

Defining and conceptualizing equity and justice in climate adaptation

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Abstract:

Diverse disciplines are contributing to the growing body of evidence exploring the interaction between climate adaptation and justice and/or equity. As a result, the literature lacks consistency in how the terms equity and justice are applied and defined, challenging efforts to synthesize evidence and translate it into policy and practice. This scoping review aims to investigate the diversity of ways in which climate adaptation researchers conceptualize equity and justice and synthesize common frameworks to lend insight into emerging practices and future research needs. Our results synthesize 316 articles and highlight several gaps in the literature with respect to specific climate hazards and social identity groups. The results also indicate that very few scholars define and differentiate between equity and justice, but when they do, issues of scale, affected actors, pathways and normative principles are key components in such definitions. We expand on these themes, arguing that there is little utility in adaptation scholars and practitioners coming to complete consensus on best approaches for studying and evaluating equity and justice. Rather, research needs to address the plurality of approaches by being explicit in their definitions and conceptual grounding. We provide guidance for achieving such clarity in both the study and practice of climate adaptation. Finally, we compare common equity and justice frameworks according to their specific utility and most relevant contexts. We conclude by underscoring the importance of pluralism in how equity and justice are measured and defined as it parallels the diverse contexts in which climate adaptation occurs. The results of our review call for more nuanced investigation and communication of the ways in which equity and justice intersect with climate adaptation.

Word Count: 7703

Keywords: Climate Change, Adaptation, Equity, Justice, Scoping Review, Interdisciplinary, Conceptual Framing

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47 1. Introduction

48

49 The impact of climate change, once viewed as a consequence for the future, is now a present-day
50 reality (Pörtner et al., 2022). Scientific experts and policy makers alike underscore the
51 importance of adaptation (defined as the ‘processes of adjustment to actual or expected climate
52 and its effects’ (IPCC, 2014, pp.5), as a critical tool for addressing the climate crisis (Chu et al.,
53 2019; Shi & Moser, 2021). However, adaptation strategies, whether they be diversified
54 livelihood programs or nature-based solutions, are shaped by the institutional systems from
55 which they emerge and are affected by the same injustices and inequities that shape the rest of
56 society (Paavola & Adger, 2006; Walker et al., 2022). In recognition of these interactions,
57 researchers are paying increasing attention to the equity and justice implications of climate
58 adaptation (Araos et al., 2021; Coggins et al., 2021).

59

60 Researchers across disciplines contribute to literature in climate adaptation and social justice and
61 as a result, have relied on a variety of conceptual approaches for investigating issues of justice
62 and equity (J/E). Interdisciplinary scholarship is an important approach for understanding
63 complex issues from multiple angles but can also create a body of work that uses different
64 terminology to discuss similar constructs (Palmer et al., 2016), has unclear gaps in the
65 knowledge and is difficult to summarize (Turner et al., 2015). Simultaneously, policy makers
66 and practitioners require clear guidance and concrete strategies for translating science into policy
67 and practice (Antonopoulou et al., 2021). Scholarship can play an important role in propelling
68 this work, but disjointed and ambiguous literature creates a barrier for such translation of science
69 into practice. This study seeks to help address this issue by reviewing and synthesizing how
70 scholars are conceptualizing J/E. We identify and discuss the diversity of theoretical framings
71 that scholars have applied by systematically reviewing the literature focused on the J/E in the
72 context of climate adaptation. We further discuss the implications for adaptation scholars and
73 practitioners.

74

75 1.1 Climate Justice

76 Issues of J/E are central to understanding how the climate crisis impacts communities around the
77 world (Sultana, 2022). The reality that ‘those least responsible for the crisis are most vulnerable’
78 and subsequent discussions about ‘who has the right to continue to emit versus who as the
79 responsibility to mitigate emissions’ has dominated the discourse on climate justice (Burnham et
80 al., 2013; Okereke & Coventry, 2016). More recently, research focused specifically on
81 evaluating the J/E impacts of adapting to climate change has gained traction as an important
82 aspect of climate justice (Coggins et al., 2021; Owen, 2021).

83

84 Regardless of focus on adaptation to impacts versus mitigation of emissions, climate change
85 scholars rely on a variety of definitions and frameworks of J/E, resulting in a need for literature
86 syntheses providing clarity on how and when such conceptual tools overlap. Thomas and
87 Twyman’s broad definition of climate justice is one of the most frequently cited: “equity and
88 justice, or ‘fairness’, in climate change can be considered in terms of processes, which largely
89 relate to emissions issues, and outcomes, which relate to impacts, vulnerability and adaptation”
90 (2005, pp 116). Further, much of the work investigating the climate crisis from a justice lens
91 applies the seminal work of David Schlosberg, who presents a multidimensional framework of
92 environmental justice (2004). This commonly referenced framework categorizes environmental

93 justice into three dimensions: the distribution of costs, risks, and benefits (distributional justice);
94 the meaningful inclusion of affected groups in decision-making (procedural justice); and the
95 prioritization of the well-being, knowledge, and perspectives of affected groups (recognitional
96 justice). Schlosberg's trivalent approach to justice has been widely used in climate and
97 environmental spaces, and has been adapted and expanded by other scholars to include structural
98 justice, the recognition of institutions and systems that shape people's ability to participate in
99 decision-making processes (Law et al., 2018; McDermott et al., 2013). While this framework is
100 popular among scholars, minimal scholarship has attempted to clarify its relationship with other
101 justice frameworks and its overlap with the concept of equity. For example, in work by Bulkeley
102 et al. studying climate change impacts in urban contexts, the authors discuss the distributional
103 and procedural aspects of justice, but also use rights-based and corrective approaches to
104 conceptualize justice (2013). Work by McDermott et al. uses an adapted version of Schlosberg's
105 trivalent approach in the context of ecosystem services and uses the term equity rather than
106 justice as the key construct (2013). The application of multiple conceptual approaches can
107 increase the nuance with which adaptation scholars collectively investigate justice and equity
108 issues. However further investigation into the linkages and distinctions between approaches is
109 needed before more nuanced understandings of these various approaches can be effectively
110 applied.

111

112 *1.2 Interaction between climate adaptation and issues of justice and equity*

113 As scientists and policy makers increasingly recognize adaptation as a critical strategy for
114 addressing the climate change impacts (Chu et al., 2019; Shi & Moser, 2021), significant
115 literature has started to document the ways in which J/E issues interact with climate adaptation.
116 This body of work demonstrates how historically marginalized communities are subject to pre-
117 existing inequities that increase vulnerabilities and limit adaptive capacity (Anguelovski et al.,
118 2016; Antwi-Agyei et al., 2021; Maru et al., 2014). Research has also shown that adaptation
119 strategies not grounded in J/E considerations can unintentionally exacerbate or create new
120 inequities (Coggins et al., 2021; Aroas 2021), resulting in maladaptation - adaptation strategies
121 that create undesirable outcomes (Bertana et al., 2022).

122

123 The J/E implications of adaptation strategies have been studied at different scales, geography
124 contexts, and thematic areas. Adaptation finance is one field in which this is evident, with
125 numerous recommendations on just and equitable adaptation funding distribution in the literature
126 (Barr et al., 2010; Grasso, 2010; Persson & Remling, 2014). Specifically, Grasso centers
127 distributive and procedural justice in funding allocation, with prioritization of those most
128 vulnerable to the impacts of climate change. Adaptive capacity has similarly been studied with a
129 J/E lens, with a focus on gender (Bhattarai, 2020; Rao et al., 2019.), urban planning (Kokx &
130 Spit, 2012) and agriculture (Abah & Petja, 2017). Rao et al. and Bhattarai focus on gender in the
131 contexts of women's agency in Asia and Africa, and in community forestry in Nepal,
132 respectively. Themes of equity and justice emerge in adaptation policy and governance as well,
133 exemplified by Brockhaus et al.'s work on climate change policies in the Global South (2021)
134 and Mach et al.'s literature on managed retreat in the United States (2019). While these studies
135 are just a small representation of the significant amount of work conducted on this topic, they
136 underscore the diversity of contexts in which climate adaptation and J/E have been discussed.

