

1 Examining knowledge and epistemic justice in the design of nature-based solutions for water
2 management

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24 **Abstract**

25 Over the last decade, Nature-based Solutions (NbS) for water management have gained
26 traction as triple-win options for climate action due to their ability to address social, economic,
27 and environmental challenges. Recent developments in the literature of NbS have resulted in a
28 body of work addressing questions about knowledge and justice. In line with these
29 developments, this paper proposes the Knowledge and Epistemic Injustice for NbS for Water
30 Framework (KEIN Framework) to identify the production of epistemic injustices in the design of
31 NbS for water management. The KEIN framework draws on questions about knowledge and
32 power raised by Avelino (2021) and five mechanisms that lead to epistemic injustice based on
33 the work by Fricker (2007) and Byskov (2021). We apply the framework to examine a proposal
34 presented to the Green Climate Fund (GCF) that included NbS for water management and
35 Indigenous Peoples in South America. Rather than being an analysis of the project or the GCF
36 per se, the goal of this analysis is to demonstrate the utility of the framework to analyze
37 proposals during the design stage. We argue that proposals submitted to the GCF are reflective of
38 a broadly held international environmental logic. We also identified indications that knowledge
39 was organized and treated in a way that favored external actors at the expense of local actors.
40 Our analysis also revealed prejudices against people's epistemic capacities, with potential
41 implications for how the generation of local knowledge is adopted on the ground. The
42 framework illustrates how the design of NbS may minimally disrupt power relations due to the
43 influential role that some actors have in generating knowledge. This study contributes to the
44 operationalization of epistemic justice in designing NbS. Through the application of the
45 proposed framework, the study contributes to future work advancing the construction of
46 epistemically just NbS.

47 **1. Introduction**

48 Over the last decade, Nature-based Solutions (NbS) for water management have gained
49 traction as triple-win options for climate action due to their ability to address social, economic,
50 and environmental challenges. However, NbS can be designed or adopted in ways that reinforce
51 existing inequalities or unsustainable practices, such as the promotion of monocropping in place
52 of traditionally-held local agricultural practices or the creation of a carbon trading system that
53 does not consider locally lived experiences, rely on the land marginalized people have
54 historically managed, and vindicate big fossil fuel polluters (1,2). Unjust NbS are likely to result
55 from failure to account for differences in power and knowledge among people involved in and
56 affected by NbS (3).

57 Water is a critical and non-substitutable resource for resilience and sustainable
58 development (4), but water access, safety, and security are increasingly driving vulnerabilities
59 for many communities (5) as climate change unevenly dries and floods regions. Simultaneously,
60 vulnerable communities experience dispossession of water resources by more powerful interests
61 through water grabbing for mining, hydropower, energy, and urban water supply (6). Due to
62 these dynamics, water management interventions in particular have been historically unjust,
63 especially because decision makers often exclude Indigenous and local Knowledge (ILK) and
64 other types of relevant knowledge in decisions and project design (7,8)

65 This paper is motivated by the limited attention that justice has received in the NbS
66 literature (9), particularly epistemic justice. Despite recent literature analyzing knowledge and
67 justice in NbS (3,10–12), epistemic justice remains a marginal topic. In line with these recent
68 articles examining power and knowledge in NbS, this article examines the potential for NbS
69 design to promote epistemic justice and identifies mechanisms through which epistemic

70 injustices can take place. To facilitate greater analysis of these issues, we propose an analytical
71 tool that can help detect and combat epistemic injustices when they occur during the framing of
72 the problem, the design of the NbS, or on the ground. The framework critically engages with
73 questions including: how are the different types of knowledge treated, organized, or used in
74 proposals for NbS seeking to build climate resilient water management practices? Is the
75 knowledge held by outsider actors, such as international institutions who play a key role in the
76 development of NbS, favored at the expense of local knowledge in the design of NbS? Are
77 prejudices against local people's epistemic capacities present in the design of NbS? And, do
78 proposals of NbS projects provide indications that ILK are excluded from the collective body of
79 knowledge?

80 To better understand how actors involved in the design of NbS might commit or
81 reproduce epistemic injustices, we propose a framework (the KEIN Framework) inspired by the
82 empirical questions that Avelino (2021) raises about power and knowledge, in conjunction with
83 Fricker's (2007) and Byskov's (2021) mechanisms that lead to epistemic injustice. Avelino's
84 questions address how knowledge is treated and used during the design stage, which allow us to
85 identify the types of knowledge included in NbS and their underpinning ideologies,
86 normativities, and assumptions while examining how power relations impact the generation,
87 organization, and management of knowledge. The five mechanisms by which epistemic
88 injustices happen, based on the work by Fricker (2007) and Byskov (2021), link questions about
89 power and knowledge with the presence of, or the potential systemic conditions that can lead to
90 the reproduction of, epistemic injustices in the case study. We then applied this framework to a
91 proposal to the Green Climate Fund (GCF) that included both NbS for water management and

92 Indigenous Peoples in South America. Rather than being an analysis of the GCF, we use this
93 case to illustrate the potential utility of the framework.

94 The KEIN framework seeks to explicitly embody the inherent political and contested
95 nature of knowledge and its role in designing NbS. It can also help draw conclusions as to
96 whether the NbS in question is upholding two key elements of a successful NbS – people and
97 biodiversity (1)– by benefitting the people most impacted by the intervention in a just, equitable,
98 and sustainable way while creating a plural knowledge system that allows the integration of
99 different ways of relating to nature.

100 **2. Background**

101 **2.1 Nature-based solutions for water management**

102 The International Union for Conservation of Nature (IUCN) definition of NbS reflects the
103 interconnectedness of climate and societal challenges. NbS are defined as “actions to protect,
104 sustainably manage[,] and restore natural or modified ecosystems that address societal challenges
105 (e.g., climate change, food and water security or natural disasters) effectively and adaptively,
106 [while] simultaneously providing human well-being and biodiversity benefits” (16). NbS for
107 water management refer to the practices that use natural processes to improve water availability,
108 water quality, and/or reduce risks from and vulnerability to weather-related events such as floods
109 and droughts (UNESCO, 2018). Some of these solutions include riparian buffer strips, the
110 construction or restoration of wetlands and/or mangroves, reforestation, green roofs, dry toilets,
111 and soil management practices that improve moisture retention and water recharging capacities
112 (18,19).

113 Human activities and climate change represent major threats to water availability,
114 biodiversity, and social prosperity. About half of the global population live in places with a high

115 risk of water insecurity (20). The main human activities driving negative impacts on global water
116 availability are irrigation, agricultural expansion, and urbanization (21). Land-use activities
117 disrupt landscapes and the waterflows and water resources which ultimately impacts water
118 availability and local ecosystems (22). Biodiversity loss in water ecosystems is also a major
119 concern. Freshwater populations have higher rates of loss compared to terrestrial ecosystems and
120 fish vertebrate populations, including fish and amphibians, have fallen by 69 percent between
121 1970 and 2018 (23). These challenges are compounded by powerful actors controlling and
122 diverting water resources for their own benefit at the expense of local communities (24).

123 Climate change, on the other hand, can disrupt water resources and ecosystems with
124 social implications. The streamflow changes caused by changes in precipitation patterns have
125 been found to have a more severe impact on future water crises than previously thought (25).
126 Due to sea level rise, saltwater intrusion makes land inadequate for farming, thus influencing
127 social choices, such as migration (26). Extreme weather events, e.g., flooding and droughts, and
128 continued glacier loss, are major disruptors in hydrological flows (21). Furthermore, higher
129 precipitation in shorter periods of time or longer periods of drought characterize the challenges
130 that contribute to the destruction of the natural resources that provide communities with
131 livelihoods and social meaning (27–29). These examples illustrate the important role that NbS
132 for water management play in simultaneously responding to climate change, human well-being,
133 and biodiversity.

