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Scenari di adattamento *design-based* ai rischi climatici nei paesaggi di bonifica del 20° secolo

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Abstract. Nel contesto della crisi climatica, i paesaggi costieri di bonifica del 20° secolo (20CRL), frutto del controllo modernista sulla natura, affrontano rischi sistemici crescenti. L'adattamento, però, è ostacolato da lacune culturali, scientifiche e istituzionali, con la ricerca progettuale ancora marginale. ReclaiMEDlanD è un'iniziativa design-based, interdisciplinare e partecipativa che, concentrandosi su due 20CRL italiani, riconsidera il rischio come una lente per ripensare le strutture spaziali e di governance attuali, per accompagnare le comunità verso scenari di adattamento di lungo termine. Il futuro dei 20CRL dipende dall'abbracciare creativamente l'incertezza attraverso il progetto, aprendo la strada a un'agenda collettiva per l'adattamento climatico.

Parole chiave: Adattamento; Rischio; Progetto; Cambiamento Climatico; Paesaggi di bonifica del 20° secolo.

Rischio, metamorfosi e adattamento nei paesaggi costieri di bonifica del 20° secolo (20CRL)

Nell'attuale condizione segnata dal cambiamento climatico e dall'intensificazione degli eventi estremi, il rischio è diventato una lente cruciale per interpretare e trasformare i territori e le forme dell'abitare (Andraos, 2016). I rischi ambientali non sono più percepiti come perturbazioni naturali esterne o episodiche, ma come conseguenze sistemiche della modernità (Beck, 1992). La riconfigurazione tecnica dei paesaggi quali i paesaggi costieri di bonifica del 20° secolo (*20th-century coastal reclaimed landscapes*-20CRL) un tempo celebrati come simboli di progresso –, ha generato vulnerabilità strutturali che oggi richiedono una «metamorfosi» (Beck, 2014; 2016): un cambio di paradigma, epistemico e operativo, che riconosce l'instabilità come condizione costitutiva del presente, trasformando tali paesaggi in luoghi di un cambiamento ontologico. In questo quadro, il rischio si configura come una categoria generativa, capace di destabilizzare modelli deterministici e aprire spazi di innovazione. L'adattamento non è più soltanto protezione dalle minacce, ma pratica creativa e collettiva che mobilità intelligenze spaziali, saperi locali e capacità d'azione condivisa per abitare l'incertezza. In quest'ottica, i 20CRL – prodotti di una modernità diversa – possono essere reinterpretati come territori emblematici della metamorfosi contemporanea. Questo contributo presenta il progetto ReclaiMEDlanD, iniziativa sperimentale internazionale inserita in una più ampia traiettoria di ricerca progettuale sui 20CRL, che assume il rischio come strumento diagnostico e generativo. Attraverso la dimensione critico-prefigurativa del progetto multi-scalare, il progetto re-immagina questi paesaggi come possibili laboratori di resilienza climatica in condizioni di profonda incertezza.

Una ricerca progettuale sui paesaggi costieri di bonifica del 20° secolo

Perché i 20CRL?

I 20CRL rappresentano alcune delle trasformazioni territoriali più vaste dell'area euro-mediterranea e oltre, modellate da interventi infrastrutturali di grande scala. Concepite entro un paradigma tecnico-scientifico, tali trasformazioni incarnano una visione moderna di controllo razionale dell'ambiente fondata sulla produttività agricola – materializzata attraverso la separazione tra terra e acqua, il riordino geometrico dello spazio, la coltivazione intensiva e assetti insediativi funzionalisti. Al contempo, questi paesaggi sono stati campi di sperimentazione per ingegneria, agronomia,

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Abstract. In the context of the climate crisis, 20th-century reclaimed coastal landscapes (20CRL) – the result of modernist control over nature – are facing growing systemic risks. Adaptation, however, is hindered by cultural, scientific, and institutional gaps, with design research remaining marginal. ReclaiMEDlanD is a design-based, interdisciplinary, and participatory initiative that, by focusing on two Italian 20CRLs, reconsiders risk as a lens for rethinking current spatial and governance structures, supporting communities toward long-term adaptation scenarios. The future of 20CRLs depends on creatively embracing uncertainty through design, paving the way for a collective agenda for climate adaptation.

Keywords: Adaptation; Risk; Design; Climate change; 20th-century reclaimed landscapes.

Risk, Metamorphosis, and Adaptation in 20th-Century Coastal Reclaimed Landscapes

In the contemporary condition shaped by climate change and the intensification of extreme events, risk has become a crucial lens for interpreting and transforming both territories and forms of inhabitation (Andraos, 2016). Environmental hazards are no longer perceived as external or episodic natural disturbances but as systemic consequences of modernity itself (Beck, 1992). The technical reconfiguration of landscapes such as the 20th-Century Coastal Reclaimed Landscapes (20CRLs)–once celebrated as symbols of progress–has generated structural vulnerabilities that now call for a "metamorphosis" (Beck, 2014; 2016), precisely an epistemic and operational shift acknowledging instability as a constitutive condition of the present, thus turning these landscapes into spaces of ontological transformation.

Within this framework, risk operates as a generative category capable of disrupting deterministic models and opening pathways for innovation. Adaptation becomes not only protection from hazards but a creative and collective practice that mobilises spatial intelligence, local knowledge, and community agency to inhabit uncertainty. Seen through this lens, 20CRLs–products of another modernity–can be reinterpreted as exemplary territories of metamorphosis.

This contribution introduces the ReclaiMEDlanD project, an international experimental initiative within a broader design-research trajectory on 20CRLs, which frames risk as both diagnostic tool and driver of transformation. Through the critical–prefigurative dimension of multi-scalar

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scienze sociali, urbanistica e architettura, generando strutture compositive e configurazioni spaziali distintive oggi sempre più riconosciute dalle comunità locali per il loro valore identitario e culturale. Un tempo espressione di un rigido controllo sulla natura, i 20CRL si trovano oggi ad affrontare la sfida dell'adattamento, tra eredità moderniste (Raffa, 2025c), vulnerabilità climatica e rischio sistemico.

Gap Attuali

Nonostante la loro rilevanza, persistono importanti lacune culturali, scientifiche e di governance che ostacolano approcci adattivi nei 20CRL.

Sul piano culturale, tali territori sono ancora percepiti come paesaggi produttivi ma fragili – segnati da obsolescenza infrastrutturale, urbanizzazione incontrollata, degrado ambientale, subsidenza e perdita di biodiversità – condizioni aggravate da innalzamento del mare, alluvioni, siccità e temperature elevate. Questa percezione rafforza un paradigma emergenziale, che marginalizza l'adattamento di lungo periodo.

