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Review

What is limiting how we imagine climate change adaptation?

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Imaginaries of adaptation are currently dominated by technocratic, homogenous, top-down approaches that hinder sustainable, just, and effective adaptation worldwide. We have identified three practices that contribute to this problem: (1) an assumption of universality in adaptation; (2) a neglect of pluralistic knowledge systems and values; and (3) an oversimplification of adaptation processes. These three practices have been found to lead to reproductions of vulnerabilities, unsustainable outcomes, or ephemeral changes. New ways of conceptualising and doing adaptation are necessary to expand imaginaries and visions around what adaptation can and cannot be. Through two examples (everyday adaptations and nature-based solutions), our review indicates that expanding or adopting alternative imaginaries of adaptation can help localise adaptation practice, particularly by acknowledging the need for multiple forms of knowledge and the iterative nature of adaptation governance processes.

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Introduction

Individual and collective visions and social expectations for a climate-adapted future (also called imaginaries) influence institutional arrangements for how adaptation is planned and executed, with real-life implications for policy processes and investment practices [1]. How future visions and imaginaries are produced and who gets to be part of this process is critical for defining successful adaptation and learning from on-the-ground practice [2–4]. Without careful consideration of whose and which views are included within adaptation planning and evaluation processes, there is a risk of privileging certain ways of seeing the world that can further create and reinforce structural inequality, vulnerability, and marginalisation within adaptation processes. Pluralistic and inclusive imaginaries emerge from collective processes of reflection, solidarity, and experimentation that acknowledge multiple visions of the future as well as experiences from the past [4]. However, societal capability for future thinking faces numerous challenges, both cultural and cognitive, particularly in that human consciousness (of self and others) and institutional contexts affect the way we imagine the future [5].

Previous literature on the social constraints and limits to adaptation [6–8] has related them to four main determinants: (1) psychological processes and thought processes related to uncertainty, reluctance to accept aid, and risk aversion; (2) lived values and cultural norms involving attachment to place, identity, and heritage; (3) societal norms shaped by expectations of preparedness, infrastructure reliability and resource availability; and (4) governance arrangements, including institutional capacities, alignment of priorities, and decision-making processes. This review, in particular, discusses the implications of the present dominance of technocratic, homogenous, and top-down approaches within adaptation governance, policy, and management and how they can limit imaginaries to climate change adaptation. These approaches are not arbitrary but rooted in individual and collective experiences and practices cultivated in an era of neoliberalism that emphasises ideas of individualism, economic growth, globalisation, reporting, and benchmarking among others [9]. Despite calls for more bottom-up and inclusive ways of doing adaptation, adaptation imaginaries are perpetuated by the so-called adaptation experts, strongly influencing individual and collective values and expectations for an adapted future [10]. We argue that these restrictive approaches, thus, dictate what adaptation can and cannot be and how to

pursue it, often limiting adaptations to off-the-shelf solutions and political fixes [11] rather than as flexible context-specific management interventions that depend on local resources and institutions and that should look at evolving local needs, vulnerabilities and societal expectations.

Within these dominant adaptation governance, policy and management approaches, we find three practices that work to constrain current imaginaries of adaptation. First, there is a tendency to standardise processes, actors and solutions, which conflicts with the accepted wisdom that adaptation should be local and context specific [12]. Second, the neglect of pluralistic forms of knowledge in the generation of adaptation processes exacerbates structural vulnerabilities and limits the adaptation solution space [13]. Third, in a world experiencing unprecedented crises and uncertain change, adaptation cannot be understood as a linear process with a definite endpoint. Instead, adaptation belongs to a messy loop of governance and management processes in which creativity, imagination, learning and experimentation are critical [14].

In the following sections, we unpack these three reductionist practices based on emergent theoretical and empirical literature connected or contributing to the field of climate change adaptation governance and decision-making, using a critical review approach [15] and backward citation tracking tools (namely, Citationchaser[1] and Inciteful[2]). This review approach is more useful in a context where there is a need to bridge disciplines and understandings and extract conclusions regarding one common theme: climate change adaptation. We use recent empirical and theoretical work as a base of evidence for the conceptual approach and the selection of examples — and depart from this to critically review the most recent literature in the field of climate change adaptation, urban studies, environmental governance, political ecology, climate justice and sustainability studies. We relate these limiting approaches to adaptation imaginaries with the four determinants of social constraints and limits to adaptation. Finally, we use two different modalities of adaptation action (everyday adaptations and nature-based solutions [NbS]) to demonstrate how these reductionist approaches can be overcome.

