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Monitoring, evaluation and learning requirements for climate-resilient development pathways

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For today's decisions to be sustainable, they need to include choices and actions that reduce poverty and improve livelihoods, counteract climate change and are equitable towards the vulnerable. Climate-resilient development pathways are a practice that aims to achieve these goals, enabling decision-makers to identify, consolidate and implement climate action and development decisions towards sustainable development. To date, there is little evidence regarding how the practice can be navigated in real-world situations. Guidance on monitoring, evaluating and learning from experience specifically for climate-resilient development pathways is largely lacking. For this article, we reviewed the literature and held reflexive sessions with experts, synthesising different perspectives to present seven process-based monitoring, evaluation and learning requirements for climate-resilient development pathways. We close with discussing the applicability of the requirements and where further research is needed. In doing so, we address an important but underrepresented topic in the expanding body of literature on climate-resilient development pathways.

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Introduction

Even under the most ambitious greenhouse gas mitigation scenarios, climate change and the challenges it brings will involve trade-offs that need to be balanced for decades to centuries [1]. Therefore, decision-making must navigate climate change while strengthening development and reducing poverty in a manner that is inclusive and equitable [2,3]. This complex challenge means that planning and action must take into consideration dynamic and uncertain conditions, while accounting for numerous stakeholder perspectives, where decisions and their outcomes can have multiple trade-offs and feedbacks. It is therefore imperative to evaluate decisions and learn from their outcomes, to understand if decision pathways are heading towards equitable and shared goals or whether changes in action are needed.

Climate-resilient development pathways are one recognised practice of decision-making that aims to identify, consolidate and implement climate action and development decisions towards sustainable development [1,2,4]. The practice draws on the concept of pathways approaches. Examples include adaptation pathways, transition pathways or climate-resilient trajectories, which were conceptualised as planning approaches that navigate uncertain future conditions, by incorporating flexibility and multiple perspectives into decision-making [5–8]. To date, there is still a gap in evidence with regard to how climate-resilient development pathways can be navigated in complex real-world situations. This was recognised by the Intergovernmental Panel on Climate Change (IPCC) in its fifth assessment report chapter on 'climate-resilient pathways', which flagged 'approaches and structures for monitoring, recording, evaluating, and learning from experience' as priority research topics critical to inform flexible decision-making [4]. Despite this call for attention, little work has gone into the role of advancing monitoring, evaluation and learning for climate-resilient development pathways. Eight years on, with the release of the IPCC's sixth assessment report Chapter 18 on 'climate-resilient development pathways', the research gap in the fifth assessment report still persists, even though a large volume of literature has emerged spanning the nexus of climate-resilient development in the intermittent period [1].

Monitoring can be generally understood as tracking progress made in implemented actions, whereas evaluation aims to objectively determine the effectiveness of these actions in relation to specific objectives and

learning encompasses iterative reflection, including on the adjustments that may be needed to address new challenges that arise to inform the planning process over time [5]. In a climate change planning context, monitoring, evaluation and learning can thus be broadly understood as a process to understand and navigate change in complex settings or systems, which provides opportunities to inform decision-making and creates possibilities for knowledge generation [6]. It is widely recognised as a key process in planning and decision-making. However, similar to many strategic pathways' planning processes around climate change, there are a number of challenges with monitoring, evaluation and learning for climate-resilient development pathways. Owing to the highly contextual nature of adaptation, resilience and sustainable development, there is a lack of consensus around processes to assess the multiple interacting choices and actions that can shift the direction and outcomes of climate-resilient development pathways [7–9]. Another difficultly lies in the mismatch of timescales between decisions and their outcomes, which lends focus to the measurement of short-term results with a heavy reliance on indicators, as opposed to process-based monitoring, evaluation and learning of long-term structural changes that are critical for climate-resilient development pathways [2,10]. This is evident from the majority of monitoring and evaluation frameworks that have been developed with pathways approaches, which are designed for data-rich situations, where outcomes are quantified with respect to how they perform in relation to specific, pre-defined metrics and where there is a clear, well-defined mandate among stakeholders [11]. Owing to complex, changing and interacting conditions driven by climate change and long-term development processes, classical monitoring and evaluation alone, which uses toolkits and metrics with a strong emphasis on indicator-based approaches, will be less effective for climate-resilient development pathways [12]. Process-based approaches to monitoring, evaluation and learning, which considers more than data- and indicator-driven inputs and outputs [13], and engages with fundamental principles [14,15], will be equally, if not more important for understanding and navigating climate-resilient development pathways. However, details of process-based approaches to monitor, evaluate and learn from decisions in complex, data-scarce and often-contested arenas, such as those found in many development settings challenged by climate change [16,17], are not well-understood. There is thus a need for process-based guidance on monitoring, evaluation and learning for climate-resilient development pathways [18], which moves beyond output indicators and enables flexible, equitable and inclusive transitions towards sustainable development. In this context, this review article focuses on the question: *what are process-based requirements of monitoring, evaluation and learning for climate-resilient development pathways?*