Sul piano della ricerca, le strategie di adattamento restano per lo più settoriali e orientate alla produttività agricola, trascurando la dimensione spaziale e storico-culturale dei 20CRL. Nonostante contributi significativi (Raffa e Macaione, 2024; Brisotto *et al.*, 2023; Nijhuis, 2020; Metta e Onorati, 2019), la ricerca progettuale è ancora marginale e poco integrata nei quadri decisionali.

Sul piano della governance, frammentazione istituzionale, disallineamenti tra politiche, e approcci top-down non radicati nel tessuto sociale compromettono la capacità di avviare trasformazioni adattive durature e condivise.

Riposizionare i 20CRL. Obiettivi e Metodi della Ricerca

La ricerca progettuale in corso affronta questi gap interconnessi esaminando le interdipendenze tra eredità spaziali moderniste, vulnerabilità climatica e traiettorie di adattamento nei 20CRL mediterranei. Attraverso un approccio multi-metodo e centrato sulla dimensione spaziale, la ricerca interpreta tali paesaggi non come fallimenti della modernità, ma come laboratori di resilienza dove i sistemi ereditati – ecologici, infrastrutturali, insediativi – interagiscono con i rischi climatici presenti e futuri, per immaginare trasformazioni adattative. Strutturata attraverso tre metodi interconnessi di indagine, cioè *research on design*, *research-by-design* e *research for design*, la ricerca persegue due obiettivi principali: (i) elaborare una metodologia operativa, individuando principi e procedure, per l'adattamento climatico nei 20CRL; (ii) tradurre al metodologia operativa in un toolkit rivolto a ricercatori e professionisti impegnati nella progettazione dei paesaggi di bonifica mediterranei.

ReclaiMEDlanD. Una sperimentazione progettuale tra rischio, adattamento e public engagement

Il progetto ReclaiMEDlanD1 costituisce un'iniziativa interdisciplinare design-based che riposiziona il rischio come una categoria generativa e diagnostica –una lente concettuale attraverso cui leggere criticamente le strutture spaziali esistenti e co-progettare percorsi adattativi e anticipatori. Sviluppato attraverso la collaborazione tra FEEM-Fondazione Eni Enrico Mattei e FIBER-Florida Institute for Built Environment Resilience/University of Florida, ReclaiMEDlanD esplora il potenziale del progetto multi-scalare di architettura come pratica

design, the project reimagines these landscapes as laboratories for climate resilience under deep uncertainty.

A Design Research on 20CRL

Why 20CRLs?

20CRLs are some of the most extensive territorial transformations in the Euro-Mediterranean region and beyond, shaped by large-scale infrastructural interventions. Conceived within a techno-scientific paradigm, they embody a modern vision of rational environmental control centred on agricultural production–materialised through the separation of land and water, orderly geometric reorganisation of space, intensive cultivation, and functional settlement patterns. These landscapes have also served as sites of innovation in engineering, agronomy, social sciences, urbanism, and architecture, generating distinctive compositional structures and spatial configurations that local communities increasingly recognise for their cultural and identity-bearing value. Once the expressions of rigid control over nature, 20CRLs now face the challenge of adaptation at the intersection of modernist legacies (Raffa, 2025c), climate vulnerability, and systemic risk.

Current Gaps

Despite their relevance, significant cultural, research, and governance gaps continue to hinder adaptive approaches in 20CRLs. Culturally, these territories are still framed as productive yet fragile environments–characterised by infrastructural obsolescence, uncontrolled urbanisation, environmental degradation, subsidence, and biodiversity loss. These conditions are exacerbated by sea-level rise, flooding, drought, and extreme heat. This perception reinforces a paradigm in which climate risk is primarily addressed through emergency response, sidelining long-term, place-based adaptation.

From a research perspective, adaptation strategies remain largely shaped by sectoral, productivity-oriented approaches that marginalise the spatial, historical, and cultural dimensions of these landscapes. Despite notable exceptions (Raffa and Macaione, 2024; Brisotto *et al.*, 2023; Nijhuis, 2020; Metta and Onorati, 2019), design research is still underdeveloped and weakly integrated into policy, planning, and design frameworks, leaving the potential of multi-scalar design to drive systemic adaptation largely unexplored.

Governance frameworks further reveal deep fragmentation across institutional levels, producing misaligned policies that insufficiently reflect community aspirations. This fragmentation undermines institutional legitimacy and social cohesion, limiting the capacity to initiate and sustain long-term adaptive transformations.

Reframing 20CRLs. Research Objectives and Methods

An ongoing design research project seeks to address these interconnected gaps by examining the complex entanglements between modern spatial legacies, climate vulnerability, and adaptation in Mediterranean 20CRLs. Through a spatially explicit and multi-method approach, the research reframes 20CRLs not as modernist failures, but as resilience laboratories–territories where inherited ecological, infrastructural, and settlement systems intersect with current and potential climate risks, encouraging people

Tab. 01 | Metodologia, ri-elaborazione di A. Raffa (2025, p. 22)
Methodology, reprocessed by A. Raffa (2025b, p. 22)

critica e prefigurativa, non confinata all'elaborazione di soluzioni predefinite, ma orientata a riformulare i problemi, esporre vulnerabilità strutturali e co-sviluppare strategie di adattamento anticipatorio e di lungo termine in due 20CRL italiani emblematici e tra i più vulnerabili al rischio di innalzamento del livello del mare (ENEA, 2023): Piana di Metaponto (Basilicata) e Bassa Romagna (Emilia-Romagna).

Una Pedagogia del Rischio: Struttura e Metodi

Il percorso di dieci mesi è stato articolato in quattro fasi sequenziali – Percezione del Rischio, Spazializzazione del Rischio, Prioritizzazione Basata sul Rischio e Adattamento Informato dal Rischio (Tab. 1) – concepite per trasformare la comprensione del rischio da minaccia da mitigare a condizione generativa per il progetto, l'innovazione nella governance e la resilienza territoriale (Cvitanovic, 2019). Tale progressione ha costituito una pedagogia del rischio: un percorso metodologico e culturale attraverso cui comunità e istituzioni hanno imparato a interpretare l'incertezza come terreno di azione collettiva e a considerare il rischio quale fondamento per l'indagine collaborativa (Benadusi, 2014). Attraverso un approccio multi-metodo fondato sul *learning-by-doing*, i partecipanti hanno indagato il potenziale dell'adattamento design-based nell'elaborazione di strategie di trasformazione di lungo periodo.

