late in comparison to other cases. Updating the plan is connected to revising the general environment programme of the city, so that the new plan will be published one year after the next programme update.

The overall adaptation justice index score for Vancouver was 31 points out of 48, 65 % of the maximum. Vancouver scored highest in procedural justice (11/15, 73 %) and lowest in restorative justice (4/9, 44 %). Vancouver published its first adaptation strategy in 2012. The main document analysed here is the first update and action plan, and in 2020 the city published a progress report. In the future, the adaptation strategy is due to be updated following the IPCC five-year reporting cycle. Reporting on progress is included in annual updates of the Greenest City Action Plan, which combines climate change mitigation, adaptation, and wider sustainability goals.

4.2. Planning for just adaptation

In addition to examining how a plan accounts for justice, the AJI can also be used to assess the extent to which the dimensions of justice are considered and how they compare to each other. In both the national and city level analyses, the procedural dimension obtained the highest scores, followed by the distributive dimension. Both the recognitional and restorative dimensions received lower scores overall. Interestingly, there are some similarities between each national and city pair in the

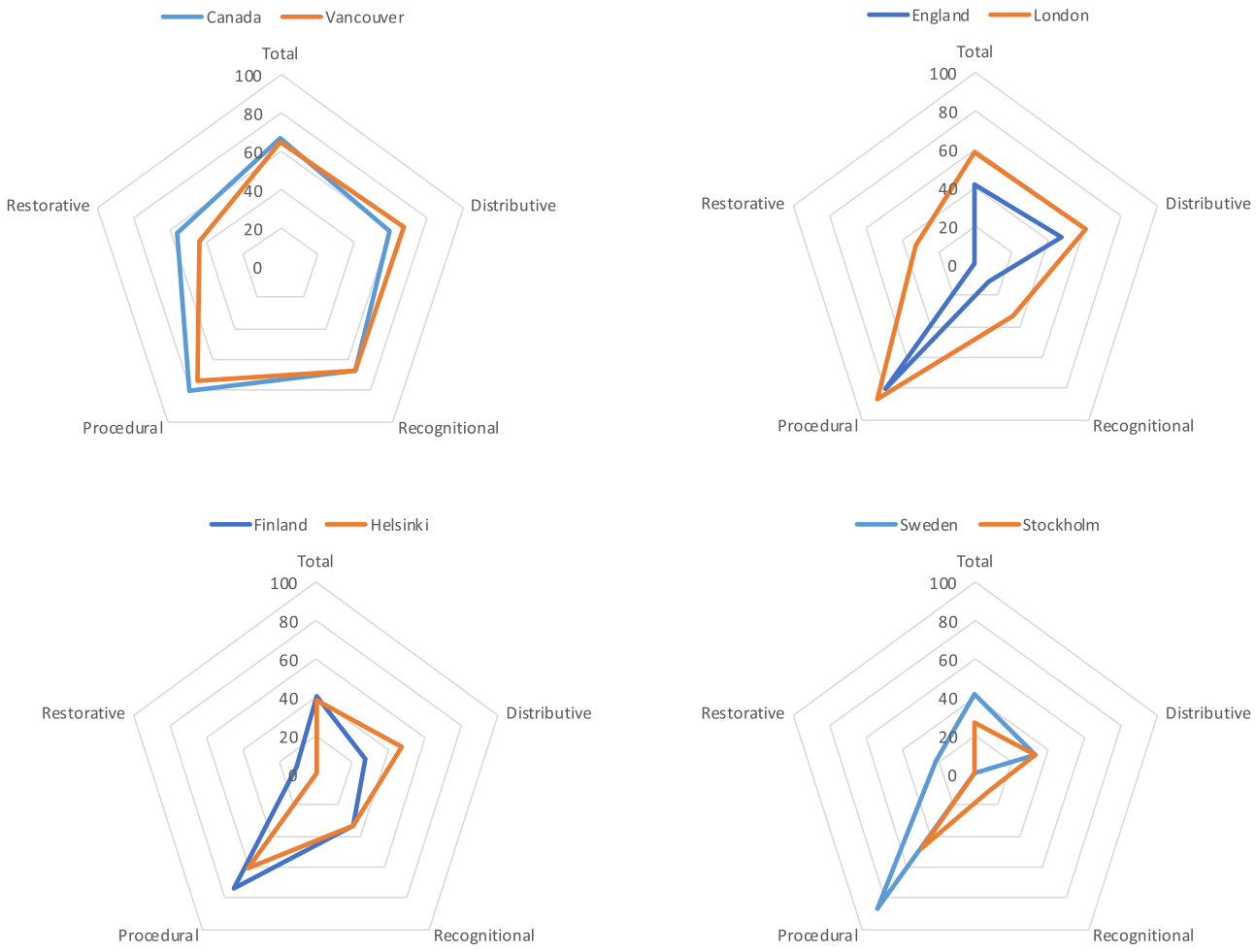


Fig. 1. National and city level scores.

overall pattern drawn by the dimension scores in Fig. 1. It is beyond the scope here to explore this further, but these may be explained by similar cultural contexts and administrative traditions regarding adaptation (Biesbroek et al., 2018; Klein and Juhola, 2018). Multi-level governance arrangements of adaptation (Bauer and Steurer, 2014, Juhola, 2016) are also likely to impact how justice can be achieved in a multi-scalar setting.

In terms of the recognitional dimension, most of the strategies acknowledge that adaptation needs differ in society but only the Canadian strategy involves groups identifying their own needs, as opposed to this being done by experts. Many of the strategies acknowledge that there may be societal structures that affect how groups are able to adapt in a general manner, but no plan assesses these in detail. However, the Vancouver plan proposes some measures to decrease the impact of these structures. The question of whether adaptation is needed to ensure basic human rights for citizens is addressed only in the Canadian and city of Vancouver strategies. The overall poor performance in recognitional justice is not surprising but it is problematic, since recognising the needs of different groups builds the foundation for distributive, procedural and restorative justice (Schlosberg, 2007).

