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RESEARCH ARTICLE

Changing the decision context to enable social learning for climate adaptation

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Abstract

1. Successful adaptation often involves changes to the decision context to enable new ways of thinking and acting on climate change. Using 16 adaptation initiatives the authors were engaged with, we analysed how and why decision contexts changed to identify ways to improve adaptation as a process of collective deliberation and social learning.
2. We used the scope of the adaptation issue and governance arrangements to classify initiatives into four types and scored changes in the decision context using three frameworks: (1) the values, rules and knowledge (VRK) perspective to identify changes to adaptation decision-making; (2) the five dimensions of futures consciousness to identify the building of adaptation capabilities and (3) the social learning cycle to reveal evidence of reflexive learning.
3. Initiatives using novel governance arrangements for discrete problems ('problem governance') or complex, systemic issues ('systems governance') scored highest for influences of VRK, futures consciousness and the social learning cycle on the decision context. Initiatives using existing management for discrete problems ('problem management') scored moderately for change in the decision context, while those using existing management for systemic issues ('systems management') scored low because change was often impeded by existing rules.
4. All three frameworks influenced decision contexts in systems governance initiatives. Problem governance initiatives revealed interactions of VRK and futures consciousness but limited influence of VRK on the social learning cycle. Scope and governance arrangements differ with the adaptation issue and initiatives adapt over time: some small-scale ones became more systemic, developed novel governance arrangements and changed the decision context.

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5. Our findings do not show that some adaptation initiatives are better or more transformative than others; just that their scope and appropriate governance arrangements are different. This questions the notion that successful adaptation requires building generic transformative adaptation approaches and capabilities. There is a diversity of arrangements that work. What is important is to align the approach to the adaptation problem. We suggest two directions for improving adaptation initiatives: first, by influencing how they can shift between problem and systems focus and between standard management and novel governance, and secondly, by using methods to diagnose and direct change in the decision context.

KEYWORDS
adaptation governance, adaptation initiatives, futures consciousness, incremental and transformative adaptation, people–nature relationships, social–ecological systems, values, rules and knowledge

1 | INTRODUCTION

Widespread, severe effects of climate change require increased ambition, effectiveness and scale of adaptation initiatives (cf. Box 1 for definition). While the need to upscale adaptation, emissions reductions and financial support was recognised in the 2015 Paris Agreement, there is little evidence of subsequent increased adaptation, despite worsening climate risks (Wright et al., 2023). This growing adaptation gap is partly caused by limited financing, competing priorities and a focus on short-term initiatives that neglect future risks and lack clear objectives (UNEP, 2022, 2024), but also due to the difficult nature of the adaptation challenge, creating uncertainty over adaptation objectives (Box 2). Improving the effectiveness of adaptation initiatives and developing transferable lessons to enable scaling up is therefore an important priority.

The difficulty of adaptation often manifests as a dilemma: adaptation can be either incremental with achievable but often maladaptive outcomes, or transformative with adaptive but highly ambitious and uncertain outcomes. Incremental initiatives can be maladaptive by failing to address future climate change, reinforcing existing vulnerabilities and introducing new ones (Berrang-Ford et al., 2021; Fedele et al., 2020; Termeer et al., 2017; Wise et al., 2014; Box 1). For example, building levee banks to mitigate flooding reduces floodplain storage capacity, increasing reliance on engineering solutions, falsely reducing perceptions of risk and limiting opportunities for transformative adaptation (Fazey et al., 2009). In contrast, transformative initiatives anticipate systemic, future climate change effects and aim for long-term fundamental changes to social–ecological systems (Kates et al., 2016; Wilson et al., 2020; Wise et al., 2014).

This apparent dichotomy between incremental and transformative adaptation is an oversimplification (Termeer et al., 2017), in part because it ignores three issues that are central to effective adaptation. First, adaptation involves developing incremental steps towards transformative change, as described by adaptation pathways approaches (Haasnoot et al., 2024; Wise et al., 2014), and highlighting the need for adaptation to exist as sustained, evolving programmes. Secondly, transformation refers to large changes in the scope, scale and framing of adaptation objectives and to the social–ecological system, but does not necessarily imply transformation for all of its participants and components. What is considered transformative from one perspective may also be incremental from another. For example, drought adaptation by irrigators via crop substitution and water use efficiency (Kirby et al., 2014) may not represent major changes at the farm scale, but has the potential to transform water balance at landscape-to-catchment scale, benefitting flow-dependent ecosystems (Grafton et al., 2022). Transformation and incremental change are therefore more complementary than they may first appear. How adaptation initiatives are framed, especially regarding the tension between immediate issues and system change, is an important focus.

Thirdly, transformation refers to *adaptation governance* of systems, especially systems that have tended to be ignored, such as how decisions are made. Adaptation governance concerns structures and processes for changing a social–ecological system to reduce vulnerability, implemented by interactions of rules and norms, social values and individual and collective knowledge (Bennett & Satterfield, 2018). It results in new values, rules and knowledge, or shifts in visions, objectives and practices (Colloff et al., 2021; IPCC, 2023, p. 125). A public health example of these interactions is how new knowledge that cigarettes cause cancer transformed social values on the acceptability of smoking, leading to legislative changes to restrict the sale and use of tobacco (Chapman, 2007). Climate change imposes novel demands on governance systems and decision makers to operate effectively under high uncertainty and rapid change (Chaffin et al., 2016; Duit & Galaz, 2008; Box 2).

Adaptation involves planned and unforeseen changes to social–ecological systems to minimise current and future climate

BOX 1 Glossary of terms used in the text

Adaptation initiative. An activity in which the participants recognise and implement the need to think and act differently from previous ways of doing things and adjust to changes in their social–ecological system, including those induced by climate change.

Adaptation governance. The systems and methods of organising an adaptation initiative, including the definition and assignment of roles and responsibilities.

Decision context. The circumstances surrounding a decision-making process and its consequences, including the consideration of existing societal values, rules and knowledge that are deemed credible, legitimate and important by decision makers to their deliberations.

Futures consciousness. The capacity to understand, anticipate and accept the future, based on a set of capabilities and ways of thinking that enable the acceptance of change and adaptation.

Incremental adaptation. Adaptation initiatives based on short-term, non-systemic issues, focused on proximate causes of change.

No-regrets strategies. Actions that can be taken now to adapt to change that are likely to remain adaptive under a range of different scenarios, even if the exact nature of change is uncertain.

Social learning. Learning by observing and working with other people to adapt individual and collective behaviours and actions.

Social learning cycle. A process of assessing and developing decisions and actions for change, with four phases: *what is*, *what should be*, *what could be*, and what *can be*.

Transformative adaptation. Systemic, long-term adaptation initiatives that create changes to social–ecological systems and anticipate the effects and risks of future climate change and other interacting drivers.

Values, rules and knowledge. The prevailing systems of world views that define and influence the context in which decisions are made about adaptation and change.