The social limits and constraints of current imaginaries

Universality in adaptation

Research to date shows how the globalisation of urban climate discourse has not necessarily led to innovation but rather to the homogenisation of urban narratives [16]. However, just as climate impacts are not universal, neither are adaptation options and pathways. Despite that, there exists a prevailing notion that adaptation measures and their management approaches can be standardised across diverse contexts and scales [12]. While we acknowledge the importance of learning from and reproducing what worked in the past and for others, standardising adaptation overlooks the inherent variability of environmental, social, and political conditions that shape local vulnerabilities and capacities for adaptation [17].

For years, research has called for adaptation strategies to be rooted in localised understandings of climate vulnerabilities and their underlying causes, considering the unique socio-ecological dynamics of local actors and systems [18,19]. To enable a fair process, topical studies highlight the imperative for adaptation to be locally led in a way that enhances community agency and empowerment while taking care not to exacerbate the burden and responsibilities placed on those disproportionately affected by climate change [20,21]. Localising adaptation efforts involves tailored mechanisms for supporting local actors [22], including not only better information, finance, and technical support but also approaches for future visioning and alternative imaginaries so they can more meaningfully define and actualise their desired future [2,23,24]. In this review, we contend that prevailing adaptation imaginaries often fail to encompass a representative range of experiences and practices, leading to potential unbalanced power dynamics and unjust outcomes. While recognising the value of local and Indigenous practices, it is crucial to acknowledge that these can also carry their own power imbalances and may not always lead to just adaptation. Ensuring the representation of diverse imaginaries is challenging, as engaging with diverse forms of knowledge can bring conflicts between groups and trade-offs between agendas [25]. Thus, it is important to recognise the tension in negotiating conflicts among differing perspectives and values. In this sense, we acknowledge that although standardised approaches to adaptation may overlook context-specific vulnerabilities, they hold the potential to enhance equality by levelling perspectives regardless of privilege and power.

Nonpluralistic knowledge systems and values for adaptation

For decades, critical social science research has advocated for recognising climate adaptation as a fundamental human right, grounded in the value systems of local populations and their understanding of good and bad adaptation [26]. This recognition entails acknowledging diverse situated knowledge systems and values, thereby challenging colonial and racialised approaches that perpetuate epistemic injustice in adaptation

[1] https://estech.shinyapps.io/citationchaser/ (Last accessed 14/03/24)
[2] https://inciteful.xyz/ (Last accessed 14/03/24)

research and practice [27,28]. Epistemic injustice prioritises the technocratic expertise and the marginalisation or exclusion of certain forms of knowledge, such as Indigenous, traditional, and experiential knowledge systems [29,30]. The exclusion of pluralistic knowledge systems not only overlooks valuable insights derived from local perspectives but also undermines the legitimacy and effectiveness of rightful adaptation interventions. To address this, we draw on longstanding calls for critical social science approaches to adaptation, aiming to diversify voices in research and incorporate historically neglected perspectives, including traditional knowledge.

Local and Indigenous communities possess invaluable knowledge about ecosystem dynamics, traditional land management practices, and adaptive strategies honed over generations to reduce vulnerability to climate change [31,32]. An already well-established scholarship highlights numerous ways in which Indigenous and local knowledge play a crucial role in enhancing climate change adaptation efforts. For example, they provide robust contextual knowledge where local data are scarce [32,33] and enrich local understandings of vulnerability, resilience, and well-being, which are absent from mainstream adaptation paradigms [34]. Moreover, an enhanced sense of ownership and active involvement of local and Indigenous communities in adaptation projects helps to address the current hegemonic lack of acknowledgement of Indigenous jurisdiction, sovereignty, and self-determination [35–37].

