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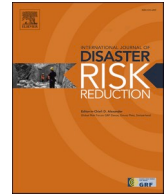
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Reformative recovery for resilience in disaster risk management: A scoping review and analytical framework

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ABSTRACT

Conventional disaster recovery often prioritizes rapid restoration to a baseline state but potentially perpetuates pre-existing vulnerabilities that neglect long-term resilience. Unlike current approaches that emphasize physical and economic rebuilding with a blind eye to the previous context of disasters, Reformative Recovery (RR) highlights the need to intervene in social and environmental long-term processes leading to vulnerability. This paper advances the concept of 'Reformative Recovery' and proposes an analytical framework as a sense-making tool to guide interpretation of recovery dynamics by foregrounding the conditions that foster vulnerability and impede long-term resilience. RR reframes recovery as a continuous and non-linear process shaped by social and institutional dynamics. The analytical framework is developed through a systematic scoping review and structured around six dimensions relevant for RR: 1) social justice, 2) governance arrangements, 3) community and culture, 4) financial mechanisms, 5) built environment, and 6) critical services. As an extension to the state of the art, a social justice dimension is proposed as an overarching component. Furthermore, the concept of critical services is extended beyond networked infrastructures to include locally defined essential services. These dimensions reflect the complex and interconnected nature of disaster impacts. For each dimension, we propose diagnostic prompts to support critical assessment of conditions and potential for inclusive and just post-disaster recovery by means of reformation. Rather than prescriptive indicators, these prompts serve as deliberative tools to support reflective and context-sensitive use by decision-makers and researchers. RR can be used to bridge short-term actions with long-term resilience-building in diverse contexts.

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1. Introduction

1.1. There is a pressing need to strengthen disaster resilience

More than ever, natural hazards are threatening lives, livelihoods, and societies worldwide. Since 1980, more than 2.5 million people have lost their lives to disasters caused by natural hazards. Approximately 8.7 million people were newly internally displaced due to natural disasters at the end of 2022 [1] and approximately \$6 trillion, adjusted by inflation, has been lost globally since 1980 [2]. Beyond fatalities, a disaster's immaterial impact can be far-reaching on a personal, community, and even societal level through psychological factors such as trauma, injury and/or displacement [3].

Natural hazards on their own are not disasters by definition. It is argued that natural hazards become disasters through specific vulnerabilities being created by planners and decision makers, making disasters social constructs [4], [5]. Natural disasters emerge not only as the result of hazards themselves, but of the exposure, vulnerability and lack of resilience that are created in a society; they are rooted in historical, social and systemic processes that shape their consequences [6]. These vulnerabilities are not only created by spatial characteristics but include aspects such as financial status, social status, and unequal access to fair decision-making and planning processes [5]. Disasters potentially deepen these pre-existing inequalities, disproportionately affecting those already marginalized by limited resources, social exclusion, or restricted access to just mechanisms.

As climate change intensifies and urbanization concentrates populations and economic activity in hazard-prone areas, the impacts of natural disasters are expected to escalate [7], [8]. The complexity and interconnectedness of modern urban systems further complicate the implementation of effective disaster risk and recovery strategies [9]. Clearly, there is an urgent need to improve disaster resilience and recovery to adapt against increasingly frequent and severe disruptions.

1.2. Current disaster management perspective

Over the years, scholarship on disaster management approaches has shifted from emergency preparedness to vulnerability and risk reduction, and to risk prevention (see e.g., Refs. [10], [11]). These shifts have resulted in a key paradigm shift from vulnerability to resilience [12], from a *reactive* approach to a *proactive* one [11]. Respectively, these shifts were adopted within international established frameworks such as the Hyogo Framework for Action (2005-2015) [13] and the Sendai Framework for Disaster Risk Reduction (2015-2030) [14].

These frameworks, however, are far from being fully effective. For example, the Sendai midterm review revealed that a primary focus is on the response rather than on prevention and preparedness [14]. Moreover, the Sendai Framework [14] misses “*concrete connections with societal issues and processes*” [15], and progress measurement remains hazard centric [16]. Consequently, opportunities to strengthen resilience are often missed [14].

Traditionally, disaster risk management still revolves around the four phases of disaster management: prevention, mitigation, response, and recovery [17], aligned with ideas of disasters being eventful [6]. Such a hazard-centric approach does not fully lend itself to managing a disaster. First, Neal [18] argues that the use of disaster phases suggests that these are discrete events. However, the social change resulting from disaster is far from discrete ([4], [6], [19]). In reality, the phases are mutually inclusive [18], which results in their boundaries being *fuzzy* [20]. Second, using phase delineation between prevention, mitigation, response, and recovery suggests that these happen in chronological order [21], whereas in practice, many people might be working on multiple phases simultaneously [22]. In a way, the delineation between phases results in a “*self-fulfilling prophecy*”, as agencies are designed to only focus on specific phases [21]. For example, funding activities of humanitarian agencies are only allowed to be linked to activities within the response and early-recovery phase [21]. Third, the distinction between phases suggests that these follow a specific objective timeframe, whereas the pace of recovery can differ cross-culturally and follows social time [22].

Consequently, scholars emphasize that disasters should not be understood as isolated events, but as processes shaped over time [6]. Within this perspective, short-term recovery must already embed considerations for long-term resilience, adaptation, and systemic change [23], [24]. Resilience here refers to the systems' ability to withstand, absorb and adapt to shocks and stresses and relates to long-term transformation and adaptability [25], [26], [27]. This calls for moving beyond the current phase-based understanding of disaster management, towards an integrated approach in which multiple phases such as preparedness, mitigation, response, recovery, and long-term planning, are addressed simultaneously. In this way, post-disaster actions can thus serve as entry points for embedding long-term resilience objectives.

1.3. Reframing the recovery narrative

Beyond disaster management cycles, the Build Back Better (BBB) movement adopts this perspective and has been a key pillar within the most recent Sendai Framework [14]. This concept emphasizes that recovery after disasters should not simply return to baseline conditions but should aim to bounce back in a way that reduces existing vulnerabilities. Despite this emphasis, there is still a wide gap between the normative ambition of BBB as a resilience narrative and its actual implementation after disasters [28]. Even though the ideal BBB narrative is based on seizing opportunities for improvement within a physical, social, economic, and environmental context [28], in practice, recovery efforts continue to focus disproportionately on reconstruction of physical and economic assets, often sidelining social and environmental contextual processes as much as justice considerations [29], [30].

Furthermore, in many contexts, the concept of “recovery” continues to be narrowly defined by measurable outcomes such as restored gross domestic product (GDP) or rebuilt infrastructure [16]. Although such indicators are useful for benchmarking and

accountability, they fail to fully capture structural transformation, lived experiences, or the development of systemic resilience. This limitation is, in part, perpetuated by the widespread use of indicator-based evaluation frameworks, which tend to prioritize quantifiable data over complex and interrelated social processes. As highlighted by Cheek and Chmutina [16], technical indicators frequently obscure the inherently political dimensions of disaster recovery, thereby reinforcing dominant narratives and marginalizing alternative perspectives related to power, equity, and community agency. As a result, communities may become vulnerable to future disasters when underlying structural issues are ignored. Relying solely on economic or infrastructure indicators neglects the lived experiences of trauma, loss, inadequate housing, and other stressors that shape the post-disaster environment [31], [32], [33].

Despite recent shifts in disaster recovery thinking and the increasing traction of the transformative resilience discourse, two dominant approaches (i.e., the traditional phase model and the BBB framework) remain limited in key respects. The traditional model conceptualizes disaster management as a linear sequence of phases (response, recovery, mitigation, preparedness), which can fragment efforts and constrain systemic thinking. Meanwhile, BBB, although transformative in intent, often remains narrowly focused on physical and economic reconstruction with a blind eye to the previous context of disasters, and limited attention to social justice, environmental sustainability, and structural transformation [34]. These shortcomings reveal the need for an alternative approach that recognizes the complexity and interdependence of recovery processes. One such emerging approach is ‘reformative recovery,’ introduced by Lallemand [21]. Inspired by Lallemand’s work, reform here is defined as the intentional and systemic transformation of processes, institutional designs, and governance practices that sustain vulnerability and inequality. Rather than seeking improvement within existing frameworks, reformative recovery aims to restructure the underlying systems through which risks and benefits are distributed, thereby addressing the root causes of disaster-related injustice already at the outset of the disaster event.

The concept of reformative recovery, as interpreted in this study, offers significant potential for several reasons. First, by departing from the traditional phase-based model and recognizing the simultaneity of recovery processes, it enables more effective collaboration among policymakers and organizations, who might otherwise be constrained by sequential disaster phase boundaries. Although reformative recovery shares some objectives with the BBB framework, its emphasis is fundamentally distinct. Specifically, reformative recovery challenges the implicit focus on only physical reconstruction embedded in BBB. Furthermore, it rejects the notion of returning to a pre-disaster status quo, thereby shifting from a reactive to a transformative approach. In addition, it addresses the ambiguity associated with the term ‘better’ in BBB, a term that is often undefined and thus open to multiple interpretations. This vagueness raises concerns regarding what constitutes ‘better’ and for whom, making the concept vulnerable to political manipulation. In contrast, the use of the term ‘reformative’ allows for the identification of specific long-term processes and antecedents explaining vulnerability and disasters, as well as reform mechanisms monitoring progress aiming to operationalize transformative resilience. However, despite the conceptual promise of reformative recovery, there remains a limited body of literature addressing its definition, its relationship to resilience, and its practical implementation.

This study addresses the conceptual and practical gap surrounding Reformative Recovery by asking: “What dimensions are essential for reformative recovery, and how can they inform inclusive, just, and equitable post-disaster recovery?” To explore this question, we conduct a systematic scoping review of academic and grey literature to identify key dimensions associated with reformative recovery. Based on this synthesis, we propose an analytical framework comprising six interrelated dimensions, each accompanied by a series of **diagnostic prompts**. Rather than functioning as fixed indicators or prescriptive checklists, these prompts are designed as deliberative mechanisms (i.e., diagnostic questions) that enable practitioners and researchers to examine and to critically reflect on the rules, responsibilities, resource allocations, and planning procedures (i.e., institutional arrangements) that shape recovery outcomes. Recognizing the diversity of environmental conditions, governance structures, cultural settings, and hazard types, this framework does not seek to impose a universal model. Instead, it offers a flexible and reflective structure that can guide context-sensitive analysis and foster inclusive dialogue. These prompts aim to support both ex-ante and ex-post evaluations, inform cross-case comparisons, and encourage adaptive practices that promote systemic resilience and justice.

To clarify how Reformative Recovery differs from and contributes to the existing recovery approaches, we provide [Table 1](#). This comparison illustrates that Reformative Recovery does not replace BBB but extends it by shifting analytical attention from post-disaster reconstruction outcomes to long-term social, institutional, and political processes. [Table 1](#) clarifies the nuances between Reformative Recovery and BBB by illustrating how each approach conceptualizes time, process, focus and recovery outcomes. While BBB typically evaluates recovery by comparing post-disaster conditions to a pre-disaster baseline, Reformative Recovery starts from the premise that

Table 1

Comparison of build back better and reformative recovery based on underlying assumptions about time, recovery processes, focus, and outcome orientation.