To address the distributive dimension, most of the strategies included some type of risk or vulnerability assessment, which focused on the geographical distribution of risks. In many cases only a few key risks were selected for further analysis. This can be reasonable from a resource efficiency point of view but may overlook some important risks (Adger et al., 2018), especially considering the low scores obtained from the recognitional justice indicators. The degree to which vulnerable groups were mentioned varied and only Canada and the city of Vancouver had connected the vulnerability assessment to adaptation planning and monitoring. Most of the strategies acknowledged that benefits and costs of adaptation may be unequally distributed; the Swedish strategy, for instance, identified certain regions and sectors that will require more adaptation funding than others, but there were no plans for a continuous assessment connected to the strategy process. Similarly, the distribution of maladaptive outcomes of adaptation was acknowledged but there were no clear plans to address it. The lack of plans to account for maladaptation is not surprising as there is yet little research on the operationalisation of the concept of maladaptation into adaptation planning, despite growing evidence of it taking place (IPCC, 2022).

The procedural dimension received the highest scores, and this can be explained by extensive stakeholder and expert participation during different phases of the strategy preparation process. Additionally, many strategies had clearly allocated responsibilities for all measures, which has been identified as one of the bottlenecks in adaptation planning (Biesbroek et al., 2013). Most of the strategies also had a clear plan for implementation, as well as for updating and evaluating through stakeholder participation, which indicates that participation is being taken seriously. However, procedural justice is naturally tied to recognitional justice, and it may be that even in very advanced participatory processes some groups are not included. Our index will not capture this and would require a more empirical, on the ground approach to see if the stakeholder process is comprehensive and continuous (van den Berg and Keenan, 2019).

Restorative justice received the lowest scores which is not surprising given the budding theoretical discussion (Robinson and Carlson, 2021).

About half of the strategies acknowledged that they may need to compensate for diverging impacts of climate change in society. For instance, the Swedish strategy recognised that some of the regions that are most exposed to climate risks also have the lower adaptive capacity. There were only cursory mentions regarding the need to compensate for possible maladaptive measures, and only Canada and Vancouver considered measures that would reallocate resources to develop adaptive capacity. This was done by identifying the distinctive capabilities and mechanisms for compensation at state and at city level. For instance, the Vancouver plan states that it focuses on risk reduction and resilience building of the frontline communities, and the national plan includes launching the Disaster Mitigation and Adaptation Fund (DMAF) that can be used for those city level measures. The relatively good scoring by Canada and Vancouver is not surprising as social justice is rooted in their governance traditions more than in the other case sites. This discussion is likely to increase since adaptation limits are being breached and approached (Thomas et al., 2021), driving the need to proactively develop compensatory instruments for adaptation for irreversible losses.