Oversimplification of adaptation processes

A political, social, and technical space that allows for experimentation and learning is crucial to achieving effective adaptation in the long run. Adaptation management is a complex process of knowledge management that is often translated into oversimplified policies and plans as well as linear and rigid decision-making environments that fail to provide iterative spaces for learning. As a result, there is a potential to ignore uncertainties and local knowledge [17] and overlook the intricate connections of climate change with other urban social, economic, political and environmental vulnerabilities and crises [27,38]. For example, evidence from government reports across sectors and scales points to a clear lack of evaluation and learning mechanisms in adaptation strategies and plans that could inform whether those strategies are actually performing effectively [39,40].

Experimental adaptation can also serve as a cradle of radical interventions that are increasingly necessary to address emergent and urgent societal and ecological risks [41]. However, there is debate about how to move from experimentation to up-scaled adaptation [14]. While some authors argue that experimental adaptation is inevitably and crucially part of adaptation processes [39], others point out potentially ineffective adaptations when experimental adaptation is dissociated from top-down programmes [42] or reproductions of inequality and exclusion framed as development opportunities [9,43]. Either way, experiments and innovation are still essential not only to validate assumptions but also to 'recalibrate' governmental approaches to adequately face the evolving and uncertain sociopolitical, economic and environmental conditions [14] provided they are coherent with their local political economic contexts [43]. Likewise, experimentation is crucial to identify and recognise new actors and knowledge systems that can infuse meaningful information, vision, and creativity into an iterative decision-making process [44].

Aligning limits to adaptation imaginaries and the determinants of social constraints to adaptation

While our review discusses limits to adaptation imaginaries centred on practices within adaptation governance, policy and management, it is also possible to relate our three identified practices (see *Universality in adaptation* to *Oversimplification of adaptation processes* above) to each of the four determinants of social constraints and limits to adaptation identified in the literature (discussed in *Introduction*): (1) psychological processes and thought processes; (2) lived values and cultural norms; (3) societal norms; and (4) governance arrangements. Based on the review above, Table 1 below offers some examples to illustrate how limits to adaptation imaginaries can expand across different social spheres in concept and practice through a set of beliefs and perceptions rooted in individual and collective experiences and practices that ultimately affect values and expectations.

In what follows, we describe two modalities of adaptation (everyday adaptations and NbS) and how these can overcome the three restrictive practices noted to limit adaptation imaginaries. Each subsection is structured to explain (1) what these modalities are, (2) the complexities and tensions when overcoming these practices and (3) how they contribute to expanding imaginaries.

Alternative imaginaries of climate change adaptation

Everyday adaptations

Everyday adaptations are "small, incremental changes made in our daily lives to accommodate the shifting ecologies in which we live […] these aggregated actions constitute larger scale societal responses to climate change" ([45], p. 2). These spontaneous microscale actions happen autonomously from formal institutions, state actors and planned processes and have been documented across socio-economic conditions, urban and rural contexts and in response to various types of climate hazards in intersection with other social dynamics (e.g. [46–48]). We argue that attention to everyday adaptations can help to re-imagine adaptation

Table 1

Determinants of social limits and constraints to adaptation to climate change and their relation to the three identified restrictive practices to adaptation imaginaries.

Determinants of social limits and constraints to adaptation (below)	Universality in adaptation	Nonpluralistic knowledge systems and values	Oversimplification of adaptation processes
Psychological and thought processes	Belief that what works in one context should work in another different context.	Belief in the superiority of expert adaptation knowledge.	Perception of adaptation being a linear process to achieve a short-term end point.
Lived values and associated cultural norms	Belief that community context, identity and idiosyncrasy will not change how an adaptation solution works.	Belief that values are universal and common across communities and knowledge sectors.	Belief that neither climate change nor adaptation will change human settlements, nature or cultural heritage.
Societal norms	Expectation that all human systems have equal interests, ability and resources to adopt a given adaptation solution.	Belief that local and Indigenous knowledge is not sufficient to prepare for climate risks and that they require scientific expert knowledge, but not the other way around.	Expectation that once an adaptation is implemented, it should work.
Governance arrangements	Belief in off-the-shelf institutional structures disregarding political, economic, and planning contexts.	Exclusive use of quantitative objective data to assess vulnerabilities or track the progress of adaptation.	Disregard of longer time frames of adaptation and climate change impacts.

praxis and to expand current adaptation imaginaries in two different ways.

