CHAPTER 6. POLICIES, GOVERNANCE, ECONOMIC INSTRUMENTS AND FINANCING TRANSITIONS

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Key messages

Section 6.1 Governance systems and interfaces

- Mediterranean climate governance spans multiple levels and actors; polycentric arrangements improve coordination and legitimacy, but fragmentation and misalignment across scales and sectors recurrently generate gaps between plans and implementation.
- Mediterranean climate risks are strongly transboundary and cross-sectoral, spanning shared water, food and energy systems—strengthening the case for integrated, nexus-based governance, even as institutional fragmentation and uneven capacities remain key constraints.
- Transparency, integrity and accountability are fundamental to democratic governance and public trust, yet their uptake is uneven and constrained by limited administrative capacity and a concentration of data and research in the north-western Mediterranean.
- Civil participation strengthens legitimacy, knowledge integration and implementation, but requires durable institutional mechanisms for trust-building and equitable representation; decentralisation alone does not guarantee meaningful participation.
- Effective climate action depends on environmental and climate justice—fair distribution of burdens and benefits, inclusive governance, recognition of diverse and Indigenous knowledge, and provision for loss and damage, particularly for the most vulnerable groups.

Section 6.2 Economic valuation and risk assessment

- Economic tools to value ecosystems and quantify the costs of inaction are increasingly available but unevenly applied and weakly integrated with adaptation and ecosystem management, so the true stakes remain underrepresented in decisions.
- Most ecosystem-service valuations in the Mediterranean are static or accounting-based and systematically underestimate regulating, non-market and non-use values; dynamic methods that capture ecological thresholds remain rare owing to high data requirements.
- The cost of inaction is shaped by a north–south divide: advanced modelling sits where institutional capacity is weakest and vulnerability highest, leaving estimates lower-bound and not directly comparable across studies.
- Generic frameworks fail to capture Mediterranean specificities—embedded agricultural adaptation, groundwater irreversibility, transboundary marine systems, endemic biodiversity and tourism competitiveness—and frequently omit water and biodiversity losses, biasing cost estimates downward.
- Risk-financing and insurance instruments stabilise income but remain compensatory and weakly linked to ecosystem condition, risking the entrenchment of long-term vulnerability.
- Green growth is the dominant, institutionally embedded paradigm, with post-growth approaches considerably outside formal policy, producing limited engagement with absolute resource limits and distribution.

Section 6.3 Climate finance mechanisms

- Climate finance is both the principal barrier to and enabler of Mediterranean climate action; mobilising public and private capital is essential in a region warming faster than the global average.
- Adaptation finance is structurally undersupplied relative to mitigation, despite acute Mediterranean exposure to water scarcity, extreme heat, coastal erosion and desertification; private capital is deterred by long payback periods and weak revenue models.
- Financing need estimates depend on value-laden assumptions and should be interpreted with caution; finance alone is insufficient without enabling economic and institutional conditions.
- De-risking instruments—debt-for-climate swaps, parametric insurance, blue carbon and microfinance—can mobilise private capital, particularly for the southern and eastern shores.
- Aligning all financial flows with Paris Agreement goals and embedding equity principles, just transition and loss and damage are central; data fragmentation across the southern Mediterranean constrains assessment.

Section 6.4 Enabling factors

- Education, communication, participation and governance are mutually reinforcing enablers and should be strengthened systemically; investment in social and institutional capacity is as important as investment in infrastructure.
- Governance quality, legitimacy, participation and social acceptance are central determinants of adaptation effectiveness; many measures fail for lack of legitimacy rather than lack of technical solutions.
- Participatory mechanisms—living labs, communities of practice, citizen science—strengthen trust and implementation, especially across linked water-energy-food challenges, but participation often does not fully redistribute decision-making power.
- Transformative education and climate literacy—lifelong, experiential, place-based, integrating Indigenous and local knowledge—are needed to move from awareness to systems literacy; educational divides persist across the basin.
- Communication is a pillar of resilience: misinformation, disinformation, greenwashing and greenhushing erode trust, requiring media literacy, trusted local intermediaries and culturally embedded multilingual strategies.
- Environmental diplomacy and shared cultural heritage provide cooperation entry points even across strained political relations, though environmental interdependence does not remove geopolitical tension.

Section 6.5 Monitoring, evaluation, and policy effectiveness

- Monitoring, evaluation and learning should function as a continuous guidance and reflexivity system, not a static compliance exercise; policy credibility depends on whether measures deliver and are revised.
- Robust SMART indicators spanning process, outcome and equity dimensions are needed; obstacles include data availability, political resistance to transparency, and difficulty attributing outcomes to specific policies.
- Harmonisation of metrics across the basin and joint regional observatories are essential to avoid uneven baselines and fragmented evaluation.
- Scaling successful pilots requires political commitment, institutional capacity, finance and careful contextual adaptation to avoid maladaptation; technical, institutional, financial and social barriers persist.
- Evaluation must integrate equity and distributional justice, assessing who bears costs and who gains resilience, with attention to low-income households, women in agriculture, migrant communities and coastal fishers.
- Innovative tools—big data, AI, machine learning and citizen science—alongside value-for-money approaches, can strengthen evaluation and align national efforts with the Paris Agreement Global Stocktake.

Executive Summary

Chapter 6 assesses the policies, governance, economic instruments and climate finance mechanisms that enable or hinder climate and environmental action in the Mediterranean, a region warming faster than the global average. The focus centres around the institutional and economic conditions that determine whether adaptation and mitigation are effectively designed, valued, financed, implemented, and evaluated. The central message is that the Mediterranean is constrained less by an absence of policy instruments or analytical tools than by their fragmented, uneven, and weakly integrated application, compounded by persistent asymmetries between northern Mediterranean Countries (majorly European Union) and southern and eastern Mediterranean Countries. Strengthening the institutional and economic conditions under which adaptation and mitigation are designed, valued, financed, delivered and evaluated is therefore decisive for turning commitments into measurable results.