Un aspetto metodologico centrale è stata la dimensione partecipativa, che ha integrato conoscenze tecnico-scientifiche con saperi locali ed esperienziali. Ricercatori ed esperti hanno apportato prospettive disciplinari provenienti dalle scienze del clima, idrologia, ecologia, agronomia, geografia, studi sul patrimonio, pianificazione urbana e architettura, mentre i rappresentanti delle comunità hanno contribuito con esperienze vissute del rischio e dei cambiamenti ambientali. Le autorità locali hanno fornito approfondimenti complementari sui processi di governance e sulle pratiche attuali di gestione del rischio.

La comunicazione del rischio ha svolto un ruolo cruciale – non come strumento unidirezionale di diffusione, ma come mezzo di co-apprendimento, negoziazione e co-creazione. La sequenza delle attività ha progressivamente costruito una comprensio-

| Tab. 01

Activity	Description	Methods	Outputs
1. Risk Perception			
Kick-off Meeting	Introduction of project objectives; framing of systemic climate risk; scoping of territorial exposure	Public meeting; feedback analysis	Stakeholder alignment on approach and objectives; Shared understanding of climate threats;
Online Workshop I	Elicitation of risk perceptions from institutional and civic actors	Participatory appraisal; open discussion; comparative analysis; feedback coding	Typologies of perceived risk defined; narratives collected; identification of institutional gaps perceived
Online Workshop II	Collective reflection on personal and community experiences of risk	Structured dialogue; comparative analysis; feedback coding	Place-based risk perceptions interpreted; socio-spatial dimensions of perceived vulnerability revealed.
2. Risk Spatialization			
Risk-Policy Analysis	Critical reading of planning tools and governance frameworks	Document review; analytical matrices; mapping and comparative analysis	Understanding of current risk governance; identification of institutional misalignments.
Spatial Vulnerability Mapping	GIS-based modeling of hazard exposure and spatial vulnerabilities, focused on flooding and drought	Layer decomposition; multi-layer mapping; hazard overlay techniques	Spatial identification of high-risk zones and exposed systems
Online Progress Meeting	Synthesis of previous phases; mapping presentation; discussion of next steps	Public meeting; stakeholder feedback	Cross-sectoral awareness of risks from spatial and governance perspectives
Online Focus Group I	Stakeholder review and refinement of risk maps	Participatory mapping; iterative validation; feedback coding	Validated maps; spatial prioritization of critical areas
3. *Risk-based Prioritization*			
Online Focus Group II	Evaluation of risks by urgency and potential; selection of representative transects for adaptation	Facilitated decision-making; participatory analysis; feedback coding	Selection of key transects; identification of emblematic case for prototyping adaptation
Field Exploration	Fieldwork across targeted transect sections	Site visit; visual survey;	Empirical confirmation of mapped risks; visual documentation acquisition
4. Risk-informed Adaptation			
Online Seminar	Lectures on design-based adaptation; reflections on challenges/opportunities	Keynote speeches; plenary discussion	Knowledge transfer on design-based adaptation as regenerative opportunity
Scenario Planning Workshop	Exploratory co-design of adaptation strategies for the selected transect	Co-design charrette; small/large group sessions	Spatial diagrams and proposals for adaptive transformation
Symposium	Public and streamed event for project's results dissemination	Keynote presentations; roundtable debates; plenary discussion	Knowledge transfer across all levels; articulation of shared design principles

Tab. 02 | Confronto tra i transetti di Bassa Romagna e piana di Metaponto sul rischio idraulico, elaborazione A. Raffa
Comparison between Bassa Romagna and Metaponto plain transects on hydraulic risks, created by A. Raffa

ne condivisa e multi-scalare dei rischi climatici, in particolare di natura idraulica, nelle due aree di studio. Ciascuna fase ha prodotto risultati che, cumulativamente, hanno rafforzato la profondità analitica e progettuale del processo.

Spazializzazione e Prioritizzazione basate sul Rischio. Un confronto analitico attraverso i rischi idraulici

Il confronto tra i due casi studio mostra come il cambiamento climatico amplifichi i rischi idraulici attraverso precipitazioni più intense, regimi idrologici alterati e l'innalzamento del livello del mare. Entrambi i 20CRL faticano a gestire picchi di piena estremi, stagnazioni prolungate e processi di salinizzazione avanzante. Tali dinamiche danneggiano l'agricoltura (perdite colturali, degrado del suolo, compromissione dei sistemi irrigui) e mettono sotto pressione le reti ecologiche, nelle quali zone umide, corridoi ripariali e foreste costiere manifestano squilibri idrici, declino della vegetazione e ridotta continuità degli habitat. Infrastrutture e insediamenti affrontano pressioni analoghe, con strade, servizi e aree edificate sempre più esposte a condizioni idrologiche problematiche. I siti archeologici, sia in forma esposta che sepolta, evidenziano una vulnerabilità crescente dovuta a umidità, erosione e regimi idrici instabili (Tab. 2).

Le attività di mappatura, condotte sia su base documentale sia in modalità partecipativa, hanno ancorato queste vulnerabilità a specifiche porzioni territoriali, consentendo agli stakeholder di individuare un transetto rappresentativo per ciascun territorio, tra costa e interno, quale test-bed emblematici (Fig. 1). Le esplorazioni sul campo hanno confermato e ulteriormente dettagliato le forme di fragilità mappate. I pattern di rischio emersi hanno rivelato una vulnerabilità sistemica e messo in evidenza l'urgente necessità di attuare strategie di adattamento integrate e multiscalari, capaci di rafforzare la resilienza territoriale di lungo periodo.