134 **2.2 Nature-based solutions and Indigenous and local knowledge**

135 NbS are not only technical solutions but also social and politically contested
136 interventions. Depending on who and whose knowledge is accounted for during the design of
137 NbS, these interventions can contribute to unjust outcomes, the unjust judgment of people's

138 epistemic capacities, unfair denial of knowers’ rights and their knowledge, and the exacerbation
139 or continuation of their existing vulnerability. This leads to a moral and ethical imperative to
140 engage all relevant actors in the creation and adoption of NbS that “foster ownership,
141 empowerment, and wellbeing of the local stewards” (1,30).

142 ILK refers to “the knowledge and know-how accumulated across generations, which
143 guide human societies in their innumerable interaction with their surrounding environment” (31).
144 It is widely recognized that ILK is valuable for NbS. Global institutions critical for the advocacy
145 and deployment of NbS recognize ILK as a disseminator of practices that build sustainability and
146 resilience (32–34). Indigenous People and local communities (IPLC) have historically used their
147 knowledge to manage and steward land and water resources while protecting global biodiversity
148 (35–37). ILK has been critical in responses to drastic changes in precipitation by enabling the
149 development and adoption of practices that decrease water inputs (38). Including ILK is critical
150 for supporting stewardship, improving adaptive capacity and management, incorporating equity,
151 creating meaningful opportunities for empowerment, and enabling longevity (1) (Table 1).
152 Despite the recognition of its value, ILK has not always been integrated into the design of NbS.

153 **Table 1. Value of Indigenous and Local Knowledge for Nature-Based Solutions for Water**
154 **Management.**

Reason	Explanation	Source
Stewardship	As the stewards of their lands and natural resources, IPLC can hold rich knowledge of local ecosystems and their management and insight into what works in their specific environmental, socio-economic, and political context. Undermining or ignoring local knowledge could result in poor and ineffective land management decisions.	Appadurai, 2018; Chatterjee, 2020; Leach & Mearns, 1996.
Adaptive	Co-creating NbS with IPLC that are tailored to the local context can facilitate adaptive capacity and management and capacity.	Sterling et al., 2017.

Equity	Local information about the diverse values of nature and how these differ across sectors of society is crucial to the equitable distribution of benefits.	Zafra-Calvo et al., 2020
Empowerment	NbS involving a more equitable distribution of power between local communities and government are more likely to have positive outcomes for both people and ecosystems.	Hajjar et al., 2021.
Duration	NbS that take account of diverse local norms, values, and beliefs to build social capital are more likely to be adopted by IPLCs and supported long term, encouraging stewardship and care.	Chan et al., 2016; Fischer et al., 2021.

155 *Based on Seddon et al. (2021)*

156 The hegemonic position of western worldviews in environmental governance (47) has
157 contributed to framings of nature that exclude different “ways of knowing and relating to nature”
158 (3). This exclusion limits the incorporation of reciprocal relations that are central to ILK (48,49),
159 which could help address the current general knowledge gap in designing and planning NbS that
160 follow less anthropocentric approaches (50). The framing of NbS that relegates ILK to the
161 sidelines can also impact how nation-wide climate policies structure NbS in ways that do not
162 clearly support or promote Indigenous self-determination (Reed et al., 2022). Other challenges
163 include: 1) gaps in the literature in which ILK assessments from the Arctic are overrepresented
164 relative to Latin America and other regions in the Global South, 2) insufficient resources to
165 assess ILK, and 3) lack of policy engagement with multiple knowledge systems (McElwee et al.,
166 2020). It is not surprising, therefore, that the integration of different ways of knowing in NbS and
167 their contribution to outcomes that go beyond incremental change has been limited (3).

168 **2.3 Epistemic justice**

169 The treatment of knowledge has important implications for creating just NbS and
170 mitigating or preventing epistemic injustices. Epistemic justice occurs when an individual or a

171 group of people are treated equally as knowers, whereas an epistemic injustice occurs when an
172 individual or epistemic group or community's knowledge is unfairly valued based on prejudices
173 about that individual (14,15). Epistemic injustices include sexism that excludes women from
174 scientific research or decision-making processes, racism that discounts Indigenous or
175 marginalized groups' knowledge, and climate colonialism (52–54). For NbS, there is a real
176 danger of not treating local communities as agents who have rich local knowledge, capable of
177 exercising choice and decision-making, or labelling them as backward, ignorant, or incapable of
178 being at the driver seat of NbS projects (1,55).

179 Building on Fricker's (2007) work, Byskov (2021) identifies five mechanisms through
180 which epistemic injustices can occur (Table 2). Epistemic injustice occurs through
181 marginalization when the terms or conceptual frameworks to understand the lived experiences of
182 marginalized groups are not included in the collective pool of knowledge. When a knower's
183 insight or knowledge is not taken seriously due to prejudices based on any number of aspects of
184 the knower's identity, including their gender, socioeconomic status, social background, accent,
185 ethnicity, or race, an epistemic injustice through prejudice occurs. Epistemic injustice through
186 the stakeholder and rights-holder exclusion mechanism occurs when a knower who is affected by
187 the NbS is denied their right to participate in decision-making processes. The expertise exclusion
188 mechanism is when an actor with relevant knowledge about the NbS is excluded in the decision-
189 making process, i.e., a financial consultant is given a say in a coastal management project but a
190 social scientist with local expertise in environmental justice is left out of the table. This
191 mechanism differentiates the exclusion of people with relevant subject knowledge from decision-
192 making and situations that discount knowledges and experiences from the collective pool of
193 knowledge (Byskov, 2021). The structural injustices mechanism refers to the recognition that

194 there are prior contextual conditions that are part of systemic injustices that exacerbate the other
195 four mechanisms of epistemic justice. Given the importance of context in NbS, prejudiced or
196 exclusionary framings of ILK limit the treatment of lived experiences as knowledge that
197 provides “insight into patterns, common behaviors, challenges, and barriers among individuals
198 who share similar experiences” (56).

199 **Table 2. Five Mechanisms through which Epistemic Injustices can occur.**

Mechanisms	Definition
Marginalization	<p>When a society itself lacks the terms or conceptual frameworks to understand, interpret, or convey an individual or group’s lived experiences. This normally advantages the powerful whose experiences are typically represented in the collective body of knowledge and disadvantages the less powerful because their experiences and knowledge are lacking from the collective pool of knowledge.</p> <p>Result: Unfair outcome</p>
Prejudice	<p>When a speaker or knower is valued more or less based on prejudices. These prejudices can be positive or negative, implicit or explicit. Prejudices might be based on gender, race, ethnicity, accent, or socioeconomic status.</p> <p>Result: Unfair judgment about capacity as a knower.</p>
Stakeholder and Rights-Holder Exclusion	<p>When a knower is excluded from a decision-making process that the knower would be directly affected by. The relevance of the knowledge is not pertinent to this mechanism.</p> <p>Result: Unfair denial of knower’s rights.</p>
Expertise Exclusion	<p>When a knower has relevant knowledge about the subject matter that is being excluded from the decision-making process.</p> <p>Result: Unfair denial of knower’s knowledge.</p>
Structural Injustices	<p>When the prior mechanisms are connected to larger structural injustices, e.g., racism, sexism, socioeconomic inequalities, or marginalization.</p> <p>Result: Unfair exacerbation or continuation of existing vulnerability.</p>

200 *Based on Fricker (2007) and Byskov (2021).*

201 **2.4 Implications of epistemic justice for other dimensions of justice**

202 Epistemic justice is inherently intertwined with four dimensions of justice: distributive,
203 procedural, recognition, and restorative (57,58). The interconnectedness between these different
204 dimensions of justice helps articulate the critical role of knowledge and epistemic justice in
205 building just NbS for water management. Epistemic justice contributes to distributional justice in
206 terms of the credibility given to actors in relation to each other (59). Epistemic justice also
207 requires the just distribution of educational goods and services that are critical for people for
208 accessing information, learning, and generating knowledge (60). Building more epistemically
209 just NbS can contribute to improvement in distributive effects that can lead to the fair allocation
210 of rights, duties, risks, hazards, and harms. The unjust distribution of credibility can have adverse
211 distributional effects. The Flint Water Crisis that particularly affected Flint, Michigan’s Black
212 residents is an example of the connection between epistemic justice with clear distributive
213 impacts, where the community’s knowledge about the presence of lead in their water was not
214 given credibility by officials (61).