Mediterranean climate governance currently operates across international, national, regional and local levels and through many public and non-state actors, but fragmentation and uneven institutional capacity blunt its effectiveness. International agreements set direction through national pledges and periodic stocktakes, national authorities translate these into sectoral laws and greenhouse-gas inventories, and regional and local bodies carry much of the operational responsibility. Multi-level and distributed (polycentric) arrangements add flexibility, experimentation and legitimacy, yet differences in institutional and administrative capacities, financial resources recurrently open gaps between adopted plans and their delivery. Coherence and coordination across levels, aligning sectoral and territorial action and closing capacity gaps, are therefore the precondition for translating climate plans into results (*high confidence*). {6.1; 6.1.2; 6.1.3}

Transparency, integrity and accountability sustain trusted, democratic environmental governance, but their application across the basin is uneven. Instruments such as the Aarhus Convention and the Paris Agreement's enhanced transparency arrangements extend access to information and reporting, yet their effect is limited by gaps in administrative capacity, civil-service training and political will. A pronounced concentration of data and research in the north-western Mediterranean further renders climate risk in the southern and eastern basin comparatively poorly documented, weakening a consistent, basin-wide picture. Broadening open, comparable information and reporting, especially in under-covered areas, is therefore needed to build public trust and a shared evidence base for action (*high confidence).* {6.1.4.1}

Equity and justice are decisive conditions for effective and durable climate action rather than secondary considerations. They span distributive justice in the fair sharing of burdens and benefits, procedural justice through inclusive and participatory decision-making, recognition of Indigenous and local knowledge, and restorative justice for loss and damage, including non-economic losses such as cultural heritage. These dimensions matter most for the groups least responsible for yet most exposed to climate change, among them low-income households, the elderly, children, smallholder farmers and displaced communities. Embedding these principles in policy design, and providing dedicated means to address loss and damage, is therefore essential to legitimacy and to protecting the most vulnerable (*high confidence*). {6.1.4.2; 6.1.3.2}

Current national climate pledges across the basin fall collectively short of the 1.5°C goal of the Paris Agreement, with ambition varying markedly between countries. On present trajectories the region would consume most of its equitable emissions budget well before mid-century, narrowing the room for an orderly transition. Meeting climate goals implies redirecting environmentally harmful subsidies toward green economic and financial instruments, but such reforms carry uneven social costs that fall hardest on lower-income southern and eastern economies with limited fiscal space. A just transition using gradual, carefully sequenced measures such as phased carbon pricing with compensation is therefore needed to reconcile climate ambition with social equity (*medium confidence*). {6.1.4.2}

The economic value of Mediterranean ecosystems is consistently understated, weakening the case for protecting them {6.2}. Most regional valuations rely on static, market- or accounting-based methods that capture provisioning uses while underrepresenting regulating and cultural services such as pollination, water regulation and coastal protection. Dynamic and production-based approaches that reflect ecological thresholds and rising scarcity, which can raise estimated values substantially as ecosystems degrade, remain rare because of their heavy data requirements. Mainstreaming fuller, dynamic valuation into planning and investment decisions is therefore needed to reflect the true contribution of nature to resilience (*high confidence*). {6.2.1}

The costs of inaction are considerable but under-measured, especially on the southern and eastern shores. The most advanced modelling sits where data and institutional capacity are weakest and vulnerability highest, so existing estimates are lower-bound and not directly comparable across studies. Even so, European Union adaptation needs could rise from about €40 billion to €175–200 billion per year as warming increases, coastal flood damages from €1–2 billion to €20–40 billion per year by 2100 without adaptation, and several southern economies could lose 2–6 % of gross domestic product because of water scarcity by mid-century, while slow-onset losses to biodiversity and marine systems remain majorly outside

the figures. Shared methods and comparable data across the basin are therefore needed to make the case for early action visible where exposure is greatest (*medium confidence*). {6.2.2}

Insurance and risk-financing instruments cushion short-term losses and serve as adaptation measures, at least in the short term, but do little to reduce the underlying drivers of vulnerability. Mature, significantly compensatory schemes operate in EU countries, while index-based, parametric and sovereign instruments, often donor-supported, are expanding in North Africa to cover drought risk. Across both settings, payouts are triggered by realized losses and remain weakly linked to the condition of soils, water and ecosystems, and persistent basis risk limits the reliability of index products in heterogeneous landscapes. Tying premiums, eligibility and pay-outs to ecosystem conditions and risk reduction is therefore needed so that these instruments lower long-term vulnerability rather than mask it (*high confidence*). {6.2.3}

Trade integration exposes the Mediterranean to both physical and transition risks, with the burden falling unevenly on the southern shore. Climate-sensitive, water-dependent agriculture is increasingly vulnerable to rising temperatures and water stress, eroding the comparative advantage of several southern exporters. At the same time, the EU's carbon border tariff (the Carbon Border Adjustment Mechanism) weighs disproportionately on southern Mediterranean exporters, with Egypt and Tunisia the most exposed, while environmental provisions in regional trade agreements remain few and frequently unenforceable. Mainstreaming enforceable environmental provisions, and pairing carbon-tariff adjustment with financial and technical support for exposed exporters, is therefore needed to prevent trade rules from widening regional inequalities (*medium confidence*). {6.2.4}

Regional sustainability strategies remain anchored in "green growth', delivering efficiency gains without transformative changes. Consequently, efficiency gains in water, energy and urban systems are frequently offset by rebound effects and rising demand, leaving absolute resource use and distribution under-addressed, a pattern of fragmentation without transition. Circular economy and decoupling operate as enabling frameworks within this paradigm, while post-growth and degrowth approaches stay considerably confined to academic and civil-society debate rather than formal policy. A sequenced strategy that moves beyond incremental efficiency toward explicit treatment of resource limits, demand and equity is therefore central to genuine transformation (*medium confidence*). {6.2.5; 6.2.6}

Climate finance is at once the principal barrier to and enabler of Mediterranean climate action, and adaptation is the weaker link {6.3}. Despite acute exposure to water scarcity, extreme heat, coastal erosion and desertification, finance for adaptation is structurally undersupplied relative to mitigation across the basin. Private investment in adaptation is deterred by long payback periods, diffuse benefits and weak direct revenue, leaving many resilience needs dependent on constrained public budgets and external support. Closing the adaptation finance gap therefore depends on instruments and public policies that make resilience investable and shift it from a residual to a core financing priority (*medium confidence*). {6.3.3}