Approach and methods

This review article brings together recently published literature in the fields of climate action, resilience, sustainable development, pathways approaches and monitoring, evaluation and learning to synthesise lessons on process-based requirements of monitoring, evaluation and learning for climate-resilient development pathways. Given that limited texts have been published explicitly focusing on monitoring, evaluation and learning for climate-resilient development pathways, to answer our research question, we build on disconnected threads in the literature that we find provide valuable lessons. Our review focused on key texts, such as the IPCC's sixth assessment report chapter on 'climate-resilient development pathways' [1], the Resilience, Adaptation Pathways and Transformation Approach (RAPTA) [12,19] and peer-reviewed articles advancing the practice of climate-resilient development pathways [2,16,20]. The literature was selected through expert judgement and citation-tracking. To validate and add to the lessons from the literature, we held reflexive sessions with six academics and practitioners with expertise in climate action, resilience, sustainable development, pathways and monitoring, evaluation and learning. The reflexive sessions were semi-structured, building from a set of pre-established questions that aimed to engage with a range of themes and to understand different expert opinions on monitoring, evaluation and learning for climate-resilient development pathways. Themes included indicators, stakeholder engagement, trade-offs and maladaptation, flexibility in approaches, monitoring across different temporal and spatial scales and experts perceived strengths and weaknesses in frameworks they have used in their own work. We synthesised the results from the literature and reflexive sessions, in which we identified seven process-based requirements of monitoring, evaluation and learning for climate-resilient development pathways.

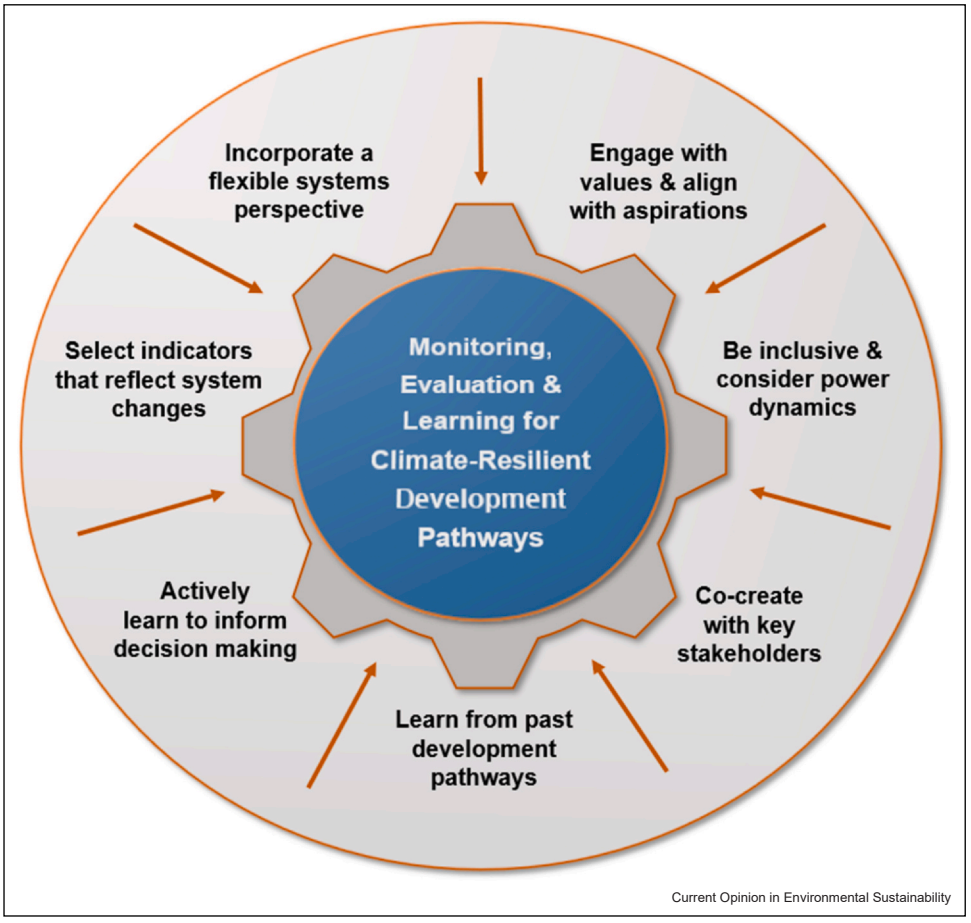
Monitoring, evaluation and learning requirements for climate-resilient development pathways

