frontiers in Climate

TYPE Perspective
PUBLISHED 26 May 2026
DOI 10.3389/fclim.2026.1825767

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OPEN ACCESS

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RECEIVED 08 March 2026
REVISED 12 April 2026
ACCEPTED 12 May 2026
PUBLISHED 26 May 2026

CITATION
Granberg M and Glover L (2026) Reframing climate adaptation and societal collapse: governance pathways for systemic risk in the Anthropocene. *Front. Clim.* 8:1825767. doi: 10.3389/fclim.2026.1825767

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Reframing climate adaptation and societal collapse: governance pathways for systemic risk in the Anthropocene

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Climate change is not a discrete hazard but a systemic risk capable of destabilizing socio-ecological systems and accelerating trajectories toward societal collapse. We argue that prevailing adaptation strategies, fragmented, technocratic, and incremental. Are failing as they are insufficient under conditions of compounding shocks and cascading failures. Adaptation must be reframed as a systemic survival strategy grounded in governance, equity and reflexivity. This Perspective advances three propositions: (1) Collapse is a process shaped by governance choices; (2) Adaptation is inherently political and must embed justice; and (3) Systemic integration of climate change adaptation (CCA) with disaster risk reduction (DRR) is essential to anticipate tipping dynamics. We argue for option-preserving policies, participatory governance and nature-based solutions to interrupt reinforcing feedbacks and sustain social cohesion. Without these shifts, adaptation risks becoming a pathway to maladaptation and social fracture rather than resilience.

KEYWORDS
adaptive capacity, Anthropocene governance, climate risk management, collapse pathways, critical adaptation studies, resilience to climate change, systemic climate hazards

1 Introduction and purpose

Societal collapse is often portrayed as sudden catastrophic event, yet evidence shows it more likely unfolds as a slow, systemic erosion of social, economic, and institutional capacities (Steel et al., 2024; Brozović, 2023). In the Anthropocene, climate change is not merely an environmental challenge, it is a paradigmatic systemic risk that destabilizes tightly coupled socio-ecological systems through cascading failures and tipping dynamics (Crutzen et al., 2000; Steffen et al., 2018). Conventional adaptation strategies, dominated by incremental and technocratic fixes, are ill-equipped to confront this reality (Dow et al., 2013; Anguelovski et al., 2016).

We argue that adaptation must be reconceptualized as a governance-led survival strategy, not a sectoral adjustment. This position aligns with a growing body of critical adaptation scholarship that challenges technocratic and depoliticized approaches to adaptation, foregrounding power relations, social justice and the politics of decision-making under climate risk (Klepp and Chavez-Rodriguez, 2018; Nalau et al., 2021; Eriksen et al., 2015; Glover and Granberg, 2020). This requires embedding justice and reflexivity at the core of decision-making (Gillard et al., 2016; Ansell et al., 2022), anticipating compound risks (Pescaroli, 2018; Andrews et al.,

2023), and integrating climate change adaptation (CCA) with disaster risk reduction (DRR) to manage both acute shocks and chronic stresses (UNDRR, 2019). Without these shifts, adaptation risks reinforcing vulnerability and accelerating collapse trajectories rather than preventing them (Steel et al., 2024).

This Perspective advances three propositions: (1) Collapse is a process shaped by governance choices; (2) Adaptation is inherently political and must prioritize equity and legitimacy; and (3) Systemic integration is essential to sustain social cohesion under accelerating climatic stress. These propositions frame our call for transformative governance capable of interrupting reinforcing feedbacks and preserving options for an uncertain future.

2 Conceptual foundations: collapse, systemic risk, and governance

We conceptualize collapse as relatively gradual and incremental, multi-scalar decline in social, economic, and institutional structures and functions, marked by diminishing returns to problem-solving and compounding stresses (Steel et al., 2024; Tainter, 1988). This perspective renders collapse actionable: governance and adaptation can change the slope of decline through investments in legitimacy, learning and diversified capacity (Granberg and Glover, 2023; Degroot et al., 2021). Adaptation initiatives in civil society and the private sector are necessary but insufficient, whereas the public sector's role is indispensable for effective action at the systemic level. Rather than predicting singular tipping events, analysis should focus on trajectory inflections: interventions that slow or reverse reinforcing feedbacks.

Human activities have reorganized the conditions for social life by altering biogeochemical cycles and biosphere integrity (Crutzen et al., 2000; Steffen et al., 2018). Climate change exemplifies systemic risk: impacts are non-linear and interdependent across tightly-coupled subsystems, producing cascading failures and socio-economic tipping points (IPCC, 2023). Moving beyond single-hazard framings requires systems design and policy coherence: adaptation should anticipate cross-scale interactions and not view hazards as isolated events (UNDRR, 2019).