First, recent work with an everyday approach provides interesting examples of how the assumption of universality in adaptation solutions, the neglect of pluralistic knowledge, and the oversimplification of adaptation processes are restricting emergent situated ways of knowing and doing adaptation. About the assumption of universality in adaptation solutions, scholarship on everyday adaptations has demonstrated how top-down off-the-shelf initiatives have often ended up undermining locally driven adaptations and increasing the vulnerability of local populations. In Malawi, large-scale homogenous water infrastructures have been shown to restrict context-specific solutions developed through a long-term household experience of dealing with urban water uncertainty [49]. In relation to the neglect of pluralistic knowledge, studies on everyday adaptations have revealed the epistemic constraints of planned adaptation processes and advocated for the integration of multiple, locally grounded, experiential, and embodied knowledge in the design of adaptation plans [50]. In the Sundarbans (Bay of Bengal), an exploration of how residents experience and respond to salinity intrusion on everyday basis has been key to revealing the limitations of common planned adaptation solutions, such as the construction of concrete embankments and the promotion of brackish aquaculture. These solutions that are deeply informed by Western expert knowledge do little to relieve the embodied suffering of local residents [50]. Finally, concerning the oversimplification of adaptation processes, studies of everyday adaptations demonstrate the importance of experiential knowledge, mutual learning, experimentation and innovation for effective adaptation. For example, in Ethiopia, Kenya and Uganda, the opportunities for iterated learning from fellow farmers and experimentation with recommended seeds or technologies were found to be key elements to the success of farmers' everyday adaptations, yet absent in planned interventions. This finding highlighted the need for planned interventions to conceptualise adaptation as a dynamic learning process and to accommodate these preferred learning tactics of farmers [48]. These examples show how a deeper and more nuanced understanding of how different individuals employ creatively their knowledge and skills to navigate socio-ecological changes, amidst multiple injustices and limitations, can provide insights into how more localised, imaginative, and inclusive ways of doing adaptation can come about.

Second, as some scholars have started to show, attention to peoples' lived experiences can broaden current adaptation imaginaries by revealing the alternative visions of the future that are produced through present peoples' everyday efforts to respond to climate change [51,52]. For example, Celermajer et al. [51] found that through their everyday adaptations, communities in India and Australia are materialising nonhegemonic climate imaginaries based on transformed relations "within the community, with the more than human and with time" (p. 15). Though the literature on what has been called 'grounded imaginaries' [51] or 'future-making practices' [52] is still emerging, we see this as a fruitful avenue towards the expansion of current adaptation imaginaries from the bottom-up.

Just because everyday adaptations are rooted in local knowledge and experiences, it does not mean they are necessarily inclusive or egalitarian. Examples of everyday adaptations that are self-centred, exclusionary, or

that increase risks for other community members abound in the literature [25]. Yet, with their contradictions, potentially conflicting agendas, and embedded injustices, attention to and integration of everyday adaptations can lead to a more imaginative adaptation praxis and pluralistic adaptation imaginaries.

Nature-based solutions

NbS encompass strategies aimed at protecting, sustainably managing, or restoring natural or modified ecosystems to benefit human well-being and biodiversity, including climate change adaptation [53]. There is a great diversity of approaches to NbS, though their main applications currently focus on the creation or restoration of forests or urban parks in terrestrial ecosystems, or renaturalisation of rivers, lakes and wetlands in aquatic ecosystems but include also approaches such as dune stabilisation or artificial reef construction in coastal ecosystems [54,55]. Owing to interconnections between the drivers, feedback and impacts of biodiversity loss, climate change, and related social justice issues, NbS are argued to present a unique opportunity to address the three different restrictive practices identified here in an interconnected way to create multiple benefits [55–57]. However, this opportunity also presents challenges to the design and implementation of NbS as an adaptation strategy because of the site-specific nature of the socio-ecological systems that underpin them and the deep uncertainty about the results of intervening within them.