137

138 Only a small number of studies have attempted to review and synthesize different aspects of
139 research on the nexus of adaptation and J/E. In their review, Coggins et al. investigate the
140 literature empirically assessing the J/E implications of climate adaptation strategies (2021). They
141 assess 1) how J/E are defined within empirical research, and 2) how extensively and rigorously
142 J/E are assessed within this literature. This study includes 68 empirical studies, highlighting a
143 significant gap between the number studies that discuss the J/E implications of adaptation (n =
144 1391), and the number that empirically assess it (n=68). Coggins et al. deductively apply a
145 combination of Schlosberg’s justice typology (2004) and the capabilities approach associated
146 with the work of Nussbaum (2000, 2003) and Sen (1993) to guide their analysis. Another review
147 by Araos et al. (2021) focuses on empirical studies discussing adaptation responses, separating
148 articles into adaptation planning versus implementation. The authors find that 52% of the
149 adaptation planning literature considers issues of J/E while 59% of the adaptation
150 implementation literature considers J/E. Further, in both the planning and implementation
151 studies, income and gender are the most common social identities studied or discussed. Similar
152 to the Coggins et al. (2021), Araos et al. (2021) apply Schlosberg’s justice framework, but only
153 consider distributional and procedural justice in their analysis. Other reviews with more specific
154 scopes, such as adaptation planning in urban contexts (see Swanson, 2021) or inclusive
155 approaches to adaptation (see Pham & Saner, 2021), have also been conducted in recent years.
156

157 Previous scholarship reviewing this literature provides a critical foundation for reaching clarity
158 on how J/E frameworks can be used to achieve more ethical and effective climate adaptation.
159 However, several key questions remain. First, how does the literature beyond the scope of
160 empirical assessments contribute to our collective understanding of the J/E approaches most
161 relevant for studying and facilitating adaptation? Second, what other frameworks or conceptual
162 tools are being applied in this literature, and what are the linkages and distinctions between them
163 and the most commonly used frameworks (i.e., Schlosberg, Sen, Nussbaum)? To address these
164 remaining gaps, our review broadly includes peer-reviewed literature focused on climate
165 adaptation and J/E and we take a more inductive approach to analyzing how scholars define J/E.
166 The specific research questions that guide this review are: 1) What are the publication trends in
167 climate adaptation and J/E scholarship – specifically, what social identities, climate hazards, and
168 geographic contexts have been studied, and using what types of data and methodological
169 approaches? 2) How do climate adaptation scholars conceptualize and define J/E? 3) Do scholars
170 make a distinction between the terms justice and equity? 4) What theoretical frameworks do
171 climate adaptation scholars use to guide their work?
172

173 **2. Methods**

174 *2.1 Article search and inclusion*

175 We conducted a scoping review in concordance with the Preferred Reporting Items for
176 Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)
177 guidelines (Tricco et al., 2018). We searched the following databases: Dimensions (via CU
178 Boulder subscription), Environment Complete (via EBSCO), Social Sciences Full Text (via
179 EBSCO), Web of Science (via Clarivate). The search was conducted by a professional
180 systematic review informationist and included a mix of keywords and subject headings
181 representing ‘climate adaptation’, ‘climate mitigation’, ‘equity/inequity’, ‘justice/injustice’, and
182 others. The search had no time limitations and was completed in May 2022. Articles were
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184 limited to those written in English language. Studies that were not published in academic
 185 journals were excluded. Reproducible search strategies can be found in the Supplemental
 186 Materials.

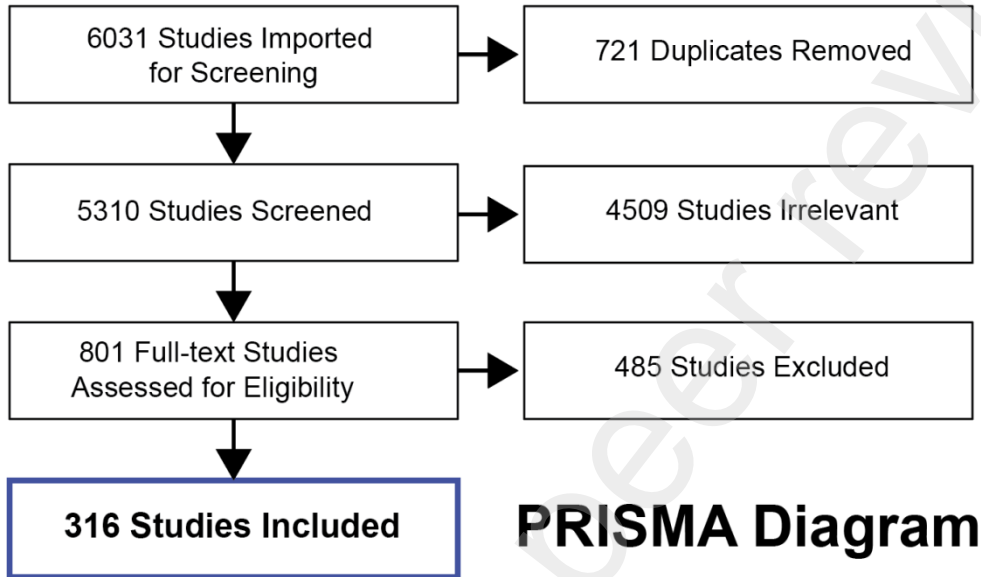
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 188 The searches yielded a total of 6031 citations across all the utilized databases. All citations were
 189 imported into the online screening platform Covidence (Cochrane) via EndNote (Clarivate).
 190 Duplicate citations (n=712) were automatically identified and removed by Covidence. Each
 191 article was independently screened by two reviewers during each stage of the screening process.
 192 A team of four reviewers screened references by title and abstract removing irrelevant articles
 193 that did not align with screening criteria (n=4509). Table 1 outlines this screening criteria. All
 194 disagreements were adjudicated by a third reviewer. Full-text articles (n=801) were screened by
 195 a team of five reviewers using the same criteria used for title and abstract screening (Table 1)
 196 and again, all disagreements were adjudicated by a third reviewer. The full-text screening
 197 excluded 485 studies, leaving 316 studies included in our review. Before both screening phases,
 198 all reviewers pilot screened approximately 38 articles to reach a Fleiss' kappa value of 0.79
 199 (Fleiss, 1971). Study selection is presented in a PRISMA flowchart (Figure 1).
 200

201 **Table 1.** *Inclusion/exclusion criteria*
 202

Criteria for Inclusion	Criteria for Exclusion
1. Peer-reviewed journal article. 2. Explicitly uses the words J/E and they must be a main focus of the paper, (i.e., terms need to be in more than just the introduction or conclusion AND need to be a variable of interest OR a key theme of the paper). 3. Focused on climate adaptation - defined as the adjustment to actual or expected climate change impacts. Includes adaptation strategies, policies, research and planning, funding for adaptation, and adaptive capacity. Authors must use adaptation/adaptive terminology. 4. Discusses the concepts of adaptation and equity in relation to each other - i.e., how equity/inequity influences adaptation or how adaptation influences equity/inequity or other interaction. 5. Available in English	1. Articles that focus only on the impacts of climate change (and not adaptation). 2. Articles that focus only on reducing carbon emissions (climate change mitigation). 3. Articles that focus on a vulnerable or marginalized groups where J/E may be relevant, but the authors don't articulate how J/E are related to climate change adaptation (e.g., study focused on climate adaptation in a low-income country or group but did not discuss how low-income status influenced or was influenced by adaptation). 4. Articles that talk about vulnerability assessments, or resilience but don't study adaptation. 5. Articles that talk about natural disasters but do not describe them as linked to climate change.

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	6. Book chapters, thesis, dissertations, conference abstracts, white papers, and professional reports.
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Figure 1. PRISMA flowchart

2.2 Data extraction of included articles

Data extraction of the included articles (n=316) was completed by 6 reviewers. Data from each article was extracted by one reviewer and checked for errors by a second reviewer. Table 2 outlines the variables extracted from each article. The team of reviewers achieved intercoder reliability by collaboratively practicing extraction, comparing decisions, and discussing any discrepancies. The team practiced coding articles in sets of ten until all reviewers were consistently extracting the same text for each extraction variable. The team practiced extraction on 30 total articles.

Table 2. List of variables extracted from articles

Extraction variable	Description
Journal Discipline	Description of disciplinary focus on journal’s website
Publication date	N/A
Aim of study	Sentences extracted from the article that uses “this study aims to,” “the goal of this study,” “the purpose of this article,” etc.