Financing needs are major and highly uncertain, and capital alone cannot deliver results. Estimates hinge on value-laden assumptions and demand scenarios, so they should guide rather than dictate policy, and effective mobilisation depends on enabling economic and institutional conditions. Risk-sharing and innovative instruments, such as blended finance, guarantees, concessional loans, green and resilience bonds, and debt-for-climate swaps, together with equity principles such as common but differentiated responsibilities, just transition and loss and damage, can channel capital toward the southern and eastern shores. Pairing such instruments with credible enabling environments and transparent tracking is therefore essential to move from pledged to deployed finance (*low to medium confidence*). {6.3.4; 6.3.5}

The success of adaptation turns on governance quality, institutional legitimacy, participation and social acceptance as much as on technology {6.4}. Measures that are technically sound frequently fail when they are perceived as imposed, unfair or disconnected from local livelihoods, values and identities. Legitimacy rests not only on formal rules but also on normative acceptance that a measure is the right thing to do and on confidence that it can solve the problem without jeopardising local economies. Designing policies for legitimacy and local fit, through transparent and inclusive processes, is therefore a precondition for effective and lasting implementation (*high confidence*). {6.4.3}

Participatory and deliberative mechanisms strengthen trust, social learning and implementation, yet have to be strengthened to shift real decision-making power. Local living labs, citizen science and multi-stakeholder platforms have improved the design and uptake of measures, particularly across linked water, energy, food and ecosystem challenges where trade-offs must be made explicit and negotiated and whenever possible agreed upon based on robust and transparent decision-making processes. In practice, however, participation is often institutionalised as consultation while authority over strategic choices (land use, expansive infrastructure and long-term resource allocation) stays with incumbent planning and investment systems. Moving from consultation to genuine co-decision is therefore needed for participation to drive the direction of transformation rather than only smooth delivery (*high confidence*). {6.4.3; 6.4.1}

Climate literacy, lifelong and place-based education, and trustworthy communication are pillars of resilience, now tested by a rising tide of misinformation. Education is shifting from awareness toward systems literacy and the integration of scientific with local and Indigenous knowledge, while field-based and continuous learning help ground adaptation in territorial realities. At the same time, misinformation, disinformation and greenwashing erode trust and stall action, and one-size-fits-all messaging fails across the region's diverse languages and cultures. Investing in media literacy, trusted local intermediaries and culturally grounded, multilingual communication is therefore essential to sustain informed public engagement (*medium confidence*). {6.4.1; 6.4.2}

Shared environmental challenges and cultural heritage open practical entry points for cooperation, even where political relations are strained. Common climate pressures generate functional interdependence that has given rise to flexible, often informal "soft spaces' of cooperation among states, regions and cities. Cultural assets, such as the Mediterranean diet, internationally designated heritage sites used as adaptation laboratories, and regional networks provide positive, identity-based framings that can mobilise joint action, although environmental interdependence does not by itself dissolve geopolitical tension. Leveraging these connections through subnational and cultural diplomacy can extend cooperation where formal state-level channels stall (*medium confidence*). {6.4.4}

Keeping policies effective under rapid change requires monitoring, evaluation and learning to operate as a continuous guidance system rather than a static compliance exercise {6.5}. Impact chains, storylines and retrospective evaluations can trace how resources translate into outcomes and reveal where funding fails to deliver. Documented mismatches between adaptation investment and observed results, particularly in water and agriculture, show that spending does not automatically reduce vulnerability, and that retroactive policy reversals can undermine confidence and long-term effectiveness. Embedding ongoing, learning-oriented evaluation and reflexivity is therefore needed to redirect resources toward what demonstrably works (*medium confidence*). {6.5.1}

Credible evaluation depends on robust, comparable indicators and shared monitoring infrastructure the Mediterranean basin currently lacks. Recent agreements on the Global Goal on adaptation and also with the NDCs and transparency framework contribute to creating a monitoring framework. Indicators spanning process, outcome and equity dimensions, together with harmonised metrics and joint regional observatories, should be developed and adjusted to the needs and specificities of the Mediterranean region to overcome uneven baselines between the northern and southern shores. Progress is constrained by limited data availability and accuracy, political resistance to transparency, and the difficulty of attributing observed outcomes to specific policies. Recent evolution in both attribution science and earth observation is helping to advance. Investing in harmonised indicators and shared observatories is therefore foundational to comparability, accountability and mutual learning across countries (*high confidence)*. {6.5.2}

Evaluation that overlooks who gains and who pays risks entrenching inequality even where measures appear technically effective. Distributional analysis must trace how costs and resilience benefits are shared across society, with particular attention to low-income households, women in agriculture, migrant communities and coastal fishers as well as key economic sectors in the context of just transition and just resilience approached. This is key for groups and sectors that often bear disproportionate climate and adjustment costs while having least influence over decisions, and/or where the economy is highly

dependent on, so aggregate metrics are needed to be able to assess potential regressive outcomes. Making distributional justice an explicit evaluation criterion is therefore necessary to safeguard fairness and social legitimacy (*medium confidence*). {6.5.4}

New data tools and innovative valuation methods can sharpen evaluation and connect national efforts to global goals. Remote sensing and earth observation, big data and artificial intelligence, and citizen science expand the evidence base for tracking land-use change, drought, biodiversity and climate impacts in near real time. Innovative approaches and cost–benefit and cost-effectiveness analysis help compare options and demonstrate the returns to early action. Deploying these tools, while ensuring data quality and accessibility, can therefore strengthen evaluation and align Mediterranean action with the global stocktake under the Paris Agreement (*medium confidence*). {6.5.5; 6.5.7}

6.1 Governance systems and interfaces

6.1.1 Governance: conceptual foundations and background considerations

Governance has emerged as one of the most significant concepts in contemporary political, economic, and administrative studies, representing a fundamental framework through which societies organise authority, manage resources, formulate policies, and pursue sustainable development. Governance encompasses the processes, institutions, and mechanisms through which public and private actors interact to achieve collective objectives and promote societal well-being.

From a general perspective, governance refers to the continuous process through which authority is exercised in managing the affairs of a state and regulating social, economic, and political activities. It provides the institutional framework necessary for maintaining stability, peace, and order under the rule of law while supporting sustainable development for present and future generations. Through the formulation and implementation of policies, governance seeks to create favourable conditions for economic growth, social cohesion, environmental sustainability, and improved quality of life for citizens.