215 Epistemic justice also contributes to building procedural justice. This is the case when the
216 design of NbS includes relevant knowledges as part of processes that treat people with dignity,
217 are perceived as trustworthy, address implicit biases, and are applied equally to everyone
218 disregarding their identity (62,63). NbS that are locally-apt and co-produced by partners, include
219 multi-level governance, and particularly Indigenous People and local communities, who together
220 negotiate ethics, values, needs, and ontologies to overcome existing power imbalances have the
221 potential to contribute to broad, long-term visions of just processes of social change (64–66).
222 Even when procedures claim to be just and neutral (62), it is critical to question to what extent
223 this is true and whether these procedures discount knowledges and lived experiences in the

224 different stages through which NbS come to fruition. When participation is just a formality
225 where boxes are ticked (1) or where consultation and informed prior consent takes place after
226 key decisions have already been made (12), NbS risk failing to meaningfully include people who
227 have been traditionally marginalized, such as IPLC.

228 Epistemic and recognitional justices are also entwined. NbS that meaningfully account
229 for knowledges and lived experiences of all relevant actors, recognize IPLC institutions, the
230 provision of resources to marginalized groups, and the fairness of government-to-government
231 relations (67). Epistemic justice can help recognize IPLC's ability to withstand, respond, and
232 adapt to the imperialist, colonialist, and capitalist systems imposed on them (68); where equal
233 respect is not a function of assimilating to the norms of the dominant group or the majority (69)
234 and there is a full recognition for a variety of flows of knowledge towards the construction of
235 pluriverse systems of knowledge (70). When prejudiced views of non-western epistemologies
236 prevent understanding the contexts in which IPLC have endured lengthy and continued
237 marginalization and subordination (71), NbS can fail to build both epistemic and recognition
238 justice and reinforce paternalistic dynamics.

239 NbS that build epistemic justice can help answer the three foundational questions of
240 restorative justice. That is, who has been harmed, what those who have been harmed need, and
241 establish who is responsible to meet those needs (72,73). NbS that also build epistemic justice
242 can also contribute to building restorative justice by providing guidance on how to create
243 substantive means necessary for people to have prosperous lives by, for instance, giving land
244 back to those who have been displaced from their homes or to establish grievances mechanisms
245 for those who need them (16,74). Without including ILK in the design of NbS in ways that

246 intend to redress harms, these solutions risk not being durable due to being perceived as
247 illegitimate.

248 **2.5 Power and knowledge**

249 Knowledge is inherently intertwined with power, so it is necessary to understand the way
250 relevant or related knowledge is utilized (Avelino, 2021). Knowledge is not independent of
251 context; time, location, relations are factors that shape the production of knowledge (70,75). Hall
252 et al. (2011) define this process as the legitimization of knowledge and argue that this is one type
253 of power (along with regulation, force, and market) that facilitates the exclusion of certain
254 groups from water and land resources. Through this legitimization, actors in dominant positions
255 use “narratives, rhetoric[,] and argumentation” to create meanings that will then be “established
256 and accepted as ‘truth’” (77). Even when ILK is considered in the design stages of NbS,
257 concerns remain as to whether ILK is understood on its own terms (78) or treated narrowly in
258 terms of participation and inclusion at the expense of quality of engagement and including ILK
259 at the right time (10,12).

260 This knowledge can “be (ab)used to exercise power in/over” (13) decision-making
261 processes where these projects are designed, funded, implemented, and monitored. For instance,
262 multi-stakeholder partnerships have been found to favor professional knowledge that tend to
263 disregard the social burdens created by NbS (10). In stormwater management projects, favoring
264 hydrology and landscape disciplines comes at the expense of biodiversity and ecology whereas
265 in the creation of urban green spaces, local community knowledge is excluded to favor
266 international consultants (12). These examples show how the organization and control of
267 knowledge is “an important dimension of power” where “the diffusion of new ideas and
268 information can lead to new patterns of behavior and prove to be an important determinant” of

269 policy development and coordination (79). These cases are also exemplary of how the
270 legitimization of some knowledges facilitate the exclusion of others (77). That is why even when
271 ILK is considered in proposals, concerns remain as to whether ILK is understood on its own
272 terms (78) or treated narrowly in terms of participation and inclusion at the expense of quality of
273 engagement and including ILK at the right time (10,12).

274 As broad, long-term visions including just processes, those framing, designing, and
275 implementing NbS must recognize that avoiding epistemic injustices requires building social
276 equality. To accomplish this, NbS should prevent “new patterns of unequal power,” where
277 “reasonable efforts and avoid[ing] bad faith” will not suffice (Fricker, 2017). That is why
278 valuing, incorporating, and centering the experiences of those knowers who have been, and
279 remain, marginalized is critical to building NbS that redistribute power such that communities
280 gain control over their own environment. NbS that foster epistemic justice necessarily move
281 away from technocratic solutions to place more emphasis on individual and social learning (80).
282 This is especially important for NbS projects that are meant to be heavily based on “providing
283 human well-being” (IUCN, 2020b).

284 Avelino’s (2021) framework for studying power is a helpful approach to examine how
285 knowledge is treated and whether those leading NbS are (ab)using knowledge to exercise power.
286 This framework explores power in processes of social change and innovation. One section in
287 Avelino’s framework addresses the interrelatedness of power and knowledge to propose a set of
288 empirical questions (Table 3). Using these questions to analyze NbS is appropriate for several
289 reasons. First, NbS are an example of a process of social change and innovation. As opposed to
290 more traditional gray infrastructure and technology investments, NbS are often considered an
291 innovative approach to sustainable development (81–83) and framed as political interventions

292 with an explicit goal to address social challenges (58). Second, using these specific questions
293 Avelino raises about power and knowledge can serve as the basis to draw connections between
294 the treatment of knowledge and the mechanisms through which epistemic injustices occur.
295 Without an explicit identification of these types of injustices, these injustices might remain
296 concealed, preventing the development of mechanisms to combat them.

297 **Table 3. The role of power and knowledge in the design of NbS.**

298

	Type of Consideration	Questions
1	Kinds of knowledge	What kind of knowledges, discourses, ideologies, and normativities underly the design of NbS implicitly or explicitly?
2	Co-evolution with power	How is knowledge of and discourse on NbS co-evolving with power dynamics in the change process?
3	Organization	How is knowledge in the context of NbS organized, for and by whom?
4	Change	How and to what extent is knowledge about NbS changing? How does the NbS involve a shift in power relations?
5	Mobilization	How and to what extent is knowledge mobilized as an object of change? As an instrument for enabling/constraining change?