There are limitations to AJI and its application here. First, there is a strong literature on the difference in power in decision-making and epistemological differences between stakeholder groups (Klenk et al., 2017; Latulippe and Klenk, Caniglia et al., 2020, 2021). These types of issues are often omitted in quantitative assessments, and AJI is not an exception. For future use, AIJ could be embedded in a broader assessment, and it could be complemented by qualitative methods to capture this. Second, the sample presented here is small and biased towards the Global North. To make more general conclusions about the state of justice in adaptation planning, the analysis should be repeated to a wider and more diverse case sample, including countries and cities of different sizes and from different socio-economical context, particularly in the Global South. In an ideal case, this could be done in cooperation with researchers familiar with the context of the selected cases and supplemented with qualitative approaches.

Future research questions include the revision of the proposed indicators as theory and empirical understanding advance. For instance, as climate change related loss and damage that could have been avoided with adaptation takes place, the identification of the "culprits" may raise interest. Thus, restorative justice indicators can be developed further, and this also calls for indicators to identify the costs of not adapting - an aspect of distributive justice. In addition, we have exclusively focused on the strategies from the public sector, but justice concerns are equally important at project level and in the private and third sector, within which future testing of the AJI could take place.

5. Conclusion

As adaptation advances both in terms of strategic development and implementation on the ground, there is an increasing need to address the social consequences of the measures taken. This includes examining the justice implications of involvement and whether the measures themselves support just adaptation. We propose a definition for just adaptation, which encompasses four dimensions of justice and develop an adaptation justice index (AJI) and apply it to eight national and city level adaptation strategies. Overall, the result reveals that procedural justice is best accounted for, followed by concerns of distributive justice. Both recognitional and restorative justice are less accounted for because both are relatively new developments even from the perspective of theoretical discussions.

While we argue that there is value in developing *ex ante* methods for assessing adaptation strategies and their planning processes, it should not be seen as a substitute for examining the implementation of adaptation empirically and over different time periods as there are changes to all dimensions of justice in relation to adaptation over time. The accumulating case study literature already demonstrates how complex the adaptation planning processes are and stresses the need to fully examine and account for injustices that may emerge in planning and implementation. Temporal analyses of how justice concerns play out are also necessary as implementation takes place in a congested policy environment, where costs or benefits of adaptation are unlikely to be static, either spatially, or temporally, across groups in society. The analysis of justice in adaptation should therefore be further connected to the more general efforts to monitor and evaluate adaptation.

CRediT authorship contribution statement

Sirkku Juhola: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Supervision, Project administration, Funding acquisition, Validation. **Milja Heikkinen:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Visualization, Validation. **Fanny Groundstroem:** Formal analysis, Writing – review & editing, Validation. Taru Pietilä: Methodology, Investigation, Writing – original draft. **Janina Käyhkö:** Formal analysis, Investigation, Writing – review & editing, Validation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2022.07.024.

References

Adger, W.N., Brown, I., Surminski, S., 2018. Advances in risk assessment for climate change adaptation policy. Philos. Trans. R. Soc. Math. Phys. Eng. Sci. 376 (2121), 20180106.

Anguelovski, I., Shi, L., Chu, E., Gallagher, D., Goh, K., Lamb, Z., Reeve, K., Teicher, H., 2016. Equity impacts of urban land use planning for climate adaptation: critical perspectives from the global north and south. J. Plan. Educ. Res. 36 (3), 333–348.

Araos, M., Jagannathan, K., Shukla, R., Ajibade, I., de Perez, E.C., Davis, K., GAMI Team, 2021. Equity in human adaptation-related responses: a systematic global review. One Earth 4 (10), 1454–1467.