In this section, we present the outcomes of our review, which are summarised in Figure 1.

Learn from past development pathways

For climate-resilient development pathways to support transformations towards sustainable development, monitoring, evaluation and learning must be informed by past system characteristics [21]. Efforts should be made to understand how governance decisions have shaped historical pathways and how historical power dynamics have resulted in inequitable and maladaptive developments [20,22,23]. Additionally, learning from the past gives insight into social practices, biophysical and social drivers of vulnerability and root causes of risks, past path dependencies and historical

Figure 1



Seven process-based requirements of monitoring, evaluation and learning for climate-resilient development pathways.

triggers of adaptation or transformation [24,25]. This information is critical for scoping context-dependent system characteristics [26], which provides understanding of what should be monitored, evaluated and learned from in the first place and can help to identify system-relevant changes. Backcasting approaches, which connect past decisions and actions with present and future aspirations, are a promising methodology [27]. Fazey et al. (2016) present four case studies that look at how understanding past change provides inspiration for transformative futures [21].

Co-create with key stakeholders

Climate-resilient development pathways require co-creating monitoring, evaluation and learning processes to instigate agency through mobilising diverse knowledge, resources and social networks. Co-creation establishes trust, which facilitates long-term collaboration needed for climate-resilient development pathways [28–30] and engages with values, as well as perceptions and expectations of stakeholders' desired development paths. It is important to co-create with vulnerable and underrepresented stakeholders to facilitate monitoring, evaluation and learning around the issues and solutions of those in need, which can strengthen stakeholder's interaction with pathways [12,31]. Deep-seated and ingrained barriers can make co-creation methods difficult. It is therefore important for facilitators to be mindful of imbalanced power dynamics (see the following step) when interacting with stakeholders. Butler et al. (2022) and (2016) offer interesting co-creation methods for pathways development that consider power dynamics [16,32]. Without co-creating, monitoring, evaluation and learning will be less effective due to mismatches about critical issues, decision-making and values and aspirations of stakeholders, which are important to sustain pathways over time [33–35].

Be inclusive and consider power dynamics

Climate-resilient development pathways involve decisions that have outcomes across a range of scales and systems, affecting the whole of society [1,36]. These decisions should be influenced by actors with different

types of knowledge and with different levels of power to ensure that perspectives are equitably represented [37]. Therefore, a requirement of monitoring, evaluation and learning is to enable inclusivity. Engagement is particularly important among marginalised groups who are disproportionately affected by climate change and have unequal access to resources [22,38], as they often do not have the voice or power to present their view even though it is important [3,16]. Inclusive monitoring and evaluation, which accounts for the perspectives of those marginalised based on gender, race, age, sexuality, disability, social status or other factors related to identity, is a key to learn how pathways outcomes affect everybody [39,40]. Co-designing frameworks with marginalised stakeholders, for example, by developing and selecting indicators that track change in intersectionality variables [41], can be one step that helps to enable more inclusive governance processes around climate-resilient development pathways. Furthermore, there should be evaluation and learning of how actors can access the power, knowledge and resources they need to influence pathways to achieve their own development aspirations, as opposed to being reliant on others [6,42].