	Build Back Better (BBB)	Reformative Recovery
Time appraisal	The past offers a benchmark to be improved after the disaster (Discrete)	The disaster is a manifestation of a long-term process shaping vulnerability (Continuous)
Positioning within disaster preparedness cycle	Post-disaster, sequential	Throughout the whole cycle: preparedness, immediate recovery, nonlinear, simultaneous.
Reactive/proactive	Reactive (the disaster sets the comparison between past and future)	Proactive (it doesn't wait until disaster strikes as it is only a manifestation of a process)
Focus	Primarily reconstruction oriented (built environment)	Broader focus on the social and environmental processes explaining vulnerability as an unfair situation where Reformative Recovery complements BBB framework
Outcome	Physical improvements, more technocratic.	Justice and community oriented (distribution of burdens, reformation of processes, institutionalization of interests) more systemic

disasters are the manifestation of long-term preexisting processes that shape vulnerability over time. Hence, Reformatory Recovery advocates a shift from viewing recovery as a discrete, post-event phase toward understanding recovery as a continuous and non-linear process spanning preparedness, immediate response, and long-term transformation. Similarly, Reformatory Recovery advocates a shift from reactive, physical reconstruction-oriented interventions towards a more proactive focus on the social, institutional and environmental processes such that risks and benefits are distributed (see Table 1). This distinction does not suggest that Reformatory Recovery offers a technical solution to complex political or economic interests. However, by centering justice, governmental arrangements and process-oriented assessment, Reformatory Recovery functions as an analytical lens to make these dynamics visible. Hence, it complements existing recovery approaches such as BBB by facilitating a more reflective and context-sensitive framework.

1.4. Scope, unit of analysis, and analytical positioning

This framework deliberately diverges from asset-based recovery approaches that emphasize physical reconstruction and economic recovery as the principal indicators of recovery. Although such approaches remain essential, specifically in response to large-scale catastrophic events, they are already extensively documented in both policy and practice. In contrast, Reformatory Recovery is positioned as a complementary analytical lens that explicitly targets the transformation of the pre-existing social structures, practices and arrangements that create vulnerability prior to the disaster and shaped unequal risk exposure and impacts. As such, it focuses on identifying and addressing historical, current and future obstacles to community agency, governance, and justice that constrained recovery trajectories before the disasters occurred. The approach examines how recovery resources are (re)distributed relative to the pre-disaster conditions, including which views and interests are institutionalized, who gain access to them, through which processes, and with what long-term effects. It is important to note that assets are not excluded from the analysis; rather, they are considered embedded outcomes of these broader processes, rather than isolated goals of recovery.

The framework is designed as a scale-agnostic and context-sensitive tool. Its unit of analysis is the recovery process itself, rather than a specific geographical, administrative, or jurisdictional level. As such, the diagnostic prompts may be applied across diverse contexts, including low- and high-income settings, urban and rural areas, and both centralized and decentralized governance systems. Rather than assuming baseline financial, technical, or institutional capacity, the framework explicitly surfaces these contextual conditions through the prompts, enabling adaptive and locally grounded interpretations of reformatory recovery.

2. Methodology of the scoping review

A systematic scoping review was conducted to investigate dimensions of Reformatory Recovery and to develop an analytical framework consisting of diagnostic prompts for conditions and potentials for inclusive and just disaster recovery. Given the limited availability of literature explicitly addressing reformatory recovery within the field of disaster risk management, the scope of the review was broadened to include studies focusing on recovery, resilience, long-term recovery, proactive approaches, justice, inclusiveness, and the BBB framework.

2.1. Literature identification

We tested several search queries in an iterative process to arrive at a formulation that yielded a relevant and manageable set of results. The final search query was developed to capture studies focusing on long-term, justice-oriented, and transformative dimensions of post-disaster recovery and resilience. It incorporated keywords reflecting temporal scope (e.g., ‘long-term,’ ‘proactive’), normative recovery framings (e.g., ‘Build Back Better,’ ‘Bounce Forward,’ ‘reformatory,’ ‘transformative,’ ‘adaptive’), and justice considerations (e.g., ‘justice,’ ‘equity,’ ‘equality,’ ‘inclusive,’ ‘dimension’). The final search query included the following keywords:

“Long term” OR “Long-term” OR “proactive” OR “post-disaster” OR “reformatory” OR “transformative” OR “adaptive” OR “Build Back Better” OR “BBB” OR “Bounce Forward” OR justice OR equity OR equality OR dimension* AND “disaster risk management” OR “DRM” AND resilience AND “inclusive” AND recovery.*

The search was conducted using Scopus and limited to articles published between 2014 and 2024, aligning with the period of adoption of the Sendai Framework for Disaster Risk Reduction. During this period, disaster literature and practice started the shift towards a multidisciplinary and proactive approach.

2.2. Eligibility criteria

Title and abstract screening were conducted by two reviewers and took place in November 2024. The query yielded 115 documents. Covidence was used to collaborate on title and abstract screening. Furthermore, we applied the following filters to refine the selection:

- Publication year: 2014–2024
- Language: English only
- Subject areas included: Social sciences, engineering, economics, finance, energy, decision sciences, arts and humanities, and multidisciplinary fields
- Excluded keywords: COVID-19, pandemic-related terms (e.g., “Coronavirus Disease 2019”) were filtered out, as the study focuses on natural hazards and not health-related crises.

We excluded:

- Articles that were too narrow in scope or did not adopt a system's perspective
- Most conference papers, books for practitioners, and non-peer-reviewed reviews. However, some systematic reviews were retained based on their relevance or theoretical contributions.

This initial screening resulted in the removal of 69 articles. Discrepancies in inclusion decisions were discussed and resolved by consensus to ensure consistency in applying the eligibility criteria and reduced potential reviewer bias. Additionally, 44 relevant articles were identified through snowballing and backtracking techniques (reviewing references and citation networks of initially selected papers). These were added to the title and abstract screening process to ensure completeness and eliminate duplicates. The full search query can be found in [Appendix A](#) and [Fig. 1](#) provides the Prisma summary of the review process.

2.3. Full text screening and review and analysis of the literature

Full-text screening was conducted through a peer review process in which five reviewers with interdisciplinary expertise in resilience, justice, disaster management across both qualitative and quantitative research methods, independently assessed each document in full. During this phase, an additional 36 papers were excluded due to limited accessibility, lack of relevance, or ineligibility based on publication type (e.g., books and conference proceedings). Discrepancies between reviewers were resolved through discussion until a consensus was reached. Following the selection of studies for full-text assessment, data extraction focused on the

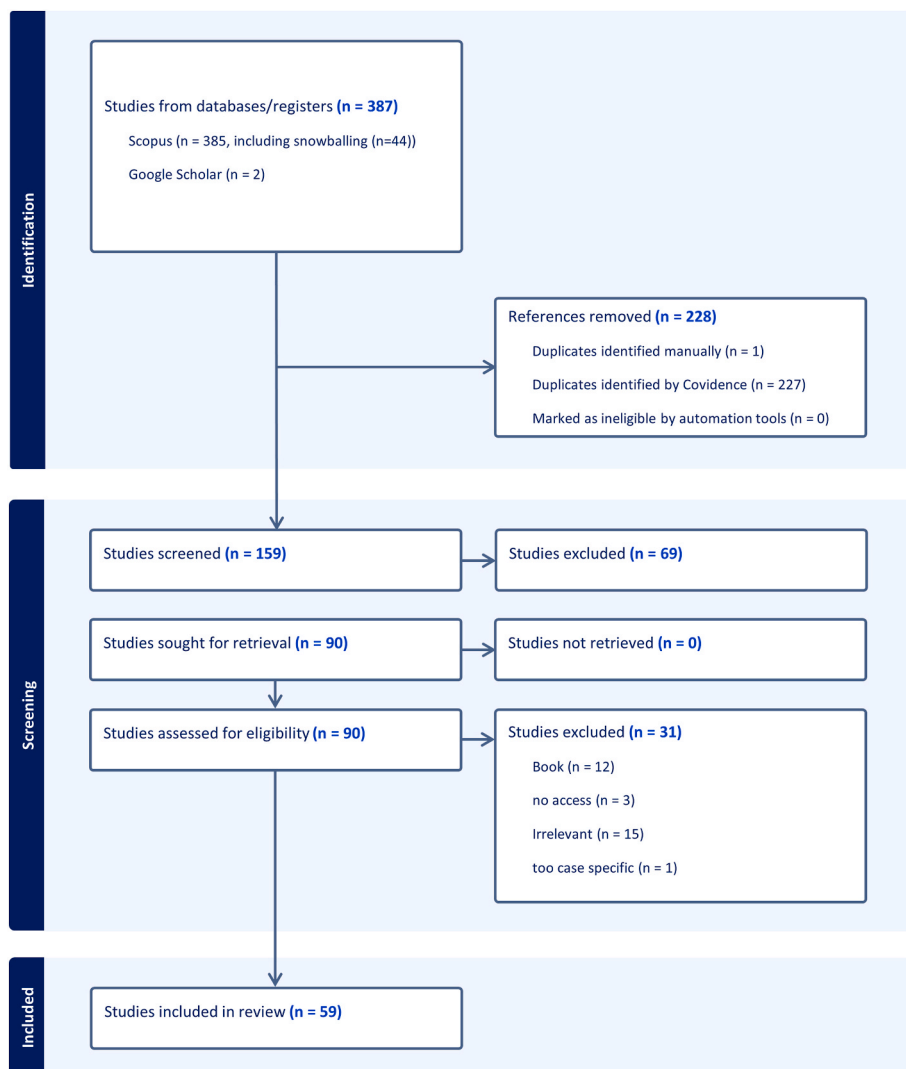


Fig. 1. PRISMA summary of the review process, image created by covidence.

following key aspects:

- To what underlying dimensions the study relates to (see also section 2.4);
- The contextual background of each paper;
- The state-of-the-art practices, approaches, or concepts discussed;
- The implications of these elements for the concept of reformative recovery;
- Where applicable, factors influencing reformative recovery, understood not as indicators but as components critical to the emergence of reformative recovery in a given domain;
- Identified obstacles, limitations, challenges, or knowledge gaps related to reformative recovery.

2.4. Synthesis

To bridge the gap between conceptual understanding and practical implementation of resilience planning in Disaster Risk Management, the studies in the literature review were used to inductively derive dimensions through which recovery and resilience are addressed. Each study was then deductively categorized using these dimensions. The dimensions are further elaborated upon in Section 3.

Based on the identified analytical dimensions, we developed a set of diagnostic prompts to support context-sensitive application. These prompts, synthesized from the literature, serve as concise entry points into each dimension and form the foundation of our analytical framework. To apply the framework, the prompts are structured around two components designed to facilitate critical reflection on the transformative potential of post-disaster recovery:

1. **Diagnosing systemic processes:** identifying the underlying structures and historical conditions that shape baseline conditions.
2. **Diagnosing transformative moments and potential reforms as turning points:** identifying whether and how post-disaster interventions reinforce, challenge, and transform these underlying systemic processes rather than merely restoring pre-disaster conditions.

This two-part view enables a deeper understanding of how reformative recovery can challenge structural injustices and support systemic change. It also offers both analytical clarity and flexibility for scholars and practitioners to operationalize reformative recovery. We showcase this synthesis based on an example application to provide empirical illustration in Section 4.