Type of data collected	Primary, secondary, systematic, or scoping review, conceptual <i>Articles could be coded as multiple</i>
Study design	Quantitative, qualitative, mixed methods, no data <i>Articles could be coded as multiple</i>
Geographic focus	Continent where data was collected <i>Articles coded as 'global' if multiple continents were included</i>
Geographic scale	Local (smaller than national), national, or international <i>Articles could be coded as multiple</i>
Climate change hazard	Air quality, disease vector, drought, extreme heat, flooding, general climate hazards, sea-level rise, storms and hurricanes, wildfire <i>Articles could be coded as multiple</i>
Social identity group implicated	Age/generation, gender, disability, LGBTQ+, nationality or migration status, previously colonized country, race and ethnicity, religion, socio-economic status, vulnerable or historically marginalized groups more broadly, other <i>Articles could be coded as multiple</i>
Equity defined	Term not used, term used but not defined, term defined
Definition of equity used	If defined, text extracted that defines term
Justice defined	Term not used, term used but not defined, term defined
Definition of justice defined	If defined, text extracted that defines term

220

221 2.3 Data analyses

222 Descriptive statistics were conducted in R statistical software (R core team, 2022) to answer
223 research questions about publication trends, adaptation foci, climate change hazards, social
224 identities, geographic context, scale, and study design. For study aim, text extracted from each
225 article was deductively coded using qualitative thematic analysis (Braun and Clark, 2006). A list
226 of study aim themes was created, and articles were subsequently categorized into these themes.
227 For social identity groups, the exact phrasing used in the article to describe the social group was
228 extracted and used to confirm the initial categorization made by reviewers. When appropriate,
229 articles were coded in more than one category to address the complexity and intersectionality of
230 social identities.

231

232 To investigate definitions of J/E, and distinctions between definitions, we conducted a multi-step
233 mixed methods analysis. During the extraction phase, coders looked for the use of the term
234 'equity' or 'justice' in each article, and an explicit definition following the use of the term. For
235 both J/E, articles were then subsequently coded as 'did not use the term,' 'used the term but did
236 not define,' or 'used and defined term'. For the articles coded as 'used and defined', all
237 definitions for both J/E were extracted. Next, two lists of definitions (one for equity and one for
238 justice) were thematically coded separately for definition components using the six-step
239 processes outlined by Braun and Clark (2006) using the qualitative analysis software NVivo
240 (QSR International, 2020). Finally, the dataset was filtered for articles that defined both J/E, and
241 definitions from these articles were used in a comparative analysis (Bazeley, 2013) looking for
242 any distinctions authors made between the definitions of the two terms.

243

244 In addition to analyzing the J/E definitions used in climate adaptation literature, we also explored
245 the most common frameworks authors referenced when defining J/E. Each time an article
246 defined the words 'justice' or 'equity', we extracted the references used in the definition. We
247 then looked at frameworks that were referenced by multiple articles and conducted a
248 comparative analysis of these frameworks. The themes that emerged from our thematic analysis
249 of the J/E definitions guided our comparative analysis.

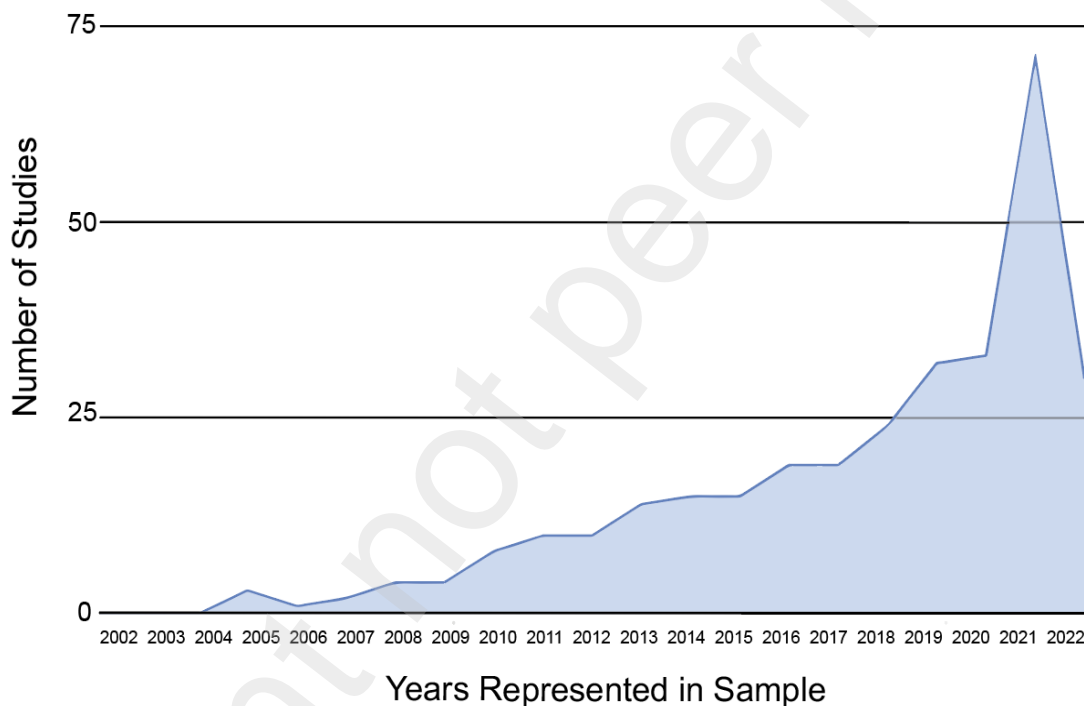
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251 3. Results

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253 3.1 Article publication trends in study design and focus

254 In total, 316 studies met our inclusion criteria. Of these 316 articles, over 36% (n=114) were
255 published in journals self-described as interdisciplinary. The earliest article included was
256 published in 2001, and publication frequency substantially increased over the course of the next
257 20 years, nearly doubling between 2020 and 2021 (see Figure 2).



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259 **Figure 2.** Article publication frequency by year

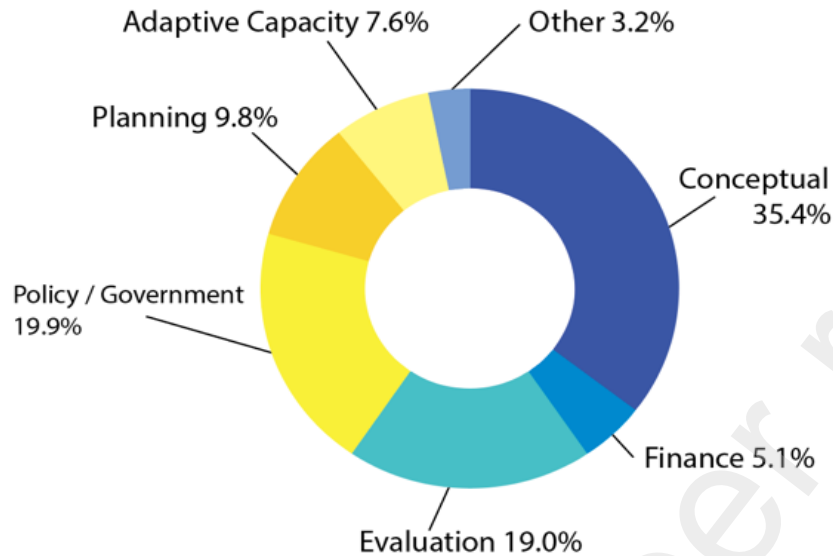
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261 We also extracted information about the study design and type of data used in each article. 42%
262 of papers were conceptual (n=135), 32% relied on primary data, 20% (n=63) utilized secondary
263 data and a remaining 17% (n=54) conducted a systematic or scoping review of pre-existing
264 literature. A significant number of papers did not rely on any data (40%, n=129), while 31%
265 (n=98) employed qualitative methods, 21% applied mixed methods (n= 66), and another 7%
266 (n=23) used quantitative methods.

