Systemic climate adaptation framework

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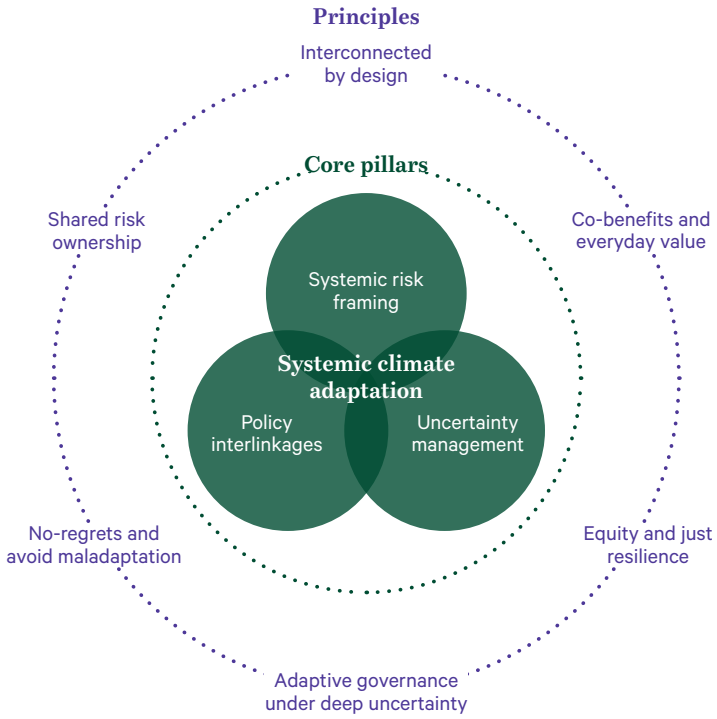
1. Purpose, scope and application

This conceptual framework is designed to support policymakers, analysts and practitioners who are grappling with the systemic nature of climate risk. It translates insights from adaptation policy experts and comparative analytical work into a set of pillars, principles and decision criteria that can help make adaptation policy more coherent, more equitable and more robust under uncertainty. The framework can be applied at multiple governance levels: by central agencies responsible for strategy and resource allocation; by sector bodies that set standards and manage investment pipelines; and by regional or municipal actors implementing measures on the ground. In each case, the emphasis is on decisions that influence vulnerability across sectors, places and time horizons.

Figure 1. The framework consists of three conceptual pillars that support six principles for guiding policy and governance.



Source: Mikaelsson, M. and Shu, M. (Stockholm Environment Institute).

The framework does not offer a ready-made toolkit to be adopted wholesale. Instead, it is a normative and analytical guide that can be applied selectively at key decision points – for example when shaping national strategies and funding programs, screening sector standards and investment pipelines, or prioritizing local actions with cross-sector implications. It is intended for use at national/central, sectoral, and subnational/local levels, and should be refined over time as evidence, practice and political realities evolve. In practice, it is most valuable at a small number of decision points, namely when strategies or sector plans are being refreshed; when major investment pipelines are being screened or prioritized; when funding programs and appraisal rules are set; and when post-disaster recovery decisions risk locking in future vulnerability. It can also be used in periodic monitoring cycles to check whether adaptation is moving beyond recognition in plans and risk assessments into operational routines such as mandates, budgets, delivery mechanisms, and accountability.

The framework is offered as **adaptable scaffolding** for stress-testing decisions in context; it is not a universally validated model, and its application should be accompanied by locally grounded evidence and inclusive deliberation, including Indigenous and local knowledge where relevant.

In that spirit, the framework:

- uses three core pillars to define what makes climate risk *systemic* and why conventional, hazard- and sector-based approaches fall short
- translates these pillars into a set of principles and criteria for assessing whether specific adaptation measures, portfolios or policy reforms enhance systemic resilience or risk reinforcing fragmentation and maladaptation
- ensures that problem framing, option design, and success metrics are informed by affected groups and diverse knowledge systems (including Indigenous and local knowledge where relevant), and that decision authority and finance are devolved where appropriate
- highlights cross-cutting conditions – especially capacities and incentives – that determine whether systemic ambitions can be delivered in practice.

Given the constraints of limited budgets, overloaded administrations, and competing political priorities, the framework should not be seen as a checklist. It is particularly suited to structuring ongoing conversations between analysts, policymakers and practitioners, rather than being applied in isolation by technical experts. Used in this way, it can provide a shared reference point for iteratively revisiting priorities and design choices as new information, shocks or political opportunities arise.

In practice, users are likely to:

- apply a subset of principles or criteria to stress-test a major investment, plan or reform
- use selected elements to structure strategic conversations across ministries or levels of government
- return to it iteratively as new risks, shocks or political openings emerge.