299 *Based on Avelino (2021)*






300 **2.6 The knowledge and epistemic injustice for NbS for water (KEIN)**

301 **framework**

302 The Knowledge and Epistemic Injustice for NbS for Water Framework (KEIN
303 Framework) is the analytical tool that we propose in this study. The KEIN Framework is aimed
304 at improving our understanding about 1) how knowers and their knowledges are treated and 2)
305 how epistemic injustices impact the valuable contribution that ILK can provide to NbS. More
306 specifically, in our framework, we use Avelino's question on power and knowledge due to their
307 relevance to analyzing epistemic justice in the design of NbS. Table 3 introduced these five

308 questions as: kinds of knowledge, co-evolution with power, organization, change, and
309 mobilization. These questions help reveal how the different mechanisms lead to epistemic
310 injustices during the design of the NbS. For instance, the Kinds of Knowledge question allows
311 for the identification of how ILK and other types of knowledges are framed in ways that
312 implicitly or explicitly underlie prejudices against ILK and marginalized people. In Table 4 we
313 intersect these questions with the mechanisms that lead to epistemic injustices (Table 2) to
314 illustrate how the KEIN Framework enables the analysis of how injustices compromise the
315 different values of ILK for NbS: *stewardship, adaptive capacity and management, equity,*
316 *empowerment, and duration* (Table 1). Prejudiced views against ILK, for instance, impact
317 whether people's expertise about agricultural practices are included in the design of NbS with
318 potential implications on stewardship and duration. While motivated by the desire to increase
319 epistemic justice in NbS, the framework focuses on the identification of epistemic injustices,
320 since analytically speaking, it is a more feasible task than the identification of justice.

321 **Table 4. The Knowledge and Epistemic Injustice for NbS for Water Framework - KEIN Framework.**

		Questions about Power and Knowledge (Avelino, 2021)				
		Kinds of Knowledge	Co-evolution with Power	Organization	Change	Mobilization
Mechanisms by which Epistemic Injustice can Occur (Fricker, 2007; Bykov, 2021)	Marginalization 	When market ideologies lead to the minimization or misconstruction of ILK, it impacts <i>stewardship, adaptive capacity and management</i> , and the <i>duration</i> of the NbS.	When the ways powerful actors value ecosystems are favored, it impacts <i>stewardship, adaptive capacity and management, equity</i> , and the <i>duration</i> of the NbS.	When NbS are organized to narrowly focus on delivering benefits for powerful actors, it affects NbS <i>legitimacy</i> and their <i>stewardship, equity</i> , and <i>duration</i> .	When local norms, values, and beliefs are excluded, it impacts <i>stewardship, equity, empowerment</i> , and the <i>duration</i> of the NbS.	When ILK is viewed as a constraint for change, it impacts <i>stewardship, equity, empowerment</i> , and the <i>duration</i> of the NbS.
	Prejudice 	When racist prejudices underestimate IPLC's epistemic capacities, it impacts <i>stewardship, adaptive capacity and management</i> , and <i>equity</i> .	When gender stereotypes reinforce patriarchal structures, it impacts <i>stewardship, equity</i> , and <i>empowerment</i> .	When paternalistic views justify a top-down organization of knowledge, it affects <i>adaptive capacity and management, equity, empowerment</i> , and <i>duration</i> .	A lack of mechanisms to address implicit bias impacts <i>stewardship, equity</i> , and the <i>duration</i> of the NbS.	When paternalistic dynamics view IPLC as illegitimate producers of knowledge, it impacts <i>stewardship, adaptive capacity and management, and empowerment</i> .
	Stakeholder & Rights-holder Exclusion 	When "box-ticking" participation is viewed as sufficient, it negatively impacts <i>equity</i> and <i>adaptive capacity and management</i> .	When techno-managerial approaches that centralize decision-making at specific institutions are prioritized, it negatively affects <i>equity</i> and <i>empowerment</i> .	When knowledge is not co-created with actors impacted by the NbS, it affects <i>adaptive capacity and management and equity</i> .	A lack of engagement with a diverse set of actors to create climate strategies through NbS limits <i>adaptive capacity and management and empowerment</i> .	When working in Indigenous territories, if Indigenous Peoples experts are not used, it can negatively impact <i>adaptive capacity and management, equity</i> , and <i>empowerment</i> .
	Expertise Exclusion 	When classism leads to the exclusion of actors with expertise (i.e., farmworkers), it negatively impacts <i>stewardship, adaptive capacity and management</i> , and <i>equity</i> .	When approaches frame change in terms of technology and markets but deemphasize social interventions, it affects <i>equity</i> and <i>empowerment</i> .	When knowledge is not co-created with actors with relevant knowledge about the NbS, it affects their <i>stewardship, adaptive capacity and management</i> , and the <i>duration</i> of the NbS.	When the knowledge of actors with a privileged status is favored at the expense of actors pursuing climate justice, it affects <i>stewardship, adaptive capacity and management, and equity</i> .	When ILK is viewed as a constraint to build resilience, it impacts <i>stewardship, equity</i> , and <i>empowerment</i> .
	Structural Injustices 	When NbS discourses disregard larger structural injustices, they negatively impact <i>equity</i> and <i>empowerment</i> .	When NbS is assumed to be neutral, it discounts prior mechanisms contributing to systemic injustices which impact <i>equity</i> and <i>empowerment</i> .	When government institutions misconstrue their own contribution to structural injustices, it negatively impacts <i>empowerment</i> .	When mechanisms to ensure IPLC are in the driver seat during the creation of NbS are lacking, it negatively impacts <i>stewardship, adaptive capacity and management, equity, and empowerment</i> .	When ILK is viewed as a constraint to re-shaping local governance of environmental resources, it affects <i>stewardship, adaptive capacity and management, and empowerment</i> .

322 The KEIN Framework uses questions connecting knowledge and power (columns) to articulate how each mechanism of epistemic
 323 injustice (rows) devalue Indigenous and Local Knowledge for NbS (in bold and italics). The examples included in the intersections of
 324 this table are not exhaustive. They represent the different ways the KEIN Framework can help highlight how epistemic injustices can
 325 occur.

326 To analyze the marginalization mechanism, the framework seeks to answer if ILK or
327 other ways of knowing are framed in ways that advantage the actors who have more power and
328 whose experience are more represented in the collective pool of knowledge. For the prejudice
329 mechanism, we assess whether prejudices against ILK or local people's epistemic capacities are
330 present during the design of NbS. For both the stakeholder and rights-holder exclusion and the
331 expertise exclusion mechanisms, we look for indications of exclusion of actors during the design
332 of NbS for water management. More specifically, actors who are either affected by the NbS or
333 who have relevant knowledge about the NbS. Finally, we examine the structural injustice
334 mechanism by asking if larger drivers of systemic injustices are dismissed or minimized.

335 **3. Methods**

336 We demonstrate the potential value of the KEIN framework through a case study of a
337 project proposal submitted to the Green Climate Fund (GCF). Our aim is to use this case study as
338 an illustrative example of how the KEIN framework can be used to determine epistemic
339 injustices being committed or unequal epistemic relationships being reproduced.

340 **3.1 Case study selection**

341 As the largest multilateral source of dedicated climate finance for developing countries,
342 analyzing one of the GCF-funded NbS for water management projects provides an illustrative
343 case of how international climate finance structures NbS in ways that reflect the dominant logics
344 of international development projects. The proposal is publicly available data that provides
345 meaningful information of NbS at the design stage. Established under the UNFCCC framework,
346 the GCF supports developing countries with financial resources to implement mitigation and
347 adaptation projects, including projects that utilize NbS. The types of NbS for water that the GCF

348 has supported include wetland restoration, water conservation, river restoration, intercropping,
349 rainfed irrigation, and green roofs (84). As of August 2022, the GCF had invested a total of USD
350 489 million in water security projects following two paths: 1) enhancing water conservation,
351 water efficiency, and water re-use, and 2) strengthening integrated water resources management
352 (85).