Governance is closely associated with the exercise of political, economic, and administrative authority. It encompasses the systems and institutions through which power is distributed, public resources are managed, and decisions are formulated and implemented. In this regard, governance represents the manner in which power is exercised in managing a country's social and economic resources for development (Frey 2008). Similarly, the World Bank defines governance as 'the manner in which power is exercised in the management of a country's economic and social resources' (World Bank, 1990, pp5–7).

In its broadest sense, governance comprises three interconnected dimensions. The first concerns the nature of the political regime, whether democratic or authoritarian, parliamentary or presidential, civilian or military (Furio 2017, p17). The second relates to the processes through which authority is exercised in managing economic and social resources, while the third concerns the capacity of governments to formulate, implement, and enforce policies and perform governmental functions effectively (World Bank et al., 1994: 58).

International organisations have contributed significantly to the conceptualisation of governance. The Organisation for Economic Co-operation and Development (OECD) views governance as the exercise of political authority and control in society through relationships that facilitate the management of resources for social and economic development (Keping 2018: 1–8). The OECD identifies legitimacy, accountability, governmental competence, policy effectiveness, respect for human rights, and adherence to the rule of law as key dimensions of governance (Srivastava 2009, p2). Likewise, UNESCO defines governance as a process through which the interests and aspirations of citizens are articulated, regulated, and integrated into collective decision-making processes aimed at achieving social and economic development and promoting the common good (Sahni and Vayunandan 2010, p99). This perspective emphasises citizen participation and the transformation of individuals into active contributors to societal development.

Contemporary governance extends beyond the traditional functions of government and involves a broad network of interactions among public institutions, private organisations, civil society actors, and citizens. Governance processes increasingly rely on collaboration, coordination, and participation among multiple

stakeholders operating at different institutional and territorial levels. Such interactions facilitate the exchange of knowledge and ideas, the coordination of actions, and the development of collective solutions to increasingly complex societal challenges.

The growing academic interest in governance has generated numerous theoretical approaches aimed at explaining how governance systems are conceived, organised, transformed, and evaluated over time. These theories contribute to understanding the roles of different public, private, and civil society actors, the mechanisms through which decisions are made, and the factors that influence governance effectiveness. They also help explain governance failures, institutional weaknesses, and opportunities for innovation, democratisation, and policy improvement. Collectively, these perspectives provide valuable analytical tools for examining governance structures and identifying pathways toward more effective and sustainable governance systems.

A central component of contemporary governance is the concept of good governance. Good governance is generally characterised by transparency, accountability, participation, responsiveness, effectiveness, efficiency, equity, and adherence to the rule of law. It requires democratic institutions capable of exercising authority responsibly while ensuring that decision-making processes remain transparent and responsive to citizens' needs. Furthermore, good governance depends upon institutional mechanisms designed to prevent corruption, strengthen accountability, protect fundamental rights, and promote public trust.

The implementation of good governance requires active collaboration between governments, civil society organisations, community groups, and private-sector actors. Such cooperation contributes to the efficient design and implementation of public policies while strengthening institutional capacities and promoting long-term societal resilience. In this context, governance must incorporate both formal and informal institutions, support legal and regulatory reforms, encourage decentralisation, and empower local communities to participate meaningfully in public affairs.

Numerous international institutions characterise good governance through effective checks and balances, independent judicial systems, transparent decision-making processes, accountable public administration, and professional public services. These elements are considered essential for ensuring legitimacy, maintaining public trust, and promoting sustainable development. Moreover, governance quality has become an important determinant of economic development, particularly in developing countries where international organisations such as the International Monetary Fund and the World Bank have frequently associated development assistance with governance reforms aimed at improving institutional effectiveness and accountability.

In recent decades, globalisation, privatisation, technological innovation, and the liberalisation of markets have significantly transformed governance systems worldwide. These developments have altered relationships between states, markets, and citizens, expanding both the scope and complexity of governance processes. The transition from welfare-state models toward more market-oriented arrangements has increased the influence of private actors in public decision-making and reinforced the need for governance frameworks capable of balancing public interests with economic efficiency.

In response to these transformations, contemporary governance increasingly emphasises strategic planning, oversight, risk management, and institutional adaptability. At both national and regional levels, governance plays a fundamental role in decision-making, strategic planning, and oversight. It provides the mechanisms through which critical decisions are aligned with strategic objectives, initiatives are implemented effectively, and performance is monitored to ensure compliance with legal, ethical, and organisational standards.

Recent governance debates have also highlighted the growing importance of innovation, digitalisation, and responsible technological development. An OECD report emphasises the need for governance approaches focused on binding legislation, standardisation, ethics by design, corporate self-governance, and participatory mechanisms to support innovation and digital transformation while addressing their broader societal implications.

Ultimately, governance represents a dynamic and evolving framework through which societies organise collective action, exercise authority, and pursue development objectives. Integrating principles of participation, accountability, transparency, effectiveness, and sustainability, into governance serves as a critical mechanism for addressing contemporary challenges and promoting the long-term well-being of society. As global challenges become increasingly interconnected and complex, the importance of effective governance systems continues to grow, reinforcing their central role in fostering stability, development, resilience, and sustainable progress.

6.1.2 Governance design and the role of SPI

6.1.2.1 Multilevel governance

Multi-level governance is a concept developed at several levels and is used as a reflection and an emphasis on the structure and manner in which power at the state level is functionally distributed vertically between levels of government and horizontally between several quasi-governmental and non-governmental organisations and actors. (Cairney et al. 2019). This distribution is seen to be based on clear criteria for the development of world states, in the sense that they are built on multiple levels of government and that they encompass multiple other organisations with common interests in the scope of policy decisions and outcomes.

International governance is grounded in the form of constructs that are based on principles that are based on multiple levels. Multi-level governance can be different from multi-level governance, which occurs when different levels of government divide or transfer responsibility between them. While multi-level governance analyses the relationship between different state levels and the interaction with different types of actors. (Schiller 2018). Local governance of immigrant integration in Europe: the state of art and a conceptual model for future research.)