Its value lies less in exhaustive application and more in shifting the questions asked about adaptation: from “Does this reduce exposure to hazard X?” toward “How does this intervention reshape vulnerabilities, risks and opportunities across interconnected systems, over time and across scales?”

2. Core pillars of systemic climate adaptation

The core pillars of systemic climate adaptation provide the conceptual foundation for understanding and governing adaptation in a world of interconnected and uncertain risks. Each pillar addresses a distinct dimension of the challenge.

The first, systemic risk framing, redefines how climate risks are understood, shifting from isolated hazards to complex, interdependent dynamics that cross sectors, scales and borders.

The second, policy interlinkages, highlights that adaptation both depends on and influences a wider web of public policies. It therefore directs attention to synergies, trade-offs and sources of maladaptation that arise across policy domains.

The third, deep uncertainty management, recognizes the limits of prediction and the need to plan for shocks, tipping points and surprises that lie beyond current knowledge or control.

Together, these pillars establish the analytical and normative grounding of the framework, ensuring that systemic adaptation is built upon a clear understanding of how risks interact, how policies align or conflict, and how uncertainty shapes long-term resilience.

Pillar 1: systemic risk framing

Systemic adaptation begins by redefining what counts as a climate risk. Traditional approaches often focus on single hazards (e.g. floods, droughts, heatwaves) in isolation. A systemic framing recognizes that climate risks can emerge, amplify and interact through multiple pathways across societies, economies and ecosystems.

In this framework, systemic risks are risks that:

- **Compound with different climatic hazards** or produce multiple consequences through distinct risk pathways (e.g. a drought and heatwave occurring together, or one hazard triggering floods, wildfires and food insecurity).
- **Compound with non-climatic drivers**, such as pandemics, conflicts or geopolitical tensions, that intensify exposure or constrain response capacity.
- **Cascade across sectors**, where impacts in one system (e.g. energy) trigger failures or disruptions in others (e.g. transport, health or finance).
- **Transcend boundaries** through trade, supply chains, migration or shared resources, turning local shocks into regional or global crises.

- **Are exacerbated by public policies and socioeconomic vulnerabilities**, when short-term priorities, inequality or maladaptive practices amplify rather than reduce systemic exposure.
- **Are shaped by knowledge and institutions themselves (**including whose knowledge is recognized in decision-making), data gaps, weak analytical capacity and fragmented or highly centralised governance that systematically obscures certain places, sectors or social groups from risk assessment and decision-making.

Why it matters. Without this framing, governments underestimate risks by treating them as siloed events rather than systemic dynamics. Systemic climate risks include not only chains of hazards and impacts, but also the institutional and epistemic structures that determine which risks are seen, measured and acted upon, and which remain invisible or politically inconvenient.

Pillar 2: policy interlinkages

Systemic adaptation recognizes that climate resilience is shaped by the wider policy landscape, not by adaptation policy alone. Climate risks and adaptation responses intersect with diverse policy domains – economic, social, environmental and geopolitical – creating both opportunities and tensions that must be understood as part of a systemic approach.

Systemic risk management acknowledges that:

- Different climate risks often require responses through multiple policy levers across sectors (e.g. agriculture, water, energy, trade).
- Individual policies can manage multiple, interconnected risks; for example, ecosystem restoration can reduce flood, drought and biodiversity risks simultaneously.
- Adaptation can deliver co-benefits for other objectives, such as mitigation, health, biodiversity and economic development.
- Adaptation policies may compete with other objectives and produce trade-offs (e.g. expanding irrigation boosting food security but straining water and energy systems).
- Adaptation can result in maladaptation if equity and justice are overlooked, for instance when protective measures for some displace or disadvantage others.
- Funding streams and incentive structures shape which risks, sectors and territories receive attention, and sector- or hazard-specific grants, pilot projects and infrastructure funds can hard-wire fragmented or regressive adaptation when their criteria are not aligned with systemic risk reduction.
- Public policies aimed at non-climate goals can exacerbate climate risks; decisions in housing, transport or finance can inadvertently increase exposure or deepen vulnerability.

Why it matters. Recognizing policy interlinkages helps prevent fragmented or contradictory action and ensures that adaptation contributes to broader systemic resilience. It enables decision-makers to prioritize measures with the greatest cross-sector and societal impact – maximizing adaptation potential at the systems level rather than merely within individual sectors.