BOX 2 Eight reasons why climate change adaptation presents novel challenges for decision-making, decision contexts and adaptation governance and how these reasons relate (in brackets) to values, rules and knowledge (VRK), the five dimensions of futures consciousness (time perspective; agency beliefs; openness to alternatives; systems perception and concern for others) and the social learning cycle of what is, should, could and can be (cf. theoretical background below)

1. Flexible decision making is required because of the rapid, widespread and unpredictable effects of climate change (knowledge-rules interactions; what could and can be);
2. There are spatial–temporal disconnects between the impacts of climate change and its causes (time perspective; systems perception);
3. Conditions of radical uncertainty apply to drivers of change and responses: there is no prospect of minimising risk by attempting to reduce uncertainty (knowledge; systems perception);
4. Due to inertia in social–ecological systems, there will always be a lag between negative effects of drivers of change and any intervention to address them (time perspective; systems perception; what can be);
5. Drivers of change and their effects challenge individual and collective world views, creating cognitive dissonance when people have to abandon as false what they had believed to be true (knowledge–values interactions; openness to alternatives);
6. Adaptation decisions tend to have a limited but unpredictable lifetime before becoming ineffective or maladaptive (time perspective; systems perception; what could and can be);
7. There is a risk of creating adaptation options and pathways that become narrow, path-dependent and exclusionary, thus cutting off options and creating winners and losers (concern for others; what should be);
8. The absence of action, or insufficient and ineffective actions, risks the crossing of social–ecological thresholds and limiting further options for adaptation now and in the future (agency beliefs; systems perception; what can be).

These eight points provide a rationale for linking adaptation to the decision context, VRK, the five dimensions of futures consciousness and the social learning cycle.

risks (Dupuis & Biesbroek, 2013; Termeer et al., 2017). Implicit to this definition are issues of *how* change occurs, *who* is responsible for adaptation; a governance issue (Box 1), and *what* actions constitute adaptation; an issue of scope of the problem framing (Dupuis & Biesbroek, 2013). These questions are intimately linked because appropriate governance is fundamental to effective action (Bennett & Satterfield, 2018; Dawson et al., 2024). In this paper, we characterise 16 adaptation initiatives according to scope of the adaptation issue and governance arrangements and examine how change in those initiatives occurred. Previously, some authors of this paper presented adaptation as a process of change in the decision context (Gorddard et al., 2016; Box 1). Adaptation initiatives

involve continuous decisions made by some actors on behalf of others, highlighting their iterative nature. The decision context can be considered a focal area within the broader societal decision system; the network of distributed decision-making processes within civil society involving governments, legal and financial systems, markets, media and public discourse (Colloff et al., 2021). The decision context is shaped by these societal influences, as are the values, rules and knowledge of decision makers (Box 1) and the adaptation options they consider credible, legitimate and important (Colloff et al., 2018; Gorddard et al., 2016). If those options become limiting, change in the decision context is needed to create new adaptation options.

Herein, we examine adaptation initiatives the co-authors have been closely engaged with as researchers and practitioners, as to whether, how and why changes to their decision context occurred. We examine changes using three analytical frameworks: the values, rules and knowledge perspective (VRK), the five dimensions of futures consciousness and the social learning cycle (cf. Theoretical Background, below). We first explain the analytical frameworks, followed by a typology of adaptation initiatives as a basis for assessing whether decision contexts changed. We sought to determine how and why decision contexts are affected differently according to the governance and problem framing in each type of adaptation initiative. We consider this analysis can reveal important drivers of change in decision contexts, thereby identifying opportunities to improve adaptation as a reflexive process of collective deliberation and social learning.

2 | THEORETICAL BACKGROUND—THE ANALYTICAL FRAMEWORKS

Below, we outline the three analytical frameworks and how they can be used as analytical lenses to assess changes in the decision context for adaptation (Table 1).

2.1 | The values, rules and knowledge perspective (VRK)

The decision context can be viewed as interacting systems of held human values, rules-in-use (i.e. social norms), rules-in-form (i.e. laws and regulations) and the knowledge systems used by decision makers. Changes in the decision context can occur via shifting social norms, cultural influences and altered perception of threats, as well as intentional, deliberative processes. Adaptation that intentionally changes the decision context involves reflexivity: consideration not just about what we do but how and why we do it (Bosomworth & Gaillard, 2019). The decision context can change by including new values, rules and knowledge and abandoning ones that are no longer useful (Gorddard et al., 2016). VRK has been applied to nature's contributions to people (NCP; Lavorel et al., 2019; Topp et al., 2022; van Kerkhoff et al., 2019); adaptation pathways (Colloff et al., 2021; Prober et al., 2017), coastal adaptation (Gorddard et al., 2016) and adaptation in alpine landscapes (Dubo et al., 2023).

TABLE 1 Attributes of values, rules and knowledge (VRK), the five dimensions of futures consciousness and the social learning cycle as analytical lenses to examine the development and implementation of adaptation initiatives.

	Values, rules & knowledge	Five dimensions of futures consciousness	Social learning cycle
What it is	A tool for describing a decision context in terms of interacting systems of values rules & knowledge	Core capabilities and attitudes required of participants in an adaptation initiative	A deliberative process for implementing adaptation in phases of what is, should, could & can be
What it can be used for	To reveal how a decision context limits adaptation options and identify potential changes needed for effective adaptation	Helps participants assess capabilities needed to plan & implement adaptation & what might be missing	Used to describe the focal system, co-design solutions, apply them, learn & adapt as circumstances change
What it cannot be used for	Not linked to how change in decision context can occur from learning by doing. Does not address capabilities required for adaptation	Does not address how capabilities are deployed effectively in an adaptation initiative. Is not a planning process	Does not address capabilities required for adaptation. Lacks clear framework to change decision contexts
How it intersects with other frameworks	Overlaps with futures consciousness: time perspective & systems perception relate to knowledge; agency to values & rules; openness to alternatives to values & rules and concern for others is a value	Overlaps with values, rules and knowledge, as described. Changes in capability and attitudes of participants will influence the decision context & what should, could and can be	Forms a fundamental planning and implementation process in which the VRK perspective and futures consciousness can be deployed and made operational
How we use it as an analytical lens	Used to determine identify & describe changes in the decision context, via interactions between V,R & K	Used to assess core capabilities in the adaptation initiative & how they are used to effect change. Also used to assess capability gaps to be filled	Used to determine whether there have been sequential shifts in the adaptation initiative and its decision context

The VRK perspective has limits. It is not well integrated with how changes in the decision context occur via learning by doing, which is fundamental to adaptation. Nor does it address the capabilities needed to envision and implement adaptation. These deficits are covered by the other frameworks.

Here, we use the VRK framework to describe the decision context and also to identify reflexive processes that intentionally change the decision context in ways that reflect changes in the values, rules and knowledge used to define and select adaptation options.

2.2 | The five dimensions of futures consciousness

The five dimensions of futures consciousness framework (Ahvenharju et al., 2018) are based on capabilities, attitudes and behaviours needed by participants to implement adaptation decisions: (1) *time perspective*: temporal perspectives on how past decisions shape the present and long-term thinking on adaptation; (2) *agency*: whereby individuals and collectives are empowered to design and implement their adaptation options; (3) *openness to alternatives*: embracing new practices, questioning norms, developing new knowledge and doing things *differently* not just *better*; (4) *systems perception*: understanding systems interactions and (5) *concern for others*: inclusion of other people, future generations and nature.