The text of the provisions of the 'Treaty on the Functioning of the European Union' (TFEU), also known as the Treaty of Lisbon, reflects a relevant step towards a recognition of the institutional values of multi-level governance in the functioning of the European Union (EU). It strengthens the powers and influence of local and regional authorities in the Community decision-making process, granting roles to national and regional parliaments, the Committee of the Regions and enshrines the territorial dimension of the European Union, in particular territorial cohesion, as part of the European integration process. The Committee of the Regions has established a system for monitoring compliance with subsidiarity throughout the process of developing European Union policies and legislation. (Committee of the Regions: Subsidiarity Monitoring Network'. cor.europa.eu. Committee of the Regions. Archived from the original on 6 September 2014. Retrieved 19 August 2014).

The EU can be characterised by a complex mix of intergovernmental cooperation and collaboration between sovereign states, codified by a succession of major treaties negotiated, agreed and signed by the Member States. These treaties reflect the main legal basis conceived on a broad and complex process of supranational integration, as they include regulations that impose the obligation of their implementation.

Multilevel governance within the EU requires compliance with the principle of subsidiarity which regulates provisions on the scope of competences, sharing of responsibilities and cooperation between the different levels of governance: the EU, the Member States, as well as regional and local authorities. At a theoretical level, this principal places decisions as close as possible to citizens and assures them that action at EU level is justified based on the possibilities available at national, regional or local level. (Committee of the Regions. 'Multilevel governance: building Europe in partnership'. cor.europa.eu. Committee of the Regions. Archived from the original on 20 August 2014. Retrieved 19 August 2025). In practice, however, it is observed that multilevel governance within the EU is based on participation and effective coordination between all levels of government, both in the decision-making process and in the implementation and evaluation of European policies.

The mix of joint decisions at European level, based on a wide range of policy areas, results in a strong interconnection of the national policy levels of the Member States with the European policy level. This

interconnection reflects a fundamental principle of the theory of multi-level governance. The theory of multi-level governance describes the EU as a pyramidal political system based on interconnected institutions that operate at multiple levels and have unique political characteristics. The EU is the European construct that operates under a pyramidal political system (European Commission, European Council and European Parliament), which contains a national dimension and a regional dimension. These dimensions influence and relate to each other in two ways: primarily between different vertical governance dimensions and secondarily with other relevant actors within the same horizontal dimension.

In the EU, studies and research have shown that 90% of local and regional authorities currently have significant competences in relevant sectors such as, economic development, transport, social policies, research, education, environment, spatial planning and public services. These local and regional authorities implement approximately 75% of EU legislation and contribute to ensuring and maintaining the exercise of the principle of democracy and European citizenship. The special rights and competences for regions, cities and communities should allow the drawing up and establishment of basic principles that ensure the preservation and maintenance of the value of diversity of governance, both at local and regional level.

In the context of the transformations generated by the institutional design of the EU, the current governance trend is outlined as a set of limitations on the margin of political discretion, with the application of major principles for the purpose of using strict rules in order to reduce the discretionary exercise of powers by the institutions, so as to avoid as much as possible their arbitrary use. The use of these principles has generated an extremely provocative effect at the European level, that of not avoiding the arbitrary use of political powers, but of ensuring and maintaining political responsibility and participation outside the decision-making process. According to Laruffa, it is found that: ‘it is quite clear that such a model of governance, which is achieved only through rules, without any role for a democratic policy-making process, imposes a de facto limit on the political rights of European citizens with the achievement of a control exercised by rules over European citizens, rather than a control of European citizens over rules and policies.’ (Laruffa 2014).

The reasoning of these theories establishes that in the traditional relations of the EU with the Member States, the concept of multi-level governance of the EU reflects and consolidates values based more on regional and transnational cooperation. Broadly speaking, this concept also encompasses the participation of non-state actors, such as, economic and social partners and civil society, in the decision-making process at all levels of governance taking over both the vertical and horizontal dimensions of multi-level governance.

It can be noted that the need for multi-level governance has emerged and been outlined more in European countries, and public policies in this field and academic research have dealt with the distribution of authority away from central states in Latin America, Asia and North America, but, lately, decentralisation has also included countries in: Latin America and Asia (Smoke et al. 2006; Bird and Vaillancourt 2008; Eaton 2008; Bertrand and Laliberte 2010; Falleti 2010;)

The responsibility and distribution of authority above the national state has gained scope and value especially in the EU, but a significant number of regional intergovernmental organisations work together on vast policy areas, starting from migration and climate change to terrorism and which are gaining and acquiring more and more cross-border interdependence, while stimulating regional organisation in many parts of the world.

For the global climate protection field, the Cities for Climate Protection (CCP) Program is a relevant example of multi-level governance of climate change. Roles and responsibilities are evenly distributed across different levels of governance, from state to non-state actors (Betsill and Bulkeley 2006). The program includes 40 major cities around the world (the Cities Climate Leadership Group) and local governments that work together in an appropriate and functional manner based on effective cooperation with national governments. However, as an exception, the program regulations provide the opportunity and possibility for local governments to modify, where appropriate, the implementation positions of policies, guidelines and regulations to compensate for urban climate change, which can generate situations of a controversial nature for the national governments concerned. (Betsill et al. 2006).

The analysis carried out shows that the program grants a freedom to change the positions of policy implementation, in the sense that, although climate change in cities can be addressed and governed at local, regional, national and international levels, these do not always respect an ordered hierarchy.

In conclusion, multi-level governance can be achieved through criteria related to increasing the democratic efficiency of a rule of law, by ensuring climate protection, economic interdependence and security at international, regional and local levels through the creation of agreed standards for the implementation and execution of policies in which cooperating states jointly manage their environmental, economic, industrial and safety policies by delegating certain decision-making processes to the higher level with the clear and objective establishment of commitments that allow and ensure the generation of efficiency gains through which all actors involved benefit from positive and lasting results.

6.1.2.2 Polycentric governance

The existing literature defines polycentric governance in the sense developed by the Bloomington School of Political Economy, but in general terms, polycentric governance allows and ensures the reunion of multiple actors involved in the provision and consumption of collective goods by addressing the interaction between multiple individual and collective actors, public, private and civil society, who are interdependent and autonomous and who operate at and between different levels.

Academic research in the field emphasises the importance of polycentric governance, which focuses in particular on the study of how order and coherence result from these interactions and how they behave in relation to their mode of organisation in terms of other performance criteria, such as, accountability, effectiveness, equity and sustainability. The methodology and techniques used from the perspective of polycentric governance refer overall to institutional processes, in which the concept of power is approached as the ability to shape and favourably influence governing institutions, through the lens of legitimisation and reporting to citizens and consumers, but over time, it has been observed that this approach is not efficient and does not focus on non-institutionalised policies.