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268 The articles focused on a variety of adaptation themes. The most frequent theme, representing
269 35% of articles, presented conceptual or theoretical framings for understanding adaptation

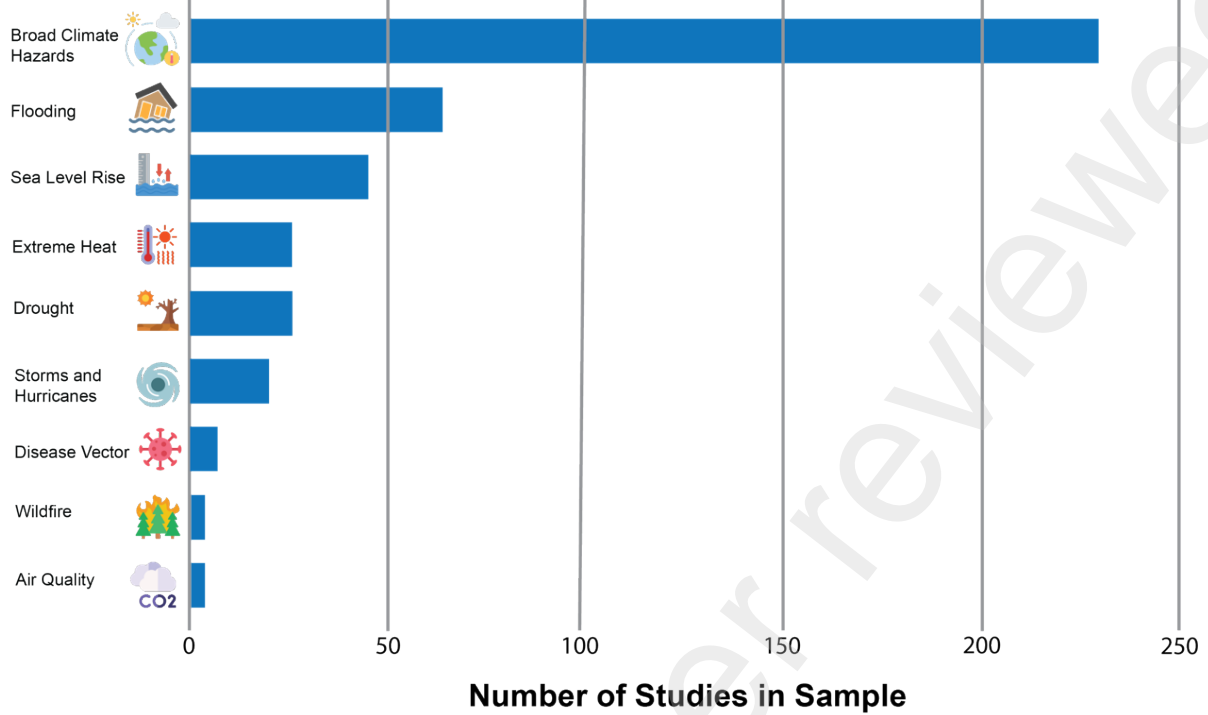
270 without a specific adaptation context, followed by 20% focused on policy and governance issues
271 and 19% discussed the evaluation of adaptation outcomes. Figure 3 illustrates the distribution
272 across of study aim themes.
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275 **Figure 3.** *Distribution of study aim themes of included articles*
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277 The majority of articles discussed climate change hazards generally (71%), while 20% focused
278 on flooding, 14% on sea-level rise, 10% on extreme heat and another 10% on drought.
279 Strikingly, only 1% of papers focused on either wildfire or air quality hazards related to climate
280 change (See Figure 4). A similar pattern emerged around social groups implicated in the J/E
281 issues. Most articles (59%, n =188) used broad language such as ‘vulnerable’ or ‘historically
282 marginalized’ groups. With respect to specific social identities, socio-economic status and
283 race/ethnicity were most commonly addressed, comprising 26% (n=82) and 15% (n=47) of
284 articles, respectively. Social identities such as age, gender, nationality/migration status,
285 Indigeneity, and colonial history were also observed in several articles, whereas religious and
286 LGBTQ+ identities were discussed in very few articles (see Figure 5). Articles were also
287 analyzed for geographic scale and location. 49% (n=150) investigated climate change adaptation
288 locally, 15% (n=47) nationally and 36% (n= 112) internationally. North American and African
289 contexts were the most frequently discussed (see Figure 6).