Futures consciousness is based on a synthesis of theory and practice from adaptation research, including resilience and systems thinking, ethics, complexity theory and social theory (Ahvenharju et al., 2018). All dimensions are relevant to adaptation (MúneraRoldán et al., 2022, 2023; Nalau & Cobb, 2022). The framework has been applied in adaptation to determine how people can think and act differently about equality, justice and agency (Múnera-Roldán, 2023; Múnera-Roldán et al., 2023).

VRK and futures consciousness overlap. Futures consciousness clarifies how held values affect an understanding of climate change impacts and, with rules and knowledge, guides adaptation. Time perspective and systems perception link to knowledge systems used for decision making; agency intersects with values and rules, explaining motivations and preferences for adaptation; openness to alternatives involves values–rules interactions and concern for others is a human value (Sagiv et al., 2017). VRK addresses adaptation from the perspective of institutions and decision contexts, which is not a focus of futures consciousness. The social learning cycle helps to explain these interactions.

2.3 | The social learning cycle

The decision context sets the framing of what is the current situation, what should be done, what could occur and what can be achieved. This perspective of *is*, *should*, *could* and *can be* is the basis of the social learning cycle (Brown & Lambert, 2015; Keen et al., 2005), which defines decisions and actions made at different stages of an adaptation initiative and their outcomes (Figure 1). What is describes the situation before the initiative began. *What should be* includes the desired vision for the future, including livelihoods, issues of equity, social justice and accountability. *What could be* includes possible futures under different scenarios of change. *What can be* represents feasible adaptation actions, accounting for the capacity of participants and constraints on implementation.

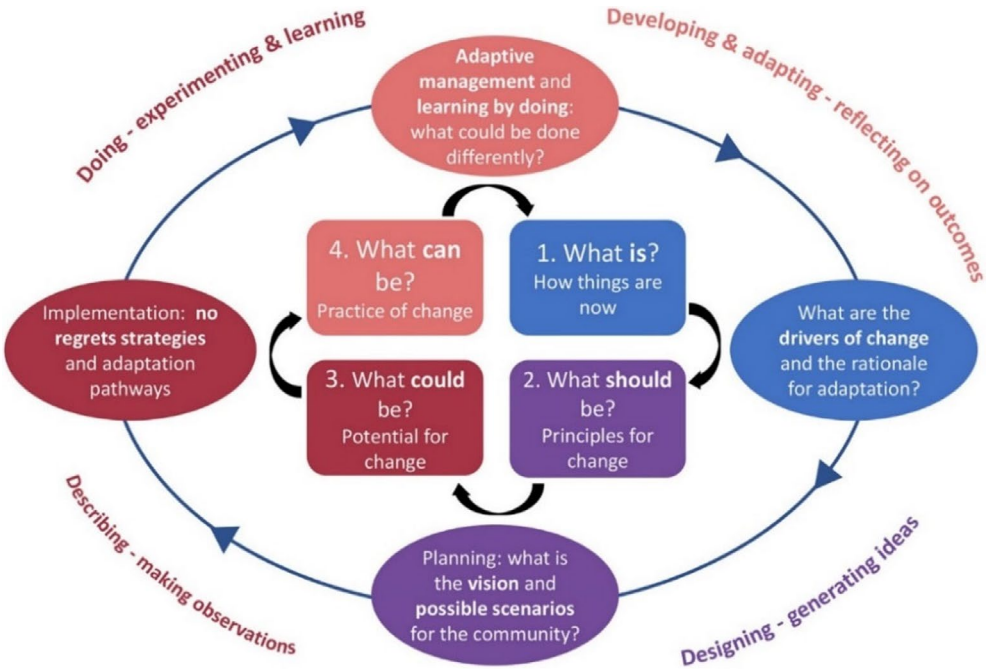

FIGURE 1 Phases in an adaptation initiative (ovals) and the stages of the social learning cycle (rectangles). Modified from Brown and Lambert (2015).

The social learning cycle has been used to describe the system of interest, co-design solutions and apply them by experimentation (Butler et al., 2015). These processes involve reflexive learning to identify what works under different decision contexts (Werners et al., 2021). Social learning has been used in adaptation initiatives to catalyse knowledge co-production, systems thinking and collective action, prompt change in the decision context and co-create new governance arrangements (Butler et al., 2016, 2020, 2022; Colloff et al., 2024).

3 | METHODS

3.1 | Adaptation initiatives

The research took place before, during and after a workshop of the Transformative Adaptation Research Alliance (TARA) in March 2023 at Sainte-Croix (Drôme, France). Some 15 scientists who are members of TARA attended that part of the workshop this paper addresses. They were selected as proponents for an adaptation initiative they had been involved with and had detailed knowledge of. Proponents were from various disciplines (ecology, sustainability research, economics, geography, sociology and political science), working on social–ecological systems with interdisciplinary and transdisciplinary approaches. Each adaptation initiative had been subject to research, planning, implementation and/or evaluation by at least one proponent and was documented in scientific publications, mostly authored by them (Supporting Information S2).

Some 11 adaptation initiatives were presented at the workshop and we identified five more later via our networks to increase the extent of geographical locations and settings. In total, we analysed 16 initiatives from 11 countries in Europe, Latin America, Africa, south-east Asia and the south-west Pacific, involving urban, rural, montane and coastal settings (Table 2). Initiatives were place-based collective activities on adaptation to climate change, directly or indirectly, either in planned or autonomous ways. They included the application of social–ecological approaches that involved people and nature (e.g. reducing risk and vulnerability of local communities and ecosystems and using contributions of nature for adaptation for people). Initiatives were 'top-down' projects funded, organised and directed by a government agency in partnership with NGOs or other organisations or 'bottom-up', whereby a community was adapting to change in its social–ecological system (Table 2). Some initiatives started by addressing livelihoods and sustainable natural resource management (AU1, ES3, FR5, FR7, ID, PNG, ZM), but adaptation to climate impacts became more important over time. Others directly address adaptation to climate change from the outset (AU2, CM, FR2, FR6, FR8, MA, PE4, SB, ZA). Seven initiatives also contributed to a related publication on co-production of nature-based adaptation (Locatelli et al., 2025) and were given identical codes (Table 2).

3.2 | Data collection

Workshop participants, who are co-authors of this paper, co-designed a questionnaire for them to complete with basic information on their adaptation initiatives (Supporting Information S1 and S2). They then co-designed, tested and refined interview questions relating to changes to the decision context, which involved test interviews, revision of questions and the interview structure. Three co-authors (MJC, RG and CMR) then conducted semi-structured interviews with each co-author, with informed consent, to assess influences of VRK, futures consciousness and the social learning cycle on changes to decision contexts and on each other (Supporting Information S3). We were advised that because interviewees were all co-authors who had designed and tested the interview process and given informed consent, there was no requirement to seek formal ethics approval.

The approach we used was inductive and iterative. The focus of research on whether, how and why change in the adaptation decision context occurred was developed only after questionnaires and interview transcripts were completed. This eliminated the risk of bias in the co-design of the questionnaires and interview questions by the co-author proponents.