A socio-ecological systems lens treats societies and ecosystems as tightly coupled adaptive systems whose interactions generate emergent vulnerabilities and resilience (Gillard et al., 2016; Anholt et al., 2021). Risks manifest across scales, from local resource conflict to global supply-chain shocks, through slow-onset changes (e.g., aridification, sea-level rise) and interacting extremes (e.g., heatwaves, floods) (IPCC, 2023). Assessment and planning should align temporal and spatial scales and anticipate cross-scale propagation, including governance strain, market volatility and migration pressures (UNDRR, 2019).

Adaptation entails adjusting social and ecological systems to climatic stimuli. Adaptive capacity comprises institutions, knowledge, resources and social relations (Dow et al., 2013). Conventional framings often privilege technocratic capabilities while under-specifying power and agency. We therefore emphasize reflexive capacity, namely the ability to interrogate assumptions, integrate plural knowledges, and revise strategies iteratively under uncertainty (Fila et al., 2024; Ansell et al., 2022; Rickards et al., 2024). Durable adaptation hinges on reflexivity, inclusion and legitimacy, alongside technical tools. Resilience scholarship similarly argues for understanding resilience less as system persistence and more as transformative and progressive interpretations that emphasize equity, redistribution and structural change. In this perspective, resilience is evaluated not only by a system's capacity to endure shocks, but by whose resilience is enhanced, at what cost and with what implications for future pathways (Ziervogel et al., 2017; Bousquet et al., 2016; Folke, 2016).

Adaptation confronts soft limits (social, economic, and political constraints) and hard limits (biophysical thresholds) beyond which options narrow or cease (IPCC, 2023). Incremental and siloed measures tend to deliver diminishing returns as hazards intensify and can entrench risk exposure through path dependency and technological lock-ins: from coastal hardening to fossil fuel-dependent infrastructures (Steel et al., 2024; Anguelovski et al., 2016). Option-preserving strategies and systemic redesign should be prioritized over short-term efficiencies that compromise future maneuverability. Recent work on progressive and transformative resilience underscores this point, arguing that resilience must be understood as a normative and political project aimed at expanding future options, addressing structural injustices and avoiding defensive strategies that protect existing power relations while externalizing risk (O'Hare, 2025; Pelling et al., 2024; Béné et al., 2018).

Cascading and compounding risks are of particular concern in the collapse discourse. Cascades occur when impacts propagate across domains, for example climate shocks → agricultural losses → price volatility → social unrest; compound risks involve co-occurring or sequential hazards that amplify each other (Pescaroli, 2018; Andrews et al., 2023). A critical feature are feedback loops driving systems toward tipping points in both biophysical and socio-economic domains (Steffen et al., 2018; van Ginkel et al., 2020). Pathway- and feedback-aware approaches are essential for locating leverage points that break reinforcement, such as ensuring equitable access to water, stabilizing food systems, or strengthening safety nets and conflict-sensitive institutions (Richards et al., 2021; Henrico and Doboš, 2024).

Adaptation redistributes risks and benefits, making choices about what to protect, who decides, and who pays and are inherently political (Glover and Granberg, 2020; Gillard et al., 2016). Neglecting distributive and procedural justice can erode social cohesion and legitimize maladaptation, even where measures are technically effective (Anguelovski et al., 2016). Co-creation and engaged scholarship improve contextual fit and social buy-in, but participation gaps can still persist (Ansell et al., 2022). Equity and legitimacy should therefore be treated as design measures for adaptation, rather than ancillary goals.

Because systemic risks present as both acute shocks and slow stresses, integrating CCA with DRR is central to multi-hazard resilience (UNDRR, 2019; Glover and Granberg, 2020). Design principles include policy coherence across scales, ecosystem-based solutions, and inclusive governance (Majlingova and Kádár, 2025). Institutionalizing co-production and accountability mechanisms can reduce legitimacy deficits, identify unintended consequences early and avoid maladaptation (Eriksen and Simon, 2025; Andrews et al., 2023).

3 Historical lessons: contingency, thresholds, and agency

Historical scholarship shows that collapse typically emerges from interacting drivers, ecological stress, political fragmentation,

economic shocks and social conflict, rather than single causes (Ponting, 2007; Middleton, 2017). Classic analyses describe complex causal webs, while archeological syntheses read collapse through multiple indicators, such as urban abandonment and institutional weakening (Tainter, 1988; Diamond, 2005; Middleton, 2017). Adaptation policy should therefore be designed for multi-causality responses, integrating climate measures with reforms in institutions, livelihoods, and social protection.

