TransformAr

Accelerating and upscaling transformational adaptation in Europe: demonstration of water-related innovation packages

Benchmark and policy guide

Deliverable 7.1

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EU	European Union
H2020	Horizon 2020
ICT	Information and communication technology
IFAD	International Fund for Agriculture and Development
KCS	Key Community System
LGBTQIA+	Lesbian, Gay, Bisexual, Transgender, Queer, Intersex, and Asexual.

Executive summary

The concept of Transformational Adaptation (TA) is defined in the EU Policy Brief on Transformational Adaptation (Cools et al., 2024), developed under MIP4ADAPT, and lead by TransformAr. The policy brief bundles the insights of EU experts to shed light on the concept of transformational adaptation and its characteristics and barriers to implementation while also providing some clarifying examples.

Transformational adaptation refers to "actions aiming at adapting to climate change resulting in significant changes in structure or function that go beyond adjusting existing practices." Adapting to climate change refers to responding to actual or expected climate change and its effects, including under uncertainty, aiming to reduce harm to people, socio-economic systems, and natural systems.

Coping responses, incremental adaptation or transformational adaptation are different responses to climate change which depend on their scope, depth, impact, timing and inclusivity (Cools et al., 2024).

Even though coping responses and incremental adaptation are essential, they may not be sufficient in the context of global warming and can lead to maladaptation (UNFCCC, 2024). Transformational adaptation has been identified as a response that needs to be accelerated and upscaled to face the emergency of climate change (Cools et al., 2024).

TransformAr, an EU-funded project, addresses transformational adaptation, aiming to develop, test and upscale products and services to initiate and accelerate large-scale transformational adaptation in vulnerable regions and communities across Europe. One of the tasks within TransformAr is to identify success factors and limitations to design, implement and assess transformational adaptation projects and formulate recommendations to facilitate the operationalisation of these initiatives for policymakers.

To address this issue, a global literature review was conducted to study transformational adaptation within 8 different Key Community Systems (KCS) (term to designate a sector in TransformAr) including agriculture, water, environment (biodiversity), infrastructure, urban planning, aquaculture / fisheries, health and tourism.

Twenty-four (24) case studies or projects were selected through a desk study, and a tool, which provides scorecards to assess the transformational adaptation dimension of a project. Following this, an analysis of the success factors (key element that contributes to achieving the project's objectives) and limitations (constraint that hinders the project's progress, effectiveness, or sustainability) of the project design and implementation was also completed, based on project documentation and scientific papers. The success factors and limitations were then re-categorised and prioritized.

Here are some key success factors identified for transformational adaptation projects design and implementation:

- A multi-stakeholder commitment,
- An in-depth study of the project's feasibility and clear definition of the objectives,
- A broad dissemination of key information and use of user-friendly communication materials,
- A strong coordination and project planning,
- A sustainable and long-term planning of the project.

Some limitations identified are:

- A lack of technical expertise and support,
- A lack of funding,
- Changes in context such as political changes or turnover which can negatively impact a project,
- A lack of equity (consideration for environmental, social and economic issues),
- An insufficient regulatory framework.

An analysis of the relationship between the given factors and sectors was completed to work out which success/limitation factors are most likely to determine success or failure for a specific sector.

By addressing these limitations and building on the identified success factors, transformational adaptation efforts can be more effective in fostering climate resilience and long-term sustainability.

1. Transformational adaptation

1. Definition of the concept of transformational adaptation

The concept of Transformational Adaptation (TA) is defined in the EU Policy Brief on Transformational Adaptation (Cools et al., 2024), developed under MIP4ADAPT, and lead by TransformAr. The policy brief bundles the insights of EU experts to shed light on the concept of transformational adaptation and its characteristics and barriers to implementation while also providing some clarifying examples.

Transformational adaptation refers to "actions aiming at adapting to climate change resulting in significant changes in structure or function that go beyond adjusting existing practices." Adapting to climate change refers to responding to actual or expected climate change and its effects, including under uncertainty, aiming to reduce harm to people, socio-economic systems, and natural systems.

Depending on the scope, depth, impact, timing and inclusivity, adaptation actions can be termed as a coping response (reacting to extreme weather), incremental adaptation (short term reactions to current climate risks, with short-term, often isolated benefits) or transformational adaptation (systemic, long-term approach) (Cools et al., 2024). Even though coping responses and incremental adaptation are essential to fight against climate change, these responses might not be sufficient in this context of global warming and can lead to maladaptation (UNFCCC, 2024).

On the other hand, transformational adaptation seeks to build sustainable, resilient, and flexible systems which address the root causes of current and future climate vulnerabilities, ensuring adaptability to future uncertainties (Cools et al., 2024).

As shown in Figure 1, both incremental and transformational adaptation involve adaptation actions (represented in Fig. 1 by blue squares). Incremental adaptation typically consists of short-term responses to current climate risks. While these actions may benefit some groups, they often fail to address the needs of the most vulnerable, such as elderly people, people in high-risk areas, or those from disadvantaged socio-economic backgrounds. These groups are most affected by climate change but have the least capacity to adapt, often being excluded from adaptation benefits, which reinforces existing inequalities.