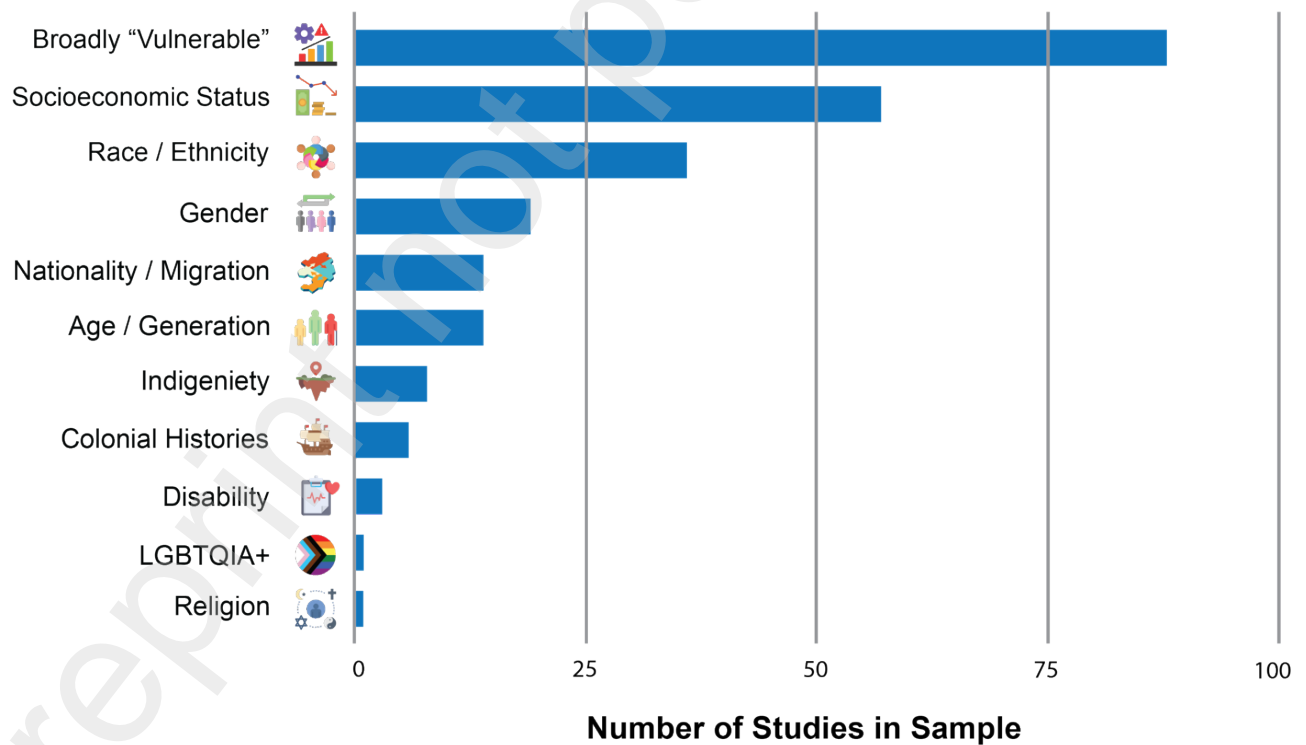
Climate Hazards



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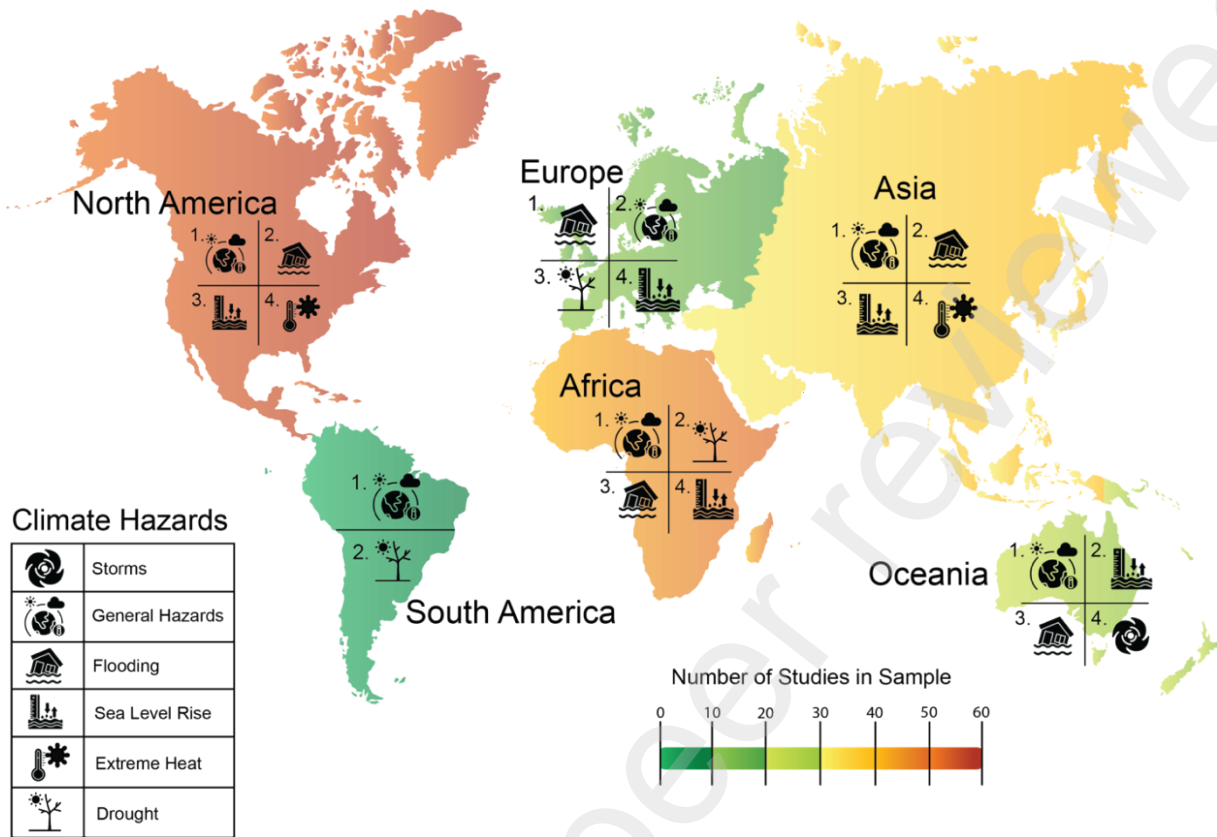
Figure 4. *Distribution of types of climate hazards studied in included articles*

Social Identities



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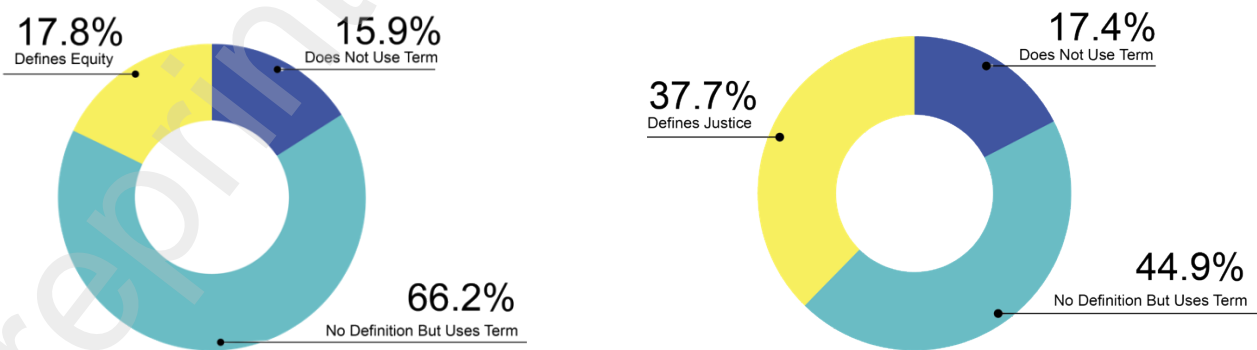
Figure 5. *Distribution of social identities studied in included articles*



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 299 **Figure 6.** Map showing distribution of studies by continent and top hazards studied in each
 300 continent.
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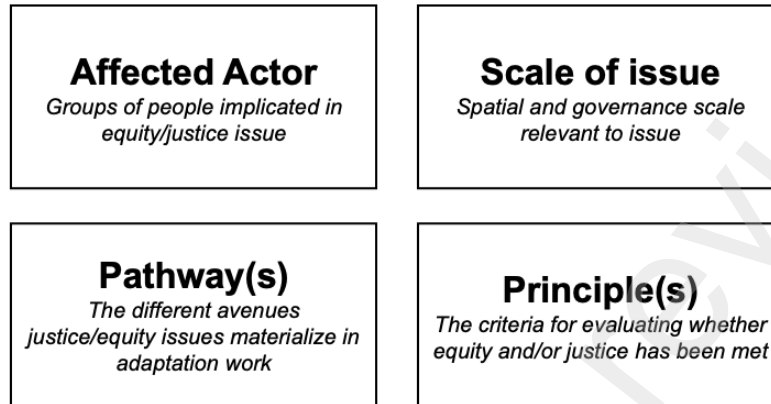
302 **3.2 Defining equity and justice**

303 Regarding the use of the term ‘equity,’ 18% (n=56) of articles used and defined the term, 66%
 304 (n=208) of articles used the term but did not explicitly define it and 16% (n=50) did not use the
 305 term at all. Contrastingly, 39% (n=119) of articles defined the word ‘justice,’ 45% (n=142) used
 306 the term but did not define it and 17% (n=55) of articles did not use the term justice at all (see
 307 Figure 7).
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 320 **Figure 7.** Proportion of studies that defined justice and equity
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322 The included articles used a variety of definitions and conceptual framings to define J/E.
323 However, authors consistently relied on several component themes in their definitions. These
324 components included the *actors affected* by the J/E issue, the *scale* of the issue, the *pathway(s)* of
325 the equity/justice issue and the normative *principle(s)* used as criteria for J/E (see Figure 8).



326

327 **Figure 8.** *Components of equity and justice definitions that emerged from thematic analysis*

328 *Affected Actors.* In nearly all the definitions of J/E, authors explicitly mentioned the various
329 groups of people that were involved in or affected by the climate adaptation issue. While the
330 affected actor component was salient to definitions of both justice and equity, there was
331 significant nuance in how articles described and categorized these actors. As mentioned above,
332 some articles discussed *affected actors* broadly, and others focused specifically on a single, or a
333 few, social identity groups. Regardless, two key patterns emerged in the ways authors studied
334 and discussed *affected actors*. First, some articles defined equity or justice using a comparison of
335 two groups, such as current vs. future generations (McGinlay et al., 2021) or Global North vs.
336 Global South (Chen et al., 2018). Conversely, other articles focused on the experience of a single
337 social group without explicitly referring to another actor(s), such as the labor burden of
338 livelihood adaptation on women, (Bhattarai et al., 2015). Second, if articles used a comparison
339 between two groups in their definition, some definitions were focused on intergenerational group
340 comparisons (e.g., social groups from across different generations), while others made
341 intragenerational group comparisons (e.g., social groups within the same generations).

342 *Scale of issue.* In addition to the actors involved, the *scale of the issue* was commonly included
343 in J/E definitions in reference to both spatial scale and governance scale. Spatial scale was
344 frequently referenced in articles focused on distributive J/E, often in the context of exposure of a
345 particular social group to a climate hazard or risk. Contrastingly, governance scale, referring to
346 the process or entity in a decision-making role (e.g., local, regional, or national governments),
347 was commonly discussed in relation to procedural J/E. Articles referencing both equity and
348 justice constructs relied on scale when defining these terms; however, justice definitions tended
349 to discuss the role of scale uniquely, sometimes including a debate over whether the individual or
350 state was the most appropriate unit of analysis for evaluating the justice implications of climate
351 adaptation.

352 *Pathway or type.* We use the term ‘*pathway*’ to reference the different ways in which J/E issues
 353 materialize in adaptation work. *Pathways* provide a ‘lens’ for identifying issues of J/E.
 354 Distributive, procedural, recognitional and structural J/E (Grasso, 2010; McDermott et al., 2013;
 355 Schlosberg, 2004) are examples of J/E *pathways*. These four *pathways* were the most commonly
 356 applied conceptual tool for thinking about J/E in the climate adaptation literature (described in
 357 more detail below). While some authors refer to these pathways as types of equity and others as
 358 types of justice, there seems to be significant consensus on the differentiation between them.