After data from questionnaires and interview transcripts were collated, a score of 0–2 was allocated by MJC for seven influences (Figure 2), based on clearly defined criteria (Supporting Information S4). Co-authors were then asked if the decision context for their adaptation initiative had changed and, if so, what were the main reasons. Another score, also of 0–2, was then allocated by MJC for extent of change in the decision context. Scores for influences and change in decision context were checked and adjusted by co-authors. Transcripts of interviews were reviewed and edited by them, as were details of their adaptation initiatives (Supporting Information S2). To minimise subjectivity in the scoring process and interpretation of the data, we used an iterative approach with several discussions between lead authors (MJC, RG and CMR) and co-author proponents, which helped align perspectives and ensure consistency within and between the case studies. These discussions were effective in addressing disagreements and reaching consensus. Limitations of this process include the lack of independent verification and the risk of group-think.

Assessment of influences on changes to the decision context was retrospective: most initiatives did not involve explicit use of the three analytical frameworks, except futures consciousness in ZA (Múnera-Roldán, 2023). The social learning cycle was used implicitly in PNG (Butler et al., 2022) and SB (Colloff et al., 2024) and VRK was used in FR6 (Lavorel et al., 2019). Another initiative (ES3) involved analysis of the integration of knowledge co-production (Norström et al., 2020), which included concepts linked to the three analytical frameworks (González-García et al., 2023).

3.3 | Typology of adaptation initiatives

We used the data from questionnaires to develop a simple typology of adaptation initiatives. We ranked adaptation initiatives on

TABLE 2 The 16 adaptation initiatives (AI), ordered by type (Figure 3).

Code	Title & type of AI	Objectives	Drivers of change	Duration	Government agency-organised, NGO &/or community-based?	Potential adaptation benefits
	Problem management					
CM	Storm-resilient housing, eastern Cameroon	Adaptation strategies used by Baka communities to reduce vulnerabilities to storms	Climate change: storm frequency & severity	2016 ongoing	Community	Reduced climate change impacts: safer, storm-resilient houses
ZM	Community development, Katete, Zambia	Financial & food security; permaculture training; employment; education; jobs	Climate change, drought, poverty, food insecurity, HIV, poor market access, soil depletion	1993 ongoing	NGO & community	Improved livelihoods, education, wellbeing
FR8	Flood protection, Pontcharra to Grenoble, France*	Protection against flooding of the Isère river	Climate change, risk of flooding; need for change in river management	1990 ongoing	Government & community	improved flood protection for ca. 300,000 inhabitants
MA	Conservation agriculture, Morocco*	Adaptation to effects of drought & soil degradation on crop production	Climate change & drought, food security, soil degradation	2010 ongoing	NGO & community	Education & capacity building in conservation agriculture
	Systems management					
AU1	Water policy reform, Murray–Darling Basin, Australia*	Return of water from irrigators to the environment, adaptation to climate change	Poor ecological condition of wetlands, drought & climate change, increasing demand for water & decreasing supply	2012 ongoing	Government	Changes in law & policy for sustainable management of water resources
FR6	Adaptation pathways, French Alps*	Participative transformative adaptation, linking adaptive capacity & governance for social innovation & ecosystem-based adaptation	Climate, ecosystem & demographic change; economic subsidies, changes in tourism & land use	2018 ongoing	Community	Knowledge & capacity building for co-production on climate adaptation
ID	Coastal communities development, Indonesia	Reduce poverty, enhance economic growth & climate resilience in coastal & island communities	Poverty & vulnerability of coastal communities	2013–2017 completed	Government	Improved fish catches, market access & fisher community prosperity
ZA	Adaptation in protected areas, South Africa	How protected area managers conceptualise adaptation & translate it to actions	Changes in water quantity & quality, fire, invasive species, sea level rise, storm surges & coastal erosion	2020–23 completed	Government & community	Landscape approaches to ensure benefits for conservation & communities
FR7	Hardwood & energy use, Chartreuse Mountains, France*	Hardwood & energy use; policies to promote wood energy & air pollution reduction due to wood use for heating	Energy crisis & shift to renewable energy, climate change & forest management	2015 ongoing	Government, NGOs & community	Renewable energy; conservation; emissions reduction; restoring air quality

(Continues)

TABLE 2 (Continued)

Code	Title & type of AI	Objectives	Drivers of change	Duration	Government agency-organised, NGO &/or community-based?	Potential adaptation benefits
	Problem governance					
AU2	Community-controlled renewable energy, Cobargo, Australia	Adaptation of energy systems, including engagement with government & infrastructure providers	Climate change: 2019–20 'Black Summer' bushfires	2022 ongoing	Community	Co-operative model for sustainable energy supply under climate change
FR2	Restoration of alpine grasslands, French Alps*	Restore grasslands with local species to conserve local populations, reduce soil erosion & limit exotic species	Climate change, degradation of local grasslands, soil erosion	2013 ongoing	NGO & community	Restoration guidelines; establishment of commercial native seed industry
FR5	Water governance, Chanaleilles, Haute-Loire, France*	Collective governance & management of water resources for agriculture, fire management & local households	Water security & availability; imposition of laws that reduce self-governance & options for adaptation	1960s ongoing	Community	Water security & affordable availability; local control of water; water to fight forest fires
	Systems governance					
ES3	Planning for a sustainable university campus, Madrid Spain*	Create guide for landscape planning system using an social–ecological systems approach to promote sustainability under climate change	Deep concern for sustainability issues, desire to integrate campus in surrounding social-ecological system	2018 ongoing	Community	Placing campus as integral to the territory to enhance social–ecological connectivity
PNG	Building capacity for sustainable development, Bismark Sea, Papua New Guinea*	Adaptation pathways to empower communities to improve livelihoods & wellbeing	Mining, oil palm plantations, power dynamics, tourism development, climate change, sustainable development	2010–13 2015–17 completed	Government & community	Build capacity for inclusive, transparent development decisions & trajectories
PE4	Water management, Abancay, Mariño watershed, Peru*	Adaptation of water management using nature-based solutions	Climate change, drought, declining water availability & quality, wetland degradation	2013 ongoing	Government & NGO	Improved water regulation & supply: benefits yet to be realised
SB	Community-led livelihood adaptation, Solomon Islands*	Empowering communities to implement climate adaptation pathways for livelihoods	Climate change, sea level rise, storms, population growth, cash economy, technological change	2018–202,023-ongoing	NGO & community	Improved livelihoods; market access; improved water & food security

Note: Those with codes in bold also used by Locatelli et al. (2025). Those with an asterisk involved nature-based adaptation approaches ($n = 11$).