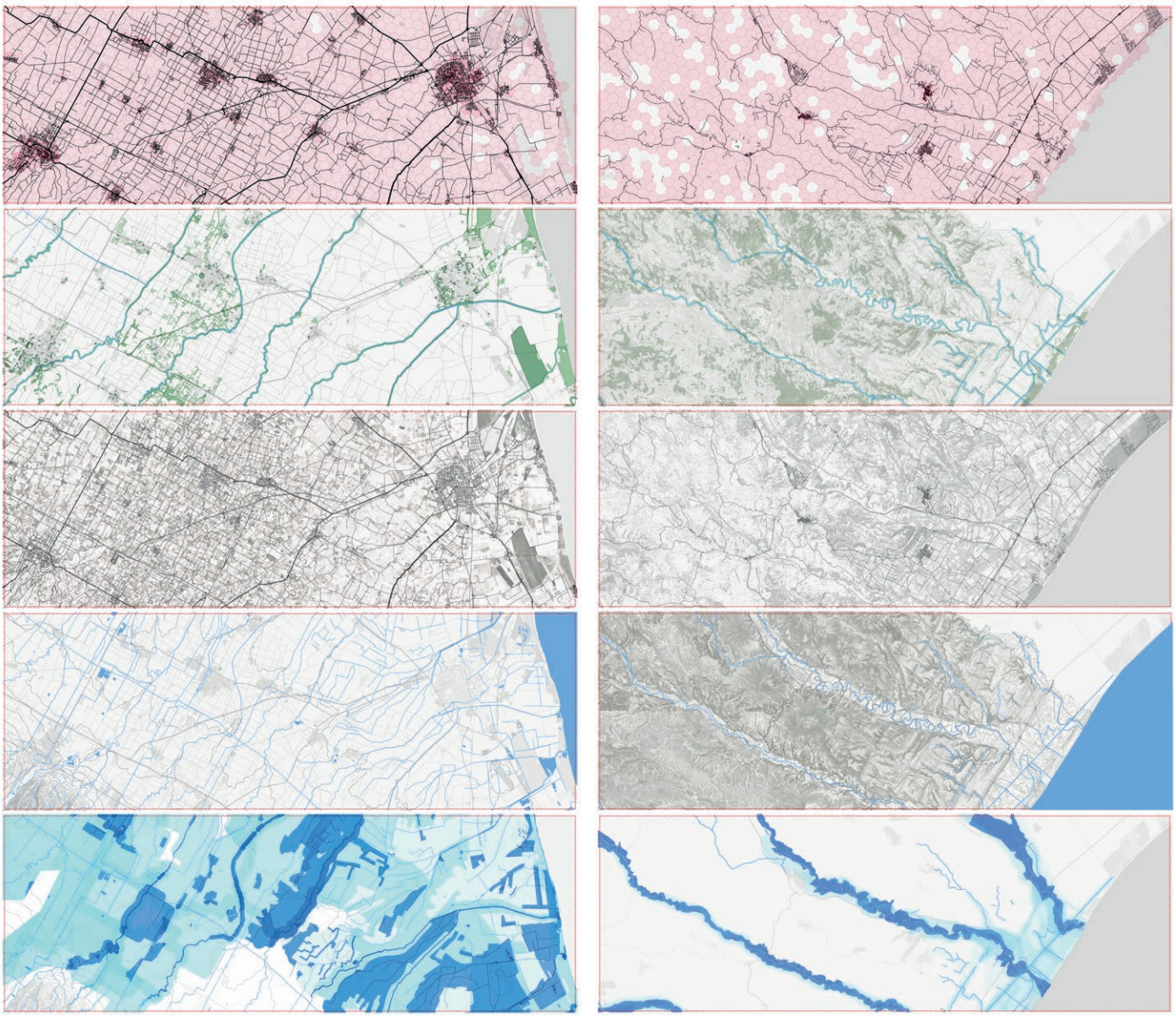
Adattamento Informato dal Rischio: workshop di scenario-planning nel transetto di Metaponto

Il workshop di scenario-planning (Haigh, 2019) ha permesso di sviluppare strategie contestuali di adattamento climatico di lungo periodo utilizzando il transetto di Metaponto come am-

Tab. 02 |

System & Features	General Impacts of hydraulic Risks	Common Risks	Differentiated Risks (Transect). Bassa Romagna (B) and Metaponto Plain (M)
Water system Drainage and irrigation network; embanked rivers; rivers	Overload of canals; river overflows; water stagnation; salinization; contamination of surface and groundwater; interruption of irrigation cycles	River overflows; increased hydraulic pressure on reclamation networks; stress on groundwater systems; reduced drainage efficiency	**B:** Overflows of Lamone Senio (Bagnacavallo), Santerno (Lugo); prolonged stagnation in rural and urban areas (Conselice). **M:** Floods of Basento and Bradano (Metaponto Borgo, Marinella); backflow in coastal ditches near Metaponto Lido.
Ecological system Wetlands; coastal dunes; shores; forests; riparian corridors	Habitat alteration and fragmentation; changes in sediment transport; biodiversity loss; shore and dunes erosion; impact on resources depletion of ecological resources and reduction in ecosystem functions	Impacts on sensitive habitats; alteration and disruption of ecological corridors; reduced ecological resilience;	**B:** Stress in rivers (Lamone) floodplains and wetland (Punta Albarete) and riparian vegetation; coastal pine woods demage and degradation; hydrological imbalance and soil pollution **M:** Erosion of coastal dunes and pine forests in Metaponto Woods; hydromorphic stress in Pantanello; altered sediment flows along the Bradano corridor.
Agricultural system Rural patterns; Windbreaks; hedgerows	Crop loss; soil compaction and degradation; decline in soil fertility and productivity; windbreaks and hedge rows loss	Crop flooding; reduced soil fertility; increased vulnerability of intensive cropping systems	**B:** Orchard and arable-land diffused damage between (from Ravenna to Lugo) **M:** Flooding in orchard/horticultural belts between Metaponto–Bernalda; erosion of sandy soils in Pantanello and Metaponto Scalo.
Infrastructural system Embanked roads/railways; depressed road sections; rural networks; slow mobility networks	Damage to roads, bridges, and underpasses; disruption of mobility networks; impairment of utilities and critical service infrastructures	Road interruptions; underpass flooding; damage to critical infrastructures and service networks	**B:** Flooded underpasses between Lugo–Alfonsine; disruptions on road SP21, SP253 and railways; impacts in industrial areas of Bagnacavallo **M:** Fragility of SP3 "Jonica"; damage on rural roads towards Metaponto Lido; instability of agricultural tracks.
Settlement system Dense urban centers; rural villages; dispersed rural settlements	Damage from flooding and humidity affecting residential areas, productive sites, and services; temporary or prolonged displacement of inhabitants	Impacts on residential and tourist settlements and economic activities; disruption of essential services; increased exposure of vulnerable populations	**B:** Flooding in Lugo, Conselice, Faenza (Lamone-adjacent urban settlements); impacts on productive districts of Cotignola; impacts on coastal tourism facilities **M:** Impacts in Metaponto Lido, Borgo Metaponto; damage to tourist settlements (Pini di Metaponto, Lido Torre).
Archaeological (heritage) sytems Low-lying sites; exposed excavated areas; buried archaeologies	Material degradation from humidity and flooding; sediment deposition; surface erosion; increased vulnerability of heritage assets	Increased exposure of cultural heritage to water, salinity, and soil instability; accelerated degradation of sensitive archaeological sites	**B:** High vulnerability of archaeological sites, i.e., Broze-Age Solarolo flooded, Roman Villa of Classe Ancient Harbour in Ravenna covered with mud. **M:** High vulnerability of the Greeck colonization archaeologies both excavated –i.e., Tavole Palatine– and buried

01 | Confronto tra i transetti di Bassa Romagna (sinistra) e piana di Metaponto (destra) tra sistemi territoriali e rischio idraulico, elaborazione di A. Raffa
Comparison between Bassa Romagna (left) and Metaponto plain (right) transects on territorial systems and hydraulic risks, created by A. Raffa



| 01

to imagine adaptive transformations. Structured through three interconnected modes of inquiry–research on design, research-by-design, and research for design–the project pursues two primary objectives: (i) to elaborate a spatially explicit operational methodology, with guiding principles and procedures, for climate adaptation in 20CRLs; and (ii) to translate these methodological insights into a practical toolkit to support researchers and practitioners in designing climate-resilient Mediterranean reclaimed landscapes.