359 Distributional J/E was the most frequently discussed pathway and refers to the difference in
 360 risks, costs and benefits of climate adaptation experienced by affected actors; it acknowledges
 361 that the distribution of these ‘goods’ and ‘bads’ occurs simultaneously and is interconnected.
 362 Most articles that used J/E terminology were focused on adaptation outcomes (e.g., exposure to
 363 risk, access to adaptation finance), while a smaller number of the justice articles included the
 364 distribution of adaptation responsibilities. Procedural J/E refers to meaningful involvement of the
 365 various actors in decision-making processes and recognitional J/E references the valuing of
 366 experiences, perspectives, knowledge, and well-being of affected actors. A significant number of
 367 studies (albeit fewer) used structural J/E (also sometimes called contextual) to reference the ways
 368 in which historical, systemic, and pre-existing inequities shape or exacerbate other equity or
 369 justice issues. Articles also noted the importance of pluralism, and that these pathways do not
 370 occur in isolation, but simultaneously and in connection to one another. Recently published
 371 articles referenced this pluralism frequently, and explicitly discuss how structural and
 372 recognitional equity lay the ‘bedrock’ for how distributional and procedural pathways occur.
 373 Table 3 provides examples of text from included articles that was coded to the various pathway
 374 subthemes.

375 **Table 3.** *J/E definitions coded to pathways theme and subthemes*

J/E Pathway	Examples of coded text from articles
Distributional	<p><i>“Distributive justice relates to outcomes in society, namely, who is beneficially or adversely affected by a decision or allocation of resources, and relates to the responsibilities and duties of the winners toward the losers”</i></p> <p><i>“We relied on a social justice framework that is based on the understanding that unequally distributed social determinants of health create a situation of inequity among European population”</i></p>
Procedural	<p><i>“In the context of adaptation, procedural justice refers to the level and form of inclusion, participation, and influence of marginalized groups in all stages of the process, including decision-making, planning, implementation, and evaluation of initiatives”</i></p> <p><i>“...justice requires explicit organizational and decision-making processes that ensure participation of affected actors in the planning process”</i></p>
Recognitional	<p><i>“(scholars) refer to recognition as the range of social and cultural values and practices that impede the full recognition of a group as an accepted member of the moral and political community”</i></p>

	<p>“How a problem is framed determines what actors are considered salient for inclusion...”</p>
Structural	<p>“(justice includes) ... the recognition that minority groups are structurally vulnerable and intergenerationally disadvantaged in terms of their cultural political and socioeconomic rights”</p> <p>“Justice theory states that vulnerability is exacerbated when these underlying social and political conditions are not properly recognised in the distributions of goods and risks”</p>

376

377 *Principle.* In addition to *pathways*, another common component of J/E definitions included the
378 normative criteria used to evaluate if J/E was achieved. We use the term ‘*principle*’ to refer to
379 these normative criteria. For example, a *pathway* lens can guide a J/E analysis to focus on the
380 disproportionate amount of adaptation burdens a social group might experience (distributional
381 J/E) but a *principle* lens helps determine how to evaluate what is considered a ‘disproportionate
382 amount.’ Any criterion used to answer this question is normative in nature and includes a
383 multitude of options. The included articles referenced a variety of normative principles that we
384 broadly categorized into *prioritarian, egalitarian, rights-based, capabilities, and corrective*
385 approaches. Articles that used a *prioritarian* principle argued that J/E should be concerned with
386 prioritizing the needs of the most vulnerable, while articles that describe *egalitarian* approaches
387 discussed equal division of resources and processes (see Holtug, 2009 for discussion on
388 prioritarian and egalitarian justice). Articles also applied and discussed *rights-based* approaches
389 (see Tschakert & Machado, 2012 for a discussion about rights-based approaches to climate
390 justice), advocating for a common ‘threshold’ of rights that all groups and individuals should
391 have, while others relied on the *capabilities approach*, a more abstract but widely referenced
392 argument for ensuring everyone can live the life they value (see Nussbaum, 2003 for discussion
393 on capabilities approach to justice). Finally, *corrective approaches* (including compensatory and
394 reparative approaches) focused on historical responsibility and current capacity as criteria for
395 who should pay the costs of equitable or just climate adaptation (see Adler, 2007). Strikingly,
396 definitions of justice frequently discussed these *principles* while equity definitions relied more
397 heavily on the vague and normative term ‘fair’ as the normative *principle*. Table 4 provides
398 examples of text from included articles that was coded to the various principle subthemes.

399 **Table 4.** *J/E definitions coded to principles theme and subthemes*

J/E Principle	Examples of coded text from articles
Prioritarian	<p>“Justice as fairness - and in particular the difference principle: if a decision-maker has no information regarding their position within a society, they would distribute resources to the most disadvantaged groups.”</p> <p>“Adaptation Finance Justice requires that developed country Parties take precautionary measures to assist developing countries to adapt to climate impacts by providing adequate, scaled up, predictable, balanced and new and additional adaptation finance, with priority to those Parties that are particularly vulnerable.”</p>

Egalitarian	<p><i>“Environmental justice is often defined as the principle that, all people and communities are entitled to equal protection of environmental and public health laws and regulations.”</i></p> <p><i>“Justice as fairness... is based on two principles of justice which guides equal, free, and mutually disinterested rational individuals in their judgments concerning their social contract and their economic and social arrangements.”</i></p>
Rights-based	<p><i>Climate justice links human rights and development to achieve a human-centred approach, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate change and its impacts equitably and fairly</i></p> <p><i>“Climate justice, highlights the substantive and procedural rights of individuals, communities, and governments to enjoy - safe, clean, healthy, and sustainable environment and take measures within their national legislative and judicial systems and at regional and international levels to mitigate and adapt to climate change, in a manner that respects human rights”</i></p>
Capabilities approach	<p><i>“Climate justice can be defined as the guarantee of restoring the individual freedoms (or capability) after climate changes or any extreme climatic event through mitigation or adaptation actions”</i></p> <p><i>“Climate change should be designed to... empower individuals while promoting community agency, self-reliance and generating improvements for health and well-being.”</i></p>
Corrective	<p><i>“The case for pre-funding rests primarily on the principle of responsibility, namely that those who have caused a harm should be required to contribute to alleviating the damage they have caused”.</i></p> <p><i>“...historical patterns of development should determine nation states, rights and responsibilities for climate mitigation and adaptation, and frames solutions primarily in terms of emission”</i></p>

400

401 3.3 Distinguishing between equity and justice

402 Of the 316 included articles, 30% (n = 95) used both the terms equity and justice but did not
403 differentiate between them, while 8% of included articles (n = 26) used both terms and made a
404 clear distinction between them. When authors attempted to make distinctions between the
405 definitions, they were often unclear. In the few cases where the distinction was clear, there were
406 a variety of ways in which authors made such a distinction and little commonality across articles.
407 For example, in a few papers, authors argued for equity as a *principle* of justice, describing
408 equity similarly to how other authors described the *principle* of *prioritarian* justice. In one such
409 paper, Grasso described equity as a normative criterion for the “implementation of justice”
410 (2007, pp. 225). Contrastingly, a handful of other articles described equity as an evaluation or
411 state (e.g., a situation is equitable or inequitable) and justice as the corrective action to address
412 the equity concern. In yet another small number of other articles, authors used the term equity
413 vaguely, often relying on the word ‘fair’ in their definitions, and then more deeply discussing the
414 literature and various pathways and principles when articulating justice definitions.

415 3.4 Common references and citations for equity and justice

416 Over two hundred different references were used by authors to define J/E. Below, we outline
417 some of the most frequently referenced frameworks that also represent a diversity of ways to
418 conceptualize J/E. Table 3 categorizes each of the frameworks using the themes that emerged
419 from our thematic analysis (*affected actors, scale, pathways, principles*).