3. Reformative recovery: Dimensions and diagnostic prompts

3.1. Identifying relevant dimensions

This review synthesizes findings from the literature to identify six underlying dimensions through which recovery and resilience are addressed: governance arrangements, social justice, financial mechanisms, community and culture, the built environment, and critical services. These dimensions are also reflected in existing literature. For example, Aydin et al. [35] provides a similar overview of the factors affecting post-disaster recovery process and identifies similar categories as influential in shaping the recovery outcomes which highlights the relevance of these dimensions. However, while these six dimensions offer a robust conceptual base, their practical application still requires further refinement. It is also important to acknowledge that this list is not exhaustive. Further specification of

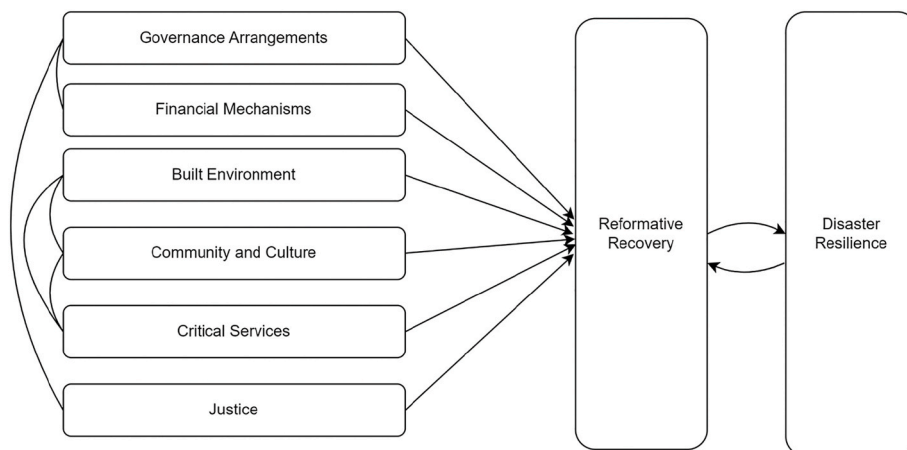


Fig. 2. Dimensions of reformative recovery, their interrelations and how they relate to reformative recovery and resilience. The dimensions of governance arrangements and justice relate to all other dimensions.

diagnostic prompts, informed by empirical insights, is encouraged.

Most of the reviewed studies addressed multiple dimensions at once, highlighting the complexity of the recovery process and the need for a systems-oriented approach. Researchers frequently examined governance arrangements and social justice together, often embedding these themes implicitly within broader discussions, such as those related to community participation or service access. They also explored intersections between governance and financial mechanisms, as well as the relationships among the built environment, community and culture, and critical services. Similarly, our review of the literature revealed frequent coupling between governance and financial mechanisms, as well as among the built environment, community and culture, and critical services. Fig. 2 maps these dimensions and their interconnections, underscoring how reformative recovery efforts rely on addressing overlapping issues. Fig. 3 illustrates how frequently each dimension appeared across the reviewed studies, with governance arrangements, community and culture, and justice emerging as dominant themes. While this pattern may reflect the study's search strategy, it also points to a persistent siloed approach in the literature. Researchers mainly gravitate either toward socio-political concerns, such as inclusivity, equity, and intersectionality, or toward technical dimensions like infrastructure design and spatial planning, with limited integration between the two. This division may hinder holistic recovery efforts and shows the importance of transdisciplinary frameworks in disaster recovery research.

In addition, the geographical distribution of case studies presented in the reviewed literature reveals certain limitations (see Fig. 4). A substantial number of studies lacked empirical case studies altogether, and among those that did include case-based evidence, the majority focused on the Asian continent. This shows not only a lack of geographical diversity and contextual variation but also the overly conceptual nature of much of the work, which limits its operationalization in practice. This trend may constrain the generalizability of current recovery research.

3.2. Analytical framework dimensions for reformative recovery

3.2.1. Social justice

Disasters are inherently social constructs [4]. From a reformative recovery perspective, social justice plays a central role in exploring how risks have been distributed in the past, how they are experienced in the present, and how they might be reshaped in the future. In this study, the dimension of social justice relates to the classical tripartite theory of justice (i.e. [36], [37]), namely distributive, procedural and recognitional justice. This tripartite social justice dimension is a cross-sectional criterion that qualifies the normative appraisal of all other dimensions. Hence, each dimension can be described as underlying factors, processes and institutional designs that together could enable or hinder (1) a fairer distribution of risks and benefits of recovery outcomes across the population, (2) a fairer recognition of the cultures, values, and situations of all affected parties, and [38] (3) a fairer representation of all affected parties in the process of decision-making [36]. From a reformative recovery perspective, social justice entails the intentional transformation of historically produced patterns of vulnerability and marginalization due to the colonial legacies, land dispossessions, unbalanced power distributions, that continue to shape disaster risks, recovery trajectories and decision-making processes.

While the conceptual elaboration of the tripartite theory of justice portrays a coherent and reinforcing system along their distributive, procedural and recognitional components (i.e. [36], [37]), in practice claims of justice within and between justice components bring tensions and compound complexities from their interplay between geographical and time scales (i.e., inter-generational justice, reparation justice, decolonial justice).

The body of literature that directly addresses issues of (in)justice in disaster recovery remains scarce and descriptive by nature. Furthermore, the approach does not bring the nexus between the tripartite dimensions of justice: distribution, process and recognition. One branch of the literature only focuses on procedural aspects of justice and its operationalization, such as formal processes of stakeholder representation and participation [39], and there is no common definition of (social) justice in Disaster Risk Management (DRM) [40].

A second stream of studies highlight the importance of inclusivity within stakeholder representation (see e.g., Refs. [41], [42],

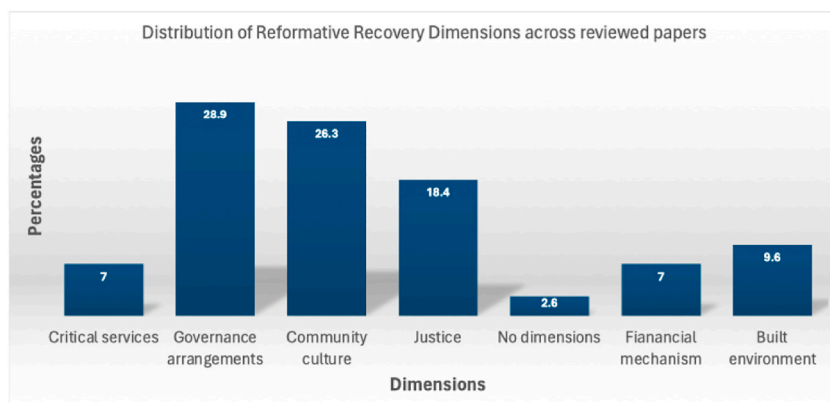


Fig. 3. Distribution of reformative recovery dimensions across reviewed papers.

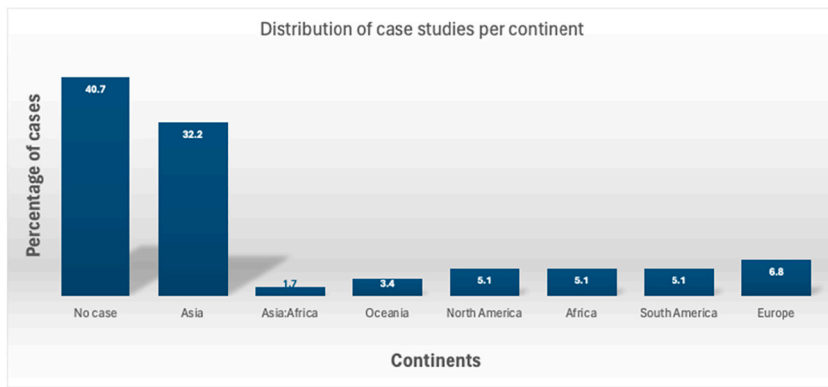


Fig. 4. Distribution of reviewed papers across continents.

[43], [44], [45], [46], [47], [48], [49], [50], [51]). The differentiated impact of disasters should be considered across the population [41], across temporal and spatial scales (e.g., Ref. [50]) or regions (e.g., Ref. [51]). For example, literature highlights the unequal burden that vulnerable groups face after disasters such as women (e.g., Ref. [42]), those in poverty or with disabilities (e.g., Ref. [43]). These issues reflect broader challenges related to distributive and recognition justice, which are not exclusive to disaster contexts but are often intensified by them. Furthermore, regions beyond the urban region (e.g., rural, urban periphery) are often overlooked in recovery plans [51].

Likewise, adopting a core focus on procedural and distributive aspects of justice does not account for the individual's own perspectives and lived experiences during and after disaster and the complex social processes through which actual lived experiences and subsequent injustices emerge (e.g., Refs. [39], [50]). As mentioned earlier, most papers addressed more than one reformative dimension, particularly governance and justice, which illustrates the complexity of recovery processes and the need for a systems approach linking distribution, recognition, and representation in decision-making process. Increasingly, studies argue for a shift of attention to an intersectional approach of disaster risk governance, recognizing that disaster experiences cut across social categories of gender, race, class, etc. (e.g., Refs. [39], [46], [50]). Actual participation and engagement of stakeholders (including communities, actors) can be affected by disaster itself (e.g., Refs. [41], [45], [52], [53], [54]), existing (colonial) power dynamics (e.g., Refs. [44], [49], [50], [55]) and individuals' lived experiences (e.g., Refs. [39], [50]).

Table 2 summarizes the overarching prompts for all reformative recovery dimensions including social justice. Overall, the social justice dimension of Reformative Recovery calls for mechanisms for transforming existing inequalities that shape disaster outcomes. Furthermore, Appendix B, Table B.1 provides accompanying diagnostic prompts that need to be addressed for enabling reformative recovery from a social justice perspective.

3.2.2. Governance arrangements

The dimension of governance arrangements is important for Reformative Recovery as governance arrangements serve as a backbone for reconstruction planning after disaster. In this study, governance arrangements refer to design of rules or mandates, the institutional mechanisms and organizational arrangements of both government and non-government actors and their collaboration in relation to DRM activities. This includes both formal procedural elements (e.g., mandates, institutional responsibilities, planning procedures, judicial and accountability mechanisms) and deliberative processes (e.g. participation, negotiation and trust-building) through which recovery priorities are shaped. Governance arrangements are the kernel of justice and the promotion of systemic change and reformative recovery (See Table 2 overarching prompt). In other words, the governance arrangements are prime designs that are susceptible to be reformed and the entry point to influence long-term social and environmental processes.

Within the governance dimension, several factors are relevant for Reformative Recovery. Many studies highlight the importance prioritizing inclusive, participatory, adaptive and proactive decision-making processes for post-disaster recovery planning (e.g., Refs.

Table 2

Reformative recovery dimensions and overarching diagnostic prompts.

Dimensions	Overarching diagnostic prompt
Social justice	How are existing distributional inequalities considered in recovery processes?
Governance arrangements	What is the level of trust in institutions?
Community culture	What kind of local knowledge exists related to disasters?
Critical services	What kind of services do the vulnerable population rely on?
Financial mechanisms	How do the funding mechanisms ensure expected liquidity requirements during and after the recovery phase? What are the boundary conditions to ensure household access to finance?
Built environment	What are the characteristics of and the conditions of structural, non-structural, and construction-related aspects of the region's-built environment (housing)?