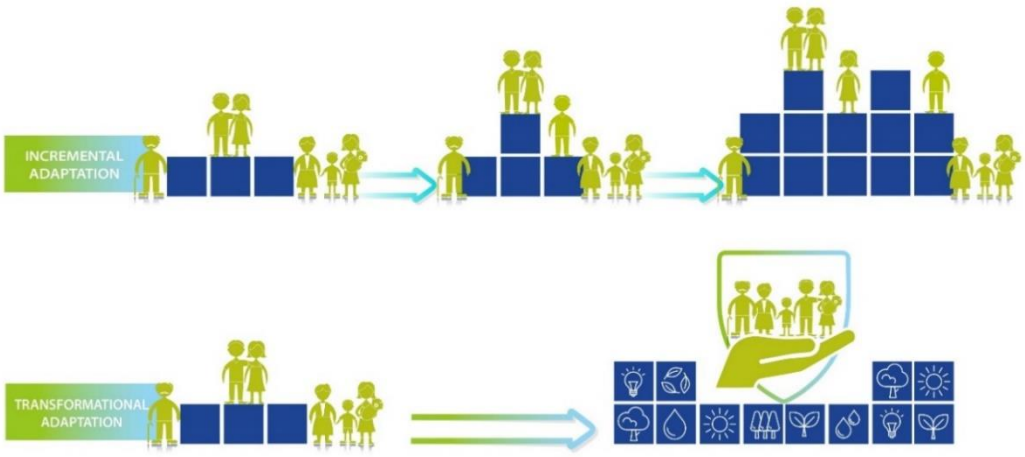

Figure 1: Incremental versus transformational adaptation (Cools et al., 2024)

Transformational adaptation is defined by the Intergovernmental Panel on Climate Change (IPCC) in their 6th assessment report (AR6) as "adaptation actions that changes the fundamental attributes of a system in anticipation of climate change and its impacts. Such adaptation actions can:

- Result in significant changes in the structure or function of the system that go beyond adjusting existing practices.
- Be adopted at a large scale, lead to new strategies in a region or resource system, transform places and potentially shift locations.
- Lead to deep and long-term societal changes that influence sustainable development (including values and world views)" (UNFCCC, 2024).

2. TransformAr

To accelerate and upscale transformational adaptation, the TransformAr project has been launched to focus on water-related innovations capable of securing systemic, large-scale, sustainable change in the water management sector ("*Accelerating and upscaling transformational adaptation in Europe: Demonstration of water-related innovation packages"* (https://transformar.eu/)).

This project was funded by the European Commission's H2020 programme for a period of 4 years (2021 - 2025) and aims to develop, test and upscale products and services to initiate and accelerate large-scale transformational adaptation in vulnerable regions and communities across Europe.

One of the objectives of the project is to structure an EU transformational adaptation community of practice by connecting and informing the scientific, institutions, policymakers and public about the innovative solutions concerning transformational adaptation in relation to the smart use of natural resources in water, agriculture, fisheries, tourism, energy use and biodiversity. One specific objective is to identify success factors, limitations and recommendations for policy makers to conduct transformational adaptation. This is the subject of this report.

2. Methodology

1. Presentation of the methodology

To identify the success factors and limitations in designing, implementing, and evaluating transformational adaptation projects, a global literature review was conducted across various sectors, referred to Key Community Systems (KCS) under TransformAr. These sectors include agriculture, water, environment, tourism, urban development, infrastructure, aquaculture & fisheries and health. Relevant projects and case studies for each sector were selected from multiple databases. A qualitative assessment was performed to verify the transformational adaptation aspect of each project or case study. Finally, success factors and limitations were extracted from the project documentation to develop recommendations.

2. Conducting a global review on transformational adaptation on the different KCS of TransformAr

This review involved examining academic research, policy reports, mainly on **google scholar** with the following key words search query:

Transformational OR transformative adaptation [KCS].

This review allowed us to identify different areas of focus (themes or solutions) which served as the foundation for the selection of case studies and projects. The level of detail on transformational adaptation varies depending on the sector being addressed.

3.1. Health

Heat waves, vector-borne diseases, air pollution and flooding are the consequences of climate change impacting human health (UNFCCC, 2024).

The UNFCCC lists different adaptation options which have a transformational adaptation potential such as (i) implementing climate-resilient health care systems through for example providing a universal health coverage dedicated to people with low income, (ii) developing infrastructures which can have an impact on health (reduction of heat-related mortality through cooler, greener cityscapes and managing water and sanitation systems) and (iii) developing the early warning systems (for natural disasters for example). Additionally, transformational adaptation within the health sector can also be about urban planning with Nature-Based Solutions in cities playing a role in reducing urban heat island effects (UNFCCC, 2024).

3.2. Agriculture

The development of diseases, the degradation of the quality of the soil and the water, the reduction of the yields and the degradation of farmers livelihood are some consequences of climate change within the agricultural sector (Réseau Action Climat, 2022).

Carter and al. (2018) defined transformative adaptation in agriculture as "intentional alterations in response to climate change–related risks that accomplish one or more of the following three goals:

- Significantly shift the geographical locations where specific types of crops and livestock and the systems that support their production, processing, marketing, and distribution take place.
- Fundamentally alter the agricultural landscape because of changes to many aspects of food production and marketing systems.
- Apply at a broad geographical scale significantly new methodologies and technologies that change the types of agricultural products produced in a particular region or production system (e.g., improved agro-processing to prevent increased spoilage due to climate-related higher temperatures, which enables production of new, value-added products)" (Carter et al., 2018).