Bauer, A., Steurer, R., 2014. Multi-level governance of climate change adaptation through regional partnerships in Canada and England. Geoforum 51, 121–129.

Berrang-Ford, L., Biesbroek, R., Ford, J.D., et al., 2019. Tracking global climate change adaptation among governments. Nat. Clim. Chang 9, 440–449. https://doi.org/10.1038/s41558-019-0490-0.

Berrang-Ford, L., Siders, A.R., Lesnikowski, A., Fischer, A.P., Callaghan, M.W., Haddaway, N.R., Abu, T.Z., 2021. A systematic global stocktake of evidence on human adaptation to climate change. Nat. Clim. Change 11 (11), 989–1000.

Biesbroek, G.R., Klostermann, J.E., Termeer, C.J., Kabat, P., 2013. On the nature of barriers to climate change adaptation. Reg. Environ. Change 13 (5), 1119–1129.

Biesbroek, R., Lesnikowski, A., Ford, J.D., Berrang-Ford, L., Vink, M., 2018. Do administrative traditions matter for climate change adaptation policy? A comparative analysis of 32 high-income countries. Rev. Policy Res. 35 (6), 881–906.

Bordner, A.S., Ferguson, C.E., Ortolano, L., 2020. Colonial dynamics limit climate adaptation in Oceania: Perspectives from the Marshall Islands. Glob. Environ. Change 61, 102054.

Boyd, E., James, R.A., Jones, R.G., Young, H.R., Otto, F.E., 2017. A typology of loss and damage perspectives. Nature Climate Change 7 (10), 723–729.

Bulkeley, H., Edwards, G.A.S., Fuller, S., 2014. Contesting climate justice in the city: Examining politics and practice in urban climate change experiments. Glob. Environ. Change 25, 31–40. https://doi.org/10.1016/j.gloenvcha.2014.01.009.

Bulkeley, H., Carmin, J., Broto, V.C., Edwards, G.A., Fuller, S., 2013. Climate justice and global cities: Mapping the emerging discourses. Glob. Environ. Change 23 (5), 914–925.

Caniglia, G., Luederitz, C., von Wirth, T., Fazey, I., Martin-López, B., Hondrila, K., König, A., von Wehrden, H., Schäpke, N.A., Laubichler D., M., Lang, D.J., 2021. A pluralistic and integrated approach to action-oriented knowledge for sustainability. Nat. Sustain. 4 (2), 93–100.

Chu, E., Michael, K., 2019. Recognition in urban climate justice: Marginality and exclusion of migrants in Indian cities. Environ. Urban. 31 (1), 139–156.