[42], [45], [46], [47], [48], [49], [52], [53], [54], [56], [57], [58], [59], [60], [61]). Accordingly, governance arrangements are used as an analytical lens to examine if existing institutional designs enable learning, adaptation, and reform or rather reproduce the drivers of vulnerability created by previous planning and decision-making processes.

From a Reformatory Recovery perspective, governance arrangements need to facilitate both physical and non-physical changes (e.g., the availability of services or changes towards a disaster safety culture), while accounting for the systemic nature of disasters, long-term risk drivers, and the needs of vulnerable groups. Gaps still prevail between inclusive intentions and actual implementation of such processes, especially in the often-chaotic timeline of post-disaster. Therefore, exploring ways to integrate these decision-making processes into the status quo and familiarizing relevant stakeholders (including communities, and relevant actors) with them is vital.

Additionally, several studies highlight the need for the presence and safeguarding of local/community knowledge and culture in recovery governance [48], [51], [52], [57], [62], [63], [64]. From a reformatory recovery perspective, governance arrangements must account for how local and community knowledge, culture, and lived experiences are recognized within the recovery planning and decision-making. In terms of collaboration, the extent to which DRM authorities collaborate with each other, with local communities and other (non)governmental organizations is a relevant factor for post-disaster recovery [62], [64], [65]. Related to this, capacity and capability are also relevant factors for post-disaster recovery that emerged from the scoping review, including existing and future organization, expert, administrative and operational capacity [11] as well as learning capabilities of the government or community [63], [65]. Several studies show that these dynamics are closely tied to power asymmetries and (post)colonial governance legacies, which influence whose knowledge is treated as legitimate and whose is dismissed as anecdotal or informal [49], [54], [55], [66]. For example, Borie and Fraser [55] show that after Hurricane Irma in the Dutch and French Caribbean, local technical expertise was available but often sidelined in favor of external experts and standards. This reflects post-colonial governance arrangements in which authority and credibility are granted to metropolitan or international actors, while locally grounded knowledge is treated as secondary.

Another relevant factor is institutional trust [53]. For example, if inclusive processes are in place but there is no trust in institutions, this could hinder the recovery process and reduce chances of transforming the initial arrangements that lead to vulnerability in the first place. This is a well-known issue in participatory processes generally, where the presence of participation does not ensure inclusive processes or better outcomes, as participation can be co-opted by local elites and used to confirm pre-determined decisions rather than meaningfully integrate local knowledge.

The presence of a DRM authority and whether this is institutionally embedded [65], as well as effects of (de)centralization are mentioned as a condition facilitating the implementation of reformatory actions. Effects of decentralization/centralization (of the DRM authority) could affect fiscal responses during recovery ([67], [68]). For example, as noted by de Mello and Jalles [67], decentralization may enhance flexibility and responsiveness in fiscal decision-making, allowing local authorities to allocate resources more rapidly and in line with context-specific needs. Conversely, centralization can support and strengthen coordination and resource pooling but may also delay localized responses, particularly in systems with formalized intergovernmental procedures. These institutional configurations also shape power relations between national and local actors, influencing whose priorities dominate recovery agendas. In parallel, Bernados & Ocampo [64] highlight the role of community networks in mobilizing resources during recovery, which is reflected as a diagnostic prompt in [Appendix B, Table B.2.](#) on whether institutional arrangements exist in formal ways so that networks can be supported and re-established during recovery.

Finally, given the increasing complexity of DRM processes, the role of forecasting and decision-support models and tools as governance instruments is becoming more important. Considerations related to data availability and quality, the use of (multi-hazard) scenarios, dealing with uncertainty, and incorporating socio-economic dimensions into physical models are essential for reformatory recovery planning [69]. In this context, decision-support tools cannot be regarded as neutral instruments, as they embed underlying assumptions concerning risk, capacity, and responsibility. Therefore, ensuring that such tools are transparent, participatory, and sensitive to local contexts is essential for promoting more equitable and accountable governance in post-disaster planning. These factors have been translated to a set of diagnostic prompts in [Appendix B, Table B.2.](#)

3.2.3. Community and culture

The dimension of community and culture from a Reformatory Recovery perspective is important to capture the social networks, cultural practices, and collective identities that shape how communities respond and recover from disasters. It includes formal and informal relationships, shared norms, attachment to a place, and local values that influence recovery and determine the potential for transformative change. Overall, the community and culture dimension examine how social networks, collective identities, and cultural norms shape recovery trajectories, and whether these community-based capacities are acknowledged, protected, and leveraged during recovery (see overarching prompt in [Table 2](#)). From a Reformatory Recovery lens, long-term resilience depends on strengthening local knowledge, practices, and relationships rather than imposing standardized interventions.

While many studies discuss the community resilience contextually or provide frameworks to assess it (see e.g., Refs. [48], [70]), our approach specifically focuses on the cultural and social dimensions from a post-disaster recovery point of view that must be addressed to reform underlying behaviors and structures that affect vulnerability and resilience.

From this perspective, our scoping review revealed several factors that are relevant to this dimension. Existing cultural norms and perceptions of risk shape how communities engage with disaster recovery processes (see e.g., Refs. [51], [65], [71], [72]). For example, Japan's long history of disasters has led to a "Culture of Prevention," which shows that deeply embedded norms can support effective recovery [71]. In other contexts, for example in Turkey earthquakes [35], it is argued that a short-term focus on the fast recovery of housing structures left communities separated during the recovery process. In Indigenous, tribal, and customary contexts, culture and community are inseparable from land, governance, and knowledge systems, and recovery processes are often shaped by

historical experiences of dispossession, cultural erasure, and struggles for self-determination ([6], [44]).

Overall, a better understanding of communities' social networks, shared practices, and needs could lead to alternative recovery pathways that strengthen resilience during the recovery process. From a Reformatory Recovery perspective, this involves examining how culturally embedded traits interact with institutional and material conditions to reveal functional gaps. The literature identifies several cultural factors relevant to recovery that can inform Reformatory Recovery, including the presence of community groups [71], the level of volunteerism ([64], [71]), disaster memory and the ability to retain disaster in memory [71], cultural heritage ([71], [73]), formal and informal education ([40], [71]), and (local) disaster knowledge ([40], [52], [71]).

Furthermore, several studies also focus on community capacity building and social capital (see e.g., Refs. [40], [43], [63], [74]). Studies address the functioning of community groups, their social network structures, and the role of social cohesion, trust, and cultural identity in supporting long-term recovery (e.g., Refs. [32], [41], [41], [44], [51], [53], [55], [64], [75], [76], [77], [78], [79]). Based on these insights, we derive the diagnostic prompts for reformatory recovery presented in [Appendix B, Table B.3](#).

3.2.4. Financial mechanisms

Availability of financial mechanisms is a central enabler for Reformatory Recovery as inadequate, unjust, slow, or reactive funding hinders the recovery process and potentially exacerbates existing vulnerabilities. At the local level, those without access to recovery support are unable to rebuild homes, access essential services, or restart their businesses and livelihoods [80]. At the macro level, when recovery financing is inadequate or not well institutionalized, public funds originally allocated for long-term development initiatives are often diverted or deprioritized in favor of immediate recovery needs [80].

The financial mechanisms dimension questions how and by whom recovery assistance is spent, what other financial mechanisms are present, whether these are mostly reactive or proactive, and from the perspective of Reformatory Recovery, how the financial mechanisms contribute to systemic, sustainable change (see [Table 2](#) overarching diagnostic prompt). Clear, inclusive, adaptive, and systemic proactive financing and investment are key to reformatory recovery.

The scoping review revealed two central themes for recovery financing, both of which need to be addressed proactively. First, given the idea that disasters are social constructs [4], financing for Reformatory Recovery is inherently linked to proactive investment in disaster preparedness and overall socio-economic development. On the global scale, disaster finance is increasingly linked to other systemic financial mechanisms, including climate finance (e.g., Ref. [81]). For example, the Transformative Climate and Disaster Risk Finance (TCDRF) framework aligns recovery investments with long-term resilience and systemic reform [81]. Investments in DRR should aim to address social inequities and drivers of natural disasters in a proactive and evidence-based manner (see e.g., Refs. [67], [68], [81]). Additionally, it is relevant to reflect on how risk and uncertainty are defined and whether these definitions are shared among actors. Inconsistent or unclear definitions of risk and uncertainty pose a key challenge in designing, allocating, and accessing disaster risk financing [82].

Second, aside from investments in DRR, it is necessary to focus on the structures of recovery financing and how they affect the (long-term) recovery process. For this, availability of and accessibility to insurance schemes (see e.g., Refs. [40], [65], [81]), existing financial and institutional boundary conditions (such as the strength of the banking sector, levels of financial integration, and regulatory safeguards) to ensure (un)expected liquidity requirements and household access to finance during recovery (see e.g., Ref. [83]) are necessary to facilitate a just, efficient and effective recovery process that serves the needs of individuals and communities.

Moreover, several studies address the influence of (de)centralization on the responsiveness and effectiveness of financing mechanisms during recovery (see e.g., Refs. [67], [68], [84]), arguing that there is a need for subnational governments to have increased fiscal autonomy during recovery phases [67]. Based on these insights, we derive the diagnostic prompts for Reformatory Recovery presented in [Appendix B, Table B.3](#).

3.2.5. Built environment

The built environment is already a focal part of the recovery process, and it is fundamental for Reformatory Recovery, as it serves as the physical manifestation of the other dimensions identified in this study. For example, a region's disaster safety culture is often strongly reflected in its housing construction (see Community and Culture Dimension), and prevailing social inequities become visible through spatial planning approaches (see Justice and Governance dimensions). In this study, the "built environment" refers to all physical structures (e.g., housing, infrastructure) as well as land-use planning, zoning practices, building regulations and heritage-sensitive spatial interventions related short-medium-long-term spatial planning approaches (e.g., use of buffer zones) in a defined region. Critical Infrastructure (CI) that is part of the built environment is characterized by its purpose of meeting different needs within society by providing fundamental services such as communication, electricity, water, etc. [85].

Built environment resilience and recovery have been studied by many; one framework from Cerè et al. [86] introduced the idea in which the design, operation, and maintenance of both structural (e.g., wooden, concrete) and non-structural components (e.g., electrical and water systems), as well as additional construction characteristics (e.g., age, foundation) of the built environment determine its resilience to certain geohazards [86].

Beyond physical components and characteristics, fuzzy considerations related to the built environment are necessary to consider. For example, in their paper on localized shelter solutions for disaster resilient housing of urban informal settlers, Vahanvati et al. [87] describe the multidimensional nature of housing considering security of tenure, availability, affordability, habitability, accessibility, location, and cultural adequacy. Moreover, from a Reformatory Recovery perspective, it is important to understand how building codes are applied and enforced across different areas, as unequal enforcement can perpetuate structural vulnerability during recovery [72]. For example, low-income or marginalized groups may reside in buildings that do not meet safety standards. This might be because they cannot afford compliance, live in informal settlements, or rent from owners who neglect enforcement. These disparities can result in

disproportionate recovery outcomes and further entrench inequality. Rivera et al. [72] show that while Chile's seismic building codes improved overall safety, uneven enforcement across income groups reproduced inequalities as a recovery outcome. Thus, building codes and zoning regulations operate as governance instruments whose uneven implementation can normalize spatial vulnerability rather than reduce it.