Moreover, Vermeulen et al. (2018) provides a quantitative framework for defining transformational adaptation in agriculture under climate change, highlighting three key aspects:

- "A response to climate risks, usually in combination with other drivers (quality).
- A redistribution of at least a third in the primary factors of production (land, labor, capital) and/or the outputs and outcomes of production (the types and amounts of production and consumption of goods and services arising from multifunctional agricultural systems) (distribution),
- Within a timeframe of 25 years (timeframe)" (Vermeulen et al., 2018).

A few papers also identify more specific solutions such as Agroforestry (Rana & Moniruzzaman, 2021; Vermeulen et al., 2018; Wolz et al., 2018). Other recommended approaches promoting climate-resilient and low-emission agricultural practices are ecosystem-based approaches to support biodiversity conservation, expanding digital climate information services, mobilizing innovative financial mechanisms to attract public and private investment, strengthening farmer and consumer networks, and fostering enabling policies and institutions to support adaptation efforts (Loboguerrero et al., 2018).

3.3. Fisheries & aquaculture

Rising temperatures, acidification and deoxygenation of the oceans, consequences of climate change, affect not only fish species, but also their habitats and, via food webs, all living things at sea and on land.

Over the last few decades, the overall abundance of species has fallen sharply. At the same time, the distribution of fish populations is changing radically and their size is decreasing, while biodiversity is being eroded (Plateforme Océan et Climat, 2024).

Fisheries and aquaculture operate within the marine environment, a domain often described as less explored than outer space. Despite being in the United Nations Decade of Ocean Science for Sustainable Development, significant knowledge gaps remain regarding the impacts of climatic variables on harvested and farmed species. While transformational adaptation approaches have been practically implemented in various sectors (UNFCCC, 2024) the volume of scientific literature specifically addressing transformational adaptation to climate change in fisheries and aquaculture remains limited.

In this context, adaptation strategies have helped people or ecosystems reduce their vulnerabilities to climate change, however, they have proven insufficient in addressing severe climatic hazards (Islam et al., 2021).

Based on the limited references available and CETMAR's international and local expertise, transformational adaptation in the sector can be understood as the systemic socio-ecological changes in management, infrastructure, and governance aimed at enhancing resilience to climate change effects (ocean warming and acidification, sea-level rise, extreme weather events…).

Within the TransformAr project, five key transformational adaptation practices have been identified among others: (1) restoring and adapting coastal and shoreline ecosystems, prioritizing nature-based solutions, (2) upgrading facilities and practices to face extreme events and effects of climate change and promoting circular economy initiatives in fisheries and aquaculture, (3) improving access to updated knowledge on local climate impacts, (4) strengthening cooperation and networks to facilitate coordinated climate action, and (5) implementing early environmental warning systems and insurance schemes to protect fishermen from climate-induced losses.

3.4. Water

The water-related effects of climate change are well documented: melting snow and ice, rising sea levels, more intense and prolonged heatwaves, extreme rainfall, etc. In addition to the environmental and health impacts, climate change is likely to cause major disruption to the availability of water resources, affecting a wide range of sectors: industry, energy production, agriculture, drinking water and sanitation (EauFrance, 2025).

The literature provides different examples of options that can be seen as transformational.

For example, a large-scale coastal and riverine project that integrates novel approaches like artificial islands, strategic evacuations, and innovative funding mechanisms is considered transformational in the literature due partly to the combining engineered solutions with ecosystem-based approaches (Kates et al., 2012).

In urban areas facing severe water shortages, decentralized rainwater harvesting is emerging as a transformational adaptation strategy. Restoring coastal wetlands is another example of transformational adaptation, where natural ecosystems are used to replace or supplement traditional flood defences. Wetlands serve as buffers against storm, reducing flood risks while enhancing biodiversity. This approach not only restructures the coastline but also redefines its function as a climate adaptation tool (Framework Convention on Climate Change, 2024).

3.5. Environment (biodiversity)

Climate change adaptation has become a prominent theme in the sector of biodiversity and environmental conservation. The rapidly changing climate is affecting species and ecosystems in complex ways, posing considerable challenges for biodiversity conservation. Stein et al. (2013) identify two types of adaptation for biodiversity: proactive adaptation actions that are undertaken to prepare for anticipated climate change impacts, and reactive adaptation, in response to existing impacts. Adapting biodiversity to the changing climate means going beyond the traditional conservancy spectrum, that solely focuses on maintaining existing conditions, but not on managing change. Stein et al. (2013) group adaptation strategies for biodiversity into three basic categories: improving current conditions, by reducing anthropogenic stresses; protecting and managing large landscapes; pursuing site-specific approaches. Adaptation options for biodiversity conservation act on "lowering vulnerability by reducing other anthropogenic impacts, such as land-use change, habitat fragmentation, pollution and deforestation" (Mukherji et al., 2023).

In accordance with the definition of transformational adaptation, we analyse in the present document adaptation solutions for biodiversity that tend to have a proactive aspect to them, attempting to transform the socio-ecological system at stake into a more resilient one.

To select the case studies, we based our review on the three main categories of options for terrestrial biodiversity identified by the IPCC: (1) conservation, rehabilitation and restoration of land, (2) fire management programmes and (3) "Ecosystem-based adaptations (EbA) and NbS that restore or recreate ecosystems, build resilience and produce synergies with adaptation and mitigation in other sectors" (Mukherji et al., 2023). For each category, we looked for case studies that went further than simply reacting to an impact, without rethinking the essence and integrity of the socio-ecological system (incremental adaptation).