Chu, E.K., Cannon, C.E., 2021. Equity, inclusion, and justice as criteria for decision-making on climate adaptation in cities. Curr. Opin. Environ. Sustain. 51, 85–94.
Colenbrander, S., Dodman, D., Mitlin, D., 2018. Using climate finance to advance climate justice: the politics and practice of channelling resources to the local level. Clim. Policy 18 (7), 902–915.
Creswell, J.W., Poth, C.N., 2016. Qualitative inquiry and research design: choosing among five approaches. Sage publications, London.
van den Berg, H.J., Keenan, J.M., 2019. Dynamic vulnerability in the pursuit of just adaptation processes: a Boston case study. Environ. Sci. Pol. 94, 90–100. https://doi.org/10.1016/j.envsci.2018.12.015.
Dizdaroglu, D., 2015. Developing micro-level urban ecosystem indicators for sustainability assessment. Environ. Impact Assess. Rev. 54, 119–124. https://doi.org/10.1016/j.eiar.2015.06.004.
Eriksen, S., Schipper, E.L.F., Scoville-Simonds, M., Vincent, K., Adam, H.N., Brooks, N., West, J.J., 2021. Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance or irrelevance? World Dev. 141, 105383.
European Commission, 2010. Stockholm –European Green Capital 2010. Publications Office of the European Union, Luxembourg. https://doi.org/10.2779/17961.
Fiack, D., Cumberbatch, J., Sutherland, M., Zerphey, N., 2021. Sustainable adaptation: Social equity and local climate adaptation planning in US cities. Cities 115, 103235.
Fitzgibbons, J., Mitchell, C.L., 2019. Just urban futures? Exploring equity in "100 Resilient Cities". World Dev. 122, 648–659.
Fitzgibbons, J., Mitchell, C.L., 2021. Inclusive resilience: examining a case study of equity-centred strategic planning in Toronto, Canada. Cities 108. https://doi.org/10.1016/j.cities.2020.102997.
Ford, J.D., Berrang-Ford, L., 2016. The 4Cs of adaptation tracking: consistency, comparability, comprehensiveness, coherency. Mitig. Adapt. Strateg. Glob. Change 21 (6), 839–859.
Granberg, M., Glover, L., 2021. The climate just city. Sustainability 13 (3), 1201.
Heikkinen, M., Ylä-Anttila, T., Juhola, S., 2019. Incremental, reformistic or transformational: what kind of change do C40 cities advocate to deal with climate change? J. Environ. Policy Plan. 21 (1), 90–103.
Holland, B., 2017. Procedural justice in local climate adaptation: political capabilities and transformational change. Environ. Polit. 26 (3), 391–412. https://doi.org/10.1080/09644016.2017.1287625.
Huggel, C., Stone, D., Auffhammer, M., Hansen, G., 2013. Loss and damage attribution. Nat. Clim. Change 3 (8), 694–696.
Hughes, S., Hoffmann, M., 2020. Just urban transitions: toward a research agenda. Wiley Interdiscip. Rev.: Clim. Change, e640.
Innes, J.E., Booher, D.E., 2004. Reframing public participation: strategies for the 21st century. Plan. Theory Pract. 5:4, 419–436. DOI:10.1080/1464935042000293170.
IPCC 2022. Climate Change 2022. Impacts, adaptation and vulnerability, Summary for Policymakers, IPCC WGII Sixth Assessment Report.
Jahnukainen, M., 2009. Extreme cases. In: Mills, A.J., Durepos, G., Wiebe, E. (Eds.), Encyclopedia of case study research. Sage Publications, London.
Jenkins, K., 2018. Setting energy justice apart from the crowd: lessons from environmental and climate justice. Energy Res. Soc. Sci. 39, 117–121.
Jude, S.R., Drew, G.H., Pollard, S.J., Rocks, S.A., Jenkinson, K., Lamb, R., 2017. Delivering organisational adaptation through legislative mechanisms: evidence from the Adaptation Reporting Power (Climate Change Act 2008). Sci. Total Environ. 574, 858–871.
Juhola, S., 2016. Barriers to the implementation of climate change adaptation in land use planning: a multi-level governance problem? Int. J. Clim. Change Strateg. Manag. 8 (3), 338–355.
Juhola, S., Westerhoff, L., 2011. Challenges of adaptation to climate change across multiple scales: a case study of network governance in two European countries. Environ. Sci. Policy 14 (3), 239–247.
Juhola, S., Glaas, E., Linnér, B.O., Neset, T.S., 2016. Redefining maladaptation. Environ. Sci. Policy 55, 135–140.
Juhola, S.K., 2019. Responsibility for climate change adaptation. Wiley Interdiscip. Rev.: Clim. Change 10 (5), e608.