420 **Table 3.** Categorization of common justice and equity frameworks using results from thematic analysis

Authors Citation	Article Summary	Related citations	Justice vs Equity	Affected Actors	Scale	Pathway	Principle
Paavola & Adger, 2006	Conceptual review of social justice dilemmas specific to climate adaptation	N/A	Justice	Vulnerable people, developed vs developing countries	Global	Distributional, procedural	Prioritarian, corrective, egalitarian
<i>Grasso 2010</i>	Justice framework for adaptation funding	Grasso, 2007	Justice	Nation states	Global	Distributional, procedural	Corrective, Prioritarian
<i>Schlosberg 2004</i>	Presents a 3-fold framework for environmental justice	Schlosberg, 2007 Schlosberg, 2012 Schlosberg & Collins, 2014	Justice	Global organizations, NGO's	Global	Distributional, procedural, recognitional	Not discussed but adds a capabilities approach in 2012 reference
<i>McDermott et al, 2013</i>	Presents a multi-dimensional framework for equity in payments for ecosystem services	N/A	Equity	Multiple actors	Local	Distributional, procedural, structural	Review multiple principles
<i>Bulkeley et al 2013</i>	Examines how issues of justice are addressed in climate change projects in multiple cities around the world	<i>Bulkeley, Edwards, & Fuller, 2014</i>	Justice	Global North and Global South cities	Local	Distributional, procedural	Rights-based, corrective
<i>Thomas & Twyman, 2005</i>	Case study approach to understanding equity and justice in climate change livelihood adaptations	N/A	Justice & equity	Natural resource dependent societies in southern Africa	Sub-national	Distributional, procedural	Prioritarian
<i>Hughes 2013</i>	Presents criteria for evaluating justice in climate adaptation in urban communities	N/A	Justice	Cities	Local	Distributional, procedural, recognitional	Prioritarian, capabilities

422 4. Discussion

423 The results of this study indicate that climate adaptation scholarship focused on issues of equity
424 and justice is often broad with respect to social identities, geographies, specific climate hazards,
425 and conceptualizations of J/E. Studies were frequently published in interdisciplinary publications
426 (such as Cities, World Development, Sustainability, and Climatic Change), but a significant
427 number of articles did not clearly define or describe J/E, despite these being important constructs
428 of the study. However, the articles that did provide definitions used similar components within
429 their definitions: *affected actors*, *scale*, *pathway*, and *principle*. Finally, a variety of frameworks
430 were referenced when explaining conceptual approaches, and these frameworks represent the
431 diverse ways in which J/E can be studied.

432 Our findings support several patterns found in other scholarship synthesizing the climate
433 adaptation literature. Like other articles, our analysis highlights how few studies clearly define
434 and describe J/E constructs, despite the increase in publication frequency over the last few
435 decades (Araos et al., 2021; Coggins et al., 2021; Pham & Saner, 2021). Much like the Coggins
436 et al. (2021) review our findings also underscore the high variability in actors, scales, and types
437 of J/E examined across studies. In terms of novelty, our study uniquely broadens the scope
438 beyond that of empirical work and includes conceptual papers (35.4% of included studies).
439 Additionally, our research questions went beyond understanding definitions from a theoretical
440 single lens (i.e., procedural and distributional justice), seeking to understand common conceptual
441 approaches to study J/E in climate adaptation by extracting data on referenced frameworks.
442 These strategies enabled us to compare the diverse conceptual approaches that various scholars
443 employ when studying J/E in climate adaptation.

444 4.1 Gaps and directions for future research

445 Our results highlight disparities in the resources spent studying specific climate hazards and
446 social identities. First, previous studies tend to discuss issues of J/E very broadly, with a majority
447 of included articles using terms such as ‘historically marginalized’ or ‘vulnerable groups.’ Of the
448 studies that focused on specific identities, shockingly few investigated climate adaptation in the
449 context of Indigenous communities. Considering the history of injustice and violence committed
450 towards Indigenous communities globally, and both the vulnerability and resilience to climate
451 change documented in the literature (Ford et al., 2020; Shaffril et al., 2020), these finding points
452 towards a critical gap in the scholarship. In addition, very few articles focus on the experiences
453 of LGBTQ+ communities or people with disabilities. Research in the hazard literature highlights
454 the unique risk posed by climate change to LGBTQ+ communities due to the exacerbation of
455 pre-existing inequalities (housing insecurity, reduced access to social services etc.) that occurs
456 during and after disasters (Goldsmith, Raditz & Mendez, 2021). Similarly, people with
457 disabilities face unique challenges when it comes to the risks of climate change. In their review,
458 Lindsay et al. highlight the lack of resources designed to support people with disabilities as they
459 prepare for and recover from climate change related disasters (2022). Despite this research, the
460 recognition of vulnerabilities to climate related hazards associated with queerness and disability
461 has had very limited representation in the adaptation literature. While frameworks and broad
462 discussions around climate adaptation and historically marginalized groups are important
463 additions to the literature, environmental justice scholars have underscored the essential need to
464 understand the nuance and complexity of specific identities (Amorim-Maia et al., 2022;

465 Mikulewicz et al., 2023). Climate adaptation scholarship needs to work to avoid further
466 marginalizing these groups by relegating them to the margins of the literature (Boderon et al.,
467 2021).

468 Like the generalized approach to studying social identities, the included articles tended to
469 conceptualize climate hazards broadly and very few articles specifically discussed wildfire, air
470 quality, and disease vectors. While there are J/E analyses of these natural hazards outside of the
471 climate adaptation space (Abara et al., 2012; Masri et al., 2021; Miranda et al., 2011), focusing
472 on the nuance of how vulnerable communities experience adaptations to these hazards within the
473 framing of climate change is an important area for future research.

474 4.2 Let's be clear about what we mean

475 One of the most important takeaways from our results is an unsurprising yet important paradox –
476 the included articles are highly interdisciplinary, but most articles also lack specificity and clarity
477 in defining key terms. When articles did define equity and justice as key constructs in their study,
478 there lacked consistency across definitions. To be clear, we are not arguing for a universal
479 definition of J/E to be used across climate adaptation literature. We recognize that such issues are
480 nuanced and complex, and therefore need to be defined and operationalized in ways that are
481 specific to contexts, scales, and the needs of impacted communities. However, the power of
482 scholarship lies in our ability to synthesize findings both to create depth in understanding of
483 specific contexts and to compare across contexts (Silver, 2008). To do so accurately and
484 efficiently, study components need to be clearly defined (Milkoreit et al., 2018). Clear
485 definitions become increasingly important when multiple disciplines are contributing to an area
486 of research and the research has significant application. As a result, we are calling for more
487 clarity through explicit definitions and rich description of what climate adaptation researchers
488 mean when they use the terms of equity and justice, especially when they are key variables or
489 themes of interest in their study (such as in the included 316 articles in this review).

490 Interdisciplinary scholarship is a powerful tool to understand issues and problems from multiple
491 angles, but only when that scholarship can be coherently tied together to build a more collective
492 understanding of a problem. Our findings highlight that climate adaptation scholarship focused
493 on J/E is being conducted using a variety of disciplinary approaches and is rapidly increasing in
494 publication frequency, with a sharp increase in 2021, perhaps as a result of the racial justice
495 movements of the previous year spurred by the murder of George Floyd¹. These findings point
496 towards an increase in resources and energy dedicated to understanding inequities and injustice
497 by adaptation scholars and funders. This is an encouraging trend as such research has the
498 potential to make adaptation practice and policy more just and equitable. However, if we want to
499 overcome the institutional barriers that make translating science into practice so difficult, we
500 must ensure that we are conducting this science with as much clarity as possible and building a
501 body of literature that can coherently highlight both areas of congruence and uncertainty.

502 Our data provide a useful tool for reaching such clarity, particularly the combination of themes
503 that emerged to conceptualize various components of J/E definitions. Rather than agreeing on a
504 single definition, we suggest articulating the *affected actors* that are involved or implicated in the
505 justice or equity issues, the *scale* of analysis, the *pathway* used to analyze the equity and justice
506 issues, and the normative *principle* applied as an evaluative criterion. These themes provide the

¹ The authors recognize that the discussion of the George Floyd murder and potential impact on publication trends deserves a much more significant and nuanced discussion, but is outside the scope of this paper and should be prioritized for future research

507 necessary information to understand which findings, frameworks and implications are most
508 relevant to one another.

509 In Table 3, we compare and contrast some of the most common frameworks used when defining
510 and operationalizing J/E. Our table highlights just a handful of the potential J/E frameworks that
511 have been applied in climate adaptation literature. While it can be hard to know which to apply
512 in various contexts, the delineation between *affected actors*, *scale*, *pathway*, and *principle* is a
513 helpful conceptual tool for determining which frameworks are most applicable to a specific
514 context or adaptation theme. By first determining how J/E issues may materialize (*pathway*) and
515 how one would know if an adaptation strategy was just and/or equitable (*principle*), scholars can
516 then determine which frameworks are most appropriate for their study context. These two
517 conceptual distinctions, in addition to the scale and affected actors, have the potential to
518 transform vague descriptions of J/E into scholarship that is specific and comparable across
519 disciplines and contexts. While categorizing all potential frameworks and creating tools to guide
520 researchers and practitioners is beyond the scope of this review, we think this is an important
521 next step for narrowing the gap between research, policy, and practice.