3.6. Infrastructure

Rising temperatures, extreme weather events, and sea level rise damage roads, bridges, and energy networks, increasing maintenance costs and disrupting essential services. Floods and heatwaves particularly threaten transport and water supply systems.

The literature on transformational adaptation in the infrastructure sector is relatively limited, partly due to infrastructure being a key element in other sectors. Strengthening the resilience of existing infrastructures is not necessarily a transformative pathway. For example, in the water sector, a transformational approach involves shifting from centralized, large-scale infrastructure (e.g., reservoirs, pipelines) to distributed, community-based systems. For coastal systems, strategic coastal retreat is identified as having the lowest risk of maladaptation compared to coastal accommodation and infrastructure options (UNFCCC, 2024).

Some solutions for transformational adaptation for infrastructures emphasize resilience attributes such as redundancy, decentralization, and diversity (Kuhl et al., 2021).

3.7. Urban planning

Rising temperatures intensify urban heat islands, increasing energy demand and health risks. More frequent floods overwhelm drainage systems and threaten coastal cities, while extreme weather events weaken infrastructure and displace vulnerable populations.

Cities are well-positioned to drive transformational adaptation due to several factors. Local and small-scale initiatives are often more innovative and likely to be transformational compared to larger-scale efforts (Kuhl et al., 2021). This potential for innovation is evident in the growing momentum of city-driven

initiatives across various scales, including networks such as C40 cities, Carbon Neutral Cities Alliance, 100 Resilient Cities, Covenant of Mayors, and WWF One Planet Cities.

Urban planning, while embedded in multiple sectors, plays a crucial role in transformational adaptation. The IPCC recognizes Nature-based Solutions (NbS) and Ecosystem-based Adaptation (EbA) as emerging adaptation options in cities. These include green spaces, ponds, wetlands, and green roofs for urban stormwater management and heat mitigation.

3.8. Tourism

Climate change alters destinations' attractiveness, with rising temperatures and extreme weather reducing viability for coastal, ski, and nature-based tourism. Biodiversity loss, water stress, and infrastructure damage further challenge the sector.

The literature provides different examples of options that can be seen as transformational. Moreover, it seems that there are not many specific transformational solutions for tourism but instead solutions within other sectors that will impact directly the tourism sector.

Broad transformational solutions are cited in the literature such as livelihood change and/or diversification, enabling voluntary relocation of communities, reshaping cities for increased disaster resilience, implementing significant policy changes that reduce vulnerability and decrease inequality (UNFCCC, 2024).

3. Identification of transformational projects and/or case studies

To identify projects and / or case studies, the following steps were followed:

4.1. Database Consultation

A review of various databases, including Climate Adapt, LIFE, European Institute of Innovation and Technology, Urban Governance Atlas, Horizon 2020, International Fund for Agriculture and Development (IFAD), etc. was carried out to identify projects or case studies.
The information found in the global literature review were used as key words to filter the projects/case studies within the databases considering the high number of projects implemented.
Case studies were sometimes found in the scientific papers and directly considered and analysed as transformational initiatives.

4.2. Criteria-Based Filtering and Selection

Projects / case studies were selected based on these criteria:

- **Level of detail:** Availability of comprehensive and detailed information about the project's objectives, implementation, and outcomes.
- **Project status:** Preference for completed projects or several years implementations to ensure outcome analysis.
- **Recency:** Focus on recent projects to ensure contemporary relevance.
- **Transformational adaptation dimension:** Emphasis on initiatives matching the characteristics of transformational adaptation.
- **Language** (English or French).

Twenty-four case studies or projects were selected following the approach outlined above. While all KCS are represented, some sectors—such as tourism or infrastructure —proved to be more challenging to

address. The selected case studies and projects primarily cover Western and Eastern Europe but also extend to developing countries (Asia and Central America).

Table 1: Transformational projects and case studies selected

Sectors	Secondary sectors	Case study / project	Scope of the document	References
Agriculture	Environment (biodiversity)	Transformative adaptation in agriculture: A case of agroforestation in Bangladesh	Bangladesh	(Rana & Moniruzzaman, 2021)
Agriculture	Environment (biodiversity)	Nicaragua: Adapting to Markets and Climate Change Project	Nicaragua	(IFAD, 2023)
Agriculture	Environment (biodiversity)	Andhra Pradesh Drought Mitigation Project	India	(IFAD, 2021)
Agriculture	Water	IRRINET: IT irrigation system for agricultural water management in Emilia-Romagna, Italy	Italy	(Climate Adapt, 2019b)
Water	Environment (biodiversity)	Transformative adaptation through nature-based solutions: a comparative case study analysis in China, Italy, and Germany	Germany	(Scolobig et al., 2023)
Water	Infrastructure	Case studies, building fire resilience using recycled water in Riba-Roja de Turia	Spain	(Adobes Golfe, 2022).
Water	Urban planning	Case studies, Development of sustainable and climate resilient urban storm water management systems for Nordic municipalities (LIFE UrbanStorm)	Estonia	(Viimi Municipality, 2021)
Environment (biodiversity)	Urban planning	Transformative adaptation through nature-based solutions: a comparative case study analysis in China, Italy, and Germany	Italy	(Scolobig et al., 2023)
Environment (biodiversity)		Large-scale Forest restoration solutions for resilience to multiple climate stressors in North Rhine-Westphalia, Germany	Germany	(ClimateAdapt, 2024)
Environment (biodiversity)		Adaptation to droughts in wetlands of Attica Region, Greece	Greece	(ClimateAdapt, 2023)