Pillar 3: deep uncertainty management

Systemic adaptation must contend with the fact that many of the most consequential climate risks remain deeply uncertain. The trajectory of climate change, the behaviour of interconnected Earth systems, and the timing or magnitude of tipping points cannot be predicted with confidence. Socioeconomic and geopolitical developments – technological change, conflict, demographic shifts – add further layers of uncertainty.

Tail risks and tipping points exemplify this challenge. These high-impact, **deeply uncertain and potentially irreversible** outcomes – such as large-scale ice-sheet loss, abrupt circulation changes or widespread ecosystem collapse – may be difficult to assign precise probabilities to, but could trigger cascading disruptions across sectors, regions and economies. Yet their very uncertainty means they are often sidelined in policy and planning, which tend to prioritize near-term and more predictable hazards. Lived experiences of "unprecedented" extremes increasingly reveal the limits of this approach. Managing deep uncertainty requires governance approaches that emphasize flexibility, robustness and precaution – recognizing that some climate risks may carry irreversible or system-wide consequences even when their likelihood cannot be precisely estimated.

Managing deep uncertainty therefore requires acknowledging that:

- Many critical climate processes are non-linear and may cross irreversible thresholds, making historical experience a poor guide to future risk.
- Uncertainty extends across sectors and scales, as systemic shocks propagate globally through trade, finance and infrastructure networks.
- Political and institutional biases toward short-term, quantifiable risks make it difficult to prepare for events perceived as unlikely or distant.
- Limited data, modelling constraints and sectoral silos impede understanding of how tail risks and tipping points interact with societal vulnerabilities.

Why it matters. Recognizing deep uncertainty is essential for building resilience in a world where surprises are inevitable. By acknowledging the limits of prediction and control, systemic adaptation can move beyond static planning to strengthen societies' capacity to absorb, adapt and reorganize when faced with shocks that defy expectations.

3. Principles of systemic climate adaptation in practice

The principles translate the three core pillars into guiding norms for policy and governance. They articulate what effective systemic adaptation looks like in normative terms – interconnected by design, risk-aware, co-beneficial, equitable and adaptive under uncertainty – anchored in an understanding of interdependent risks, cross-sectoral policy dynamics and pervasive uncertainty.

Each principle defines a key dimension of systemic resilience and is accompanied by indicative decision criteria – essentially, questions that can be asked to appraise adaptation measures, portfolios or reforms.

Principle 1: interconnected by design

Adaptation must strengthen resilience across systems, not only within isolated sectors. This principle emphasizes recognizing and acting on the interconnections between climate risks, policy domains and governance levels to ensure coherence and avoid counterproductive outcomes. Systemic adaptation begins with the recognition that climate risks rarely occur in isolation. Hazards interact across environmental, social and economic systems, creating compound and cascading effects that no single policy or sector can manage alone. Building on systemic risk framing, this principle emphasizes that adaptation should be conceived and tested in relation to the wider policy and risk ecosystem.

Key considerations:

- Systemic risk coverage: does the policy or measure reduce vulnerability to multiple, interlinked hazards and sectors rather than optimizing for a single one?
- Spillover and support awareness: how does the intervention affect adaptation and risk-management efforts in other sectors or regions – does it reinforce, complement or conflict with them?
- Feedback sensitivity: does the policy or measure recognize feedback loops and long-term dependencies that may amplify or offset its intended outcomes?
- Implementation gap and level mismatch: does the measure explicitly address the gap between systemic rhetoric and hazard- or sector-based practice, and consider vertical alignment between central mandates and the capacities and priorities of local authorities, communities and frontline institutions?

Principle 2: shared risk ownership

Systemic risks rarely fall neatly within the remit of a single ministry or level of government. This principle highlights the need for **shared risk ownership** across institutions, sectors and scales, with clear mandates and accountability for managing interconnected risks.

Systemic adaptation requires governance arrangements that reflect the way risks propagate in reality, rather than the way bureaucratic boundaries are drawn. Responsibilities for assessment, decision-making and implementation are often fragmented, leading to gaps, overlaps and “orphaned” risks.

Key considerations

- Clarity of mandates: are roles and responsibilities for managing systemic climate risks clearly defined across ministries, agencies and levels of government?
- Coordination mechanisms: are there robust arrangements – formal or informal – for coordinating decisions across sectors and scales, including mechanisms to resolve conflicts?
- Accountability for systemic risk: do oversight and accountability mechanisms (e.g. audits, reporting requirements, parliamentary scrutiny) explicitly consider systemic risks and cross-sectoral impacts, or only sector-specific performance?
- Stability and continuity: are mandates, coordination bodies and cooperation arrangements for systemic risk management designed to withstand political turnover and shifting priorities, with sufficient resources or legal standing to avoid being easily dismantled or sidelined?