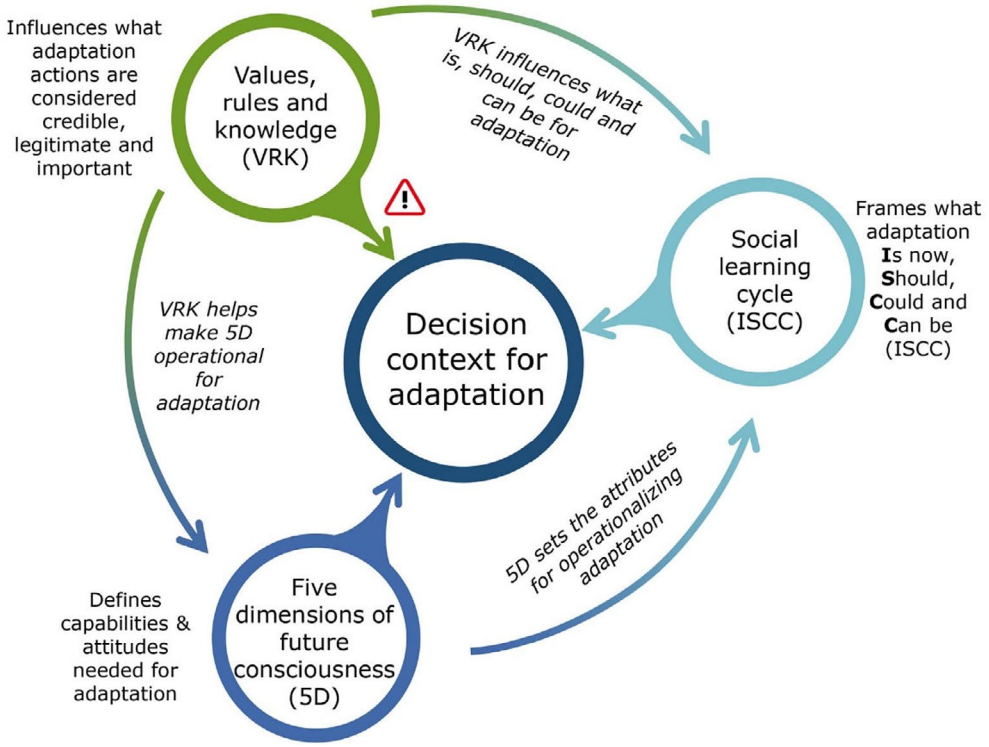

FIGURE 2 Influences of values, rules and knowledge (VRK), five dimensions of futures consciousness (5D) and the social learning cycle (ISSC) on each other and the decision context. Arrows indicate influences used to assess adaptation initiatives. Triangle indicates a seventh influence, where rules constrained decision context.

two gradients: (1) the scale and scope of the adaptation issue; the so-called 'problem-system' gradient and (2) the nature of governance arrangements; the 'management-governance' gradient; cf. Supporting Information S5 for criteria that form the basis of the gradients.

4 | RESULTS

4.1 | Typology of adaptation initiatives

Each adaptation initiative was ordered on the 'management-governance' and problem-system' gradients (Figure 3). Placing an initiative at the management end of the gradient indicated it used either standard management (formal structures and processes such as committees, technical expert panels and hierarchies of responsibilities) or informal, *ad hoc* arrangements. At the governance end, initiatives involved new, inclusive, co-created governance, designed to address diverse perspectives of multiple participants. Initiatives on the problem-system gradient were ordered by whether they addressed one or two discrete issues ('problem-focussed'), or complex, interacting systemic issues ('systems-focussed'). The four categories were:

1. *Problem-management* initiatives, addressing mostly single, discrete issues, included adoption of conservation agriculture and flood protection. They used traditional management approaches (FR8, MA) or informal arrangements (CM, ZM) which may enable participants to have a say. Initiatives were typically at local-scale, affecting a community or group of communities.
2. *Problem-governance* initiatives addressed sector-specific issues, such adaptation to vulnerability of a particular resource (FR2, FR5), or how a community transitions to renewable energy use (AU2). Because these issues affected many stakeholders (FR2) and are influenced by external policies and politics (AU2, FR5) new governance arrangements were needed.
3. *Systems-management* initiatives addressed complex, interacting, cross-sectoral issues such as adaptation of livelihoods (ID, FR6), access to resources and power imbalances (AU1, ZA), typically at regional scale. They used existing, top-down management from lead organisations (typically government agencies; AU1, ID, ZA). Alternatively, they used traditional or informal arrangements as a default because of lack of clarity about roles and responsibilities (FR6).
4. *Systems-governance* initiatives addressed complex, interacting, cross-sectoral issues using deliberative co-design of governance to address them. Initiatives were often at regional scale but governance arrangements were typically owned and operated by participants (ES3, FR7, PNG, PE4, SB).

4.2 | Changes to the decision context of adaptation initiatives

Regarding changes to the decision context (Table 3), problem-management initiatives scored moderately (median score 1) and

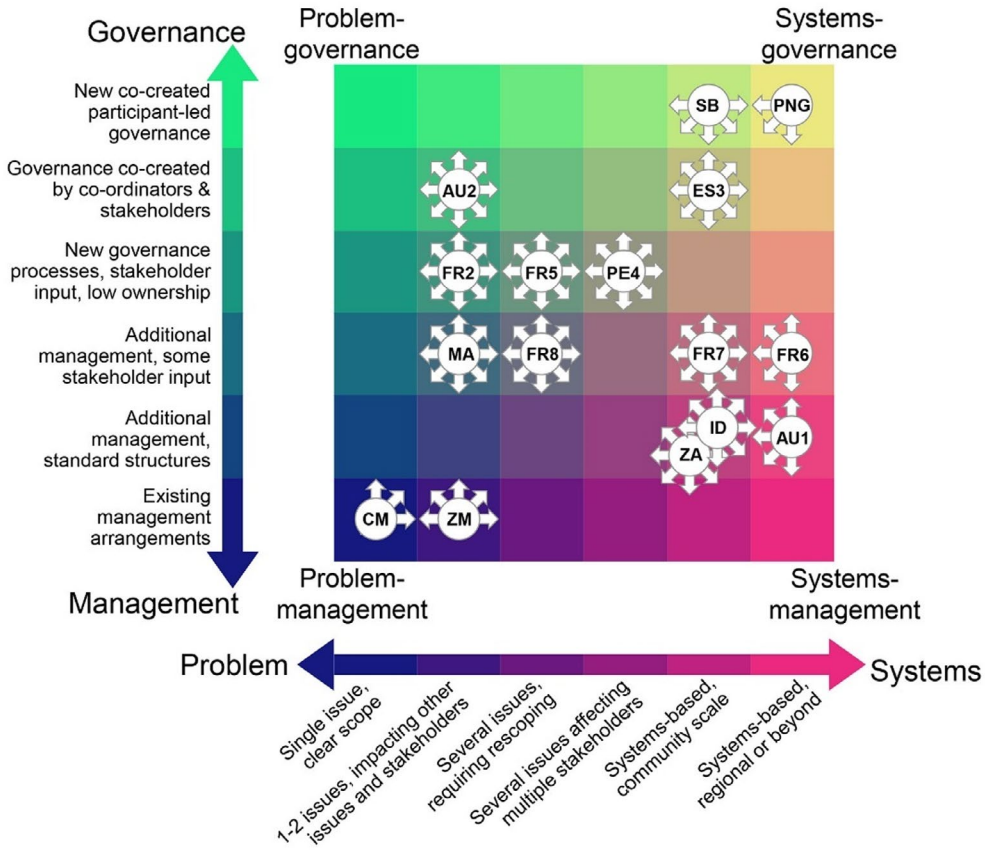

FIGURE 3 Plot of the 16 adaptation initiatives (cf. codes in Table 2) along two gradients, representing problem-systems and management-governance. The initiatives are represented by circles, with arrows indicating that their positions on the plot are dynamic. The criteria for rankings are in Supporting Information S3.

systems-management initiatives scored low (0), with change impeded by existing rules. Problem-governance and systems-governance initiatives scored highest (2), with changes due to influences of VRK, futures consciousness and the social learning cycle. Decision context changed in 13 initiatives due to changes in VRK and the influence of social learning, either alone or interactively. Influence of futures consciousness was evident in four initiatives. These changes are summarised for each initiative below (detailed in Supporting Information S3).