For example, human geography and political ecology literature highlights how climate vulnerability is a function of *socionatural* change, which is underpinned by context-specific, local human–nature relationships that are often undervalued in adaptation design and implementation [58]. The growth of silvopastoralism as an adaptation strategy against drought within Masai communities in Tanzania is an often cited example, as it works with, rather than opposes, existing relationships with the land that additionally addresses increasing climate vulnerability that varies greatly across time and space [56]. In this way, the integration of diverse forms of knowledge into NbS design and implementation is critical to not only ensuring success but further avoiding as much as possible unexpected negative outcomes — what many refer to as maladaptation in a spectrum where we can strive to push adaptation efforts towards more equitable outcomes [59]. This involves blending local knowledge of site-specific contextual factors with scientific and technical knowledge through participatory processes that empower local knowledge holders [60]. Integrating multiple knowledge, though, must be done with care at stages of the adaptation management process where it is most salient. Evidence in Lilongwe (Malawi) shows, for example, the need to integrate local knowledge and knowledge holders at specific (though not all) stages of the process to avoid deviations from local needs and priorities while also avoiding overburdening local populations [61].

Central to NbS is experimentation, which has been argued to provide fertile ground for shifting adaptation praxis away from anthropocentric, 'off-the-shelf' infrastructural adaptation strategies towards tailored, local approaches that integrate both human and more-than-human needs [56,57]. Indeed, NbS are currently serving as literal 'living labs' worldwide, normalising adaptation governance through experimentation [62] and emphasising learning across institutional settings [63]. An illustrative example of learning from adaptation processes is the Connecting Nature framework, which emerged from a project linking multiple European cities and stakeholders across the fields of urban design, biodiversity conservation, and climate action in designing, implementing, and managing local NbS [64]. This initiative embarked on the 'difficult, yet [worthwhile]' task of integrating opportunities for reflexive learning into the design and implementation processes of NbS, both at the local level and among participating cities. Creating NbS 'communities of practice', for example, has been noted for its potential to catalyse paradigmatic shifts in how adaptation is done locally by strengthening opportunities for learning that are systematically integrated into future practice [65].

While NbS have been criticised as being applied as top-down off-the-shelf approaches [66], the examples provided here provide clear evidence of how NbS have also contributed towards an expansion of imaginaries of adaptation by foregrounding the importance of the interplay of both local social and ecological dimensions of climate change within adaptation. These examples of NbS highlight the importance of context-specific human–nature relationships as a key leverage point to alleviate climate vulnerability, rather than off-the-shelf infrastructural and design-based adaptation strategies. It is then here an opportunity for the emergence of everyday nature-based adaptations. Built into this relational focus is the importance of incorporating local forms of knowledge and existing on-the-ground adaptation practices that relate to the socio-ecological systems where adaptation is done. Because of the dynamic and continuously changing nature of socio-ecological systems, experimentation and learning become particularly important for adaptation through NbS. NbS thereby further expand the field of what kind of system dynamics are learned about, particularly those relating to socio-ecological interactions and relationships.

Conclusions

Climate adaptation imaginaries are a product of individual and collective thought processes about what good or bad adaptation is or can be. Current technocratic,

top-down, and homogenised approaches affect individual and collective values and expectations, leading to limits on our imaginaries for what adaptation can or cannot be, that is, how we perceive, experience, and do adaptation to climate change. We explain these constraints and limits through three reductionist practices that currently dominate adaptation governance processes: assuming the universality of adaptation, using nonpluralistic knowledge systems and values for adaptation, and oversimplifying adaptation processes. We relate these reductionist practices with four determinants of social constraints to adaptation. To illustrate how these restrictive practices can be overcome and how alternative practices can expand imaginaries of adaptation, we use two modalities of adaptation (everyday adaptations and NbS) and a selection of examples from their practice on the ground. Common to these examples is the importance of engaging with the specificities of local contexts, considering and integrating multiple forms of knowledge along adaptation processes, and experimenting and learning in the practice of adapting. We conclude that understanding and integrating these elements into higher-level imaginaries and discussions is crucial for expanding the adaptation solution space and for producing a more just and effective adaptation research and praxis.

CRediT authorship contribution statement

MO: Conceptualization; Investigation; Methodology; Writing – original draft; Writing – review & editing; Funding acquisition. **CAV/SG/ATAM:** Investigation; Writing – original draft; Writing – review & editing.

Data Availability

No data were used for the research described in the article.