In terms of spatial planning, the role of informal settlements in rebuilding efforts before, during and after disaster is highlighted (e.g., Refs. [41], [42], [49], [51]). Informal settlements, land use, or building efforts are often not recognized in institutional arrangements, yet these are often the most vulnerable populations. Empirical evidence shows that post-disaster land-use planning can even normalize such vulnerabilities: Triantis [47] demonstrates how recovery planning after the 2018 Attica wildfire legalized informal development and reinforced private property regimes, while Fuentealba et al. [49] show how buffer-zoning displaced communities and encouraged informal resettlements, increasing long-term exposure and spatial segregation.

Several studies address the importance of considering broader social and well-being goals during physical reconstruction efforts (e.g., Refs. [41], [48], [88]), as well as considering vulnerable populations in spatial planning approaches (e.g., Refs. [41], [46], [49]) and ((post)colonial) power dynamics (e.g., Refs. [44], [48], [50], [55]). Although we included these factors as diagnostic prompts in the Social Justice dimension, their relevance is also clear from the built environment dimension point of view.

In terms of DRR interventions, Sony et al. [32] document a shift in the coastal regions of Bangladesh from traditional, community-based DRR practices to more contemporary, infrastructure-focused interventions. This transition is reflected in changes to the built environment, such as replacing vernacular housing with cyclone-resistant structures and adopting modern water and food storage systems. For Reformative Recovery, it is essential to assess how both traditional and modern DRR interventions shape spatial vulnerability and to consider these trade-offs in recovery planning.

Along this line, Imperiale and Vanclay [51] highlight the importance of recognizing, protecting, and supporting informal and shared spaces in post-disaster planning as these are in general central to social learning, emotional recovery and collective agency. In other words, the recovery of shared spaces is not only about rebuilding physical infrastructure but about re-establishing the social fabric that those spaces support. Similarly, nature-based solutions and green infrastructure can function as spatial buffers and provide eco-system services, however, their contribution to Reformative Recovery depends on how access, governance, and long-term distributional effects are addressed. From a Reformative Recovery perspective, nature-based solutions should be assessed not only for their protective functioning, but for how they redistribute risks, benefits, and access to environmental assets.

Drawing from the several factors for reformative recovery identified in the scoping review, Appendix B, Table B.5. proposes diagnostic prompts to consider when planning for reformative recovery. Overall, Reformative Recovery requires planning that not only restores the built environment but reconfigures it to support equity, resilience, and collective well-being (See Table 2 overarching prompt). The authors stress that given the manifestation of the other dimensions in the built environment, it is important to view these diagnostic prompts as complementary to the other dimensions' prompts.

3.2.6. Critical services

The critical services dimension focuses on a twofold set of questions (see Table 2 overarching prompt): what services are critical for local recovery, and what services determine attractiveness for return after a disaster? What is relevant for a reformative recovery is that there needs to be a shift from a focus on solely (re)building and increasing resilience of the physical built environment and critical infrastructure to considering the region's context-dependent service recovery priorities across all recovery stages.

If the services behind CI and other aspects of the built environment are unable to meet population demand during different disaster recovery stages, communities suffer disaster impact more severely [85]. For example, it is widely established that limited access during the recovery to medical services impacts long-term health (see e.g., Ref. [62]). Moreover, the availability of a region's specific service priority potentially also influences the return to a region after a disaster, further impacting the long-term recovery. For example, the availability of education might be important for regions characterized by many young families [35]. If such regional service needs are not recognized, the risk might emerge that families are less inclined to return to a disaster area if no education facilities are available. Therefore, recovery of built environment services beyond the physical and structural system is an important component relevant to Reformative Recovery.

Services might include ecosystem services (e.g., Refs. [45], [79]) where communities rely on the function of, or medical [62] and education-related services [89], as stated above. We argue that for reformative recovery, it is also important to recognize that during the disaster recovery, local needs for specific services (healthcare, education, crisis response) are dynamic and facilitation of such critical services should be adaptive in physical space and capacity. For example, education facilities such as schools may be used as temporary shelters, or crisis coordination centers. Availability and planning of such flexibility can increase the immediate response but also could support community needs in the long term which is essential for reformative recovery planning.

Nevertheless, our review did not yield many resources from this aspect. In other words, compared to other dimensions, the critical services literature is more fragmented and often treated in sector-specific silos. This limits the extent of which reformative recover is explicitly theorized in this domain. As a result, the diagnostic prompts in this dimension primarily function as an entry point that help stakeholders examine how service provision, restoration sequencing, and access to critical services shape recovery trajectories and opportunities over time. The identified diagnostic prompts are given in Appendix B, Table B.6.

4. Example ex post application

In 2023, the southeastern part of Turkey was struck by two major earthquakes with magnitudes of 7.9 and 7.6, devastating eight cities across a wide geographic area. Antakya, the city center of Hatay Province, was among the most severely affected: the death toll

exceeded 50,000, more than 50% of the building stock surrounding the historical core was destroyed, critical services were rendered non-functional, and hundreds of thousands of residents were displaced. Overall, the disaster exposed profound systemic vulnerabilities across social, infrastructural, cultural, and institutional domains. Aydin et al. [35] documented the post-disaster recovery trajectories that emerged from qualitative interviews and focus group discussions conducted in Antakya. Grounded on this empirical material, we use the diagnostic prompts for Reformative Recovery to critically reflect on systemic processes affecting the recovery process and potential reforms for a more resilient future. Table 3 presents the justice-related diagnostic prompts as applied to this case, while Appendix D provides the full framework and elaborates on the remaining dimensions. We illustrate how justice-related processes shape recovery dynamics and how recovery processes reflect and reproduce existing patterns of inclusion, power, trust, and recognition.

First, the evidence in Aydin et al. [35] reveals systematic exclusion of residents from recovery planning and decision-making. Interviews with local stakeholders, professional chambers, and residents indicate that reconstruction planning remained largely centralized, with limited opportunities for structured participation. As discussed in Aydin et al. [35], citizens and planning professionals were typically informed only after plans had been announced, which lead to uncertainty and frustration rather than co-ownership of recovery decisions. From a Reformative Recovery perspective, these findings indicate that previous exclusions from planning processes exacerbated post-disaster vulnerability, as groups already marginalized before the earthquake faced disproportionate uncertainty and displacement during recovery.

Second, the justice dimension highlights the role of power asymmetries and politicized governance in shaping recovery outcomes. The interviews reveal persistent misalignments between central and local government actors, and disputes over authority, and perceptions of political favoritism in reconstruction decisions (Aydin et al. [35], see Section 4.1.2; Quotes Q8–Q15). These power dynamics shape whose preferences are translated into plans and whose claims are marginalized, contributing to perceived unfairness and marginalization. At the same time, the evidence in Aydin et al. [35] suggests that conflict and contestation can also function as a transformative moment: when governance failures become visible, they can open space to redesign recovery governance and institutionalize community voice through more formal participatory mechanisms.

Closely linked to these dynamics is the issue of institutional trust. Although trust was not measured as a discrete variable, the empirical material points out mistrust as a logical outcome of opaque decision-making, inconsistent communication, and prolonged uncertainty (see Aydin et al. [35] Sections 4.1.3 and 5; Quotes Q15, Q26 Rumors surrounding relocation, lack of clarity regarding housing plans). From a reformative perspective, these findings show that trust is not solely an attitudinal concern but a structural condition for transformative recovery: without credible, transparent, and inclusive governance processes, the capacity to implement long-term reforms remains limited. Therefore, the Antakya case evidence presented in Aydin et al. [35] supports the view that rebuilding governance legitimacy through transparency, clarity of responsibility, and participation is a necessary enabling condition for reformative change.

Finally, the justice dimension addresses recognition of cultural identity, local knowledge, and place-based attachments. An

Table 3
Diagnostic prompts from justice dimension applied on Antakya case study. Note that prompts are shorten for readability see appendix B for details).

Dimension	Diagnostic Prompt	Relevance/ category	(1) Diagnosing Systemic processes Antakya Evidence (Aydin et al., 2025)	(2) Diagnosing Transformative Moments & Potential Reforms (Aydin et al., 2025)	Reformative Insight
Justice	Which stakeholders are included/excluded in recovery planning? Who dominates, who benefits, who is left behind? (prompt B.1.1; B.1.4)	Inclusion & representation	Limited consultation to residents/survivors; vulnerable groups excluded.	Open space for formal participatory mechanisms	Reveals structural underrepresentation and procedural injustice
	How do power dynamics, including, institutional trust, and colonial/state authority shape justice? (prompt B.1.8)	Power dynamics & trust	Misalignments between local and central government leading to mistrust and perceived marginalization.	Conflicts create a a turning point for redesigning recovery governance to institutionalize community voice	Shows necessity of addressing governance legitimacy and institutional distrust (typically ignored by BBB)
	How do power dynamics, institutional trust, and colonial/state authority shape justice? (prompt B.1.8)	Trust	Distrust is an outcome of institution failing and without trust reformative action is not possible	Conflicts create a turning point for redesigning governance to institutionalize community voice	The necessity of addressing governance legitimacy builds upon the capacity to create trust.
	Whose knowledge, culture, or identity is acknowledged in recovery plans? (prompt B.1.12)	Recognition	Failed to recognize cultural identity and diversity threatened by relocation; heritage at risk In Turkey there is evidence that lack of previous recognition led these population on vulnerability, and there is chances that reallocation reproduces the previous misrecognition practices	Relocation debates create a reform opportunity for embedding diverse cultural heritage into spatial and urban design policy	Highlights need to safeguard identity and diversity in recovery

important finding of the Antakya case is that cultural identity and social ties are foundational to recovery. Interviews emphasized concerns around relocation and deterioration of cultural bonds, and Antakya's historically diverse identity (see Aydin et al. [35] Sections 4.1.3 and 4.2; Quotes Q17, Q18, Q31). The paper demonstrates that lack of recognition before the disaster had already contributed to vulnerability, and that if cultural and social dimensions are not embedded into spatial and urban planning, recovery strategies risk reproducing these patterns. At the same time, the case evidence in Aydin et al. [35] highlights that relocation debates and heritage concerns can become reform opportunities: they create a window to embed cultural heritage and community perspectives into spatial and urban design policy.

The Reformative Recovery framework helps practitioners surface tensions between recovery priorities and societal needs that may otherwise remain invisible. Identifying these tensions can reveal opportunities to reconsider recovery priorities. In the case of Antakya, applying the diagnostic prompt B.1.12 (see Table 3) helps reveal that a housing-only reconstruction approach risks overlooking the social processes and service needs that enable residents to return. Recognizing this tension allows practitioners to reconsider recovery priorities and shift the focus from rebuilding physical assets alone toward restoring social and community functions. For example, rather than focusing solely on rapid housing delivery, recovery planning could prioritize neighborhood-based strategies that preserve social networks, restore shared spaces, and integrate community input into spatial planning. Such prioritization can be justified through explicit justice considerations: procedural justice, which emphasizes meaningful participation and inclusion of local knowledge, and recognition justice, which acknowledges cultural identity and place-based attachments. In this way, the diagnostic prompts help practitioners move from identifying competing claims to articulating transparent and defensible recovery decisions.

Together, these empirically grounded insights reported in Aydin et al. [35] show how justice dimension can operate as a systemic and cross-cutting dimension of recovery in Antakya. The justice prompts diagnose how exclusion, power asymmetries, institutional distrust, and misrecognition interact to shape recovery trajectories and where recovery processes hold potential for structural reform rather than mere reconstruction.