Sectors	Secondary sectors	Case study / project	Scope of the document	References
Environment (biodiversity)	Urban planning	Main Green Structure (Hoofdgroenstructuur) - Amsterdam	Netherlands	(Urban Governance Atlas, 2023)
Health		Implementation of the Heat-Health Action Plan of North Macedonia	North Macedonia	(Climate Adapt, 2021)
Health		Climate Crisis and Health: Education of health professionals for Transformative Action, Germany	Germany	(Climate Adapt, 2022a)
Health	Urban planning	Chief Heat Officers	Cities (Athens for Europe, 5 other cities worldwide)	(Myrivili, 2022)
Health	Infrastructure	New North Zealand Hospital: A resilient acute care hospital for the future, Hillerød, Denmark	Denmark	(Climate Adapt, 2022b)
Health	Urban planning	Paris OASIS Schoolyard Programme, France	Cities (Paris, then replicated in other French cities)	(Climate Adapt, 2022c)
Urban planning		EGOKI: integrating adaptation to climate change in spatial and urban planning in municipalities in Navarre	Navarre Region	(AdapteCCa, 2018)
Water	Tourism	Planned relocation of municipal campsite alongside floodplain restoration in Normandy (France)	France	(Climate Adapt, 2024)
Environment (biodiversity)	Tourism	Climate adaptation strategy for the Grimsel area in the Swiss Alps	Switzerland	(Climate Adapt, 2019a)
Water	Tourism	Revival Partnership Plan of Don river - Doncaster	United Kingdom	(InterlaceHUB, 2023)
Tourism		Diversifying activities in a ski resort	France	(Métabief Montagnes du Jura, 2017)
Fisheries & aquaculture	Environment (biodiversity)	The FutureMARES EU Project Synthesis Report. Marine Nature-based Solutions and Sustainable Seafood Harvesting in a Future Climate	Europe	(FutureMARES Consortium, 2024)

Sectors	Secondary sectors	Case study / project	Scope of the document	References
Fisheries & aquaculture		Marrisk deliverables	Spain-Portugal	(MARRISK, 2020)
Fisheries & aquaculture		Roadmap for implementation of recommendations of the ClimeFish DSF	Europe	(Chapela et al., 2020)

4. Evaluation to ensure the transformational dimension of projects / case studies

To confirm the transformational nature of the selected projects / case studies, a qualitative evaluation was conducted using a scorecard developed by the University of Antwerp within the TransformAr project (described in D6.4, Fabri et al., 2025). This scorecard has listed essential pillars and characteristics for a project to be defined as achieving transformational adaptation. The tool provides a list of criteria which can be assessed with scores ranging from 1 (scarcely compliant) to 5 (fully compliant) to find out whether the characteristics defining the project's transformational nature have been verified. The Table 2 below lists the pillars and characteristics developed in the scorecard.

Table 2: Transformational pillars and characteristics score card (Fabri et al, 2025)

Pilar	Characteristics	Description
Scope	Systemwide	Affecting an entire region, sector, ecosystem or community, rather than just a component of a system
	Multi-scale	Has an impact across multiple scales, sectors, governmental levels
	Scalable	The project can be spread and/or replicated geographically
Impacts	Beliefs/attitudes	A change in beliefs among the public and policymakers towards risk tolerance, away from status quo bias and group thinking
	Governance	The adoption of alternative policy instruments or the involvement of and interaction between different stakeholders in the planning of the project and the consideration of diverse views
Depth	Path-shifting	The system's current trajectory is altered towards a new direction or economic orientation
	Re-structuring	Reorganising existing structures, processes, or relationships to facilitate the change/improve climate resilience
	Addressing root causes	Addressing both the drivers of (climate) risk and vulnerabilities
Temporality	Persistent	Long-term change, no intention to go back to the previous state
	Long-term vision	Future climate risks are considered, not just past experienced risks
	Future benefits	The project generates benefits over time
	Dynamic	Flexibly adjusting to evolving (climatic) changes
Inclusivity	Equitable	The project benefits vulnerable groups equally, if not disproportionately

Pilar	Characteristics	Description
	Synergetic	Also contributes to climate change mitigation, besides adaptation
	SDG-aligned	The project addresses multiple of the Sustainable Development Goals

Using the available project or case study documentation, the scorecard was completed for each project, with justifications provided for each score.

3. Results

1. Analysis of success factors and limitations

1.1. Success factors

The Table 3 below presents the identified success factors (key element that contributes to achieving the project's objectives), the number of projects that mention this success factor, and a summary of the main points discussed within the project's documentation.