ReclaiMEDlanD. A Design Experimentation Between Risk, Adaptation, and Public Engagement

The ReclaiMEDlanD project[1] is an interdisciplinary design-based initiative (Raffa, 2025a) that repositions risk as a generative and diagnostic category – a conceptual lens through which to critically examine existing spatial structures, and to co-design adaptive and anticipatory pathways. Developed through collaboration between FEEM-Fondazione Eni Enrico Mattei and FIBER-Florida Institute for Built Environment Resilience/University of Florida, the project explores the potential of multi-scalar architectural design as a critical and prefigurative practice. It is not confined to delivering predefined solutions, but oriented towards reframing problems, exposing structural vulnerabilities, and co-developing long-term anticipatory adaptation strategies in two emblematic Italian 20CRLs that are most vulnerable to sea-level rise flooding (ENEA, 2023), precisely the Metaponto plain (Basilicata) and Bassa Romagna (Emilia-Romagna).

A Pedagogy of Risks: Structure and Methods

The ten-month process was articulated into four sequential phases–Risk Perception, Risk Spatialisation, Risk-Based Prioritisation, and Risk-Informed Adaptation (Tab. 1)–designed to shift the understanding of risk from a threat requiring mitigation to a generative condition for design, governance innovation, and territorial resilience (Cvitanovic, 2019). This progression constituted a *pedagogy of risk,* a methodological and cultural pathway through which communities

bito di sperimentazione speculativa. Tale scelta si è fondata su ragioni metodologiche e operative: oltre alla sua rappresentatività, essa presenta un'elevata vulnerabilità a causa di un'economia fortemente dipendente dall'agricoltura, processi di spopolamento, scarsa manutenzione delle infrastrutture di bonifica e assenza di politiche di adattamento – condizioni che amplificherebbero gli impatti di eventi analoghi all'alluvione che ha colpito la Bassa Romagna del 2023.
Partendo da una lettura spaziale delle dinamiche socio-ambientali, dalle proiezioni climatiche per un aumento di +1,5 °C entro il 2100 e dalle criticità emerse nelle precedenti fasi partecipative, sono stati elaborati quattro scenari tematici interconnessi. Pensati non come modelli predittivi, ma come dispositivi euristici, gli scenari hanno favorito una riflessione critica oltre i vincoli dell'attuale pianificazione/progettazione e gestione del rischio, affrontando al contempo la sfida trasversale della rinaturalizzazione introdotta dalla Nature Restoration Law (2024) europea.
A partire dagli scenari, i partecipanti hanno elaborato strategie spaziali di lungo periodo per affrontare i rischi di natura idraulica, attraverso la gestione diffusa delle acque, la riconnessione ecologica, la mobilità e l'abitare resilienti, l'agricoltura adattiva e la protezione del patrimonio archeologico (Tab. 3). Questi contributi hanno informato visioni spaziali specifiche lungo il transetto, delineando traiettorie di trasformazione orientate alla resilienza climatica (Fig. 2).

Risultati, limiti e prospettive future

ReclaiMEDlanD, pur avendo una natura metodologica ed esplorativa, ha prodotto un corpo consolidato di risultati che rafforza sia le capacità analitiche sia quelle operative necessarie per l'adattamento climatico nei 20CRL, offrendo al contempo indicazioni critiche per lo sviluppo della ricerca progettuale in corso.
Sul piano analitico, la sequenza delle attività partecipative ha generato una comprensione condivisa e multi-scalare dei rischi idraulici e climatici nei due territori, rivelandone la natura sistemica, tra pressioni ambientali, percezione pubblica, rigidità infrastrutturali e forme di governance frammentate. Questa comprensione ha inoltre permesso di individuare potenziali leve per processi di trasformazione adattiva. Tuttavia, la disponibilità limitata e la qualità disomogenea dei dati ambientali e idraulici quantitativi – quali serie idrologiche di lungo periodo, misurazioni della subsidenza e modelli di rischio ad alta risoluzione – hanno ridotto le possibilità di integrare in modo efficace l'esplorazione progettuale con valutazioni quantitative robuste.
Sul piano metodologico–operativo, il processo (Raffa, 2025b) ha condotto alla formulazione di una prima elaborazione di linee guida di adattamento trasferibili (Raffa, 2025a), derivate dall'analisi comparativa dei casi e dagli esiti del workshop. Concepite non come soluzioni prescrittive, ma come principi operativi, tali linee guida intendono orientare futuri processi progettuali in 20CRL mediterranei analoghi e richiederanno una sperimentazione iterativa in molteplici contesti. Per mantenere la logica comparativa della ricerca e validare operativamente queste linee guida, un secondo workshop di scenario-planning sarà realizzato sul transetto della Bassa Romagna, rafforzando l'apprendimento inter-territoriale.
A livello di governance, il progetto ha favorito processi di apprendimento collaborativo tra istituzioni, esperti e comunità,

and institutions learned to interpret uncertainty as a terrain for collective action, and to view risk as a foundation for collaborative inquiry (Benadusi, 2014). Through a multi-method, learning-by-doing approach, participants engaged with the potential of design-based adaptation to elaborate long-term transformative strategies.
A central methodological component was the participatory framework, which integrated technical–scientific knowledge with local and experiential insights. Researchers and experts contributed disciplinary perspectives from climate science, hydrology, ecology, agronomy, geography, heritage studies, urban planning, and architecture, while community representatives conveyed personal experiences of risk and environmental change. Local authorities provided complementary insights into governance processes and risk management practices.
Risk communication played a pivotal role–not as a one-directional dissemination tool, but as a medium for co-learning, negotiation, and co-creation. The sequence of activities progressively built a shared, multi-scalar understanding of climate risks, in particular hydraulic, in the two case-study areas. Each phase generated outputs that cumulatively reinforced the analytical and projective depth of the process.