4.2.1 | Problem-management initiatives

Storm-resilient housing, Cameroon (CM)

Social learning was a strong influence on change in the decision context, achieved by dialogue between men and women to co-operate in constructing storm-resilient housing. The community came to recognise how change can be achieved through social processes.

Community development, Zambia (ZM)

The initiative involves capacity building to address food insecurity, poverty and disease in a remote rural community. Decision context changed from a focus on immediate, urgent issues (spread of AIDS, income generation) to longer-term ones (improved nutrition, education and training), with changes in values to address what was needed, rules on how to achieve goals, and new knowledge to overcome beliefs that had hindered progress.

Isère Amont flood protection, France (FR8)

The initiative started as a top-down engineering scheme, but was opposed by the association of river managers and eventually stalled. Decision context changed once due to shifts in values–knowledge interactions to include values of local stakeholders and a shift in the objectives to incorporate more green infrastructure.

Conservation agriculture, Morocco (MA)

Drought and declining soil fertility were drivers of change. New knowledge of techniques, research networks, new technology and farmer support aided gradual change in the decision context and adoption.

4.2.2 | Systems-management initiatives

Water policy reform, Australia (AU1)

This initiative involves restoring water over-allocated for irrigation back to the environment in a major river basin, using new

TABLE 3 Changes in the decision context (DC) of adaptation initiatives (AI), ordered according to type (Figure 3) and factors that were responsible for change or lack thereof.

Code	Title & type of AI	Change in DC?	Score	Main reasons for change in decision context or lack thereof
	Problem management			
CM	Storm-resilient housing, Cameroon	Yes, continuous	2	Social learning
ZM	Community development, Zambia	Yes	1	Values–rules–knowledge interactions. Changed from focus on immediate, urgent issues to longer-term ones
FR8	Flood protection, France	Yes	1	Values–knowledge interactions
MA	Conservation agriculture, Morocco	Yes, gradual	1	New knowledge, technology & support, values shift
	Systems management			
AU1	Water policy reform, Australia	No	0	Need for change recognised, but rules still limit options for change
FR6	Adaptation pathways, French Alps	No	0	Needs to change and is just starting to, due to agency beliefs & empowerment. But divergent values & power dynamics still block progress
ID	Coastal communities development, Indonesia	No	0	Needed to change but did not. A theory of change based on unrealistic assumptions was imposed top-down, inhibiting progress
ZA	Adaptation in protected areas, South Africa	Yes	1	Futures consciousness & social learning, but top-down policies limit options
FR7	Hardwood & energy use, France	Yes	1	Rules–values interactions
	Problem governance			
AU2	Community-controlled renewable energy, Australia	Yes, continuous	2	Knowledge–values interactions & futures consciousness prompted capacity building & social learning
FR2	Restoration of alpine grasslands, French Alps	Yes	1	Knowledge transfer from ecologists to stakeholders; funding
FR5	Water governance, France	Yes, continuous	2	Strong leadership on values, rules & governance
	Systems governance			
ES3	Planning for a sustainable university campus, Spain	Yes, twice	2	Strong leadership on knowledge, values & social learning
PNG	Building capacity for sustainable development, PNG	Yes	2	Social learning & knowledge–values interactions
PE4	Water management, Peru	Yes, gradual	2	Values–rules–knowledge interactions, futures consciousness & social learning combined to build trust & re-balance power relations
SB	Community-led livelihood adaptation, Solomon Islands	Yes	2	Strong leadership & values led to development of local governance rules

Note: Scores: 0 = no change; 1 = moderate change; 2 = major or continuous change. Median scores for change in DC: Problem management: 1; systems management: 0; problem governance: 2; systems governance: 2. Bold text indicates the four categories of adaptation initiatives.

laws and policies implemented by government agencies. These laws and policies have been circumvented by decision makers for short-term gains. The need for change in the decision context has been recognised, evident by the lead agency attempting to re-build trust with stakeholders, but existing rules limit options for change.

Adaptation pathways, French Alps (FR6)

Multiple stakeholders are addressing livelihood adaptation and complex interactions among drivers of change in a mountain social–ecological system. The decision context needs to change and is starting to do so due to stronger agency beliefs, but aspects of VRK on divergent values and power dynamics have blocked progress. The

community knows what it could do but has not yet operationalised what it can do.

Coastal communities development, Indonesia (ID)

The initiative addressed complex interactions between poverty, degraded natural resources, economic growth and climate adaptation in coastal fisher communities. The decision context needed to change but did not because of the top-down imposition of a theory of change based on untested assumptions and low community input.

Adaptation in protected areas, South Africa (ZA)

The initiative focussed on how national park managers understood and implemented climate adaptation. The decision context has constantly changed as system changes are understood. Futures consciousness and social learning were important drivers of change. But top-down rules excluded climate adaptation from management planning, constraining options and agency.

4.2.3 | Problem-governance initiatives

Community-controlled renewable energy, Australia (AU2)

The initiative involves a recovery plan developed by the community of Cobargo, badly damaged by bushfires in 2019–20. Decision context has changed continuously, enabling implementation. Capacity building for co-operative investment in renewable energy emerged from a shared understanding of community needs and values, driven by social learning and futures consciousness of what needs to change.

Restoration of alpine grasslands, French Alps (FR2)

This transdisciplinary initiative with multiple stakeholders involves changing grassland restoration practices to promote the use of seed from native plants resilient to climate change. Awareness of stakeholders was raised by knowledge transfer from ecologists through increased collaboration and guaranteed funding.

Water governance, France (FR5)

This initiative involves a community-operated water supply system in a small municipality. New national laws, if introduced, will remove the rights of the community to manage its water. The decision context changed several times, most recently when the community decided to transform governance and possibly operate a private utility company when the new laws are introduced. Strong leadership on values, rules and options for new governance drove the change.

4.2.4 | Systems-governance initiatives

Planning for a sustainable university campus, Spain (ES3)

The decision context changed twice. Strong leadership on knowledge and values and interaction with social learning and futures consciousness shifted the decision context to a systems perspective, with greater participant inclusion and agency. New leadership enabled further change through the process of building networks and implementing the plan.

Hardwood and energy use, Chartreuse Mountains, France (FR7)

This initiative involves local and national policies for the use of firewood; a source of renewable energy and pollution. Markets are mainly local, but new rules for low-emissions heating systems and values of urban consumers demanding products with specific qualities (dry, small amounts) shifted the decision context and markets are changing to meet demand.

Building capacity for sustainable development, Papua New Guinea (PNG)

The initiative was about food security but shifted to governance for sustainable development due to dysfunctional planning processes. Social learning (visioning and scenario planning) and knowledge–values interactions changed the decision context to address negative effects of development, maladaptive decision making and power imbalances.

Water management, Peru (PE4)

This initiative involves nature-based solutions and payments for ecosystem services to Indigenous communities to conserve wetlands and water supply for downstream urban users. Changes in decision context were gradual and iterative, involving lead agencies with the mandate (rules) and skills (knowledge) to mediate interactions among stakeholders. Concern for others (futures consciousness) and willingness to work together (values) were important, together with social learning on what worked and what did not.