Engage with values and align with aspirations

Owing to the complexity that comes from multiple scales, systems and stakeholders, it is not possible to monitor, evaluate and learn from all interactions and outcomes of climate-resilient development pathways, resulting in the need for triage [43]. To prioritise monitoring, evaluation and learning actions, attempts should be made to understand how climate-resilient development pathways are engaging with values and aligning with aspirations of stakeholders. This is because developing and implementing solutions aspiring to sustainable development require synergising multiple different values and aspirations towards shared goals [1,44]. Engaging with values and aspirations through a structured monitoring, evaluation and learning approach can help to enable societal participation needed for climate-resilient development pathways, by building a stronger understanding of stakeholders' perceptions and expectations for the future and centralising learning outcomes around their specific needs [44]. Furthermore, it facilitates an understanding whose values and aspirations are diminished as a result of climate threats and unsustainable development, which can help to prioritise where resilience-strengthening capacities are needed [45,46]. Given that stakeholder groups have conflicting values and aspirations, trade-offs will undoubtedly arise [43]. Co-creation methods that result in meaningful participation and identifying and acknowledging trade-offs, through, for example, pathways mapping approaches [3,16], can support more equitable management of them [9].

Incorporate a flexible system's perspective

Systems theory denotes that system boundaries alter due to changing climatic or social–ecological conditions and that system dynamics increases with complexity [47]. This is a challenge for monitoring, evaluating and learning of climate-resilient development pathways, as the approach is long term, will likely have no definitive end when the goal is ambiguous such as sustainable development, and multiple different pathways can lead towards or away from objectives [2,48,49]. Rigidly defining 'systems of interest', pre-defining all stakeholders and anticipating long-term goals will result in blind spots for monitoring dynamics such as feedback and cascading effects, as not all system elements can be known or measured at one point in time [50–52]. A flexible system's perspective is therefore required, in which there is reflexivity of what and who to monitor, evaluate and learn from as boundaries and dynamics change over time [50,53]. This reflexivity can be informed through monitoring, evaluation and learning outcomes themselves [52], in which it is important to accept, embrace and then analyse system complexity. Integrating a system's perspective, however, is a challenge in the policy domain, where there are targeted goals in specific sectors, as this conflicts with the interconnectivity of systems theory.

Select indicators that reflect system changes

Indicators provide tractable forms of information in specific contexts, measuring change in variables that are relevant at a fixed point in time, for a fixed objective [12]. This is a challenge for monitoring, evaluation and learning of climate-resilient development pathways. Owing to the directional and temporal nature of the approach, and the explicit focus on dynamic and multidimensional components across sectors and scales [31,32], indicators related to fixed objectives will become less relevant over longer time periods as objectives will change. Additionally, pathways for advancing climate-resilient development involve system transitions [1,9]. Selecting indicators that can provide information on how systems are changing can be useful for a monitoring, evaluation and learning approach with climate-resilient development pathways in mind. For example, indicators that reflect changes in biophysical and ecosystem conditions, inclusive governance, equity and climate justice [9] and systemic levers for transformation [29,54,55] can support learning about systems, where broad linkages can be made to moving climate-resilient development goal targets. This should not replace indicator selection that is linked to context-specific goals, but rather compliment it. This is because indictors that capture system change strengthen opportunities to capture logic in the complexity of change across contexts, scales and over longer time frames [56,57].

Actively learn to inform decision-making

Climate-resilient development occurs in dynamic, uncertain and interconnected systems, where present changes can influence future objectives and the underlying assumptions can become less relevant over time. This results in a high amount of ambiguity and uncertainty for decision-making. A key requirement to enable overcoming this is to build an iterative process of active learning into monitoring, evaluation and learning approaches. Active learning informs decision-making for responding to rapid, unprecedented or uncertain change [12], and provides opportunity for knowledge generation and integration. Actively learning through disaggregated intervals builds structured reflection into pathways, creating space for managing trade-offs, accommodating for uncertainties and for readjustment to avoid path dependencies [2]. Additionally, disaggregating monitoring intervals enables evaluation and learning of incremental change [14], in advance of structural and transformative change tracked over longer time periods, which are critical for climate-resilient development.

Discussion

In this review article, we focus on the question: *what are process-based requirements of monitoring, evaluation and learning for climate-resilient development pathways*? Here, we discuss some of the implications that need to be considered when integrating the requirements into monitoring, evaluation and learning frameworks, highlight the limitations of the review and suggest priority research topics.