Risk-based Spatialisation and Prioritisation. An analytical comparison through hydraulic risks

The comparison between the two case studies shows how climate change amplifies hydraulic risks through more intense rainfall, altered hydrological regimes, and sea-level rise. Both 20CRLs struggle to manage extreme peak flows, prolonged stagnation, and advancing salinisation. These dynamics damage agriculture (crop losses, soil degradation, compromised irrigation systems) and stress ecological networks, where wetlands, riparian corridors and coastal forests present altered water balances, vegetation decline, and reduced habitat continuity. Infrastructures and settlements face similar pressure with roads, services, and built-up areas increasingly exposed to risky hydrological conditions. Archaeological sites, in both exposed and buried forms, show heightened vulnerability due to humidity, erosion, and unstable water regimes (Tab. 2). Desk-based and participatory mapping anchored these vulnerabilities to specific territorial sections, enabling stakeholders to identify one representative coastal–inland transect per territory as an emblematic risk test-bed (Fig. 1). Field explorations confirmed and further detailed the mapped forms of fragility. The resulting patterns of risk revealed systemic vulnerability and underscored the urgent need to implement integrated, multi-scalar adaptation strategies capable of enhancing long-term territorial resilience.

Risk-Informed Adaptation: Scenario-Planning workshop in the Metaponto transect

The scenario-planning workshop (Haigh, 2019) developed situated long-term climate-adaptation strategies using the Metaponto transect as a speculative test bed. The area was selected for both methodological and operational reasons. Beyond its representativeness, it displays high vulnerability due to an agriculture-dependent economy, depopulation, poor mainte-

Tab. 03 | Scenari sul transetto di Metaponto. Vulnerabilità, Opportunità e Strategie di Adattamento, elaborazione di A. Raffa
Metaponto Transect Scenarios. Vulnerabilities, Opportunities and Adaptation strategies, created by A. Raffa

Infrastructure and Settlement Dynamics
Scenario 1

In 2100, The elevation of the **main roads** has played a crucial role in renewing the region's infrastructure and settlement system. By reducing travel times and mitigating flood risks, the intervention improved territorial mobility between the coast and the interior. However, it also produced significant **side effects**: reduced accessibility to intermediate settlements contributed to their **economic and social marginalization**, while **coastal depopulation** intensified due to climate vulnerabilities and agricultural decline. As a result, populations began to **relocate inland,** repopulating and expanding long-abandoned urban areas. At the same time**, new amphibious living models** and emerging agricultural opportunities are beginning to repopulate coastal zones (Raffa and Brisotto, 2025, p. 34)

Scenario Vulnerabilities

- **Marginalization of intermediate settlements**: Reduced access has led to social and economic decline in areas bypassed by the new infrastructure.
- **Depopulation of coastal and reclaimed areas**: Due to increased climate vulnerability (e.g., flooding, salinization) and the decline of traditional agriculture.
- **Loss of diffuse settlement patterns**: The historical spatial logic of the bonifica landscape is being eroded by urban concentration inland.
- **Displacement of coastal population**:

Scenario Opportunities

- **Improved climate-resilient mobility**: Reduced flood risk and enhanced connectivity between inland and coastal areas;
- **Repopulation of abandoned inland towns**: Infrastructural investment has triggered the revitalization of old urban centers.
- **Emergence of new adaptive living models**: Coastal repopulation driven by **amphibious housing solutions** and **innovative agricultural practices** suited to changing environmental conditions.

Long-Term Adaptation Strategies

- **1.1 Elevation of primary infrastructure** to ensure mobility even during extreme weather events;
- **1.2 Improvements to local road systems** must guarantee agricultural enterprises access to collection and distribution points;
- **1.3 Integration of structural (e.g., levees, mobile barriers) and non-structural solutions (e.g., nature-based solutions)** to create multifunctional infrastructure;
- **1.4 Selective densification in urban areas** less exposed to hydrogeological risks.
- **1.5 Managed retreat strategies** between the coast and inland areas, including the **regeneration of abandoned villages** located in lower-risk zones.
- **1.6 New amphibious housing models** to continue inhabiting coastal territories through flexible and adaptable solutions.
- **1.7 Nature-based regeneration of urban and peri-urban open spaces**, including permeable soils, ecological corridors, rain gardens, tree-lined paths, and urban agriculture.

Amphibious Renaturalization
Scenario 2

In 2100, environmental and agricultural policies have driven the conversion of intensively farmed reclaimed land along the coast into **wetland ecosystems**, radically transforming the landscape and economy of the Metaponto area. Biodiversity has been restored, and watercourses have regained their **ecological functions**, particularly in sediment transport toward the coast. Though the renaturalization reduced arable land, it fostered a **new nature-based economy**, including **eco-tourism, aquaculture, and sustainable wetland management**. Small eco-lodges now dot the coast, and previously degraded soils have regained fertility. However, this shift has challenged traditional farming models, creating tension among farmers unable to adapt, many of whom demand more land for cultivation (Raffa and Brisotto, 2025, p. 35)

Scenario Vulnerabilities

- **Reduction of arable land** leading to tensions with traditional intensive farming models;
- **Difficulty for** some farmers in **adapting** to new sustainable practices;
- **Socio-economic imbalance** due to transition-related disruptions;

Scenario Opportunities

- **Restoration of wetlands and biodiversity**;
- **Recovery of degraded soils and water quality**;
- **Development of eco-tourism and sustainable aquaculture**;
- **Emergence of a nature-based economy**;

Long-Term Adaptation Strategies

- **2.1 Restoration of the coastal system**, through: artificial beach nourishment and dune restoration, artificial reefs and submerged structures, coastal wetlands. Areas for fish farming as coastal protection and the generation of new alternative economies.
- **2.2 Renaturalization of riverbeds and banks**, through: setback of embankments, creation of bypasses and oxbow lakes, recovery of historical riverbeds, implementation of physical structures in riverbeds to redefine sediment ecology between inland and coastal areas.
- **2.3 Afforestation of coastal areas, riverbeds, and riverbanks** to improve biodiversity and ecological performance, and in response to climate risk.
- **2.4 Develop new supply chains linked to food tourism**, which in the long term can become a consolidated economic resource integrated with agriculture.