Principle 3: co-benefits and everyday value

Adaptation has greatest systemic value when it generates co-benefits across multiple policy goals and delivers benefits that are visible in everyday life, not only during crises. This principle emphasizes designing measures that simultaneously strengthen resilience and advance wider social, economic and environmental objectives.

Key considerations

- Alignment with broader goals: does the measure support or interact constructively with key objectives in areas such as development, mitigation, biodiversity, health and social protection? Alignment reduces policy conflict and helps ensure adaptation contributes to broader resilience transitions.
- Local co-benefits and everyday value: does the measure generate tangible social and economic benefits in normal times, for example safer and more liveable public spaces, improved health and wellbeing, more secure livelihoods or better access to services, that can build local support and make adaptation politically and socially durable?

Principle 4: no-regrets and anti-maladaptation

Effective adaptation reduces rather than redistributes risk. This principle highlights the need to avoid maladaptive measures and to reform public policies that inadvertently increase exposure or vulnerability, ensuring resilience that endures over time instead of shifting risks elsewhere.

Adaptation should strengthen long-term resilience rather than displace or defer risk. Yet many measures, while well-intentioned, end up shifting risk – across locations, social groups or time – rather than addressing root causes. At the same time, policies aimed at non-adaptation goals can lock in exposure and vulnerability.

Key considerations

- Path-dependency and risk shifting: does the policy reduce risk sustainably, or does it relocate risk across space (to another region), time (to future generations) or social groups (to less powerful or resourced communities)? Effective adaptation tackles underlying drivers of vulnerability rather than redistributing its consequences.
- Cross-sector and cross-policy consistency: are other public policies – particularly in land use, infrastructure, energy, agriculture or economic development – aligned with adaptation goals, or are they inadvertently increasing exposure? Assessing coherence is essential to prevent systemic contradictions.
- Reversibility and learning: can the measure be modified or reversed if unintended consequences emerge? Policies that embed flexibility and regular review processes are less likely to create long-term harm or rigid path dependencies.
- Distributional screening of non-adaptation policies: are disaster recovery, infrastructure, spatial planning and development programs systematically screened to ensure they do not create, amplify or relocate risks, especially onto poorer, more remote or politically marginalized communities (e.g. by diverting impacts, concentrating protection on high-value assets or displacing people without adequate compensation)?

Principle 5: equity and just resilience

Resilience is unsustainable without justice. This principle recognizes that vulnerability is something that is produced by politics and social and economic structures. As such, it calls for adaptation that actively redresses inequalities and redistributes power and opportunity.

Systemic adaptation must move beyond treating vulnerability as a residual condition to be managed, and instead confront it as a political problem: whose interests shape development? Whose risks are deemed acceptable? Whose voices and knowledge count in decision-making?

Key considerations

- Structural and policy drivers of vulnerability: does the policy explicitly identify and address public policies, economic incentives or governance arrangements that create or perpetuate inequality and exposure (e.g. zoning rules, industrial policies, austerity measures)? Adaptation should challenge, not adapt to, these structures.
- Equity impact and redistribution: does the measure reduce risk for those historically marginalized or disproportionately exposed? Equity should be assessed in terms of redistributive effect – who benefits, who bears the costs, and whether adaptation reallocates resources and power toward those most at risk.
- Voice, power and representation: are the people most affected by climate impacts actively shaping decisions, or are they mainly consulted after choices are made? Effective participation means shifting agency and accountability, not simply holding dialogues.

- Justice across time and space: does the policy ensure that resilience gains today do not produce future burdens or spatial inequalities elsewhere? Intergenerational and geographic justice require that adaptation does not export risks to future generations or less powerful regions and communities.
- Visibility and data justice: do risk assessments, monitoring systems and decision-support tools capture conditions in marginalized and remote communities, informal settlements and groups with limited voice? Are qualitative knowledge and community-generated data used to counter systematic blind spots in official statistics and models?

Principle 6: adaptive governance under deep uncertainty

Adaptation operates within complex systems where uncertainty cannot be eliminated. This principle promotes governance that is flexible, learning-oriented and robust across a wide range of plausible and unforeseen climate futures.

Because uncertainty cannot be removed, effective adaptation must rest on governance that rewards learning and adjustment rather than rigid adherence to pre-set plans.