Community-led livelihood adaptation, Solomon Islands (SB)

The initiative built on traditional governance to implement adaptation pathways under climate change. It was locally led, systems-based, co-produced and social learning-focused. Community leadership and ownership led to new local governance arrangements and rules and change in the decision context.

4.3 | Archetypes of influences on the decision context

We detected clear influences among VRK, futures consciousness and the social learning cycle that led to changes in the decision context. Based on scores of seven influence types (Figure 2; Table S1), we found four archetypes of change (Figure 4).

For problem-management initiatives, interactions were found to be moderate, with VRK influencing futures consciousness and both influencing the decision context but not the social learning cycle. VRK had a moderate influence on futures consciousness, which moderately influenced the social learning cycle, which, in turn, moderately influenced the decision context.

Systems-management initiatives showed moderate influences of VRK on futures consciousness and of the social learning cycle

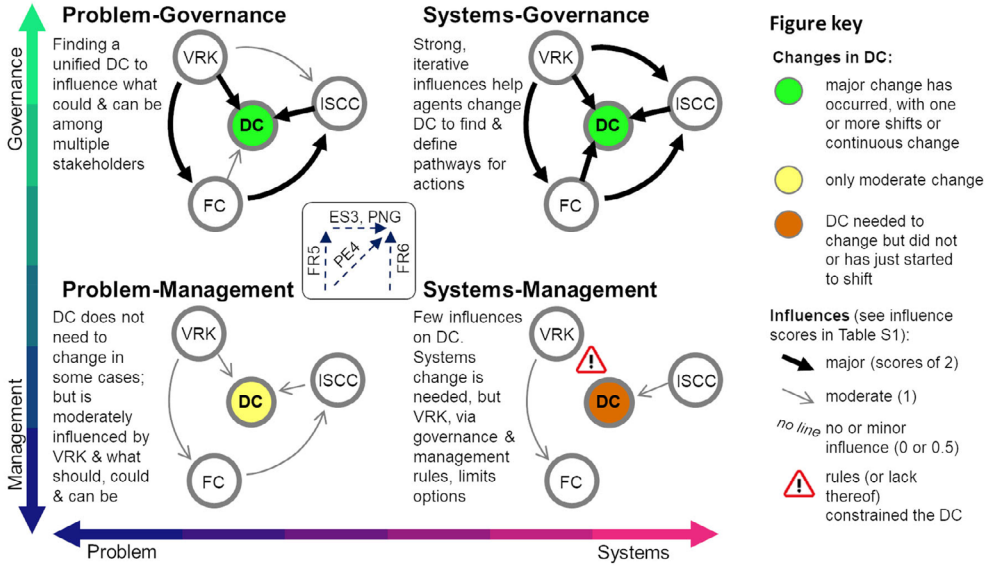

FIGURE 4 Typology of adaptation initiatives and archetypes of influences among values, rules and knowledge (VRK), futures consciousness (FC), the social learning cycle of what is, should, could and can be (ISCC) and the adaptation decision context (DC). Dashed arrows in the centre box indicate how adaptation initiatives (cf. codes in Table 2) evolved over time and shifted to another type, or are likely to shift.

on the decision context, but rules (or lack thereof) were observed to strongly constrain the decision context and limited options for adaptation.

For problem-governance initiatives, which involve a greater need for novel governance and partnership arrangements, VRK and the social learning cycle strongly influenced the decision context, but futures consciousness had only a moderate effect. VRK strongly influenced futures consciousness, which, in turn, strongly influenced the social learning cycle.

Systems-governance initiatives scored high for VRK, futures consciousness and the social learning cycle shifting the decision context. VRK strongly influenced the social learning cycle and futures consciousness and futures consciousness also strongly influenced the social learning cycle. These interactions were typically iterative as the initiatives progressed.

5 | DISCUSSION

5.1 | Typology of adaptation initiatives and changes over time

The new typology presented here, based on the scope of the problem framing and governance arrangements, reveals a more nuanced grouping that goes beyond the standard dichotomy of incremental and transformative adaptation (UNEP, 2022; Wise et al., 2014). Initiatives that start by addressing single, discrete issues may evolve to become more systems-based, with novel governance arrangements. Conversely, big, complex systems-governance initiatives may need to be reduced to simpler problem-management types to achieve action. A balance exists between maintaining systems thinking and simplifying problems to make progress. In accord with our findings on the dynamic and diverse nature of adaptation initiatives, multiple clusters were found among 51 initiatives that showed varying characteristics of transformative change, strengthening the perspective of adaptation as multidimensional and involving continuous change (Engberson et al., 2024).

Most of the adaptation initiatives we examined were built on previous activities and have a long history (median duration [$n = 16$]: 8.5 years; range 2–59 years; Table 2) and are in a second or third phase. Twelve initiatives are still underway. Some have shifted scope, objectives, participants and governance. This historical perspective and that most are ongoing, indicates adaptation initiatives evolve over time, demonstrating decision contexts can be changed deliberately (Colloff et al., 2021). Evidence from these initiatives indicates that influences among VRK, futures consciousness, the social learning cycle and decision context, whether used implicitly or explicitly, help participants reflect, redirect and re-organise governance arrangements, adaptation options and objectives according to emerging needs.

Some initiatives started by addressing single issues with existing management but shifted to a systems focus with novel governance over time (Figure 4, dashed arrows). PE4 shifted from problem management to systems governance; ES3 and PNG shifted from problem governance to systems governance; FR6 will shift from systems management to systems governance when governance arrangements are co-created by stakeholders, and FR5 will shift from problem management to problem governance if new legislation forces the municipality to transform how they operate their water supply. These shifts illustrate how a simple typology of incremental or transformative adaptation does not fit with reality (Termeer et al., 2017).

5.2 | Changes to the decision context and archetypes of influences

We found reinforcing interactions between futures consciousness and VRK that influenced some decision contexts. For example, time perspective and systems perception interacted with knowledge on systemic interactions of risk, vulnerabilities and resilience (PNG and SB). Adaptation initiatives strong in VRK interactions and futures consciousness capabilities of agency beliefs, concern for others and openness to alternatives were important in influencing the social learning cycle and the decision context and, consequently, the distribution of benefits and disbenefits of adaptation among stakeholders (FR2, FR5, FR8, ES3, PNG, PE4, SB). Futures consciousness capabilities interacted with human values of self-transcendence and openness to change (Sagiv et al., 2017; Schwartz et al., 2012; Table 1), helping participants understand how power imbalances negatively influence adaptation options and to develop governance arrangements to address this issue.

Negatively reinforcing interactions among VRK strongly inhibited social learning and change to the decision context. Common themes were how rules-in-form (legislation, policies, plans, governance) and rules-in-use (social norms) limited adaptation options, either because rigid rules excluded certain stakeholder perspectives and their VRK (AU1, FR7, ID, PE4, ZA), or the lack of governance rules inhibited agency (FR6) and societal norms inhibited change (ID, ZM). A rule of adaptation is that institutions developed during periods of stasis or marginal change will be maladaptive under rapid change and high uncertainty (Dryzek & Pickering, 2019, p. 27). Path-dependency occurs because early decisions constrain later ones, limiting adaptation options and agency (Box 2). These negative effects were apparent in AU1, FR7, ID, ZA, and in PE4 and FR8 before shifts in VRK changed the decision context.