Even under severe climatic stress, societies have adapted successfully through collective action, effective governance, and social learning (Degroot et al., 2021; Caradonna, 2015). Deterministic accounts attributing collapse primarily to environmental limits being exceeded obscure the roles of agency and institutional capacity (Swyngedouw, 2013; Dobson, 2007). Adaptation policies should therefore prioritize legitimacy, participation, and reflexive learning, alongside technical measures.

Earth-system research shows abrupt shifts via tipping points and threshold effects, and social systems can experience rapid reconfigurations when cumulative pressures cross critical levels (Lenton et al., 2019; Cooper et al., 2020). Predicting such outcomes is difficult due to complex feedbacks but contingency planning, diversified infrastructures and early-warning indicators can reduce risk and bolster resilience (Sato and Lindenmayer, 2018; Rodríguez et al., 2015).

Late-twentieth-century environmental debates, as fostered by *Silent Spring* and *The Limits to Growth*, framed risks from pollution and carrying-capacity overshoot, sparked tensions between coercive limit-enforcement and democratic, justice-oriented trajectories (Carson, 1962; Meadows et al., 1972; Dobson, 2007; Hardin, 1968). Contemporary critiques emphasize uneven vulnerability and socio-economic inequities, highlighting socially differentiated risks when socio-economic systems approach certain limits (Dryzek, 2005; Hardin, 1993). Embedding justice in adaptation design can lessen or avoid social harms.

Climate change accelerates biodiversity loss and threatens ecosystem services foundational to human well-being (Bellard et al., 2012; Kolbert, 2014). Ecosystem collapse is marked by functional and structural degradation and replacement by novel states, complicating recovery (Rodríguez et al., 2015; Malhi et al., 2020). Ecosystem-based and nature-based solutions should therefore play central roles in adaptation to sustain cultural, health, food and water services.

Industrialization offset some Malthusian constraints but created new dependencies and vulnerabilities, particularly fossil-energy lock-ins and coastal urbanization, that shape present risk (Omran, 1971; Dryzek, 2005). Degrowth scholarship calls for re-orienting socio-economic systems toward sufficiency, resilience and option preservation (D'Alisa et al., 2015; Schmelzer and Vetter, 2022). Adaptation should challenge lock-ins and align development with long-term resilience.

3.1 Synthesis: design principles for contemporary adaptation

We argue that the historical and ecological evidence discussed above converge on six design principles: (1) Integrate multi-causal stressors: combine climate measures with institutional and socio-economic reforms; (2) Center governance and agency: build reflexive, participatory institutions capable of learning and course correction; (3) Anticipate thresholds and feedbacks: invest in monitoring, diversified capacities and contingency planning for non-linear change; (4) Embed equity and legitimacy: address distributional impacts and power asymmetries to avoid maladaptation; (5) Protect ecosystems: prioritize ecosystem-based adaptation and nature-based solutions; and (6) Avoid lock-ins: steer investment away from risk-entrenching infrastructures and toward resilient socio-technical configurations.

4 Discussion and policy implications

Reframing collapse as a process situates adaptation within a risk continuum that ranges from incremental adjustments to transformative change. This framing resonates with recent scholarship on transformative and progressive resilience which emphasizes the need for structural change, justice-oriented governance and proactive reconfiguration of socio-technical systems rather than reactive stabilization. Our policy agenda can be understood as contributing to these debates by situating resilience explicitly within the governance of systemic collapse risk. The three propositions, collapse as governable, adaptation as political and systemic integration, suggest a policy agenda oriented toward interrupting reinforcement and sustaining cohesion. We highlight six domains for action in Figure 1.

Even well-designed strategies struggle without enabling institutions, finance, and data. Multi-level coordination is needed to align national frameworks with local capacities and priorities. Dedicated finance streams, public, private, and blended, should support option-preserving investments (e.g., flexible water allocations, green corridors and modular energy systems) and protect social safety nets during shocks. Legal tools can create space for adaptive governance (e.g., adaptive zoning, rights-based access to critical services and sunset clauses for high-risk infrastructure) and help manage trade-offs among stakeholders. Data infrastructures should integrate climate, ecological, and socioeconomic indicators, enabling early-warning and trigger-based decision-making, while safeguarding privacy and equity. Finally, capacity-building through knowledge exchange, peer learning and training should be institutionalized to sustain reflexivity across electoral cycles and leadership changes.