5. Discussion

5.1. Reframing recovery through systemic reform

This study aimed to explore the concept of Reformative Recovery and its constituent dimensions to provide an analytical framework to promote a just, equitable, and actionable post-disaster recovery process. Our scoping review findings indicate an emphasis on “bouncing back” within existing recovery frameworks such as BBB, wherein justice and equitable recovery are rarely treated as explicit and overarching components. Recovery efforts, in many geographical contexts, continue to prioritize physical reconstruction, specifically housing and infrastructure, while participatory and community-based approaches remain underrepresented. This leads to a loss of opportunity to pursue value-based, transformative solutions that explicitly incorporate equity considerations for post-disaster recovery [90].

The framework is deliberately designed to be flexible to enable broad applicability across varying governance structures and recovery trajectories. Rather than prescribing fixed indicators that may not be relevant across contexts, it introduces diagnostic prompts to examine how context-specific conditions influence recovery processes and outcomes. The framework does not seek to bypass political, economic, or institutional constraints, but to make them explicit and open to critical reflection, thereby supporting more informed and realistic recovery decision-making within existing systems. Similarly, Reformative Recovery does not assume that distributive, procedural, and recognition-based justice claims can be fully aligned. In practice, recovery decisions often involve trade-offs between these dimensions under conditions of urgency, scarcity, and unequal power. Rather than offering prescriptive rules for resolving such conflicts, the justice dimension is intended to surface where and how these tensions arise, making trade-offs explicit and subject to deliberation, negotiation, and accountability. In this way, the framework supports comparative reflection without advancing a singular normative model of recovery.

Importantly, it is not intended to prescribe sector-specific solutions or design interventions for individual dimensions such as the built environment. Instead, it functions as an analytical sense-making tool that helps identify how dimensions interact, where systemic vulnerabilities originate, and which post-disaster decision points may enable reform, while leaving the design of context-specific interventions to domain experts. In practice, Reformative Recovery recognizes that recovery decisions are shaped both by formal decision-making structures, such as planning rules and institutional responsibilities, and by participatory processes, including dialogue, negotiation, and collective reflection. This does not prescribe how recovery should be governed or what outcomes should be achieved; rather, it highlights the types of processes through which coordination, agreement, and progress can emerge in complex recovery contexts.

Recovery unfolds over extended timeframes, shaped by shifting priorities and evolving political contexts. Accordingly, the diagnostic prompts are not intended as one-off or static assessments, but as tools that can be revisited iteratively throughout the recovery process. revisiting the prompts over time is recommended for practitioners and researchers to reflect on how recovery trajectories evolve, which tradeoffs emerge, and how changing institutional arrangements and political priorities may open or constrain opportunities for reform. This form of iterative use of diagnostic prompts is critical for ensuring that reformative goals extend beyond the immediate recovery phase and maintain their focus despite potential shifts in political priorities. Given that recovery processes are shaped by evolving power relations, resource availability, and governance dynamics, the relevance of different prompts may shift over time.

For example, in early recovery stages, prompts related to access to critical services, emergency decision-making, and coordination across governance levels may be particularly salient, while later stages may require greater attention to spatial planning, institutional

reform, and community recovery processes. However, the framework does not assign specific prompts to fixed recovery stages. This reflects the paper's broader critique of rigid, stage-based disaster management models, which often assume linear transitions between phases. Instead, recovery processes frequently overlap, evolve unevenly, and are shaped by local institutional and political conditions. Accordingly, the relevance of prompts may vary across contexts and may emerge at different points in the recovery process depending on local priorities and constraint.

5.2. Cross-cutting themes and dimension interlinkages

The six dimensions from our analytical framework illustrate the multidimensional and interdependent nature of reformative recovery. Although developed separately, the diagnostic prompts are interrelated and should be understood as complementary, reflecting the complexity of recovery processes. Among these dimensions, governance and justice emerged as cross-cutting themes that underpin all other aspects of recovery and resilience. Across both the governance and justice dimensions, the framework explicitly surfaces power asymmetries by examining who holds decision authority, whose voices are included or excluded, and how institutional arrangements shape recovery priorities over time.

Furthermore, this review identified important linkages between governance and the built environment, particularly in relation to how decision-making processes and governance instruments influence spatial interventions. These include, for instance, the planning of recovery in informal built environments and the integration of nature-based solutions for future climate-related disasters. These interlinkages between various dimensions emphasize the importance of a holistic approach in recovery processes.

Nevertheless, certain dimensions, such as critical services, have received comparatively limited attention in the existing literature. In this review, the concept of critical services was extended beyond networked infrastructures to include locally defined essential services. For example, ecosystem services may play a critical role in the livelihoods of marginalized communities. This variability presents challenges for generalization and reflects a significant gap in the current literature. However, the relative scarcity of literature on critical services does not reduce the importance of this dimension, rather it highlights the need to explicitly consider how essential services shape recovery. The example application case from Antakya, Turkiye, illustrates that critical services can play a central role in shaping recovery trajectories, specifically through service-led reverse migration, differential access, and prioritization of decision that can influence who can return when, and under what conditions (see [Appendix C](#), Aydin et al. [35]). The reformative recovery framework supports this analysis by providing diagnostic prompts that help stakeholders examine how essential services influence recovery dynamics.

The principles of multifunctionality (i.e., the ability of systems to perform multiple roles) and flexibility (i.e., capacity of a system to adapt to changing needs) are particularly relevant here because they enable critical services to meet diverse, evolving demands during recovery [23]. While these principles connect to other dimensions, they are central to rethinking critical services not as fixed infrastructures, but as adaptive systems capable of supporting long-term, just resilience.

Another significant insight concerns the community and culture dimension, where the boundary between preparedness and recovery is frequently ambiguous. Cultural norms, risk perceptions, and community capacities that influence recovery trajectories are often rooted in pre-disaster conditions. For example, the presence, or absence, of a "culture of prevention" affects not only how communities prepare for hazards but also how they recover. This observation suggests that key elements of Reformative Recovery such as social cohesion, trust, and local knowledge are not confined to the post-disaster phase but are instead embedded in ongoing preparedness activities. Recognizing this overlap reinforces the view that Reformative Recovery should be understood as a continuous and iterative process rather than a discrete, post-event phase.

5.3. Justice, indicators, and prompts for post-disaster recovery

Contrary to the aspirational framing of BBB, which advocates for improvements across physical, social, economic, and environmental domains [28], in practice, recovery remains predominantly centered on physical and economic reconstruction ([29], [30]). This disproportionate focus marginalizes critical social, environmental, and equity-related concerns that are essential for a holistic approach to recovery. The findings of this scoping review support calls to move beyond traditional phase-based models and the limitations of the BBB framework, toward a conception of Reformative Recovery that views recovery as a simultaneous, multidimensional process aimed at building resilience that extends beyond physical rebuilding [29].

These dimensions align with previous literature on resilience and emerging perspectives on social justice within DRM. For example, Hamdanieh [40] offers a detailed synthesis of how social justice is conceptualized within DRM, identifying the absence of a common definition as a key limitation. The authors propose a definition of social justice as equity in worth, rights, resource distribution, and outcomes across all phases of DRM. This comprehensive understanding of equity resonates with the principles of reformative recovery, particularly in its focus on justice as a central guiding element. However, a key distinction lies in this study's inclusion of the critical services dimension, which is not explicitly considered in Hamdanieh's framework. Furthermore, while Hamdanieh's analysis centers on formal institutional mechanisms, the present study adopts a broader interpretation of governance that includes both formal and informal structures.

This research intentionally prioritized diagnostic prompts over fixed indicators in conceptualizing reformative recovery. While indicators can support cross-case comparisons and temporal tracking [91], they often risk oversimplifying complex recovery processes and may fail to capture diverse social realities or marginalized voices. Diagnostic prompts, by contrast, offer a flexible and inclusive means of fostering critical reflection and supporting adaptive decision-making. They serve as deliberative tools that encourage stakeholders and researchers to consider the underlying values and contextual dynamics influencing reformative recovery. While

diagnostic prompts could also be used to develop indicators or evaluation criteria, it is important to emphasize that diagnostic prompts and indicators should not be viewed as mutually exclusive. Rather, prompts can inform and guide the development and application of indicators, thereby enabling critical reflection, surfacing underlying assumptions, trade-offs and justice considerations which often remained hidden in indicator-based evaluations.

6. Limitations and future work

This study has several limitations that should be acknowledged. First, the analytical framework and diagnostic prompts are derived primarily from a systematic scoping review rather than from primary empirical fieldwork specifically designed to validate the framework itself. However, the framework is empirically informed through the extensive body of reviewed literature, a substantial proportion of which is grounded in empirical case studies across diverse geographical and socio-institutional contexts (see [Appendix C: Literature review case studies](#)). In addition, the manuscript includes an illustrative example application drawing on existing qualitative research to demonstrate how the diagnostic prompts can be operationalized.

At the same time, the framework has not yet been examined through participatory or practitioner-led implementation in real-time recovery settings. Hence, the example application is illustrative rather than evaluative and does not constitute empirical validation of the framework. The framework therefore does not claim to directly represent lived experiences or practitioner priorities, but instead synthesizes recurring patterns reported across empirical studies to support analytical reflection and sense-making. As such, it is intended to complement, rather than substitute for, participatory and practitioner-led recovery processes.

Second, the reviewed literature exhibits a geographic concentration, with a substantial share of studies focusing on Asian contexts. This reflects, in part, broader patterns in disaster scholarship and the disproportionate concentration of disaster impacts in the region. While this concentration limits the empirical diversity underpinning the framework, the literature-base still provides strong support for diagnosing socio-political recovery dynamics, including governance arrangements, justice considerations, power asymmetries, and the role of indigenous or local knowledge in shaping recovery processes. At the same time, the literature base provides limited support for assessing cross-sectoral variations in critical service restoration and for validating the framework through practitioner-led implementation in real-time recovery settings. Consequently, future research should apply and refine the framework through empirical studies in underrepresented regions, using longitudinal, participatory, and practitioner-led research designs. Such approaches would be particularly valuable for capturing the dynamic and evolving nature of recovery priorities over time, as the dimensions of reformative recovery are inherently context- and temporally dependent.

In recognition of the qualitative orientation of this scoping review, future research is encouraged to employ statistical methodologies to further establish and validate the dimensions and their interrelationships. For instance, a Principal Component Analysis (PCA) using survey data from practitioners and scholars could offer empirical support for the proposed framework and potentially reveal additional dimensions not captured in the present study. Future research should seek to incorporate a wider range of case studies from underrepresented regions, particularly Africa, Latin America, and small island states. Expanding the geographical scope in this manner would enhance the understanding of diverse recovery experiences and contribute to the development of archetypes of recovery trajectories. Moreover, the relatively limited insights into critical services dimension reflects both the gaps in the existing literature and the challenges of developing cross-sectoral insights for this dimension. This highlights the need for further empirical and theoretical research in this area.

Furthermore, this review has concentrated on the recovery phase, without extending its scope to include other phases of disaster management such as preparedness and mitigation. While some diagnostic prompts may have broader applicability, future studies should explore what a comprehensive, multi-phase approach to reformative recovery might entail. Comparative analyses examining distinctions between reformative recovery and alternative recovery frameworks could also help clarify the unique contributions and limitations of this emerging approach.