Iterative influences of VRK, futures consciousness and social learning on the decision context occurred in most systems-governance initiatives (Figure 4), which involve multi-stakeholder networks, participatory processes and consideration of diverse values of nature in decision-making; what Dubo et al. (2023) called *multi-scale co-production*. Some problem-governance initiatives share elements that fit this description (AU2, FR2). Problem-management initiatives were mostly local, involving experiential knowledge, relational human-nature values and informal governance; the *local transformation* of Dubo et al. (2023). Systems-management initiatives were mostly top-down, rules-based and promoted instrumental values of nature, though some relational values had moderate influences on decision contexts in most cases (AU1, FR6, ZA).

5.3 | Knowledge gaps

We have highlighted how characterising decision contexts according to governance and problem framing helps in understanding how social learning operates in adaptation initiatives. However, there are two important knowledge gaps that need to be addressed to make further progress.

First, our long-term perspective and observations of changes in adaptation initiatives over time will not apply to shorter-term research addressing novel adaptation problems under non-analogue climate change. This gap is addressed in part by research and practice on adaptation pathways, especially transformation-oriented pathway development (Werners et al., 2021). Such approaches allow identification and sequencing of specific adaptation actions under conditions of high uncertainty (Haasnoot et al., 2024; Lavorel et al., 2019; Wise et al., 2014) and require detailed reporting of monitoring and evaluation, not just to document adaptation dynamics but to support social learning (Colloff et al., 2024).

Secondly, while a focus on process is essential, adaptation studies too rarely document outcomes of initiatives, precluding the assessment of success or limitations (Donatti et al., 2020) and how particular combinations of governance and problem framing support adaptation according to the context (Ford et al., 2013). Without this information, we will not be able to replicate and scale out positive outcomes and scale up initiatives into institutions (Cortinovis et al., 2022). Living labs, as places for experimenting with new practices, collaborations and governance through co-production and inclusion of multiple knowledge systems (Bhatta et al., 2025) are one example of ways to address these gaps.

5.4 | Implications for adaptation and prospects for the improvement of adaptation initiatives

In considering why climate change presents particular challenges for adaptation, it became apparent that the eight reasons in Box 2 can be related to VRK, futures consciousness and the social learning cycle. These linkages provide a rationale for the use of the three frameworks as analytical lenses to address the challenges of adaptation decision making and help change how participants think and act about adaptation.

Over two-thirds of the initiatives we examined involved nature-based approaches, whereby adaptation is innately a social–ecological process. Analysis of 25 adaptation initiatives, from weak to strong people–nature interactions, revealed distinct modes of co-production that can be mobilised to inform better strategies and policies (Locatelli et al., 2025). Strengthening people–nature relationships frames adaptation as a relational process that offers participants opportunities for deliberative, reflexive engagement and collective learning that build on a diversity of values, rules and knowledge (Goodwin et al. 2025). Such approaches reflect the reality of adaptation decision making as dynamic, with shifting decision contexts, rather than as static, functionalist and based on overcoming constraints (Biesbroek et al., 2015; Gorddard et al., 2016).

Our intent in this research was to find practical ways to improve adaptation initiatives. This process can commence early on by clarifying how changes to the decision context can occur through the influences of VRK, futures consciousness and reflexive social

learning. Responsibility for initiating these discussions is primarily the task of participants, who may include researcher-practitioners, to engage in collective, reflexive learning. Collective reflexivity is regarded as a crucial capacity for addressing change and adaptation (Lazurko et al., 2025). For social learning to occur, understandings of how the decision context can be changed need to be disseminated and a range of participant capabilities is required to do so (Butler et al., 2022; Colloff et al., 2024), as expressed in the five dimensions of futures consciousness.

Appropriate governance is essential for effective adaptation (Martin et al., 2021; Termeer et al., 2017). The diagnostic test for barriers to adaptation varies according to the analytical lens used to determine those barriers (Biesbroek et al., 2014), but common themes include competing values and interests, power imbalances, structural constraints imposed by social, political and economic factors and a lack of understanding of how governance arrangements can inhibit agency and constrain adaptation options (Eisenack et al., 2014). All of these issues were present in the systems-management initiatives (AU1, FR6, ID and ZA). In some problem-management initiatives, the lack of co-produced governance arrangements was less of an impediment because they were small scale and issues could be addressed informally (CM, ZM). In other initiatives, deficiencies in governance arrangements had to be addressed explicitly as they arose, and changes in rules were initiated to enable the initiative to continue (FR5, FR8, PE4).

Our analyses revealed the importance of enabling participatory approaches and appropriate governance arrangements that participants have ownership of and could use to improve adaptation initiatives. These arrangements included processes for setting and modifying objectives and decision-making processes, examining who holds power and authority and clarifying roles and responsibilities for engagement and participation (Shackleton et al., 2023). Effective, equitable governance entails full and inclusive engagement, whereby participants are empowered to influence planning, implementation, monitoring and adaptation through social learning. Interventions with these governance characteristics were more likely to deliver positive outcomes than those lacking them (Dawson et al., 2024; Huber et al., 2023).

Only a quarter of the adaptation initiatives involved deliberative co-production of governance arrangements by participants (AU2, ES3, PNG, SB). We consider this process to be fundamental to successful adaptation because governance encodes values–knowledge interactions as rules, which influence futures consciousness and social learning. Accordingly, assessment of such influences can be used to adapt and improve adaptation initiatives.

Our research reveals multiple interactions among values, rules and knowledge, futures consciousness capabilities and social learning processes in adaptation, and the need to integrate diverse perspectives to unravel these interactions. We show how combining the three frameworks as analytical lenses helps us understand individual and collective processes for changing the decision context that are linked to management, governance and scope of adaptation. Assessing initiatives using a narrower perspective ignores these interactions and the central role of social learning in adaptation.

AUTHOR CONTRIBUTIONS

Matt Colloff, Russell Gorddard, Claudia Múnera-Roldán, Bruno Locatelli and Sandra Lavorel: conceptualisation, investigation, writing of original draft and revision, data analysis and curation, methodology; Bruno Locatelli: graphic design; all other co-authors: investigation, writing—review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

All the data presented in this study are included in the main text and Supporting Information.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Table S1: Median influence scores for the four types of adaptation initiatives in relation to interactions between values, rules and knowledge, the five dimensions of futures consciousness and the social learning cycle.

Data S1: Basic questionnaire for case studies.

Data S2: Details of adaptation initiatives, based on data from completed basic questionnaires (cf. S1) and additional information from semi-structured interviews (cf. S4) and references for each initiative.

Data S3: Topics and questions for the semi-structured interviews (ca. 60–90 min. each).

Data S4: Criteria for scoring the case studies in relation to influences among values, rules and knowledge, futures consciousness, the social learning cycle and the adaptation decision context (cf. Table S1).

Data S5: Typology of adaptation initiatives and criteria for ranking the case studies on the governance-management and problem-system gradients (cf. Figure 3 in main text).

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