Table 3: Success factors

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
Multi-stakeholder commitment	19	The active involvement of a wide range of stakeholders, including national, regional, and local public authorities has been identified in the review as a key success factor to conduct a transformational adaptation project. Commitment across different economic sectors and between public institutions, private entities, research bodies, NGOs, and citizens have been identified as essential. Additionally, engaging conflicting advocacy groups is important to address diverse perspectives and build consensus. Effective stakeholder engagement should occur at various phases, from the design to the implementation and finally the assessment of the project. An early engagement is key.	(AdapteCCa, 2018; Adobes Golfe, 2022; Chapela et al., 2020; Climate Adapt, 2019b, 2021, 2022b, 2022c; ClimateAdapt, 2018, 2023, 2024; FutureMARES Consortium, 2024; IFAD, 2021, 2023; InterlaceHUB, 2023; MARRISK, 2020; Métabief Montagnes du Jura, 2017; Myrivili, 2022; Scolobig et al., 2023; Urban Governance Atlas, 2023; Viimi Municipality, 2021)
In-depth study of the project's feasibility and clear definition of the objectives	9	In-depth study of the project's feasibility and objectives definition encompasses a thorough analysis of key problems and root causes, along with a clear identification of the climate risks that need to be addressed. Pilot projects at a small scale allow to test and improve different practices before scaling up. The project design process can take several years, and flexibility is necessary to adapt to evolving conditions. Defining clear objectives and establishing a well-defined scope are essential to ensure the project's relevance. A clear need of the project shall be identified by the stakeholders.	(Chapela et al., 2020; Climate Adapt, 2021; ClimateAdapt, 2018; IFAD, 2021; MARRISK, 2020; Métabief Montagnes du Jura, 2017; Rana & Moniruzzaman, 2021; Scolobig et al., 2023; Viimi Municipality, 2021)

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
Broad dissemination of key information and use of accessible material	9	Effective communication is essential at every stage of a project, from its inception to completion. It has been identified as key to clearly explain the objectives and disseminate to the stakeholders the results but also the uncertainties. Interactive workshops are recommended to attract stakeholders and encourage participation. User friendly materials is suggested to help raise awareness and engage people. A narrative that is accessible can unite people around a common goal. The use of scientific research is important and shall be translated into accessible information for policymakers and beyond. Sharing lessons learned on the project helps in monitoring and evaluating the program and reinforcing best practices.	(Chapela et al., 2020; Climate Adapt, 2019b, 2021; ClimateAdapt, 2018; IFAD, 2021; InterlaceHUB, 2023; MARRISK, 2020; Scolobig et al., 2023; Viimi Municipality, 2021)
Strong coordination and project planning	7	Effective cooperation and support between different teams is key to success. A dedicated team to lead the project should be selected. Involving consultants, from the private sector, within the management can be valuable. The use of project management tools—such as work plans, investment plans, and expected outcomes—ensures clear direction. Clarifying roles and responsibilities is essential within the project, alongside maintaining flexibility to adapt as needed. Sharing resources across teams enhances efficiency and strengthens collaboration.	(AdapteCCa, 2018; Chapela et al., 2020; Climate Adapt, 2024; ClimateAdapt, 2018; IFAD, 2021; MARRISK, 2020; Rana & Moniruzzaman, 2021)
Sustainability and long-term viability of the project	6	A long-term commitment including a strong monitoring and evaluation seem important. To monitor the project, a set of predefined indicators ensures continuous assessment of progress and impacts.	(Adobes Golfe, 2022; IFAD, 2021; InterlaceHUB, 2023; MARRISK, 2020; Scolobig et

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
		Regular maintenance, supported by a dedicated budget, is essential to sustain the project's effectiveness over time. Periodic evaluations help refine strategies, ensuring long-term success and adaptability to evolving needs.	al., 2023; Viimi Municipality, 2021)
Access to funding	6	The successful implementation of transformational adaptation projects relies on access to funding. This funding can be diversified and can include public funding.	(Climate Adapt, 2019b, 2022b, 2024; ClimateAdapt, 2018, 2024; Rana & Moniruzzaman, 2021)
Technical support and data availability	6	The commitment of technical experts is crucial to ensure the success of the project, bringing in specialized knowledge and expertise. Local knowledge should also be integrated, enriching the process with insights that are contextually relevant and culturally informed. Regular skills assessments help identify areas for development and ensure that the team has the necessary capabilities to meet project goals. Data availability is essential for informed decision-making.	(AdapteCCa, 2018; Climate Adapt, 2021; ClimateAdapt, 2018, 2024; Métabief Montagnes du Jura, 2017; Urban Governance Atlas, 2023)
Equitable (Environmental, social and economic sustainability	5	A holistic approach, which addresses environmental, social and economic dimensions, has been identified as a key success factor. By including vulnerable groups in both the conception and implementation phases, the project fosters social equity and inclusivity. Prioritizing low-cost measures makes the initiative more accessible and scalable. Additionally, the creation of job opportunities and economic diversification contributes to long-term resilience Addressing social issues ensures that the project aligns with community needs.	(Chapela et al., 2020; IFAD, 2023; MARRISK, 2020; Rana & Moniruzzaman, 2021; Scolobig et al., 2023)

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
Participatory process	5	Using a bottom-up approach to design and implement a transformational project has been identified as a key factor of success. Co-design is a prerequisite to gain support from people. This inclusive, participatory process invites a diverse range of perspectives, ensuring that every voice is heard. Moreover, it encourages debates and discussions, fostering an environment where ideas can be shared and explored collaboratively.	(ClimateAdapt, 2018, 2023; MARRISK, 2020; Scolobig et al., 2023; Viimi Municipality, 2021)
Use of technology and digital technologies	5	Using digital tools can significantly enhance the monitoring and evaluation process, providing real-time data and insights for better decision-making. These technologies also help attract the younger generation, who are more engaged with digital platforms, encouraging their participation and involvement in the project.	(Chapela et al., 2020; Climate Adapt, 2022a; IFAD, 2021; InterlaceHUB, 2023; Rana & Moniruzzaman, 2021)
Alignment with key national and local strategies	5	The project shall be aligned with the national adaptation strategy, ensuring that it supports broader climate resilience goals. The project should be designed to comply with existing laws and regulations, guaranteeing its legitimacy and sustainability. Additionally, the initiative plays a key role in supporting ongoing reforms or assisting in the drafting of policy guidelines.	(Climate Adapt, 2022a, 2022b, 2022c; ClimateAdapt, 2023; InterlaceHUB, 2023)
Agreement on a common vision	5	A common understanding of the project concept is essential to ensure that all stakeholders are aligned from the start. Working under a shared vision fosters collaboration and a unified approach. It is important to confirm interpretations and commitment from everyone involved to ensure clarity and accountability.	(Chapela et al., 2020; ClimateAdapt, 2024; InterlaceHUB, 2023;