Finally, while there is an extensive body of literature addressing various strategies for resilience building, future research should prioritize the integration of these diverse approaches into a coherent and widely accepted methodology. Advancing such integration is essential for the operationalization of reformative recovery as a practical and context-sensitive framework for post-disaster governance.

7. Conclusion

Recovery efforts, particularly in many geographical contexts, continue to prioritize physical reconstruction, specifically housing and infrastructure, while participatory and community-based approaches remain underrepresented. Reformative Recovery offers significant potential in this direction to move beyond physical recovery efforts and promote a just, equitable and actionable post-disaster recovery process. The recovery process should transcend disaster phases and focus on dimensions of governance arrangements, justice, culture and community, critical services, and the built environment. Based on our comprehensive systematic scoping review, we constructed an analytical framework that identifies these core dimensions and corresponding diagnostic prompts to facilitate the assessment and formulation of reformative recovery strategies. It is recommended that scholars and practitioners engage in structured dialogue to determine the foundational diagnostic prompts that should inform the reformative recovery process.

CRedit authorship contribution statement

Neeltje Annemarie: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Methodology,

Investigation, Formal analysis, Data curation, Conceptualization. **Juliana Goncalves:** Writing – review & editing, Investigation, Formal analysis, Data curation, Conceptualization. **Camilo Benitez Avila:** Writing – review & editing, Investigation, Formal analysis, Data curation, Conceptualization. **Trivik Verma:** Writing – review & editing, Investigation, Formal analysis, Data curation, Conceptualization. **Nazli Yonca Aydin:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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Declaration of competing interest

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APPENDIX A. Search string

all "Long term" OR "Long-term" OR "proactive" OR "post-disaster" OR "reformative" OR "transformative" OR "adaptive" OR "Build Back Better" OR "BBB" OR "Bounce Forward" OR justice OR equity OR equality OR dimension* AND "disaster risk management" OR "DRM" AND resilien* AND "inclusive" AND recovery AND PUBYEAR > 2014 AND (EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "EART") OR EXCLUDE (SUBJAREA , "MEDI") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "HEAL") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "NURS") OR EXCLUDE (SUBJAREA , "MATE") OR EXCLUDE (SUBJAREA , "PHYS") OR EXCLUDE (SUBJAREA , "CENG") OR EXCLUDE (SUBJAREA , "NEUR") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "IMMU") OR EXCLUDE (SUBJAREA , "PHAR") OR EXCLUDE (SUBJAREA , "AGRI") OR EXCLUDE (SUBJAREA , "PSYC") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "BIOC") OR EXCLUDE (SUBJAREA , "BUSI")) AND (EXCLUDE (LANGUAGE , "Chinese")) AND (EXCLUDE (EXACTKEYWORD , "COVID-19") OR EXCLUDE (EXACTKEYWORD , "Pandemic") OR EXCLUDE (EXACTKEYWORD , "Epidemiology") OR EXCLUDE (EXACTKEYWORD , "COVID-19 Pandemic") OR EXCLUDE (EXACTKEYWORD , "Coronavirus Disease 2019") OR EXCLUDE (EXACTKEYWORD , "Coronavirus"))

APPENDIX B. Diagnostic prompts-extended

Table B.1
Diagnostic prompts relevant to reformative recovery for social justice dimension

Diagnostic prompts	Related literature
1. Which stakeholders are included in the recovery process, and how are they identified and engaged?	[43], [48], [50], [52]
2. Which communities or regions are overrepresented or underrepresented in recovery planning and decision-making?	[43], [48], [92]
3. To what extent are the differentiated impacts of disasters on vulnerable or marginalized groups reflected in stakeholder representation?	[41], [43]
4. What are the actors involved in the decision-making process on post-disaster recovery and who should be involved from an intersectionality perspective? (Who dominates, Who benefits, Who gets left behind?), Are stakeholders who cannot consent (i.e., future generations, environment) considered in recovery planning and decision-making?	[43], [46], [50]
5. How are non-urban regions (e.g. rural, peri-urban) represented in the recovery planning?	[50], [51]
6. What long-term distributional inequities are being addressed (historical and future-oriented), or overlooked through the recovery process?	[40], [93]

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Table B.1 (continued)

Diagnostic prompts	Related literature
7. How are existing distributional inequalities considered in recovery processes?	[40], [42], [43], [55], [93]
8. How do (colonial) power dynamics (i.e. lack of self-determination, dehumanization and land disposition of indigenous peoples) affect stakeholder engagement in recovery processes?	[44], [49], [50], [55]
9. What is the level of community participation in disaster risk reduction and recovery planning?	[41], [45], [52], [53], [54]
10. How is it fair? Are participation mechanisms accessible to all?	[45], [93]
11. Whose knowledge (i.e., lived experiences and perspectives) are considered, and how are they integrated into recovery decisions? Are technical and institutional voices privileged over experiential knowledge?	[50]
12. How is local/community knowledge represented in recovery planning? How can this be safeguarded?	[39], [41], [45], [48], [52], [53], [54], [55], [93]

Table B.2

Diagnostic prompts relevant to reformative recovery for governance dimension.

Diagnostic prompts	Related Literature
1. To what extent are decision-making processes inclusive, participatory, adaptive, and proactive? Are these processes already operationalized during recovery and known by stakeholders?	[42], [45], [46], [47], [48], [49], [52], [53], [54], [56], [57], [58], [59], [60], [61]
2. Is there a DRM authority? Is its presence permanent and institutionally embedded? How does institutional embeddedness hinder or boost the effectiveness of the DRM authority during (long term) recovery processes?	[65]
3. What is the effect of decentralization/centralization of the DRM authority on recovery processes?	[67], [68]
4. How do politics and policy affect the region's disaster management? What are the underlying power relations? How is knowledge/expertise used politically in relation to recovery processes?	[49], [54], [55], [66]
5. What is the level of trust in institutions during recovery processes?	[53]
6. How is state responsibility for DRM beyond immediate relief institutionally embedded?	[40], [61]
7. What is the current level of collaboration among stakeholders and across sectors? How might this possibly affect recovery processes?	[48], [53], [60], [63]
8. To what extent do DRM authorities collaborate with local communities and (non)governmental organizations? What is the level of cross-jurisdictional cooperation and multi-sector partnership? How might this possibly affect recovery processes?	[62], [64], [65]
9. How is local/community knowledge and culture represented in recovery planning? How can this be safeguarded?	[48], [51], [52], [57], [62], [63], [64]
10. What knowledge/expertise is necessary to operationalize reformative recovery?	[55], [65]
11. What community networks are present, and how can they be leveraged to mobilize resources during recovery? To what extent do formal institutional arrangements support the re-establishment and coordination of these networks post-disaster?	[60], [63], [64], [65]
12. To what extent is model-based decision-making embedded within DRM processes? How do these models deal with data availability, multi-hazard scenarios, uncertainties in recovery processes, and urban systems?	[69]
13. What is the existing and expected future organizational, expert, administrative and operational capacity in relation to recovery planning?	[11]
14. To what extent are local capacities such as community-level knowledge, social infrastructures, and informal networks recognized, supported, and strengthened through recovery planning and implementation?	[48], [51], [52], [62], [63], [64]

Table B.3

Diagnostic prompts relevant to reformative recovery for community and culture dimension.

Diagnostic prompts	Related Literature
1. How are community groups distributed across space and demographics?	[71]
2. What is the existing culture regarding disaster risk management in the region/amongst community groups in the region?	[52], [65], [71], [72]
3. What are gaps toward a disaster safety culture?	[71]
4. How does the existing culture shape engineering practices and risk perception?	[72]
5. What kind of local, Indigenous, or customary knowledge exists related to disasters, and how is this knowledge recognized and integrated into recovery planning?	[52]
6. How do existing community groups function? and what social network structures exist?	[53], [64], [79]
7. What is the role of (kinship) networks?	[32]
8. What is the level of social cohesion and social capital?	[64], [75], [76]
9. What is the level of trust within communities?	[53], [64]
10. How does migration affect the community (networks)?	[32]
11. What are shared social practices and cultural norms?	[51]
12. What is the sense of place, land attachment, or territorial connection within the community, and how do these shape recovery priorities and decision-making?	[75], [77]
13. Are colonial or post-colonial power dynamics present, and how do these affect community functioning, land relations, and planning during recovery?	[44], [55]
14. What forms of community identity, volunteerism, collective space, and aspirations, including Indigenous or customary forms of organization, can be leveraged for recovery purposes?	[44], [64], [78]
15. What is the level of community participation (in relation to DRR) and how is this affected by disaster? How is it fair?	[41], [52], [53], [54]

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Table B.3 (continued)

Diagnostic prompts	Related Literature
16. What mechanisms (physical, social) are in place to retain disaster in memory that could lead to transformative change?	[71]
17. What is the role of informal education?	[71]
18. Is this education flexible towards local characteristics?	[71]
19. How do local historical and political experiences shape the community's resilience for future?	[94]
20. What cultural heritage is present in the region?	[73]
21. How to build capacity through learning at the community level?	[43], [63], [74]
22. What are community needs in terms of technical guidance, financial and economic assistance, and representation during recovery? Informal settlements	[87]

Table B.4

Diagnostic prompts relevant to reformatory recovery for finance dimension

Diagnostic prompts	Related Literature
1. To what extent do existing recovery funding mechanisms align with principles of Transformative Climate and Disaster Finance?	[81]
2. Are clear funding mechanisms present?	[84]
3. How do the funding mechanisms ensure expected liquidity requirements during and after the recovery phase? What are the boundary conditions to ensure household access to finance?	[83]
4. Are funding mechanisms decentralized?	[67], [68]
5. Who manages the funding mechanisms? Are there gaps between the management of mechanisms and implementation?	[67], [68], [84]
6. What is the level of evidence-based (regional/national) investment into DRR?	[68], [82]
7. How are risk and uncertainty defined and operationalized within disaster risk financing mechanisms? Are these definitions consistent across institutions involved in funding allocation and decision-making?	[82]
8. How does insurance affect the process of reformatory recovery on the micro level?	[40], [65], [81]
9. What are the household sources of (immediate) access to finance? How are these sources potentially affected by disaster?	[83]

Table B.5

Diagnostic prompts relevant to reformatory recovery for built environment dimension

Diagnostic prompts	Related literature
1. What are relevant (future) geo-environmental hazards to consider?	[86]
2. What are the characteristics of and the conditions of structural, non-structural, and construction-related aspects of the region's-built environment (housing)? How does this affect recovery processes?	[86]
3. How is the local built environment characterized in terms of traditional vs contemporary DRR interventions? What is the effectiveness of traditional vs contemporary DRR interventions in the region's local built environment?	[32]
4. What kind of building codes and regulations are there and how are they applied across the population? How does this affect reformatory recovery?	[72]
5. What is the state in the region of the current housing (i.e., security of tenure, availability, affordability, habitability, accessibility, location, cultural adequacy) in the region, and how might this be affected by disaster in the short and long term? And how can it be transformed in the short-long term?	[87]
6. How are physical reconstruction efforts linked to serve broader social and well-being goals? How can hard adaptation and soft adaptation measures be combined?	[41], [48], [88]
7. Is an integrated infrastructure planning approach considered?	[89]
8. What (informal) settlements are present in the region? How might these areas be affected by disaster? How are (informal) settlements considered within recovery approaches?	[42]
9. What buffer capacity exists in the region? Where might new buffer capacity be created and impact density and segregation? How can these affect reformatory recovery?	[49]
10. What is the role of shared spaces in the region? Can these shared spaces be continued during and after a disaster? What role can shared spaces have towards reformatory recovery?	[41], [51]
11. What informal rebuilding efforts emerge post-disaster?	[51]
12. What arrangements are in place to integrate informal rebuilding efforts in post-disaster (long-term) recovery planning?	[51]