Starting from the interpretation given to the concept by Vincent Ostrom and his colleagues, it has been observed that the analysis of the polycentric phenomenon refers to several decision-making centres that are formally independent of each other, but which function independently or, on the contrary, which essentially constitute an interdependent system of relationships. (Ostrom et al. 1961, p831).

This interpretation, although it has undergone many interpretations over time, leads us to conclude that polycentric governance does not follow the study of monocentric governance, from the perspective of top-down governance approaches in which outcomes are determined by a single decision-making centre, in which a single individual or collective actor decides how to provide public collective goods or common resources to a country or region.

Therefore, the study of polycentric governance highlights how decision centres relate to each other and follow how these interactions determine coordination and cooperation through the exchange of information, data, mutual adaptation and the creation of predictable patterns of behaviour between actors, as opposed to division, or irregular interactions. For example, an ideal type of polycentric governance system for water resources would require an appropriate and well-determined interaction between consumers and local, regional and national authorities to deliver, produce and finance technological interventions (where appropriate) to develop knowledge and ideas and to implement and enforce appropriate political and organisational measures for this area.

Thiel and Moser identify and highlight the fundamental conditions that influence the performance of polycentric governance, through the typology of three factors that generally refer to the characteristics of the community, the characteristics of social problems and the general fundamental principles of the rule of law (Thiel and Moser 2018; Thiel and Moser-Priewich 2019).

Considering the general fundamental conditions that influence polycentric governance, the characteristics of the community relate to the threshold of diversity among the members of the collective, in relation to the values and social and economic characteristics of a country or a region.

Therefore, in the context of the implementation of polycentric governance, it is observed whether a collective undertakes, for example, measures and provides support in actions for climate protection and in the protection of water resources through the adequate and efficient management of watersheds, a collective that includes actors with similar or even diverse inclinations in its composition. It is also noted that the diverse spectrum of demands for collective goods and services, from a community or region, or state influences both positively and negatively its general organisation. It is also noted that the supply at local, regional and national levels with collective goods can be negatively influenced or even endangered if the capacities to pay for them vary and are not constant within the population involved.

In practice, however, it is noted that most of the time, situations arise in which actors with different characteristics can also prioritize different performance criteria, such as, sustainability, effectiveness, equity, resilience and political representation. (Aligica and Tarko 2012).

Another representation of the various typologies of actors that can shape the polycentric governance of a collective good is the one that refers, for example, to the water quality in a river delta, in different and complex ways, as is the case of urban populations, rural populations, ecologists and even farmers. However, it is found that the diversity of community characteristics is relevant for the results of polycentric governance, and academic research undertaken has not found a clear and efficient way to focus on the desired effects.

The general rules of polycentric governance conceptualize the formal independence of decision centres, as well as their capacities to influence and determine the decisions and the available options that each decision centre has in relation to other decision centres, either through contractual relationships, hierarchical relationships, competitive relationships or even through collaborative and cooperative relationships. However, it is noted that there are mixes of contractual, hierarchical, competitive and cooperative arrangements in this area (Thompson 1991; Pahl-Wostl et al. 2020).

Post-growth studies and research on polycentric governance illustrate a varied and diverse range of concerns that could be grouped in the sense of adapting the scale of the social system to the carrying capacity of the ecosystem either by biophysical deterioration generated by establishing and maintaining ordinary activity, or by limiting the intervention of political will in the context of establishing a high degree of equality in the support and support process that would result in ensuring adequate, sustainable living conditions and well-being for all citizens of the planet.

It is worth noting that most authors are focused on concerns, often related to the policies of economic transition (Kallis et al. 2025), such as, economic growth, steady-state economics, environmental economics, regenerative economics and other schools of thought with similar concerns. There is, however, also a consensus regarding the assurance and maintenance of democratic principles, in relation to the condition of the existence of demands for the expansion of citizens' participation in the construction and functioning of the rule of law in terms of the implementation of good governance based on functional autonomy. For example, the followers of economic degrowth tend to admit that local levels are more suitable and adequate for societal transformation, since they contain more efficient versions of democracy and are easier to exercise in the rule of law. In addition, small-scale political systems with substantial and meaningful powers, which give local communities control over immediate resources, allow citizens to design, implement, protect and govern their projects.

However, it is noted that social and ecological problems arise at different levels, starting from the local scale and reaching the global scale, and the division into jurisdictions at a limited scale can influence and hinder the process of effective organisation and coordination at a higher scale, even if the vast majority of authors of the decline of the economy argue and declare that local structures are the preferred themes for politics and call for the development of regulations that contain bottom-up mechanisms and levers to design and develop vertical policies focused on the nation-state.

This situation illustrates a potential theoretical underdevelopment that can be approached and analysed through a perspective based on polycentrism reasoning in which polycentric governance aspires to have a role in reconciling large-scale coordination with small-scale autonomy, while providing democratic

mechanisms and levers for decision-making. For this theory, it can also operate as a missing link in which post-growth ensures the drafting of proposals and initiatives focused on compatibility with small-scale autonomy. The essential aspects of a polycentric approach to post-growth transformation remain insufficiently analysed and developed, although there is a recognition of the potential of polycentric governance (Latouche 2009; Bauwens and Mertens 2017; Savini 2021), but which most often led to a lack of in-depth analysis of its structure, implementation and long-term viability.

Critical gaps often include understanding how such systems can be conceptualized, constructed, established, and maintained in relation to how they reconcile local autonomy with broad coordination, institutional frameworks that support their functionality in the context of defining the role of the rule of law. Research on polycentric governance must address and focus on a greater diversity of decision-making sites that determine polycentric governance and its performance, in a system of approaching structures in which neglected forms are exercised, and last but not least, to analyse the sphere and domain in which actors are marginalised in the context of providing collective goods related to a thinking and a political will that encourages ecology and the well-being of citizens.