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
			MARRISK, 2020; Scolobig et al., 2023)
Transferability/replicability	4	A replicable approach or method which can be duplicated in other contexts, is also a success factor within transformational adaptation projects.	(Chapela et al., 2020; Climate Adapt, 2019b, 2022c; MARRISK, 2020)
Use of evidence-based scientific data	4	Integrating practical scientific knowledge into actionable steps is central to the success of the project. The extensive scientific expertise of the participating experts can play a very important role throughout the planning and implementation process, providing invaluable insights. New and robust scientific evidence, combined with innovative ideas, help providing robust information and support decision making.	(Chapela et al., 2020; ClimateAdapt, 2024; InterlaceHUB, 2023; Scolobig et al., 2023)
Innovation	3	Innovation is important within a transformational adaptation project, driving new approaches for example for governance. Innovation and research drive continuous improvement.	(ClimateAdapt, 2018; InterlaceHUB, 2023; Scolobig et al., 2023)
Natural resources availability	2	To conduct transformational adaptation projects and some specific actions, natural resources availability seems to be important (example: land availability and access for relocation).	(Adobes Golfe, 2022; Climate Adapt, 2024)
Early engagement	2	Early engagement of the stakeholders allows for a better involvement	(Adobes Golfe, 2022; ClimateAdapt, 2023)
Values	1	It is important to clearly identify, with all stakeholders, the VALUES from which the future model cannot deviate.	(Métabief Montagnes du Jura, 2017)

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
Forecasting	1	FORECASTING enables development scenarios to be defined and a future to be seen. It can be utopian, but the essential thing is to imagine a shared future together.	(Métabief Montagnes du Jura, 2017)

1.2. Limitations

The Table 4 below presents the identified limitations, the number of projects mentioning this factor and a summary of the main points discussed within the project documentation.

Table 4: Limitations

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
Lack of technical expertise and support	8	The limited operational capacity of involved services hampers project implementation. Inadequate data availability and accuracy hinder transparent decision-making. A shortage of skilled personnel for project design, procurement, and implementation poses a significant challenge. Additionally, insufficient and inaccessible policy guidelines further delay progress.	(AdapteCCa, 2018; Adobes Golfe, 2022; Climate Adapt, 2019b; ClimateAdapt, 2023; IFAD, 2021, 2023; Myrivili, 2022; Rana & Moniruzzaman, 2021)
Lack of engagement of stakeholders	6	Little interest in the project from local authorities and the lack of collaboration across different stakeholders have been identified as a strong limitation. The lack of public and private collaboration to ensure the sustainability of the project, was identified for the agricultural sector.	(Chapela et al., 2020; Climate Adapt, 2022a; ClimateAdapt, 2024; FutureMARES Consortium, 2024; IFAD, 2021; Myrivili, 2022)

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
		Virtual interactions have been considered as a constraint to conduct constructive discussions. Additionally, over-soliciting stakeholders can lead to demotivation and stakeholder fatigue, which are challenges to overcome.	
Lack of broad dissemination of key information and use of accessible materials	4	The project would likely see more success if its results and benefits were communicated more broadly. Consultations / interactions should be adjusted to the technical level of the people we talk to. Inadequate dissemination of knowledge regarding the environmental impacts for example, limits awareness and engagement of the stakeholders.	(Climate Adapt, 2022a; ClimateAdapt, 2018; Rana & Moniruzzaman, 2021; Scolobig et al., 2023)
Lack of coordination and planning of the project	3	The lack of clarity of roles and responsibilities within the project implementation has been reported as a limitation. Bureaucracy often burdens the project, slowing progress, and the lack of collaboration between stakeholders remains a significant challenge.	(Adobes Golfe, 2022; IFAD, 2021; Myrivili, 2022)
Lack of funding	3	There is a lack of clear and accessible policy guidelines on potential financing for project coupled with insufficient and limited funding, which hinders the project's progress.	(Rana & Moniruzzaman, 2021; Scolobig et al., 2023)
Changes in context (political)	3	The project's success is often dependent on political will and election outcomes. Political changes, staff turnover, and shifts in the federal government can negatively impact the effectiveness of a project. Additionally, the narrow, fragmented mandates of administrative bodies is seen as a limitation.	(ClimateAdapt, 2018; Scolobig et al., 2023; Urban Governance Atlas, 2023)