Table B.6

Diagnostic prompts relevant to reformatory recovery for critical services dimension

Diagnostic prompts	Related Literature
1. What is the role of flexibility in terms of providing critical services during recovery?	[85]
2. What are critical services (i.e., healthcare, education, ecosystem services, etc) for the region beyond a networked system? What are the required services that are necessary for communities to return after a disaster and how does the (expected) presence/absence of critical services affect reformatory recovery?	[62], [79], [85]
3. What kind of services do the vulnerable population rely on, e.g., ecosystem services? -	[45], [79]
4. How are these services linked to the built environment? E.g., distance and preferred road type to reach services (which relates to the built environment),	[85]
5. What is the level of criticality of a certain service across different disaster stages?	[85]
6. What is the level of (perceived) availability and awareness of a service during a certain disaster stage? (proximity, operational capacity) How does this affect recovery?	[88], [85]
7. What are the required services that are necessary for communities to return after a disaster?	[62], [79], [85]

APPENDIX C. Literature review case studies

Reference	Listed case study
11	No case study
38	Bihar & Kerala states, India, rural areas, casestudy about community assertions against structural inequality and injustice in the disaster recovery context
39	No case study
40	No case study
41	Mumbai Metropolitan Region, India, urban flooding. Case study about lived experiences of women in situations of urban flooding
42	Bangladesh, cyclone Amphan and COVID-19 pandemic
43	Kerala, India, rural area. Casestudy about how space shapes vulnerability and disasters. Community perspective
44	urban and rural Central Vietnam, flood vulnerability (2017)
45	Caribbean islands
46	peri-urban east Attica, Greece
47	No case study
48	Santiago, Chile, landslide (1993)
49	No case study
50	L'Aquila, Italy, earthquake (2009), rural area
51	South Western, Central, South Eastern coastal zones, Bangladesh
52	Cyclone Pam (2015), Vanuatu, Oceania
54	St Maarten, St Martin, post-Hurricanes Irma and Maria (2017)
55	Japan
56	Santiago, Chile, landslide (1993)
57	No case study
58	Wenchuan, China (2008), rural (poor) areas
60	Caribbean islands
61	Amman (Jordan) and Khartoum (Sudan)
62	coastal Odisha, India, post-supercyclone Ersama (1999)
63	No case study
64	Barguna district, Bangladesh, coastal area, Cyclone Sidr (2007)
65	suburban villages in the Central Philippines
66	Uttarakhand and Odisha, India (multiple natural disasters in 1999, 2001, 2004)
67	Chaiten, Chile (2008), urban area
68	No case study
69	Southern African Development Community region
70	No case study
71	Nepal, Earthquake (2015)
72	Japan
73	No case study
74	No case study
75	Phillipines
76	landslide Cisolak in Sukabumi and Sunda strait tsunami in Pandeglang, Indonesia (2018)
77	Yogyakarta, Indonesia, earthquake (2006)
78	the Abruzzo earthquake (southern Region of Italy) in 2009 and the Emilia - Romagna earthquake (northern Region of Italy) in 2012
79	rural areas, China
81	No case study
82	urban informal settlers of Honiara, the capital city of Solomon Islands
84	No case study
85	No case study
86	East Asia
87	Zimbabwe
88	coastal Bangladesh
89	No case study
90	Hong Kong

APPENDIX D. : Case study Antakya

Dimension	Diagnostic Prompt	Relevance/ category	(1) Diagnosing Systemic processes Antakya Evidence (Aydin et al., 2025)	(2) Diagnosing Transformative Moments & Potential Reforms (Aydin et al., 2025)	Reformative Insight
Justice	Which stakeholders are included/excluded in recovery process? How are they identified and engaged? Who dominates, Who benefits, Who gets left	Inclusion & representation	Limited consultation to residents/survivors; vulnerable groups excluded.	Open space for formal participatory mechanisms	Reveals structural underrepresentation and procedural injustice

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Dimension	Diagnostic Prompt	Relevance/ category	(1) Diagnosing Systemic processes Antakya Evidence (Aydin et al., 2025)	(2) Diagnosing Transformative Moments & Potential Reforms (Aydin et al., 2025)	Reformative Insight
	behind? (prompts B.1.1; B.1.4, &B.1.9.) How do (colonial) power dynamics (i.e. lack of self- determination, dehumanization and land disposition of indigenous peoples) affect stakeholder engagement in recovery processes? (prompt B.1.8) How is local/ community knowledge represented in recovery planning? How can this be safeguarded? (prompt B.1.12)	Power dynamics & trust Recognition	Misalignments between local and central gov. leading to mistrust and perceived marginalization. Distrust is a logical outcome of institution failing and without trust REFORMATIVE action is not possible Evidence from Turkey Failed to recognize cultural identity and diversity threatened by relocation; heritage at risk In Turkey there is evidence that lack of previous recognition led these population on vulnerability, and there is chances that realocation reproduces the previous misrecognition practices Conflicting messages between central and local government; fragmented multi-level governance	Conflicts create a a turning point for redesigning recoverygovernance to institutionalize community voice Conflicts create a a turning point for redesigning recovery governance to institutionalize community voice Relocation debates create a reform opportunity for embedding diverse cultural heritage into spatial and urban design policy	Shows necessity of addressing governance legitimacy and institutional distrust (typically ignored by BBB) The necessity of addressing governance legitimacy builds upon the capacity to create trust. Highlights need to safeguard identity and diversity in recovery
Governance	To what extent are decision-making processes inclusive, adaptive, and proactive? (prompt B.2.1) What is the effect of decentralization/ centralization of the DRM authority on recovery processes? (prompt B2.3) How do politics and policy affect the region's disaster management? What are the underlying power relations? How is knowledge/expertise used politically in relation to recovery processes? (Prompt B.2.4)	Inclusiveness & transparency Institutional capacity & fragmentation& conflicts Expertise & knowledge	Weak municipal capacity; competing plans; political tensions shape recovery Politicized zoning; exclusion of local knowledge	Opportunity to design transparent recovery coordination platforms Potential reform point to strengthen local capacity and depoliticize the technical decisions. Turning point to shift towards evidence-based participatory planning	Identifies governance incoherence and limits to adaptive processes Helps to reveal misalignment between local and central government Exposes weak institutional misalignment, conflicting governance structures (politicizing recovery) Shows how political logics overwrite expertise or local knowledge (e.g. TOKI site selection)
Community & Culture	How are community groups distributed across space and demographics? How do existing community groups function? and what social network structures exist? (prompt B.3.1; B.3.6) What mechanisms (physical, social) are in place to retain disaster in memory that could	Social networks & culture Safety culture & memory	Dispersed population; fear of losing neighborhood bonds; risk of social fragmentation due to relocating communities to high- rise or TOKI housing; Community fears cultural erasure through relocation. Historical seismic knowledge exists but not integrated; known risks fail to translate	Community resistance becomes a turning point to redesign neighborhood- based recovery models that preserve socio-spatial ties and culture. Natural hazards create a critical moment ot Institutionalize learning	Demonstrates centrality of social cohesion (not only physical recovery); Reinforces cultural determinants of recovery; reveal social networks is tied to attachment to location, identity and long- term recovery Reveals gaps in institutional learning

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Dimension	Diagnostic Prompt	Relevance/ category	(1) Diagnosing Systemic processes Antakya Evidence (Aydin et al., 2025)	(2) Diagnosing Transformative Moments & Potential Reforms (Aydin et al., 2025)	Reformative Insight
Finance	lead to transformative change? (prompt B.3.16; B.3.20) How do the funding mechanisms ensure expected liquidity requirements during and after the recovery phase? What are the boundary conditions to ensure household access to finance? (prompt B.4.2; B.4.5)	Funding fairness	into policy or building code regulation enforcement Low state investment relative to taxes	and revise building codes/enforcement mechanisms. Opportunity for fiscal reform; redistribute resources through equity-focused recovery financing	Identifies distributive injustices
	How does insurance affect the process of reformative recovery on the micro level? (prompt B.4.8)	Insurance & liquidity	Insufficient compensation; uninsured -commercial- buildings	Post-disaster reforms could expand insurance coverage, financial protection instruments, and microcredit schemes.	Shows barriers to household-level to commercial-level financial recovery
	What are the household sources of (immediate) access to finance? How are these sources potentially affected by disaster? (prompt B.4.9)	Barriers to reverse migration	Lack of systematical incentives; financial obstacles to return	Opportunity to support small businesses to incentivize and build return policies	Highlights finances are a hard constraint for reverse migration and recovery
Built Environment	What are the characteristics and conditions of structural, non-structural, and construction-related aspects of the region's-built environment?" (prompt 5.1)	Structural risk/systemic vulnerability	High-rise density; pre-disaster zoning; unsuitable ground conditions	A clear turning point to reform zoning, site selection and code enforcements; enforce evidence-based planning based on scientific hazard assessments.	Clearly defines the potential and need for regulatory reform in planning
	How is the local built environment characterized in terms of traditional vs contemporary DRR interventions? What is the effectiveness of traditional vs contemporary DRR interventions in the region's local built environment? (prompt B.5.3; B.5.5)	Housing typologies	Conflict between Mass housing construction company and planned public housing models and community preferences for low-rise and socially coherent neighborhoods	Moment to shift toward co-designed housing typologies grounded in community needs and cultural identity.	Shows mismatch between community needs and built environment plans
	What (informal) settlements are present in the region? How might these areas be affected by disaster? How are (informal) settlements considered within recovery approaches? (prompt B.5.8)	Informal rebuilding	Self-built prefabs/houses, informal networks to solve housing gaps	Opportunity to integrate informal practices into adaptive, participatory long-term reconstruction planning.	Signals unmet needs and grassroots adaptation, shows RR captures that people with means have advantages over vulnerable population.
Critical Services	What are critical services (i.e., healthcare, education, ecosystem services, etc) for the region beyond a networked system? (prompt B.6.2)	Service accessibility	Education emerges as a key driver of recovery	Reform to elevate education service to core pillar of recovery	Demonstrates services as anchors of recovery; RR captures Critical services which go beyond physical infrastructure.
	What are the required services that are necessary for communities to return	Service-led return	Education service availability might impact long-term return; educational	A turning point to reframe recovery goals around service continuity, quality	Highlights service-based recovery of long-term recovery, reveals RR uncovers invisible recovery

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Dimension	Diagnostic Prompt	Relevance/ category	(1) Diagnosing Systemic processes Antakya Evidence (Aydin et al., 2025)	(2) Diagnosing Transformative Moments & Potential Reforms (Aydin et al., 2025)	Reformative Insight
	after a disaster? (prompt B.5.7)		access is a hidden recovery determinant.	and accessibility, not just rebuilding assets.	bottlenecks that BBB doesn't capture.

Data availability

Data will be made available on request.

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