(Continued)

nance of reclamation infrastructures, and the absence of adaptation policies, conditions that would amplify the impact of events comparable to the 2023 Bassa Romagna flood. Four interconnected thematic scenarios were defined based on a spatial reading of socio-environmental dynamics, climate projections for +1.5 °C by 2100 and critical issues that had emerged from previous participatory phases. Conceived not as predictive models but as heuristic frameworks, they enabled critical reflection beyond current planning, design, and risk-management constraints, while also addressing the cross-cutting challenge of re-naturalisation highlighted by the EU Nature Restoration Law (2024). By reflecting on the scenarios, participants developed long-term spatial strategies to address hydraulic-related risks through distributed water management, ecological reconnection, resilient mobility and housing, adaptive agriculture, and the protection of archaeological heritage (Tab. 3). These contributions informed context-specific spatial visions along the transect, outlining trajectories of transformation oriented toward climate resilience (Fig. 2).

Results, limitations and future directions

The ReclaiMEDlanD process, while methodological and experimental in nature, produced a consolidated body of results that strengthens both the analytical and operational capacities required for climate adaptation in 20CRLs. It provides critical insights for ongoing design research.

Tab. 03 | Scenari sul transetto di Metaponto. Vulnerabilità, Opportunità e Strategie di Adattamento, elaborazione di A. Raffa
Metaponto Transect Scenarios. Vulnerabilities, Opportunities and Adaptation strategies, created by A. Raffa

Tab. 04 |

New *Forms of Existence for 20CRL as Cultural Landscape*
Scenario 3

In 2100, climate change adaptation efforts–especially the restoration of coastal wetlands–have rendered the original reclamation system obsolete, exposing its climatic vulnerabilities. Local people react negatively to re-naturation initiatives, denunciando la perdita del valore culturale. Along the coast, these landscapes have largely given way to renaturalization, while in the inland fringe, remnants of the reclamation and land reform interventions–such as drainage canals, rural road grids, hedgerows, and dispersed settlements–still persist. These elements are now being recovered and reimagined through adaptive reuse. The result is a **post-reclamation landscape** that merges 20th Century **heritage protection with adaptation needs, enabling new recreational and cultural tourism functions,** and supporting **emerging amphibious agricultural practices** (Raffa and Brisotto, 2025, p. 36)

Scenario Vulnerabilities

- **Obsolescence of historical reclamation systems;**
- **Top-down nature restoration planning;**
- **Loss of cultural identity perceived by local communities;**
- **Degradation of land and soil in post-agricultural areas;**

Scenario Opportunities

- **Culturllay-sensitive renaturation of reclamation infrastructure;**
- **Adaptive reuse of 20th century relclamation l abandoned farm houses and rebuilding;**
- **Development of amphibious agriculture and diversified rural economies;**
- **Cultural tourism and recreational uses linked to cultural heritage landscape;**

Long-Term Adaptation Strategies

- **3.1 Make space for agriculture** through solutions such as **amphibious farming** in areas prone to waterlogging, seasonal flooding, or high salinity levels, or through **raised-bed agriculture** where soil quality is inadequate**;**
- **3.2 Regenerate soil** using **phytoremediation forests** and **wetland-based regenerative systems** for abandoned, degraded, or contaminated land, enabling long-term recovery of fertile soils and enhancing biodiversity**;**
- **3.3 Reforest using agroforestry techniques**, contributing to diversified production and enriching both landscape variety and ecological biodiversity**;**
- **3.4 Restore and redesign windbreak hedgerow networks**, considering variability in wind frequency, direction, and intensity across the entire territory**;**
- **3.5 Renaturalize drainage canals** as new **blue-green infrastructure** connecting urban areas, farmland, and the coast–while **preserving historic reclamation structures** as sites of interest**;**
- **3.6 Design and build rainwater storage basins**, at both farm and community scales, to ensure water availability during drought periods**;**
- **3.7 Restore minor access paths** between fields and urban settlements to promote **sustainable mobility** and create new **ecological connections;**

Protection and Enhancement of (Archaeological) Heritage
Scenario 4

In 2100, climate change and the adaptation strategies implemented over the preceding decades have had varied impacts on widespread cultural heritage, particularly **archaeological assets**. **Some** minor sites–either insufficiently protected or located in highly vulnerable areas–have been **irreversibly lost**. **Others**, however, have become the focus of **adaptive reuse and valorization efforts**, establishing new relationships between cultural heritage and the amphibious landscape that now defines the region. Other submerged sites remain dormant, awaiting reactivation through underwater tourism initiatives. In this new paradigm, **archaeological protection has evolved**: while acknowledging the inevitable material loss of some elements, it embraces the opportunity to redefine heritage through new forms of existence, integrated with the surrounding ecological transformations (Raffa and Brisotto, 2025, p. 36)

Scenario Vulnerabilities

- **Loss of minor or unprotected sites** due to flooding, erosion, and soil instability;
- **Material degradation** of archaeological assets caused by increased salinity, humidity, and temperature extremes;
- **Conflict between renaturation efforts and community identity**, particularly where heritage is tied to land use legacies;
- **Inadequate institutional coordination** between cultural protection and climate adaptation frameworks;

Scenario Opportunities

- **Reframing archaeological heritage within a dynamic and evolving amphibious landscape;**
- **Development of new cultural economies, such as underwater tourism and amphibious cultural parks;**
- **Integration of heritage with ecological infrastructure, creating synergies between conservation, adaptation, and landscape design;**
- **Revitalization of marginal spaces through multifunctional uses that combine memory, ecology, and public engagement;**
- **Increased visibility and educational value of archaeological sites through adaptive interpretation strategies;**

Long-Term Adaptation Strategies

- **4.1 Reframe coastal shifts** to reinterpret the relationship between archaeological heritage and the sea, balancing protection, adaptation, and layered historical narratives;
- **4.2 Archaeological buffers**: Abandoned or unproductive areas, floodplains, and renaturalized drainage canals can be designed as **threshold spaces** using **nature-based solutions** to protect archaeological sites from water excess while integrating with ecological and slow-mobility networks;
- **4.3 Amphibious archaeological parks**: Designed to "make room for water" through adaptive pathways, structures, and cooling green infrastructure that respond to floods and rising temperatures;
- **4.4 Submerged archaeological parks**: In areas highly exposed to flooding or permanent water presence, selected sites may be **reinterpreted as underwater heritage** compatible with cultural value and material resilience;
- **4.5 Vegetal reconstructions**: Vegetation is used to **enhance the legibility** of archaeological spaces by tracing paths, highlighting structures, or suggesting original spatial configurations;

Analytically, the sequence of participatory activities generated a shared, multi-scalar understanding of hydraulic and climate risks within the two territories, revealing these risks as *systemic conditions* shaped by climatic pressure, public perceptions, infrastructural rigidity, and fragmented governance. This understanding also exposed potential leverage points for adaptive transformation. However, the limited availability and uneven quality of quantitative environmental and hydraulic data–such as long-term hydrological series, subsidence measurements, and high-resolution risk modelling–constrained the integration of design exploration with robust numerical assessments.