Operationally, governments and communities can advance this agenda through: (1) Establishing cross-departmental adaptation units mandated to integrate CCA-DRR and equity goals; (2) Adopting adaptive pathways planning with trigger points linked to early-warning indicators; (3) Implementing co-production processes with affected populations and independent oversight for accountability; (4) Prioritizing ecosystem-based interventions that deliver multiple benefits; and (5) Developing conflict-sensitive risk governance in hotspots where climate pressures overlap with social fragility.

5 Research directions and conclusion

Future research should support operationalizing reflexive governance, develop knowledge of justice-oriented adaptation, and identify intervention points that can disrupt locked-in systems. Comparative studies across socio-political contexts are needed, as are interdisciplinary approaches linking climate science, social theory and systems modeling to improve anticipatory capacity and threshold awareness.

A richer research agenda should address the climate–conflict nexus in ways that connect micro-level grievances, meso-level institutional performance and macro-level shocks across time and space.

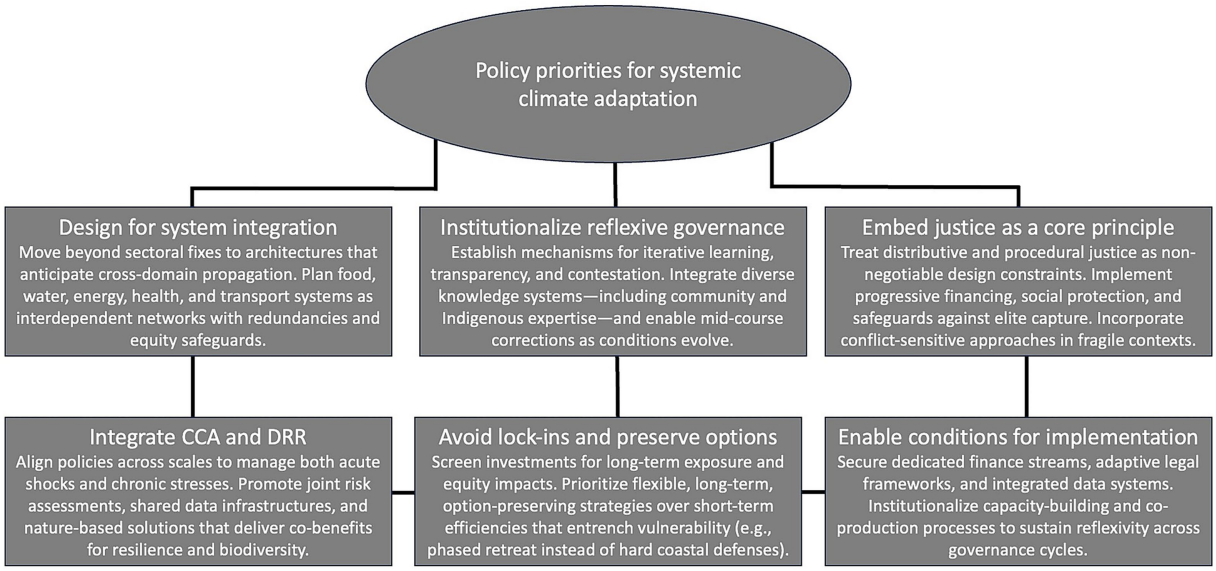

FIGURE 1
Policy priorities for systemic climate adaptation.

Evaluations of ecosystem-based interventions should track socio-economic outcomes and path dependencies to detect potential or emerging maladaptation. Methodological innovation is also needed to explore feedbacks, tipping points and option-preserving policies under deep uncertainty. Finally, governance scholarship should examine enabling conditions for reflexivity, accountability mechanisms, financing instruments and legal mandates, to understand how to maintain adaptive capacity across electoral cycles and crises.

In sum, adaptation must be treated as a systemic survival strategy embedded in governance architectures that are anticipatory, inclusive and capable of navigating uncertainty. Social change due to climate change is a certainty, but collapse is not inevitable. Societies can adapt successfully and sustain social well-being in the Anthropocene through commitments to effective governance.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

MG: Writing – review & editing, Writing – original draft. LG: Writing – review & editing, Writing – original draft.

Funding

The author(s) declared that financial support was not received for this work and/or its publication.

Acknowledgments

We thank Karlstad University for providing faculty resources that supported this research. We also acknowledge the constructive feedback from colleagues within CSR, CNDS, and CCA.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was used in the creation of this manuscript. Generative AI (Copilot) aided in condensing the manuscript to 3,000 words.

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