353 Proposals submitted to the fund are reviewed and approved by the board based on six
354 criteria: potential for a) impact, b) paradigm shift, and c) sustainable development; d) the needs
355 of the recipient; e) country ownership; and f) efficiency and effectiveness (86), which have
356 important connections to knowledge and epistemic justice. Impact determines the project's
357 contribution to achieve GCF's mitigation and adaptation goals through quantitative and
358 qualitative information such as greenhouse gas emissions reductions or the number of direct and
359 indirect beneficiaries. For epistemic justice, who and whose knowledge and lived experiences are
360 included in these indicators can have important implications on how, for instance, rights, harms,
361 participation, and decision-making power are justly distributed. Paradigm shift determines the
362 project's potential for knowledge-generation and learning. As part of this criterion, knowledge is
363 characterized as a vehicle to innovate, replicate, and upscale solutions at sub-national and
364 national scales (84,86). Needs of the recipient is defined in terms of the state of vulnerability of a
365 country's population, which is relevant for the knowledge and lived experiences of vulnerable
366 populations that remain excluded from the collective understandings of vulnerability. Country
367 ownership considers local institutions' capacity to engage with relevant actors and partners
368 which has important implications for how knowledge is collected, managed, and organized.
369 Across these criteria, scholars have argued that the dominant logics of science and the market
370 have shaped the GCF and marginalize the normative and political aspects of vulnerability (87–

371 89). These dominant logics can also limit the possibility to articulate the normative and political
372 aspects of knowledge.

373 Our case study is a project in the region of La Mojana, Colombia (FP 056: Scaling up
374 climate resilient water management practices for vulnerable communities in La Mojana). This
375 project proposes climate-resilient water management practices for water availability and quality
376 since flooding and droughts are a major concern in this part of the country. This region sits in a
377 deltaic plain in the north of Colombia and, due to climate change, is projected to become
378 increasingly drier. Increasing dry periods create vulnerability that is met and exacerbated by
379 forecasted increased precipitation in upstream regions (90). The project provides an interesting
380 case because, according to proposal writers, it represents a departure from past experiences
381 where government-led projects did not engage diverse actors, including Indigenous people and
382 local communities, for building resilience and disaster risk management programs at the regional
383 level. This approach is presented to the GCF as an element that enables a paradigm shift.

384 This proposal includes three NbS for water management including rainwater harvest
385 technologies, a wetland community restoration plan, and the creation of climate-resilient
386 agroecosystems. The proposal also includes the improvement of 96 existing micro aqueducts
387 (installing filters and replacing current pumps with solar-powered ones), the provision of training
388 to community members, and efforts to improve the existing early warning system.

389 **3.2 Analysis**

390 The analysis is based on the project proposal that is publicly available on GCF's website
391 (91). The proposal was coded by two coders using our proposed framework in NVivo software.
392 We analyzed the coded text through content analysis first to systematically identify instances of
393 the five mechanisms that lead to epistemic injustice. For each instance of a mechanism, we then

394 applied the framework to code how the considerations of power and knowledge can inform
395 understanding of epistemic injustice, with attention to how the epistemic injustices compromise
396 the value of ILK.






397 **4. Results and discussion**

398 **4.1 Overview of the findings**

399 In this section we analyze the evidence that epistemic injustices are present in the case
400 study using the guiding questions in our proposed framework (Table 4). Our results are
401 organized around each of the five mechanisms through which epistemic injustices can occur (the
402 columns in the framework). In each sub-section, we highlight the connecting power and
403 knowledge questions that helped us relate our findings to the five mechanisms. These questions
404 also allowed us to reveal how epistemic injustices can prevent ILK from contributing to the
405 stewardship, adaptive capacity and management, equity, empowerment, and duration of the NbS
406 for water.

407 Our case does not encompass all the epistemic injustices included in our framework, but
408 the proposal does contain textual evidence illustrating how each mechanism can lead to injustice.
409 Table 5 illustrates where we found evidence of potential injustices (indicated by cells with red
410 fill), which we discuss further in the text below. *Stakeholder and rights-holder* and *expertise*
411 *exclusion* and *structural inequalities* were particularly relevant mechanisms we identified in the
412 proposal, with multiple considerations of power and knowledge represented. We also found that
413 the *kinds of knowledge* questions and the *organization* questions were particularly relevant.

414 **Table 5. Application of The KEIN Framework to GCF Proposal FP056: Scaling up climate resilient water management**
 415 **practices for vulnerable communities in La Mojana.**

		Questions about Power and Knowledge (Avelino, 2021)				
		Kinds of Knowledge	Co-evolution with Power	Organization	Change	Mobilization
Mechanisms by which Epistemic Injustice can Occur (Fricker, 2007; Bykov, 2021)	Marginalization 	When market ideologies lead to the minimization or misconstruction of ILK, it impacts <i>stewardship, adaptive capacity and management</i> , and the <i>duration</i> of the NbS.	When the ways powerful actors value ecosystems are favored, it impacts <i>stewardship, adaptive capacity and management, equity</i> , and the <i>duration</i> of the NbS.	When NbS are organized to narrowly focus on delivering benefits for powerful actors, it affects NbS <i>legitimacy</i> and their <i>stewardship, equity, and duration</i> .	When local norms, values, and beliefs are excluded, it impacts <i>stewardship, equity, empowerment</i> , and the <i>duration</i> of the NbS.	When ILK is viewed as a constraint for change, it impacts <i>stewardship, equity, empowerment</i> , and the <i>duration</i> of the NbS.
	Prejudice 	When racist prejudices underestimate IPLC's epistemic capacities, it impacts <i>stewardship, adaptive capacity and management</i> , and <i>equity</i> .	When gender stereotypes reinforce patriarchal structures, it impacts <i>stewardship, equity</i> , and <i>empowerment</i> .	When paternalistic views justify a top-down organization of knowledge, it affects <i>adaptive capacity and management, equity, empowerment, and duration</i> .	A lack of mechanisms to address implicit bias impacts <i>stewardship, equity</i> , and the <i>duration</i> of the NbS.	When paternalistic dynamics view IPLC as illegitimate producers of knowledge, it impacts <i>stewardship, adaptive capacity and management, and empowerment</i> .
	Stakeholder & Rights-holder Exclusion 	When "box-ticking" participation is viewed as sufficient, it negatively impacts <i>equity</i> and <i>adaptive capacity and management</i> .	When techno-managerial approaches that centralize decision-making at specific institutions are prioritized, it negatively affects <i>equity</i> and <i>empowerment</i> .	When knowledge is not co-created with actors impacted by the NbS, it affects <i>adaptive capacity and management and equity</i> .	A lack of engagement with a diverse set of actors to create climate strategies through NbS limits <i>adaptive capacity and management, equity, and empowerment</i> .	When working in Indigenous territories, if Indigenous Peoples experts are not used, it can negatively impact <i>adaptive capacity and management, equity, and empowerment</i> .
	Expertise Exclusion 	When classism leads to the exclusion of actors with expertise (i.e., farmworkers), it negatively impacts <i>stewardship, adaptive capacity and management, and equity</i> .	When approaches frame change in terms of technology and markets but deemphasize social interventions, it affects <i>equity</i> and <i>empowerment</i> .	When knowledge is not co-created with actors with relevant knowledge about the NbS, it affects their <i>stewardship, adaptive capacity and management, and the duration</i> of the NbS.	When the knowledge of actors with a privileged status is favored at the expense of actors pursuing climate justice, it affects <i>stewardship, adaptive capacity and management, and equity</i> .	When ILK is viewed as a constraint to build resilience, it impacts <i>stewardship, equity, and empowerment</i> .
	Structural Injustices 	When NbS discourses disregard larger structural injustices, they negatively impact <i>equity</i> and <i>empowerment</i> .	When NbS is assumed to be neutral, it discounts prior mechanisms contributing to systemic injustices which impact <i>equity</i> and <i>empowerment</i> .	When government institutions misconstrue their own contribution to structural injustices, it negatively impacts <i>empowerment</i> .	When mechanisms to ensure IPLC are in the driver seat during the creation of NbS are lacking, it negatively impacts <i>stewardship, adaptive capacity and management, equity, and empowerment</i> .	When ILK is viewed as a constraint to re-shaping local governance of environmental resources, it affects <i>stewardship, adaptive capacity and management, and empowerment</i> .