Declaration of Competing Interest

Marta Olazabal reports financial support was provided by European Commision. Ana Terra Amorim-Maia reports financial support was provided by European Commission. Cecilia Alda-Vidal reports financial support was provided by European Commission. Sean Goodwin reports financial support was provided by European Commission. Marta Olazabal reports financial support was provided by State Agency of Research. Ana Terra Amorim-Maia reports financial support was provided by State Agency of Research. Cecilia Alda-Vidal reports was provided by State Agency of Research. Sean Goodwin reports financial support was provided by State Agency of Research. Marta Olazabal reports financial support was provided by Basque Government. Ana Terra Amorim-Maia reports financial support was provided by Basque Government. Cecilia Alda-Vidal reports financial support was provided by Basque Government. Sean Goodwin reports financial support was provided by Basque Government. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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- • of special interest
- •• of outstanding interest

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This paper underscores the significance of Indigenous and Local Knowledge (ILK) in climate change adaptation across Africa, advocating for its wider utilization to enhance adaptation outcomes and preserve biocultural heritage.

33. Chanza N, Musakwa W: **Indigenous local observations and experiences can give useful indicators of climate change in data-deficient regions**. *J Environ Stud Sci* 2022, **12**:534-546.

34. Menzies AK, Bowles E, Gallant M, Patterson H, Kozmik C, Chiblow S, McGregor D, Ford A, Popp JN: **"I see my culture starting to disappear": Anishinaabe perspectives on the socioecological impacts of climate change and future research needs**. *FACETS* 2022, **7**:509-527.

35. Pisor AC, Basurto X, Douglass KG, Mach KJ, Ready E, Tylianakis JM, Hazel A, Kline MA, Kramer KL, Lansing JS, *et al.*: **Effective climate change adaptation means supporting community autonomy**. *Nat Clim Chang* 2022, **12**:213-215.

36. • Reed G, Brunet ND, McGregor D, Scurr C, Sadik T, Lavigne J, Longboat S: **Toward Indigenous visions of nature-based solutions: an exploration into Canadian federal climate policy**. *Clim Policy* 2022, **22**:514-533.
This paper evaluates Canada's approach to NbS, examining its impact on Indigenous self-determination. It proposes a novel policy lens,

highlighting gaps in recognising Indigenous jurisdiction and land relationships.

37. •• Thompson K-L, Ban NC: **Turning to the territory": a Gitga'at Nation case study of Indigenous climate imaginaries and actions**. *Geoforum* 2022, **137**:230-236.
This study explores the climate perspectives of the Gitga'at Indigenous Nation in British Columbia, revealing how their approach rooted in ancestral connections to the land challenges dominant settler-colonial climate narratives. It urges recognition of diverse knowledge and value systems in climate adaptation discourse and strategies.

38. Westman L, Patterson J, Macrorie R, Orr CJ, Ashcraft CM, Castán Broto V, Dolan D, Gupta M, van der Heijden J, Hickmann T, *et al.*: **Compound urban crises**. *Ambio* 2022, **51**:1402-1415.

39. Nadeau C, Hughes A, Schneider E, Colarusso P, Fisichelli N, Miller-Rushing A: **Incorporating experiments into management to facilitate rapid learning about climate change adaptation**. *Biol Conserv* 2024, **289**:110374.

40. Reckien D, Buzasi A, Olazabal M, Spyridaki N-A, Eckersley P, Simoes SG, Salvia M, Pietrapertosa F, Fokaides P, Goonesekera SM, *et al.*: **Quality of urban climate adaptation plans over time**. *npj Urban Sustain* 2023, **3**:1-14.

41. Morrison TH, Adger WN, Agrawal A, Brown K, Hornsey MJ, Hughes TP, Jain M, Lemos MC, McHugh LH, O'Neill S, *et al.*: **Radical interventions for climate-impacted systems**. *Nat Clim Chang* 2022, **12**:1100-1106.

42. Qamar MU, Archfield SA: **Consider the risks of bottom-up approaches for climate change adaptation**. *Nat Clim Chang* 2023, **13**:2-3.

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44. Olazabal M, Broto VC: **Institutionalisation of urban climate adaptation: three municipal experiences in Spain**. *Build Cities* 2022, **3**:570-588.

45. •• Castro B, Sen R: **Everyday adaptation: theorizing climate change adaptation in daily life**. *Glob Environ Change* 2022, **75**:102555.
The authors conceptualise everyday adaptations and describe two theoretical components that help to understand the logic of everyday adaptations. These are adaptation labour and value adaptation. This is one of the first publications to approach everyday adaptations from a theoretical point of view.