Jurgilevich, A., Räsänen, A., Groundstroem, F., Juhola, S., 2017. A systematic review of dynamics in climate risk and vulnerability assessments. Environ. Res. Lett. 12 (1), 013002.
Klein, J., Juhola, S., 2018. The influence of administrative traditions and governance on private involvement in urban climate change adaptation. Rev. Policy Res. 35 (6), 930–952.
Klein, J., Araos, M., Karimo, A., Heikkinen, M., Ylä-Anttila, T., Juhola, S., 2018. The role of the private sector and citizens in urban climate change adaptation: evidence from a global assessment of large cities. Glob. Environ. Change 53, 127–136.
Klenk, N., Fiume, A., Meehan, K., Gibbes, C., 2017. Local knowledge in climate adaptation research: moving knowledge frameworks from extraction to co-production. WIREs Clim. Change 8 (5), e475. https://doi.org/10.1002/wcc.475.
Krippendorff, K., 2004. Content Analysis: An Introduction to its Methodology. Sage Publications Ltd., London, UK.
Latulippe, N., Klenk, N., 2020. Making room and moving over: knowledge co-production, Indigenous knowledge sovereignty and the politics of global environmental change decision-making. Curr. Opin. Environ. Sustain. (2020) https://doi.org/10.1016/j.cosust.2019.10.010.
Leiter, T., 2021. Do governments track the implementation of national climate change adaptation plans? An evidence-based global stocktake of monitoring and evaluation systems. Environ. Sci. Policy 125, 179–188.
Lesnikowski, A., Ford, J., Biesbroek, R., Berrang-Ford, L., Heymann, S.J., 2016. National-level progress on adaptation. Nat. Clim. Change 6, 261–264.
Mayer, A.L., 2008. Strengths and weaknesses of common sustainability indices for multidimensional systems. Environ. Int. 34 (1), 277–291.
McCauley, D., Heffron, R., 2018. Just transition: integrating climate, energy and environmental justice. Energy Policy 119, 1–7.
McManus, P., Shrestha, K.K., Yoo, D., 2014. Equity and climate change: local adaptation issues and responses in the City of Lake Macquarie, Australia. Urban Clim. 10, 1–18.
Meerow, S., Newell, J.P., 2019. Urban resilience for whom, what, when, where, and why? Urban Geogr. 40, 309–329.
Meerow, S., Pajouhesh, P., Miller, T.R., 2019. Social equity in urban resilience planning. Local Environ. 24 (9), 793–808. https://doi.org/10.1080/13549839.2019.1645103.
Miller, F., Bowen, K., 2013. Questioning the assumptions: the role of vulnerability assessments in climate change adaptation. Impact Assess. Proj. Apprais. 31 (3), 190–197.
Mohtat, N., Khirfan, L., 2021. The climate justice pillars vis-à-vis urban form adaptation to climate change: a review. Urban Clim. 39, 100951.
Neumann, J.E., Chinowsky, P., Helman, J., et al., 2021. Climate effects on US infrastructure: the economics of adaptation for rail, roads, and coastal development. Clim. Change 167, 4. https://doi.org/10.1007/s10584-021-03179-w.
Nthambi, M., Markova-Nenova, N., Wätzold, F., 2021. Quantifying loss of benefits from poor governance of climate change adaptation projects: a discrete choice experiment with farmers in Kenya. Ecol. Econ. 179, 106831.
O'Connor, C., Joffe, H., 2020. Intercoder reliability in qualitative research: debates and practical guidelines. Int. J. Qual. Methods. https://doi.org/10.1177/1609406919899220.
O'Brien, K., Selboe, E. (Eds.), 2015. The adaptive challenge of climate change. Cambridge University Press, Cambridge.
OECD (Organisation for Economic Co-operation and Development), 2002. Aggregated environmental indices: review of aggregation methodologies in use, Organisation for Economic Co-operation and Development Report No. ENV/EPOC/SE(2001)2/FINAL, Paris, France https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/SE %282001 %292/FINAL&docLanguage=En.
Olazabal, M., Galarraga, I., Ford, J., Sainz De Murieta, E., Lesnikowski, A., 2019. Are local climate adaptation policies credible? A conceptual and operational assessment framework. Int. J. Urban Sustain. Dev. 11 (3), 277–296.
Omukuti, J., 2020. Challenging the obsession with local level institutions in country ownership of climate change adaptation. Land Use Policy 94, 104525.
Parling, I. 2021. Human Rights and Climate Change: Are States Violating the Right to Life by Not Cutting Emissions?. The Swedish Institute of International Affairs, Ui Paper, (3).