417 We would not expect a single proposal to provide evidence for each consideration, as it
418 would be unusual for a single proposal text to contain examples of every power and knowledge
419 consideration for every mechanism of injustice. Rather, the case illustrates the extent to which
420 the framework helps organize analysis regarding the potential for epistemic injustices in the
421 design of NbS.

422 This case study is of particular interest because of its explicit intention to create a project
423 where a diverse number of actors are included. Even as some of these findings might not be
424 viewed as egregious examples of epistemic injustice, the KEIN Framework allows us to reflect
425 on the potential tools and actions that can be taken to address potential issues that require
426 attention to build just NbS. It is worth noting that these proposals are limited to the funder's
427 logics which do not lend themselves to address some of the issues we raise in this paper. As an
428 analytical tool, the KEIN Framework makes a valuable contribution to identify the different
429 mechanisms through which epistemic injustices can happen during the design of NbS even in a
430 case study where there is an explicit intention to be more inclusive. The KEIN Framework would
431 also be applicable in case studies where there are more problematic treatments of both
432 knowledge and knowers.

433 **4.2 Marginalization**

434 To examine the marginalization mechanism, we draw heavily from the kinds of
435 knowledge and organization questions to: 1) identify the different types of knowledge included
436 in the proposal and their underlying discourses, ideologies, and normativities, and 2) illustrate for
437 and by whom some types of knowledges are organized.

438 *Kinds of Knowledge*: This section considers whether ILK is favored or treated equally as the
439 knowledge held by outsider actors, such as international or government institutions that play a

440 central role in adopting NbS. Mostly referred to as traditional practices or traditional knowledge
441 in the proposal, the quote below illustrates how ILK is framed in terms of productivity (i.e.,
442 practices used in small-scale and livestock production). This framing represents an epistemic
443 injustice through marginalization because it prevents ILK from being understood or interpreted
444 on its own terms (78). For instance, these practices can also be interpreted in cultural terms that
445 serve as a mechanism to cope with and process the effects of climate change or as a political tool
446 to guarantee the rights of self-governance (92). These practices could also be understood in terms
447 of the notions of self-sufficiency and food sovereignty which are not in alignment with the logic
448 of productivity (93,94). Similarly, the logic of production is at odds with the concept of
449 resilience (95). Instead, this knowledge is only valued when it can be translated into the logic of
450 dominant groups.

451 *Traditional agricultural practices employed by rural communities (small scale*
452 *agriculture and cattle ranching) and that are finely tuned to seasonal climate*
453 *variations have been placed under increasing pressure from prolonged and*
454 *unpredictable flooding... To ensure that local knowledge, particularly that*
455 *associated to indigenous groups, is collected and built upon, the service provider*
456 *will... support directly at least 9 indigenous associations (cabildos) to lead*
457 *collection of local knowledge and identification of traditional productive*
458 *practices relevant for climate change adaptation as well as to facilitate... the in-*
459 *field testing of those production practices in their communities.*

460 The quote above displays an element of paternalism, where the proposal writers structure
461 knowledge in a way they find acceptable (i.e., limited to whatever project proponents find
462 relevant to climate change adaptation) creating a condition that favors knowledges that are better

463 represented in the collective body of knowledge (i.e., knowledge around markets).

464 The way the proposal frames ILK is in terms of productivity also reveals how market-
465 based logics are an underlying ideology throughout the proposal as exemplified by this quote:

466 *Financial viability of the project investments is assured through a combination of*
467 *elements...include[ing]:...[b]uilding on traditional systems with innovative*
468 *climate-resilient technologies and best practices, particularly considering the*
469 *traditional knowledge of use and management of wetlands and natural wetland*
470 *channels, or the operation of micro-aqueducts and home gardens that will be*
471 *enhanced with adaptation techniques and technologies, in order to continue to*
472 *operate these for recurring benefits that will ensure operational and financial*
473 *viability beyond the project period.*

474 The proposal writers are in a position of power and dominance relative to the
475 communities that the projects impact, which give them a position to “shape [the] perceptions and
476 preferences” (13) of the dominated groups. Through the marginalization mechanism, epistemic
477 injustices take place in ways that prevent ILK’s contribution to building just NbS for water
478 management. The framing of ILK in terms of productivity can exclude critical insights on local
479 environmental, socio-economic, and political contexts that impact IPLC’s ability to **manage**,
480 **steward**, and **sustain** natural resources for long periods of time.

481 Organization: Knowledge held by government institutions that heavily rely on aggregated data
482 can also reinforce the marginalization mechanism. Despite the critical role that aggregated data
483 plays in enabling the adoption of NbS and providing a better understanding of the local
484 community’s high levels of poverty and limited access to water, as illustrated in the quote below,

485 aggregated data can be insufficient to ensure NbS benefits are equitably distributed among
486 highly vulnerable populations (96–98).

487 *Over 42% of the population has no access to drinking water, and where water is*
488 *available, the access is extremely unequal. 20% of the population in Magangué*
489 *lack access to water. In contrast, more than 80% of the population in Achi and*
490 *Ayapel do not have access to safe water... 27.8% of the total population and*
491 *47.8% of the rural population in Colombia is classified as poor, when measured*
492 *under the GoC's Multidimensional Poverty Index. While important gains have*
493 *been made at poverty reductions, economic development has not spread evenly*
494 *throughout the country.*

495 This particular quote does not represent an egregious epistemic injustice per se. It does
496 represent the project's intentional purpose to address poverty and lack of access to essential
497 goods that the targeted community needs to prosper. The KEIN Framework allowed us to reflect
498 more on the implications of the reliance that NbS, and their supporting policies and legal
499 frameworks, have on high-level data on vulnerability and how it relates to the marginalization
500 mechanism. The critical issue is that aggregated data has its own limitations. Without ILK, it is
501 difficult to address what information needs to be disaggregated to begin with. ILK is essential to
502 address the needs and want of vulnerable population and avoid the production of epistemic
503 injustice through the marginalization mechanism. Without ILK, NbS risk not building baselines
504 or tools that capture the effective management of lands (*stewardship*) or the distribution of
505 benefits (*equity*) of NbS for water management, which could also have implication on how IPLC
506 see the solutions proposed as legitimate affecting their *duration* as well.

507 Although we did not identify textual evidence of Co-evolution with Power, Change, or
508 Mobilization connected to the Marginalization mechanism in this case, but they would occur
509 whenever, for instance, 1) the value of the NbS benefits is favor the objectives of the most
510 powerful actors, 2) the local beliefs about how power should be redistributed is excluded, or 3)
511 when top-down approaches view the lived experiences of local residents as a constraint to drive
512 change through NbS.

513 **4.3 Prejudice**

514 To analyze the prejudice mechanism, we rely on the kinds of knowledge and the
515 mobilization questions to: 1) identify the kinds of knowledge, ideologies, and normativities
516 underpinning NbS for water management, and 2) determine how different types of knowledges
517 were viewed as either an enabling or constraining instrument for change.