522 *4.3 Recently published frameworks that provide clarity to justice and equity investigations*

523 In addition to the frequently referenced articles included in Table 3, we would also like to
524 highlight some lesser-known frameworks (most likely due to their recency) that we believe are
525 helpful tools for investigating J/E in climate adaptation. For example, in their work focused on
526 urban adaptation, Amorim-Maia et al. develop a conceptual framework tying together a cross-
527 disciplinary body of literature discussing intersectionality, climate change adaptation, and urban
528 justice (2022). They outline the drivers of injustice associated with urban adaptation strategies
529 and associated intersectional climate justice pathways. Chu and Cannon review adaptation plans
530 and subsequently develop indicators to evaluate the extent to which adaptation plans take into
531 consideration the J/E implications of suggested adaptation strategies (2021). Malloy and
532 Ashcroft synthesize literature on urban climate change governance, climate adaptation, urban
533 planning, social justice theory, and policy implementation, presenting three requirements for the
534 implementation of just adaptation. They argue that just adaptation must incorporate 1) the
535 inclusion of socially vulnerable populations as full participants, 2) adaptation framings that
536 explicitly recognize systemic injustices (frames of resilience, equity, transformation), and 3) a
537 focus on incremental evaluations of implementation. Finally, Leonard proposes a sea-level rise
538 adaptation framework that is explicitly designed and developed by Indigenous scholars and
539 communities, prioritizing Indigenous water security and knowledge systems (2021). These
540 frameworks rely on unique assumptions regarding pathways and principles and can be applied in
541 multiple contexts and scales.

542 *4.3 Limitations*

543 While we believe this review has important implications for future climate adaptation research,
544 there are also some important limitations to the study. First, we recognize our limited ability to
545 extract data that reflects the intersectionality of social identities and groups. Several
546 environmental justice scholars have argued for the use of an intersectional lens to understand J/E
547 in environmental contexts with more nuance (Alvarez & Evans, 2021; Malin & Ryder, 2018).

548 Our data extraction process captured whether an article discussed multiple distinct social
549 identities, but due to limited resources and need for continuity in the extraction process, we did
550 not differentiate between studies that discussed people with multiple identities versus studies that
551 separately evaluated multiple social identity groups. Understanding if and how climate
552 adaptation scholars are considering intersectionality in their work should be a priority for a future
553 review.

554 The second key limitation of this review is a result of the interdisciplinary nature of climate
555 adaptation research. The authors of this review largely distinguish between adaptation and
556 mitigation by defining adaptation as adjustments or changes to deal with the impact of climate
557 change and mitigation as efforts to reduce emissions. However, we recognize that in some fields,
558 and particularly in literature on fire hazards, the terms mitigation and risk mitigation are often
559 similarly to how we think about adaptation (Brenkert–Smith et al., 2006; Meldrum et al.,
560 2019). As a result, this review includes articles that use adaptation language, and might have
561 missed studies that only use the word mitigation when discussing changes or adjustments to
562 expected or actual climate change effects.

563 A third limitation is that we were only able to include studies with an English translation
564 available. Though we sought translation for any studies not written in English, eleven studies
565 were excluded for this reason. Finally, all our data comes from peer-reviewed publications which
566 is inherently an inequitable and unjust space (Demeter, 2020; Skopec et al., 2020). The work of
567 grassroots organizations and those unable to pay high publishing fees are excluded in this sample
568 and analysis. We hope future scholarship can build upon the results of this study to overcome
569 these important limitations.

570 *4.4 Conclusions and key takeaways*

571 The findings from this review contribute to a growing body of literature highlighting a recent and
572 rapid increase in scholarship focused on the J/E implications of climate adaptation. It also
573 underscores the unequal distribution in where, who and in what adaptation contexts such
574 scholarship is focused. Specifically, our review synthesizes the large number of studies that are
575 conceptual rather than empirical in nature and discuss climate hazards and social identities
576 broadly across multiple scales and a variety of geographic contexts. Most significantly, our
577 findings underscore the interdisciplinary nature of J/E and adaptation literature, which we
578 believe explains an additional finding from our review: rarely does the literature clearly define
579 J/E. When authors do define these constructs, there are a multitude of conceptual approaches that
580 guide such definitions. Our subsequent analysis of the definitions and references authors rely on
581 to explain J/E highlights critical definition components. We suggest that the themes from our
582 analysis (*affected actors, the scale, the pathway, and principle*) provide helpful guidance for
583 clearly explaining the nuances of J/E and adaptation work. They can also be utilized to support
584 the selection of frameworks that are best suited for designing and J/E implications of climate
585 adaptation strategies. Interdisciplinary work is a critical tool to understand the multifaceted
586 intersection of social justice and climate adaptation. However, if climate adaptation scholars
587 want to do work that engages multiple types of science and has applied value, they need to think
588 through the complex assumptions often hidden in our vague descriptions of J/E and clearly
589 explain their conceptualizations.

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591 **Declaration of competing interest:**

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

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Supplemental Materials

1. Search Strategies and Results:

Dimensions Search Results

Set #	<i>Each set searched by Title and Abstract</i>	Results
1 Climate Adaptation/ Mitigation	"climate adaptation"~5 OR "climate adaptions"~5 OR "adapting climate"~5 OR "adapting climates"~5 OR (climate? AND (adapt* OR mitigat*))	28,073
2 Equity and Justice	equit* OR inequit* OR equal* OR inequal* OR just* OR injust* OR unjust OR fair* OR unfair* OR marginal* OR disparit* OR disadvantage* OR discriminat*	4,982,239
3	#1 AND #2 <i>Executed as:</i> ("climate adaptation"~5 OR "climate adaptions"~5 OR "adapting climate"~5 OR "adapting climates"~5 OR (climate? AND (adapt* OR mitigat*))) AND (equit* OR inequit* OR equal* OR inequal* OR just* OR injust* OR unjust OR fair* OR unfair* OR marginal* OR disparit* OR disadvantage* OR discriminat*)	3,010
4	#4 limit to Articles publication type	2,143

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818 *Environment Complete Search Results*

Set #		Results
1	((DE "CLIMATE change" OR DE "GLOBAL warming" OR DE "CLIMATE change mitigation") AND TX (adaption OR mitigation)) OR ((TI climate OR AB climate) AND (TI (adaption OR mitigation) OR AB (adaption OR mitigation)))	28,057
2 Equity and Justice	DE "ENVIRONMENTAL justice" OR TI(equit* OR inequit* OR equal* OR inequal* OR just* OR injust* OR unjust OR fair* OR unfair* OR marginal* OR disparit* OR disadvantag* OR discriminat*) OR AB(equit* OR inequit* OR equal* OR inequal* OR just* OR injust* OR unjust OR fair* OR unfair* OR marginal* OR disparit* OR disadvantag* OR discriminat*)	221,498
3	#1 AND #2	2,803
4	#3 Limiters - Publication Type: Academic Journal; Document Type: Article, Editorial, Letter	2,616

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820 *Social Sciences Full Text Search Results*

Set #		Results
1 Climate Adaptation/ Mitigation	(DE "Climate change -- Social aspects" OR DE "Climate change" OR DE "Global warming") OR (TI climate* OR AB climate*) AND (TI (adapt* OR mitigate*) OR AB (adapt* OR mitigate*))	8,083

2 Equity and Justice	DE "ENVIRONMENTAL justice" OR TI(equit* OR inequit* OR equal* OR inequal* OR just* OR unjust* OR unjust OR fair* OR unfair* OR marginal* OR disparit* OR disadvantage* OR discriminat*) OR AB(equit* OR inequit* OR equal* OR inequal* OR just* OR unjust* OR unjust OR fair* OR unfair* OR marginal* OR disparit* OR disadvantage* OR discriminat*)	178,074
3	#1 AND #2	1,029
4	#3 Limiters - Publication Type: Academic Journal; Document Type: Article, Case Study, Editorial, Letter	815

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Web of Science Search Results

Set #		Results
1 Climate Adaptation/ Mitigation	TS=(climate* AND (adaptation OR mitigation))	65,968
2 Equity and Justice	TS=(equity OR equitable OR inequit* OR equalit* OR inequalit* OR justice OR injustice OR unjust OR fair OR fairness OR unfair OR unfairness OR marginalized OR marginalizing OR marginalization OR disparity OR disparities OR disadvantage* OR discrimination OR discriminated OR discriminatory)	1,194,288
3	#1 AND #2	3,792

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2. Full Text Screen Decision Tree

Full Text Screen Accept/Reject Decision Tree - Adaptation & Equity Review