6.1.2.3 Transboundary governance

Climate change policy provides a good example of transboundary governance. Climate governance is primarily structured through cooperation among sovereign states and international institutions. The main tools at this level are international agreements and cooperative frameworks, most notably the Paris Agreement (2015), which establishes a system of nationally determined contributions (NDCs) and periodic global stocktakes (Dencer- Brown et al. 2022; Perera et al. 2024). Additional tools include climate finance mechanisms, such as global funds supporting mitigation and adaptation projects, and knowledge-sharing platforms that facilitate the exchange of best practices across countries (see Section 6.2). While enforcement capacity at this level is relatively limited, its strength lies in coordination, agenda-setting, and norm diffusion, which guide national policy development.

Moving to the national level, governments act as the central link between international commitments and sub-national implementation. National authorities—including ministries, parliaments, and regulatory agencies—are responsible for translating global agreements into domestic policy frameworks. Their functions are broad and encompass the design of national climate strategies, the establishment of emissions reduction targets, and the development of sectoral policies in areas such as energy, transportation, agriculture, and industry. National governments also regulate performance through standards (e.g. building codes, appliance efficiency requirements), allocate funding for infrastructure and technological innovation, and coordinate across different policy sectors.

A critical function at this level is the development of national greenhouse gas inventories, which provide the empirical basis for understanding emissions trends and identifying mitigation opportunities (EU Regulation 2018/1999). National authorities are also responsible for conducting risk assessments related to climate impacts and defining adaptation strategies accordingly (COM/2021/82 final). Monitoring and evaluation systems are established to track policy effectiveness and ensure accountability. Furthermore, national governments play a supportive role toward sub-national actors by providing guidance, data, and financial resources (Purushotham and Thompson 2026).

The tools available at the national level are diverse and include legislative instruments, economic mechanisms, and planning frameworks. Climate laws and regulatory standards form the backbone of policy implementation, while market-based instruments such as carbon taxes or emissions trading schemes incentivize behavioural change. Public investment in infrastructure—such as renewable energy systems, transport networks, and water management facilities—is another key lever. In addition, national governments develop analytical tools, models, and data systems to support evidence-based policymaking across all levels (Regulation (EU) 2021/1119).

At the regional or sub-national level—including states, provinces, or regions—governance becomes more context-specific and operational. Regional authorities act as intermediaries between national frameworks and local implementation, adapting policies to territorial conditions and sectoral priorities. Key actors

include regional governments, planning bodies, and specialized agencies responsible for sectors like energy, environment, and water management (Avellan et al, 2025).

The functions of regional governance are multifaceted. First, regional authorities are tasked with implementing national laws and standards within their jurisdictions. At the same time, they often develop their own climate policy frameworks, setting short- and long-term targets that reflect regional circumstances (Yang et al. 2026). Where permitted by national legislation, they regulate sectoral performance—for example, by setting building standards or energy efficiency requirements. Regional governments also play a coordinating role, aligning actions across municipalities and ensuring coherence among local initiatives.

Another critical function is the provision of resources and support for local action. This includes offering financial incentives, funding programs, and institutional guidance to municipalities. Regional authorities are also responsible for conducting risk assessments at the regional scale, identifying vulnerabilities, and defining risk management strategies (Charchousi et al. 2026). Monitoring systems are established to track greenhouse gas emissions and evaluate policy performance over time. Additionally, regions often fund analytical work and data collection efforts that inform both regional and local decision-making.

The tools used at this level include regional legislation, strategic planning frameworks, financial instruments, and monitoring systems (Tranoulidis et al. 2024). These may take the form of regional climate strategies, sectoral policies, emissions inventories, and data platforms. By combining regulatory authority with financial and informational resources, regional governments enable more effective and tailored climate action (Salvia et al. 2024).

Overall, multi-level governance of climate change is characterised by interdependence and interaction across scales. The international level provides direction and coordination, setting shared goals and facilitating cooperation (Komendantova et al. 2026). The national level translates these commitments into enforceable policies and allocates resources, while the regional adapts and implements these policies in ways that reflect local conditions. Although each level has distinct roles, their effectiveness depends on alignment, communication, and mutual support.

In conclusion, addressing climate change requires not only strong action at each governance level but also coherence across levels. Fragmentation or misalignment can undermine policy effectiveness, while well-coordinated multi-level governance can enhance efficiency, innovation, and legitimacy. As climate challenges intensify, strengthening these vertical linkages and ensuring that actors at all levels are equipped with appropriate tools and capacities will be essential for achieving meaningful and sustained climate action.

6.1.3 Governance as process: frameworks to align sectoral and cross-border climate policies

Climate change poses a significant challenge to conventional governance systems, as its impacts extend across national borders, economic sectors, and multiple levels of governance (Cappellano et al. 2025). Across the Mediterranean region, climate-related risks such as droughts, floods, wildfires, heat waves, biodiversity loss, water scarcity, coastal erosion, and food insecurity exhibit strong trans-boundary and cross-sectoral dimensions and create interdependencies among neighbouring countries and regions (MedECC 2020, 2024). At the same time, climate governance is progressively moving beyond traditional sectoral approaches. Many climate-related challenges originate from interactions among sectors rather than within individual policy domains. These interdependencies have stimulated the adoption of integrated governance approaches, including nexus-based frameworks, ecosystem-based adaptation, and policy integration strategies designed to identify synergies and manage trade-offs across sectors, regions, and stakeholder groups (Papadopoulou et al. 2020; Mooren et al. 2025a; Lucca et al. 2025).

Multilevel governance has emerged as a central framework for understanding climate policy implementation. Climate objectives are formulated through interactions among EU institutions, national governments, regional authorities, municipalities, civil society, and private sector. While European and national climate strategies provide overarching policy guidelines, implementation mainly depends on regional and local institutions that possess the technical knowledge, the operational responsibilities and

preparedness, and the direct link with the local communities. Adaptation governance analysis indicates that differences in institutional capacities, financial resources, and administrative structures frequently generate implementation gaps that weaken policy effectiveness (Colocci et al. 2025; Favretto and Stringer 2026).

The increasing complexity of climate challenges has also stimulated interest in polycentric governance arrangements. Such arrangements may enhance flexibility, experimentation, and adaptive learning, particularly in contexts characterised by uncertainty and rapidly evolving climate risks. Evidence from environmental governance and nexus-related studies suggests that polycentric structures can facilitate collaboration across sectors and jurisdictions, provided that adequate mechanisms for information exchange, trust building, and conflict resolution are established (IPBES 2024; Mooren et al. 2024).