518 *Kinds of Knowledge:* The quote below illustrates a prejudice against ILK because the knowledge
519 generated by IPLC's needs to be validated in terms of "*scientific standards.*"

520 *To ensure that local knowledge, particularly that associated to indigenous*
521 *groups, is collected and built upon, the service provider will be instructed to*
522 *support directly at least 9 indigenous associations (cabildos) to lead collection of*
523 *local knowledge and identification of traditional productive practices relevant for*
524 *climate change adaptation as well as to facilitate, with GCF funds, the in-field*
525 *testing of those production practices in their communities. In field*
526 *experimentation will be led by the cabildos (indigenous associations) in their own*
527 *communities and fields under the guidance of the service provider (to ensure*
528 *scientific standards), who will then work to record and systemize the information.*
529 *Through this effort the project will promote local knowledge as well as provide a*

530 *forum to rescue traditional adaptive practices and create and opportunity for*
531 *local communities to define their own adaptive solution.*

532 This quote illustrates how IPLC's capacity as a knower, or as a knowledge producer, is
533 valued less.

534 The proposal emphasizes the presence of opportunities for IPLC to define adaptive
535 solutions. However, the framing of ILK in terms of productivity creates a condition through
536 which NbS are likely to be favored and accepted as "valid" or "suitable for building resilience"
537 only if they align with that productive logic, which can have particular implications on the
538 inclusion of ILK to manage natural resources (*stewardship*), limits the ability to genuinely co-
539 create solutions with IPLC (*adaptive capacity and management*), or designs the NbS in ways
540 that might not contribute to equitably distribute their benefits (*equity*).

541 Mobilization: Even though IPLC in this region of the country have limited access to education,
542 the proposal writers' use of the term *educational backwardness*, rather than *educational*
543 *attainment* or a different wording, is illustrative of prejudiced text. Historically, Colombia's elite
544 have claimed the communal use of the land and the land-use practices represent "backward"
545 ways that Indigenous People have not successfully detached from, leading them to succumb to a
546 state of under-development (99). While interpreting textual meaning can sometimes be
547 challenging when proposal writers are not necessarily native English speakers, in this case the
548 Spanish translation also reflects this prejudice.

549 We also found that ILK is contradictorily characterized as both an enabler of change yet
550 also insufficient for building resilience:

551 *The key barriers that have held back climate resiliency in La Mojana include*
552 *...[l]imited knowledge of traditional and technical best practices and their*

553 *implementation on wetland dynamics including the practice of climate smart*
554 *agriculture by local communities, productive associations and the public sector.*

555 This specific treatment of ILK in the proposal discounts ILK's capacity to be innovative,
556 technologically apt, or forward looking, indicating prejudice against ILK.

557 *Financial viability of the project investments is assured through a combination of*
558 *elements that builds ownership and the technical, financial, operational and institutional*
559 *capacities of the national and sub-national governments and local communities to*
560 *maintain and derive economic, social, environmental benefits from the proposed*
561 *investments. These aspects include: ...[b]uilding on traditional systems with innovative*
562 *climate-resilient technologies and best practices, particularly considering the traditional*
563 *knowledge of use and management of wetlands and natural wetland channels, or the*
564 *operation of micro-aqueducts and home gardens that will be enhanced with adaptation*
565 *techniques and technologies, in order to continue to operate these for recurring benefits*
566 *that will ensure operational and financial viability beyond the project period.*

567 Prejudices against ILK prevents the design of NbS in ways that redistribute power
568 between local communities from more powerful actors (i.e., **empowerment**). Similarly,
569 prejudices against IPLC's epistemic capacities are likely to prevent co-creation of NbS that
570 facilitate their **adaptive capacity and management** and **stewardship** of water resources.

571 Although we did not identify textual evidence of Co-evolution with Power, Organization,
572 or Change connected to the Prejudice mechanism in this case, it would look like 1) the inclusion
573 of gender stereotypes that reinforce patriarchal structures, 2) classist views that advocate for top-
574 down approaches to organize the production and dissemination of knowledge, or 3) indications
575 of underlying classism that dismiss the need to shift power relations.

576 **4.4 Stakeholder and Rights-holder exclusion and expertise exclusion**

577 Although for this case study, it was difficult to distinguish between the *Stakeholder and*
578 *Rights-holder Exclusion* and the *Expertise Exclusion* mechanisms, we expect that with a larger
579 set of case studies, there would be examples where it is possible to identify the exclusion of those
580 who are directly impacted by a NbS separate from the exclusion of those who have NbS
581 expertise but are not necessarily impacted by the NbS. For this reason, in our results, we discuss
582 these two mechanisms jointly.

583 To better understand these exclusion mechanisms, we draw from co-evolution with
584 power, organization, and change questions to: 1) examine how knowledge around NbS is co-
585 evolving with power dynamics in the process of change 2) identify how knowledge is organized,
586 for and by whom 3) analyze to what extent knowledge about NbS is changing and whether it
587 involves shifts in power relations.

588 *Co-evolution with Power:* The proposal makes it clear that the siting of wetland conservation
589 interventions has already been pre-determined by national agencies and agreed upon with local
590 authorities before conducting consultation with IPLC.

591 *The MADS National Restoration Plan has prioritized the restoration of 121,614 hectares*
592 *of wetlands in La Mojana... In addition, the NAF has a hydro dynamic model of the*
593 *wetlands that evaluates flood pulse and flow which has provided further support in*
594 *identifying strategic areas... Agreements have been made with the local environmental*
595 *authorities and the NAF to ensure complementarity of prioritized areas. Through these*
596 *processes, wetlands in Guaranda, San Jacinto del Cauca, Majagual and Achi have been*
597 *identified as areas of intervention... Consultation with the communities in close proximity*
598 *to the wetlands will be approached to prioritize more areas of restoration on the basis of*

599 *the environmental services provided to the region and to community livelihoods.*

600 This approach illustrates how through the stakeholder exclusion mechanism, epistemic
601 injustices take place in the design of NbS for water management. The actors directly impacted
602 the wetland restoration and actors who have subject knowledge but are not members of the
603 national agencies or the local authorities have been unfairly denied their rights as knowers
604 because their participation was excluded in early stages of the process during which NbS were
605 shaped. This exclusion has implications for the *stewardship, equity, and empowerment* of NbS.

606 Organization and Change: The proposal provided evidence that ILK was organized to identify
607 capacity gaps rather than co-creating the knowledge management system and how the proposal is
608 not involving a shift in power relations.

609 It does not matter if a significant quantity of actors who are affected or have relevant
610 knowledge will be included at some point in the future when critical decisions will have already
611 been made. To meaningfully address the exclusion of relevant actors, NbS for water
612 management also have to move beyond participation narrowly focused on quantity over quality.
613 Mabon et al. (2022) found that NbS in cities in Europe and Asia included more citizen
614 participation. This participation, however, remained restricted to providing feedback or
615 preferences. For this case study, the proposal portrays community participation as a process to
616 identify gaps, as illustrated in this quote:

617 *The solutions are both technical in nature and include systemized knowledge*
618 *management mechanism and activities that will ensure that the information is shared*
619 *with relevant stakeholders at a community, rural productive and local planning level thus*
620 *addressing the information and capacity gaps identified above through active community*
621 *participation.*

622 The previous quote also highlights how knowledge is expected to be managed by
623 communities despite being produced without their inclusion or input, as knowledge is frequently
624 organized by governmental agencies.