Key considerations

- Robustness and flexibility of decisions: Are measures assessed and prioritized according to their ability to manage climate risks across a wide range of scenarios, including non-linear, compounding and extreme events? Do designs and instruments allow adjustment over time without prohibitive costs or institutional inertia?
- Resilience across disruptive or threshold futures: does the intervention remain viable under both gradual climate change and abrupt, non-linear shifts (such as tipping points), avoiding strategies that are adaptive under one set of conditions but maladaptive if climate dynamics change direction or magnitude?
- Learning and iteration as core functions: are there systematic processes for learning – through monitoring, evaluation, experimentation and feedback – that capture unintended consequences as well as intended outcomes? Are review cycles institutionalized so that strategies are regularly updated?
- Path-dependency and future options: does the decision avoid locking systems into narrow or hard-to-reverse pathways, and does it preserve flexibility for future adaptation as conditions, knowledge and technologies evolve?
- Precaution and safeguards against irreversible harm: Does the measure apply a precautionary approach, protecting against plausible high-impact or threshold-driven outcomes even when their probabilities are uncertain, and ensuring that decisions do not create vulnerabilities that would be irreversible or catastrophic if such thresholds are crossed?
- Institutional readiness for change: do mandates, incentives and organizational cultures allow institutions to change course when new information or shocks emerge, rather than penalising flexibility?
- Transparent and participatory foresight: are foresight processes (scenario planning, horizon scanning, stress-testing) used in an inclusive way, to explore alternative futures and surface diverse knowledge and values?

- Temporal and intergenerational accountability: are long-term distributions of risks and benefits made visible, with mechanisms to ensure that today's choices do not offload new costs or vulnerabilities onto the future?
- Shock-triggered learning: are there mechanisms to capture lessons from extreme events and feed them back into standards, plans and investment priorities before attention and political momentum fade?

4. Cross-cutting criteria: enabling conditions and incentive alignment

While each principle includes specific considerations, two cross-cutting dimensions should inform the appraisal of any adaptation measure or portfolio:

1. **Enabling conditions.** Systemic adaptation depends on sustained human, analytical and institutional capacity at all levels, particularly in local authorities and frontline institutions that are often under-resourced or data poor. Even the most sophisticated systemic framings remain aspirational if those charged with implementation lack the tools, time and mandate to act on them.
2. **Funding and incentive alignment.** Much adaptation in practice is mediated through existing disaster risk reduction, infrastructure, development and social-protection programs. The rules, metrics and grant conditions of these regimes often determine whether systemic risk is reduced or reinforced. Criteria and indicators that privilege short-term outputs or high-value assets can steer resources toward measures that look efficient on paper but yield regressive or maladaptive outcomes.

Evaluating adaptation therefore requires asking not only whether a measure is conceptually systemic, but also whether the capacities and incentives surrounding it make systemic delivery feasible.

Indicative questions include:

- Are the key institutions involved in delivery equipped – in terms of staff, skills, data and mandates – to manage cross-sectoral risks and deep uncertainty?
- Do budgeting, procurement and grant rules reward systemic, co-beneficial interventions, or do they favour narrowly defined, sector-specific projects?
- Are monitoring and evaluation systems capable of tracking cross-sectoral impacts, distributional outcomes and learning, rather than only immediate outputs?

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5. Using the framework in practice

It is important to stress that this framework is not intended as a rigid template to be inserted wholesale into existing policy processes. Real-world policymaking operates under tight fiscal constraints, limited analytical capacity, political contestation and administrative overload. In many settings, the full and meticulous integration of every principle and criterion would be unrealistic – and, in some cases, counterproductive.

Instead, the framework is best used selectively and iteratively, for example to:

- Screen major adaptation investments or policy packages for systemic effects, including potential risk shifting and maladaptation.
- Prioritize measures that generate multiple co-benefits across sectors and social objectives, especially where resources are scarce.
- Identify governance gaps – such as unclear risk ownership, misaligned incentives or weak capacities at critical levels – that may undermine systemic resilience.
- Strengthen learning and flexibility, by highlighting the importance of monitoring, evaluation, foresight and iterative adjustment under deep uncertainty.
- Structure cross-government dialogue, helping different ministries and levels of government see how their decisions interact in shaping climate risk.

In some contexts, a small subset of principles and criteria might be applied to stress-test flagship projects or national adaptation strategies; in others, the framework might inform the design of new coordination structures, revisions to sectoral plans or the redesign of funding mechanisms.

Ultimately, the framework is an evolving attempt to capture what systemic climate adaptation could mean for policy and governance. Its role is to support gradual shifts:

- away from fragmented, hazard-by-hazard responses toward more coherent, system-aware strategies
- away from treating vulnerability as a technical residual toward addressing its structural and political drivers
- away from reliance on prediction and control toward learning-oriented governance under deep uncertainty.

As understanding of climate risks and governance realities improves, the framework itself should be revisited, challenged and refined – remaining a living tool that grows with practice rather than a fixed blueprint.

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