Peel, J., Osofsky, H.M., 2015. Climate change litigation (No. 116). Cambridge, Cambridge University Press.
Peel, J., Osofsky, H.M., 2018. A rights turn in climate change litigation? Transnatl. Environ. Law 7 (1), 37–67.
Ponce Oliva, R.D., Montevechio, E.A., Jorquera, F.F., et al., 2021. Water use and climate stressors in a multiuser River Basin Setting: who benefits from adaptation. Water Resour. Manag. 35, 897–915. https://doi.org/10.1007/s11269-020-02753-8.
Preston, B. 2016. The Role of the Courts in Facilitating Climate Change Adaptation (August 16, 2016). The Asia-Pacific Centre for Environmental Law Climate Change Adaptation Platform, SSRN: https://ssrn.com/abstract=2829287.
Rawls, J., 1971. A theory of justice. Original ed. Belknap Press, Cambridge, Mass.
Reckien, D., Salvia, M., Heidrich, O., Church, J.M., Pietrapertosa, F., De Gregorio-Hurtado, S., Dawson, R., 2018. How are cities planning to respond to climate change? Assessment of local climate plans from 885 cities in the EU-28. J. Clean. Prod. 191, 207–219.
Robinson, R.S., 2014. Purposive Sampling. In: Michalos, A.C. (Ed.), Encyclopedia of Quality of Life and Well-Being Research. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-0753-5_2337.
Robinson, S.A., Carlson, D.A., 2021. A just alternative to litigation: applying restorative justice to climate-related loss and damage. Third World Q. 1–12.
Rolfe, J., Scarborough, H., Blackwell, B., Blackley, S., Walker, C., 2021. Estimating economic values for beach and foreshore assets and preservation against future climate change impacts in Victoria, Australia. Aust. J. Environ. Manag. 28 (2), 169–187.
Schlosberg, D., Collins, L.B., 2014. From environmental to climate justice: Climate change and the discourse of environmental justice. WIREs Clim. Change 5 (3), 359–374. https://doi.org/10.1002/wcc.275.
Schlosberg, David, 2004. Reconceiving environmental justice: global movements and political theories. Environ. Polit. 13 (3), 517–540. https://doi.org/10.1080/0964401042000229025.
Schlosberg, D. 2007. Defining Environmental Justice: Theories, Movements, and Nature. (Vol. 9780199286). https://doi.org/10.1093/acprof:oso/9780199286294.001.0001.
Shaw, C., 2015. The role of rights, risks and responsibilities in the climate justice debate. Int. J. Clim. Change Strateg. Manag. 8 (4), 505–519. https://doi.org/10.1108/IJCCSM-10-2014-0127.
Shen, L.-Y., Ochoa, J., Shah, M.N., Zhang, X., 2011. The application of urban sustainability indicators—a comparison between various practices. Habitat Int. 35, 17–29.
Shi, L., Chu, E., Anguelovski, I., Aylett, A., Debats, J., Goh, K., Schenk, T., Seto, K.C., Dodman, D., Roberts, D., et al., 2016. Roadmap towards justice in urban climate adaptation research. Nat. Clim. Change 6, 131–137.
Street, R.B., Jude, S., 2019. Enhancing the value of adaptation reporting as a driver for action: lessons from the UK. Clim. Policy 19 (10), 1340–1350.
Surminski, S., 2013. Private-sector adaptation to climate risk. Nat. Clim. Change 3 (11), 943–945.
Thomas, A., Theokritoff, E., Lesnikowski, A., Reckien, D., Jagannathan, K., Cremades, R., Bowen, K., 2021. Global evidence of constraints and limits to human adaptation. Reg. Environ. Change 21 (3), 1–15.

Thompson, A., Otto, F.E.L., 2015. Ethical and normative implications of weather event attribution for policy discussions concerning loss and damage. Clim. Change 133, 439–451. https://doi.org/10.1007/s10584-015-1433-z.

Tonmoy, F.N., El-Zein, A., Hinkel, J., 2014. Assessment of vulnerability to climate change using indicators: a meta-analysis of the literature. Wiley Interdiscip. Rev.: Clim. Change 5 (6), 775–792.

Tubi, A., Williams, J., 2021. Beyond binary outcomes in climate adaptation: The illustrative case of desalination. Wiley Interdisciplinary Reviews: Climate Change 12 (2), e695.

Wenta, J., McDonald, J., McGee, J., 2018. Enhancing resilience and justice in climate adaptation laws. Transnatl. Environ. Law 8 (1), 1–30. https://doi.org/10.1017/S2047102518000286.

Yang, H., Lee, T., Juhola, S., 2021. The old and the climate adaptation: climate justice, risks, and urban adaptation plan. Sustain. Cities Soc. 67, 102755.