The seven process-based requirements presented in this article should be embedded as best as possible into monitoring, evaluation and learning approaches for climate-resilient development pathways. Figure 1 is a useful heuristic to guide research and practice in doing this. However, in light of real-world constraints, trade-offs will likely have to be made in application of the requirements regarding which need to be prioritised, to what extent and when. For example, inclusive co-creation methods will be challenging where stakeholders have conflicting values and aspirations, and taking incorporating a flexible systems perspective that looks at interconnectivity is a challenge for sectorally defined policy goals. Some of the requirements may come later in a monitoring, evaluation and learning cycle, such as actively learning from outcomes, and some earlier, such as learning from past development pathways. However, we do not suggest a hierarchy or sequential order, where one principle is more important or should be integrated before another, as this will be influenced by specific needs of stakeholders and policy goals. However, for climate-resilient development pathways to navigate complex and uncertain conditions as best as possible, each of requirements should be taken into consideration from the start of planning processes. This will allow for prioritisation of each of the requirements, and can result in better management of trade-offs that will inevitably arise between integrating them into a framework. This emphasis of thinking about monitoring, evaluation and learning early in the planning process run opposite to much of the traditional framing, where it is frequently included as a last step in planning [58].

Another important consideration for integration of the seven requirements in monitoring, evaluation and learning approaches concerns context specificity. Not only do stakeholders have specific mandates for interventions or policies, there are also context-specific challenges to systems of interest [59]. This context specificity relies on tailoring monitoring, evaluation and learning approaches and process. For example, some frameworks will be designed at the local scale, for a specific goal, whereas some will be designed at the national or regional scale, for any number of cross-cutting goals. While acknowledging that the seven requirements defined in this review are broad and not tailored to a specific context, they are equally cross-cutting and emphasise the importance of flexibility, enabling equitable decision- making and the inclusion of local perspectives in monitoring, evaluation and learning approaches. These three qualities, flexibility, equitability and inclusion, are a well-agreed- upon mandate for climate-resilient development pathways [1–3,16,37], which we find are an equally important lesson for successful application of context-specific monitoring, evaluation and learning approaches.

Owing to the scope of this review focusing on process-based requirements, and because much of the climate-resilient development pathways literature has focused on qualitative research, limited literature was analysed on quantitative monitoring, evaluation and learning techniques and methodologies. However, the coupling of different types of approaches is important, and should not be discounted in monitoring, evaluation and learning for climate-resilient development pathways [54]. When designing frameworks and approaches, experts will need to grapple with the challenge of synergising and appraising metrics related to mitigation and the efficacy of adaptation in reducing risk or enhancing climate-resilient development [60]. Given that monitoring, evaluation and learning are relatively well-established for climate mitigation compared with adaptation, we observe there may be valuable lessons from the mitigation domain. Additionally, while the seven process-based requirements developed from this review drew on the current pathways literature, as the application of pathways methodologies is growing in research and practice [31], new lessons can also be derivable from complimentary approaches such as adaptation pathways, transition pathways or climate-resilient trajectories. Another

important point to note is that monitoring, evaluation and learning techniques that provide understanding of complex system attributes such as resilience, feedback effects and system interdependencies [17,57] are important to understand and a priority research topic, however, this was outside the scope of our review. Empirically informed research that can provide guidance on how to do this, while integrating some or all of the process-based requirements, would be beneficial to further advance monitoring, evaluation and learning approaches for climate-resilient development pathways.

Conclusions

While there is a growing interest in climate-resilient development pathways in research, policy and practice, limited progress has been made on advancing monitoring, evaluation and learning. Through our review, the seven process-based requirements presented in Figure 1 contribute to closing this gap. Our review highlights that approaches should be flexible, equitable and inclusive; and that monitoring, evaluation and learning should be understood as a key enabler of the success of climate-resilient development pathways. By synthesising and presenting requirements of monitoring, evaluation and learning, we address an important but underrepresented topic in the expanding body of literature on climate-resilient development pathways.

CRediT authorship contribution statement

Edward Sparkes: Conceptualization, Methodology, Formal analysis, Writing – original draft and Visualization, **Saskia E. Werners**: Conceptualization, Methodology, Writing – review & editing, Visualization.

Data Availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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- • of special interest
- •• of outstanding interest

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