On a methodological–operational level, the process (Raffa, 2025b) led to the formulation of an initial set of transferable adaptation guidelines derived from cross-case analysis and workshop insights (Raffa, 2025a). Conceived not as prescriptive solutions but as *operational principles*, these guidelines are intended to inform future design

02 | Metaponto 2100. Visualizzazione con strategie di adattamento (si veda Tab. 3-7) implementate, durante (sopra) e dopo (sotto) un ciclone tropicale di Cat. I, elaborazione di A. Raffa con OpenAI

Metaponto 2100. Visualisation with adaptation strategies (see Tab. 3-7) implemented during (top) and after (bottom) a Cat. I tropical-like cyclone, created with OpenAI by A. Raffa

rafforzando le capacità anticipatorie e aprendo nuovi spazi di dialogo sull'adattamento di lungo periodo. Ha inoltre valorizzato il ruolo del progetto come strumento di mediazione ed esplorativo, capace di tradurre dinamiche di rischio astratte in conoscenze spazialmente operabili. Al contempo, ha messo in luce criticità persistenti, tra cui la difficoltà di tradurre le visioni in strumenti di policy, la fragilità della continuità dei percorsi partecipativi e la scalabilità disomogenea dei metodi in contesti socio-ecologici eterogenei.

Dal punto di vista della ricerca, gli esiti consolidano la base empirica del più ampio programma di studio sull'adattamento nei 20CRL mediterranei e hanno direttamente alimentato le fasi di *research-by-design* e di *research for design*, informando lo sviluppo della metodologia operativa per l'adattamento dei 20CRL e del toolkit rivolto a ricercatori e professionisti attivi in questi contesti.

Verso un'agenda riflessiva e progettuale per l'adattamento climatico dei 20CRL

ReclaiMEDlanD[2] dimostra il potenziale del progetto come pratica riflessiva, immaginativa e partecipativa, capace di rispondere ai rischi sistemici che interessano i 20CRL. Concettualizzando il rischio non come una minaccia isolata da contenere, ma come una lente generativa attraverso cui interpretare e trasformare le configurazioni spaziali ereditate, il progetto contribuisce a un cambiamento di paradigma che può incidere anche sul piano della governance e della gestione. In linea con la nozione di «catastrofismo emancipativo» (Beck, 2014), ReclaiMEDlanD riformula la crisi climatica come un'opportunità per mettere in discussione i modelli attuali e immaginare futuri plurali, situati e culturalmente radicati, spostando il focus dalla logica del contenimento a quella della trasformazione, dai piani rigidi agli scenari adattivi. ReclaiMEDlanD mostra che l'adattamento al cambiamento

| 02

processes in analogous Mediterranean 20CRLs, and will require iterative testing across multiple contexts. A second scenario-planning workshop focused on strengthening cross-territorial learning will be conducted on the Bassa Romagna transect to maintain the comparative rationale of the research, and to validate these guidelines operationally.

At the governance level, the project fostered collaborative learning among institutions, experts, and communities, enhancing anticipatory capacities and opening new spaces for dialogue on long-term adaptation. It also leverages the role of design as a mediating and exploratory tool, translating abstract risk dynamics into spatially operable knowledge. It also revealed persistent challenges, including the difficulty of translating visions into policy instruments, the fragile continuity of participatory processes, and the uneven scalability of methods across heterogeneous socio-ecological settings.

From a research perspective, the outcomes strengthen the empirical foundation of the broader study on adaptation in Mediterranean 20CRLs, and have directly informed both the research-by-design and research-for-design phases, thus contributing to the development of an operational methodology for 20CRL adaptation, and to the creation of a toolkit for researchers and practitioners working in these contexts.

Toward a Reflexive and Design-Based Climate Adaptation Agenda for 20CRLs

ReclaiMEDlanD[2] demonstrates the potential of spatial design as a reflexive, imaginative, and participatory

climatico nei 20CRL non può essere ridotto a semplici retrofit tecnici o alla pianificazione dell'emergenza. Deve invece essere inteso come un progetto profondamente culturale, politico e spaziale –che abbraccia il rischio come condizione di trasformazione e il progetto come strumento di anticipazione collettiva. Se i paesaggi costieri di bonifica del XX secolo sono nati da un progetto di controllo razionale della natura, la loro rigenerazione nel XXI secolo dipenderà dalla nostra capacità di costruire un'agenda per l'adattamento climatico che impieghi il progetto per abitare il rischio e l'incertezza in modo critico, creativo, e collettivo.

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[2] Nel 2025, il progetto è stato esposto nel Padiglione Italia alla Biennale di Architettura di Venezia ed è stato inoltre riconosciuto da ASviS come buona pratica territoriale. Approfondimenti successivi sono stati premiati con il primo premio ex-aequo al "World Heritage and Food to Feed" Design Ideas Competition, nell'ambito del XXIII International Study Forum "Le Vie dei Mercanti", 20-21 giugno 2025, Napoli e Capri.

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practice capable of responding to the systemic risks affecting 20CRLs. By conceptualising risk not as an isolated threat to be controlled, but as a generative lens through which to read, interpret, and transform inherited spatial configurations, the project contributes to a paradigm shift that also resonates at institutional and policy levels. In line with the notion of «emancipatory catastrophism» (Beck, 2014), ReclaiMEDlanD reframes the climate crisis, and associates risks as an opportunity to challenge up-to-date models, and to envision plural, situated, and culturally grounded futures – shifting focus from containment to transformation, from rigid plans to adaptive scenarios. ReclaiMEDlanD shows that climate adaptation in 20CRLs cannot be reduced to mere technical retrofitting or emergency planning/design. Rather, it must be understood as a deeply cultural, political, and spatial project – one that embraces risk as a condition for transformation, and design as a tool for collective foresight. If 20CRLs issued from a project of rational control over nature, their regeneration in the 21st century will depend on our capacity to construct a climate adaptation agenda that employs design to inhabit risk and uncertainty in a critical, creative, and collective manner.

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[2] In 2025, the project was exhibited in the Italian Pavilion at the Venice Architecture Biennale, and was also recognised by ASviS as Territorial Best Practice. Further developments were awarded first prize ex-aequo at the "World Heritage and Food to Feed" Design Ideas Competition, as part of the 23rd International Study Forum "Le Vie dei Mercanti", held on June 20–21, 2025, in Naples and Capri.

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