FACTORS	Number of projects mentioning this factor	DESCRIPTION	REFERENCES
Lack of equity (consideration for environmental, social and economic issues)	2	Some projects have reported the inadequate integration of marginalized communities, overlooking their involvement in key stages. Economic sustainability is only briefly mentioned, with little focus on long-term financial viability. Additionally, social justice considerations are not explicitly addressed in the design, planning, or implementation of the projects missing an important opportunity to ensure equity and fairness.	(Rana & Moniruzzaman, 2021; Scolobig et al., 2023)
Lack of sustainability and long-term viability of the project	2	A short period of time to implement a project has been reported as a limitation. The implementation period should be extended to ensure proper execution.	(IFAD, 2021, 2023)
Insufficient regulatory framework	2	The current legislation is insufficient to support some projects, and as a result, some measures have been postponed in the projects analyzed.	(Adobes Golfe, 2022; ClimateAdapt, 2023)
Lack of in-depth study of the project's feasibility and objectives	1	Lack of analysis of the root causes of different hazards and the lack of anticipation, such as implementing risk mitigation measures after the disasters occur, have been identified as a limitation.	(Scolobig et al., 2023)
Stakeholder's conflicts	1	Conflicts between authorities acting at different scales/levels, leading to opposing views and priorities for risk mitigation has been highlighted as a limitation.	(Scolobig et al., 2023)
Lack of the use of technology and digital technologies	1	A lack of utilization of technology and digital tools, hindering efficiency has been identified as a limitation. Providing the necessary information and communication technology (ICT) management tools is essential to improve the project design and implementation.	(IFAD, 2021)

2. Connections between success factors / limitations and sectors

The Table 5 below shows the potential connections between the success factors and limitations identified and the key community systems. The greener the cell is, the more the factor was mentioned in case studies related to the sector. This table helps to identify the factors that are particularly key for the success of the project and point of caution. For example, the multi-stakeholder commitment factor is coloured in green for most of the sectors, which means that it is an important success factor for those sectors. However, depending on the level of details of the documentation and the quality of the evaluation, the relations between the factors and the sectors should be treated with caution.

Table 5: Relations between the factors and the sectors

FACTORS	Health	Agriculture	Fisheries & aquaculture	Water	Environment & Biodiversity	Infrastructure	Urban planning	Tourism
SUCCESS FACTORS								
Multi-stakeholder commitment								
In-depth study of the project's feasibility and objectives definition								
Broad dissemination of key information and use of user-friendly material								
Sustainability and long-term viability of the project								
Environmental, social and economic sustainability								
Access to funding								
Participatory process								
Strong coordination and project planning								
Use of technology and digital technologies								
Alignment with key national and local strategies								
Technical support and data availability								
Agreement on a common vision								

FACTORS	Health	Agriculture	Fisheries & aquaculture	Water	Environment & Biodiversity	Infrastructure	Urban planning	Tourism
Transferability/replicability								
Use of evidence-based scientific data								
Innovation								
Natural resources availability								
Early engagement								
Values								
Fore casting								
LIMITATIONS								
Lack of technical expertise and support (data availability)								
Lack of engagement of stakeholders								
Lack of consideration for environmental, social and economic issues								
Lack of sustainability and long-term viability of the project								
Lack of broad dissemination of key information and use of user-friendly material								
Lack of coordination and project planning								
Insufficient regulatory framework								
Lack of funding								
Changes of context (political)								
Lack of in-depth study of the project's feasibility and objectives								
Stakeholders conflicts								
Lack of the use of technology and digital technologies								

4. Discussion

Despite conducting a global literature review on transformational adaptation and analysing a substantial number of case studies, our methodology presents some biases.

First, an iterative approach was used to identify case studies and projects considered to have a transformational adaptation dimension. However, not all selected projects fully align with the pillars of transformational adaptation, as meeting all necessary characteristics is challenging.

To enhance the assessment of transformational adaptation through the project scorecard, involving project owners in the evaluation process would be beneficial, as they have a more comprehensive understanding of project implementation and outcomes.

Additionally, variability in documentation quality and project assessments results in inconsistencies in identifying success factors and limitations. The qualitative nature of the assessment introduces further bias, as it relies heavily on available documentation, often emphasizing success factors while underrepresenting limitations.

The analysis of connections between sectors and factors was not considered highly relevant in this study but could be further explored. The number of case studies / projects analysed should be much higher to have a better representativity and to be able to draw better conclusions.

5. Conclusion

This report provides information and references regarding elements of success and limiting factors for the implementation of transformational adaptation projects. However, reaching transformational adaptation appears to be a challenge: meeting the necessary success factors and mitigating the limitations require substantial efforts from multiple stakeholders.

Unless, with global warming becoming increasingly evident and the urgency to adapt more pressing, activating transformational adaptation is essential. This is why it is important to share information and operationalize the insights from TransformAr - the practical recommendations identified in this report - to support policymakers and relevant stakeholders (public, private, NGOs, Citizens, etc.) to apply transformational adaptation concretely.

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Climate change impacts are here and now. The impacts on people, prosperity and planet are already pervasive but unevenly distributed, as stated in the new EU Blueprint strategy (European Commission-EC, 2019). To reduce climate-related risks, the EC and the IPCC agree that transformational adaptation is essential. The TranformAr project aims to develop and demonstrate products and services to launch and accelerate large-scale and disruptive adaptive process for transformational adaptation in vulnerable regions and communities across Europe.

impacts of climate change. Based on existing successful initiatives, the project will develop, test and demonstrate solutions and pathways, integrated in Innovation Packages, in 6 territories.

Transformational pathways, including an integrated risk assessment approach are co-developed by means of 9 Transformational Adaptive Blocks. A set of 22 tested actionable adaptive solutions are tested and demonstrated, ranging from nature-based solutions, innovative technologies, financing, insurance and governance models, awareness and behavioral change solutions.

TransformAr

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