46. • Cobbinah PB, Asibey MO, Boakye AA, Addaney M: **The myth of urban poor climate adaptation idiosyncrasy**. *Environ Sci Policy* 2022, **128**:336-346.
This paper addresses the lack of empirical documentation of everyday adaptations of poor residents in African cities and argues that planned adaptation strategies should be designed to complement these autonomous measures.

47. Teebken J, Mitchell N, Jacob K, Heimann T: **Classifying Social Adaptation Practices to Heat Stress — Learning from Autonomous Adaptations in Two Small Towns in Germany**; 2023, 15.

48. •• Cuni-Sanchez A, Twinomuhangi I, Aneseyee A, Mwangi B, Olaka L, Bitariho R, Soromessa T, Castro B, Zafra-Calvo N: **Everyday adaptation practices by coffee farmers in three mountain regions in Africa**. *E&S* 2022, **27**:art32.
This paper explores the everyday adaptations of coffee farmers in East Africa. Iterative mutual learning and experimentation, which are often not incorporated into planned adaptation interventions, are revealed as crucial elements shaping these everyday actions.

49. • Alda-Vidal C, Browne AL, Lawhon M, Iossifova D: **Sanitation configurations in Lilongwe: everyday experiences on and off the grid**. *Urban Stud* 2024, **61**:1773-1788, https://doi.org/10.1177/00420980231217661.
This paper delves into the conflicts between everyday and expert urban sanitation imaginaries and calls for exploring the possibilities and limitations of residents' everyday adaptations to address different infrastructure risks.

50. •• Sen R: **Salt in the wound: embodied everyday adaptations to salinity intrusion in the Sundarbans**. *E&S* 2023, **28**:art10.
This paper reveals the incapacity of current planned interventions framed under neoliberal development paradigms to address the personal and intimate effects climate change has on the people of the Sundarbans. The paper calls attention to the everyday adaptations of residents for an alternative framing of adaptation action.

51. •• Celermajer D, Cardoso M, Gowers J, Indukuri D, Khanna P, Nair R, Orlene J, Sambhavi V, Schlosberg D, Shah M, *et al.*: **Climate imaginaries as praxis**. *Environ Plan E Nat Space* 2024, **7**:1015-1033, https://doi.org/10.1177/25148486241230186.
Using the notion of 'grounded imaginaries', authors show how through their everyday practices communities in India and Australia are challenging unjust and extractive hegemonic adaptation imaginaries and opening-up new visions of climate-adapted futures.

52. •• Moulton H, Carey M: **Futuremaking in a disaster zone: everyday climate change adaptation amongst Quechua women in the Peruvian Cordillera Blanca**. *Environ Sci Policy* 2023, **148**:103551.
This paper proposes the term 'futuremaking practices' to describe the ways in which of Quechua women of Peruvian highland communities are navigating the effects of climate change as part of their daily lives. A futuremaking framework is helpful to challenge dominant technocratic adaptation paradigms applied in glaciated regions and centre the lived experiences, needs and desires of marginalized communities.

53. IUCN: **Guidance for Using the IUCN Global Standard for Nature-Based Solutions**. 1st edition, IUCN, International Union for Conservation of Nature; 2020.

54. Chausson A, Turner B, Seddon D, Chabaneix N, Girardin CAJ, Kapos V, Key I, Roe D, Smith A, Woroniecki S, *et al.*: **Mapping the effectiveness of nature-based solutions for climate change adaptation**. *Glob Change Biol* 2020, **26**:6134-6155.

55. • Goodwin S, Olazabal M, Castro AJ, Pascual U: **Global mapping of urban nature-based solutions for climate change adaptation**. *Nat Sustain* 2023, **6**:458-469, https://doi.org/10.1038/s41893-022-01036-x.
This paper presents a comprehensive systematic review of implemented urban NbS projects worldwide looking to their contributions beyond adaptation to climate change and with a climate, biodiversity and society nexus lens.

56. • Seddon N: **Harnessing the potential of nature-based solutions for mitigating and adapting to climate change**. *Science* 2022, **376**:1410-1416.
The author presents a debate on how NbS to climate problems are embraced or rejected by different organisations and communities and reviews their benefits and limits and how they compare with technological approaches.