625 The proposal recognizes that knowledge for scaling up NbS (i.e., silvopasture and best
626 agricultural practices for rice production) has been organized for large-scale national producer
627 federations and has not *“been adapted to the particular conditions of La Mojana nor have they
628 been adapted to the realities facing smallholders with less than 5 hectares of land who are most
629 vulnerable to climate change.”* The proposal also states that *“technical assistance or rural
630 extension programs [have been] limited to the efforts that producer associations have in the
631 region... These support schemes are based on the needs of each value chain.”* This
632 acknowledgment is one step in the direction of change, but it also reveals the limitations of the
633 proposal writers’ capacity to shift these dynamics within the confines of the climate finance
634 logics that currently guide GCF decision-making (88). For building more epistemically just NbS,
635 the inclusion of mechanisms to address this power imbalance during the design stage is a critical
636 task to change existing epistemic disparate relationships where the NbS can serve as a vehicle to
637 changing the unjust denial of knowers’ knowledge and their rights to participate in decision-
638 making processes, with potential impacts on *stewardship, adaptive capacity and management,
639 equity, empowerment, and duration.*

640 While we did not identify textual evidence of Kinds of Knowledge or Mobilization
641 connected to the Stakeholder and Expertise Exclusion mechanisms in this case, they would look
642 like discourses that explicitly or implicitly view the exclusion of certain actors as a positive
643 outcome (i.e., excluding farmworkers but including large landholders) because their knowledge
644 is viewed as a constraint to create innovative and effective NbS.

645 **4.5 Structural injustices**

646 To evaluate structural injustices, we draw from the kinds of knowledge, co-evolution
647 with power, organization, and change questions to 1) reveal the knowledges and discourses that
648 underly the process of change in which NbS take place 2) examine how knowledge of NbS is co-
649 evolving with power dynamic in the process of change, 3) assess how the generation of
650 knowledge is organized, and 4) the extent to which knowledge is shifting power relations.

651 *Kinds of Knowledge*: Based on natural science-based knowledge that is largely generated by
652 government agencies, the proposal states how extreme weather events along with structural
653 socio-economic drivers exacerbate systemic vulnerabilities for IPLC, as illustrated in the quote
654 below.

655 *La Mojana experiences extreme rainfall patterns and higher flood levels. Its delta*
656 *plain characteristics makes it particularly susceptible to flash flooding during La*
657 *Nina years. La Mojana was severely affected by the La Niña event of 2010-2011*
658 *which coincided with La Mojana's secondary rainy season... La Mojana is also*
659 *vulnerable to anomalous prolonged dry seasons particularly during El Niño*
660 *years. These pose a significant threat to water supply throughout the year. In*
661 *2015, and the initial months of 2016, the effects of the El Niño affected all of La*
662 *Mojana, resulting in a reduction of the wetland areas by approximately 70%. The*
663 *cumulative economic, environmental, and social impact was significant in the*
664 *region. During this event, the entire rice harvest was lost resulting in significant*
665 *food insecurity.*

666 *Co-Evolution with Power*: In the quote below, the proposal writers appear to blame the conflict
667 for the lack of government services in this area. The conflict was, of course, in part, to blame.

668 However, the conflict has been “over” for six years and the people in this region continue to be
669 underserved by the government (CNMH, 2021), showing that the “end” of the conflict did not
670 end up being panacea it was marketed as. Ending, or partially ending, the conflict created an
671 opportunity to help IPLC, but the conflict is not, nor was it ever, the only barrier to the
672 government serving these communities.

673 *The armed conflict in Colombia has had an important impact in local governance*
674 *conditions and has hindered the development of the communities inhabiting that*
675 *territory. La Mojana’s location as a corridor and connector inside the country*
676 *has made it the subject of dispute between different guerrilla groups for control of*
677 *territory as well as a subject of smuggling and drug trafficking routes. Between*
678 *1999 and 2012, there were, on average, 4,000 displaced people/year arriving in*
679 *La Mojana. Poverty and limited access to government support have increased the*
680 *vulnerability of these populations, making them more vulnerable to climate*
681 *dynamics.*

682 Failure to accurately identify current structures of injustice in the NbS context – i.e.
683 misrepresenting vulnerability caused by insufficient governmental support as due to armed
684 conflict – is unlikely to contribute to **equity** and **empowerment** for the community, because the
685 current causes of vulnerability and marginalization are not identified and therefore cannot be
686 addressed.

687 Organization: While the country is technically post-conflict, La Mojana continues to live in a
688 reality remarkably similar to that of during the conflict: one marked by uncertainty and violence
689 (100,101). The quote below illustrates how the project proposed to analyze conflict.

690

691 *A sustainability analysis will be carried out to ensure long term sustainability of*
692 *the restoration process and to ensure that land tenure conflicts do not arise from*
693 *restoration actions. This phase will include community outreach directed at*
694 *collecting local knowledge of wetland management as well as establishing*
695 *community restoration plans and agreements on long term maintenance and*
696 *commitments to wetland management.*

697 Change: In terms of the structural injustices mechanism, the language in the proposal indicates a
698 failure on the part of proposal writers to only examine conflict in terms of how land tenure
699 conflict arises from the adoption of NbS for water management. This approach risks excluding
700 having a better understanding about prior conditions that impact IPLC's capacities to both
701 contribute to (i.e., *stewardship, adaptive capacity and management, duration*) and benefit (i.e.,
702 *equity and empowerment*) from NbS for water management.

703 We did not identify textual evidence of Mobilization connected to the Structural Injustice
704 mechanism in this case, but injustices can take place through the mechanisms when 1) discourses
705 explicitly indicate that excluding the analysis of structural injustices as a desirable outcome or 2)
706 when ILK is viewed as unsuitable to bring change about.

707 **5. Conclusions**

708 This paper introduces the KEIN framework that combines mechanisms of epistemic
709 injustice, considerations of power and knowledge, and valuation of ILK. We then apply the
710 KEIN Framework to the case of a GCF proposal to demonstrate its use in articulating how
711 epistemic injustices occur and prevent future injustices. This case study was particularly
712 interesting due to its intention to include a diverse number of actors, including Indigenous
713 People, representing a departure from the traditional ways the government has followed to

714 implement regional water management programs. The KEIN framework helped us identify the
715 production and reproduction of epistemic injustices in the design of NbS through the use of five
716 different mechanisms (marginalization, prejudice, stakeholder exclusion, expertise exclusion,
717 and structural injustices) along with five questions about power and knowledge in the KEIN
718 framework. We argue that these two elements are critical to build a powerful analytical tool that
719 reveals the inextricable relation between the production of epistemic injustices and the different
720 ways that ILK is compromised in the design of NbS. Our analysis allowed us to identify how
721 ILK can be viewed both as an enabling or constraining element for designing NbS which has
722 impacts on the ability that IPLC have to *steward* the land. Our analysis illuminated how
723 underpinning ideological, normative, and discourses that reinforced the exclusion of ILK from
724 the collective body of knowledge including through implicit and explicit prejudices against ILK
725 impact the ways through which adaptive capacity and management can contribute to building
726 just NbS. By using of the KEIN Framework, we identified the limited measures in the proposal
727 to shift power relations. This finding allowed us to connect how these proposals follow the
728 funder's logic which does not necessarily lend itself to include elements that more explicitly
729 address mechanisms to address shifts in power relations. Insights gained from the framework on
730 the treatment and organization of knowledge in the proposal further shed light on the roles of
731 paternalistic views and influential knowledge-producing actors in NbS framing and design,
732 exacerbating epistemic justices that prevent ILK to contribute to more *equitable* and
733 *empowering* NbS.

734 Epistemic injustices are unlikely to be eradicated, but we hope this novel framework
735 contributes to identifying these injustices to effectively build mechanisms to prevent them or
736 combat them. Our analysis was limited to one case to highlight the conceptual contribution of the

737 KEIN framework, but future work could apply the framework to more completely explore how
738 NbS can proactively advance epistemic justice for ILK within and across contexts. The KEIN
739 Framework can also be applied to other contexts beyond NbS. NbS for water management have
740 the potential to become essential policies to meet climate and development challenges, but with
741 their increasing prominence, it is also increasingly essential that they do not exacerbate
742 injustices. NbS that promote epistemic justice are more likely to succeed in delivering their
743 potential, and analysis with the KEIN framework can help to support these efforts.

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