57. Woroniecki S, Spiegelenberg FA, Chausson A, Turner B, Key I, Irfanullah HM, Seddon N: **Contributions of nature-based solutions to reducing people's vulnerabilities to climate change across the rural Global South**. *Clim Dev* 2022, **15**:590-607, https://doi.org/10.1080/17565529.2022.2129954

58. • Nightingale AJ, Gonda N, Eriksen SH: **Affective adaptation = effective transformation? Shifting the politics of climate change adaptation and transformation from the status quo**. *WIREs Clim Change* 2022, **13**:e740.
"This article highlights the importance of intersubjectivity in understanding effective adaptation. The authors highlight, as adaptation has relational implications (how we relate to one another as humans, and also with nature), adaptation cannot transform the socio-ecological systems they intervene in without regard to intersubjectivities. Incorporating intersubjectivities means paying closer attention to the process of adaptation and its implications for human – nature relationships, uncertainty, and incorporating plural forms of knowledge that define relationships and uncertainty within adaptation practice."

59. Reckien D, Magnan AK, Singh C, Lukas-Sithole M, Orlove B, Schipper ELF, Coughlan de Perez E: **Navigating the continuum between adaptation and maladaptation**. *Nat Clim Chang* 2023, **13**:907-918, https://doi.org/10.1038/s41558-023-01774-6

60. •• van der Jagt APN, Buijs A, Dobbs C, van Lierop M, Pauleit S, Randrup TB, Wild T: **An action framework for the participatory assessment of nature-based solutions in cities**. *AMBIO A J Hum Environ* 2022, **52**:54-67, https://doi.org/10.1007/s13280-022-01772-6.
The authors highlight opportunities for NbS to refocus adaptation efforts on local vulnerability needs, social justice considerations, and improving

governance processes rather than (re)inventing and fine-tuning individual indicators of success.

61. Rochell K, Bulkeley H, Runhaar H: **Nature for resilience** •• **reconfigured: global-to-local translation of frames in Africa**. *B& C* 2024, **5**.

This paper provides nuance to the usual narrative on the problems created by the imposition of adaptation and resilience goals from donor agencies on local beneficiaries in the top-down manner by identifying which parts of the project cycle are most impacted by a lack of participation.

62. Tozer L, Bulkeley H, van der Jagt A, Toxopeus H, Xie L, Runhaar H: **Catalyzing sustainability pathways: navigating urban nature based solutions in Europe**. *Glob Environ Change* 2022, **74**:102521.

63. Hölscher K, Frantzeskaki N, Collier M, Connop S, Kooijman ED, Lodder M, McQuaid S, Vandergert P, Xidous D, Bešlagić L, *et al*.: **Strategies for mainstreaming nature-based solutions in urban governance capacities in ten European cities**. *npj Urban Sustain* 2023, **3**:1-11, https://doi.org/10.1038/s42949-023-00134-9

64. Collier M, Frantzeskaki N, Connop S, Dick G, Dumitru A, Dziubała • A, Fletcher I, Georgiou P, Hölscher K, Kooijman ED, *et al*.: **An integrated process for planning, delivery, and stewardship of urban nature-based solutions: the Connecting Nature Framework**. *Nat-Based Solut* 2023, **3**:100060, https://doi.org/10.1016/j.nbsj.2023.100060.

The paper presents a co-created, iterative, and reflective approach to mainstreaming NbS in cities and to overcoming typical barriers related to financing, implementation and assessment. The framework is tested in European cities, and authors offer guidelines on how to replicate the approach elsewhere.

65. King P, Martin-Ortega J, Armstrong J, Ferré M, Bark RH: **Mainstreaming nature-based solutions: what role do Communities of Practice play in delivering a paradigm shift?** *Environ Sci Policy* 2023, **144**:53-63.

66. Melanidis MS, Hagerman S: **Competing narratives of nature-** • **based solutions: leveraging the power of nature or dangerous distraction?** *Environ Sci Policy* 2022, **132**:273-281.

This is a leading publication that questions the seemingly unchallenged and uncritical positivity around the emergence of NbS across numerous areas of policy. Using empirical data, the authors provide nuance to the discussion of what NbS are for and when they can be useful, particularly questioning the context-free application of NbS as an off-the-shelf solution to climate change and other interconnected crises facing humanity.