Climate governance increasingly recognizes that adaptation and mitigation objectives cannot be addressed independently. Climate operational programmes across Europe and the Mediterranean typically combine priorities related to emission reductions, renewable energy deployment, resource efficiency, ecosystem restoration, disaster risk reduction, and climate resilience. This reflects the growing understanding that adaptation and mitigation interact across sectors and governance scales. For example, renewable energy investments contribute to mitigation objectives but may simultaneously affect water resources, land-use patterns, biodiversity conservation, and local livelihoods (Said et al. 2025). Similarly, ecosystem restoration and nature-based solutions support adaptation by enhancing resilience to climate impacts while also contributing to carbon sequestration and mitigation goals (Lucca et al. 2025, Hossain et al 2026). Water management interventions may reduce climate vulnerability while strengthening food security and ecosystem integrity (Mooren et al. 2025b).

Nevertheless, implementation often remains constrained by institutional fragmentation and limited coordination among responsible authorities. As climate risks intensify, governance effectiveness increasingly depends on the ability of institutions to coordinate actions across scales, sectors, and national borders (Velander 2025). As climate risks intensify, governance effectiveness increasingly depends on the ability of institutions to coordinate actions across scales, sectors, and national borders.

6.1.3.1 Policy coherence

Policy coherence has become a central principle of climate governance because climate-related challenges emerge from highly interconnected socio-ecological systems (Ye et al. 2026). Policy coherence refers to the systematic identification and management of synergies and trade-offs among policies operating across sectors, governance levels, and jurisdictions. Policy coherence in climate governance can be assessed through three interrelated dimensions: horizontal, vertical, and territorial coherence. Horizontal coherence refers to the extent to which sectoral policies, including water management, energy, agriculture, biodiversity conservation, spatial planning, and disaster risk reduction (DRR), reinforce rather than undermine climate objectives while effectively managing synergies and trade-offs among competing policy goals (Nilsson et al. 2012, Papadopoulou et al. 2020). Vertical coherence concerns the alignment of objectives, policy instruments, resources, and implementation mechanisms across supranational, national, regional, and local governance levels, as weak integration can create implementation gaps and reduce policy effectiveness (Galarraga et al. 2011). Territorial and cross-border coherence addresses the need for coordination across administrative boundaries, particularly in shared ecosystems, river basins, coastal zones, and other transboundary socio-ecological systems, where effective climate action depends on collective action, knowledge exchange, coordinated planning, and joint implementation (La Jeunesse and Larrue 2020; Roidt and Avellán 2019). Together, these dimensions determine the capacity of governance systems to provide consistent policy direction, enhance policy coherence, and effectively address complex and interconnected climate challenges across multiple scales (Nilsson et al. 2017).

In the Mediterranean, where climate change interacts with water scarcity, ecosystem degradation, food insecurity, energy transitions, and increasing environmental risks, coherent policymaking is increasingly recognized as a prerequisite for effective adaptation and mitigation (Adamescu et al 2026). Water resources constitute one of the most climate-sensitive sectors in the Mediterranean. Climate change is projected to intensify droughts, alter hydrological regimes, reduce groundwater recharge, and increase

competition among water users. Despite the central role of water in adaptation strategies, evidence indicates that water policies frequently remain disconnected from broader climate objectives. Adaptation measures designed within the water sector often fail to adequately account for implications for agriculture, energy production, ecosystem services, and regional development. Such fragmentation reduces adaptive capacity and may unintentionally transfer vulnerabilities across sectors (Papadopoulou et al. 2020; Lucca et al. 2025). The WEFE nexus literature demonstrates that water governance challenges cannot be addressed effectively through single-sector interventions (Behnassi et al. 2025). Water allocation decisions influence food production, energy generation, and ecosystem functioning simultaneously. Consequently, climate-resilient water governance increasingly requires integrated planning approaches that account for cross-sectoral interdependencies and cumulative impacts (Mooren et al. 2025a). Evidence suggests that climate and energy policies are generally better integrated than other sectoral policy domains. Nevertheless, substantial opportunities remain for strengthening coordination with water, biodiversity, and agricultural policies. Integrated resource management approaches offer pathways for maximising co-benefits while minimising trade-offs associated with energy transitions (Lucca et al. 2025).

Agricultural production depends heavily on climate-sensitive resources such as water, land, soil quality, and ecosystem services. At the same time, food systems are significant contributors to greenhouse gas emissions. Recent reviews indicate that climate, agricultural, trade, and food security policies frequently evolve independently despite their strong interdependencies (Said et al. 2025). Policy incoherence may increase resource pressures, undermine resilience, and limit opportunities for sustainable transformation. Healthy ecosystems contribute to climate adaptation and mitigation through carbon sequestration, water regulation, soil protection, and resilience enhancement. Conversely, poorly designed climate interventions may generate adverse impacts on biodiversity and ecosystem services. Recent ecosystem-centred approaches argue that long-term climate resilience depends on maintaining ecosystem integrity while simultaneously pursuing adaptation and mitigation objectives (Mooren et al. 2025b).

Policy coherence is equally important across governance scales. Climate governance in the Mediterranean operates within a complex institutional architecture involving European, national, regional, and local authorities. The effectiveness of climate action depends not only on the quality of policy design but also on the alignment of objectives, instruments, and implementation mechanisms across governance levels.

At the European level, ambitious climate targets and strategic frameworks provide overarching guidance for adaptation and mitigation. However, translation into effective action depends on national implementation and enforcement mechanisms. National governments play a critical role in adapting European frameworks to domestic contexts, yet climate objectives often coexist with sector-specific policies developed under different institutional mandates, planning horizons, and political priorities. Regional authorities frequently act as intermediaries responsible for coordinating implementation and adapting climate strategies to local conditions. Meanwhile, municipalities increasingly occupy a frontline role in climate adaptation, disaster risk reduction, and resilience planning. Evidence from adaptation governance studies demonstrates that successful implementation depends on continuous interaction among governance levels, effective knowledge-sharing mechanisms, and alignment of planning processes (Colocci et al. 2025; Favretto and Stringer 2025).

Many climate-related challenges in the Mediterranean transcend national boundaries. Shared river basins, marine ecosystems, migratory species, droughts, wildfires, and extreme weather events require coordinated responses across jurisdictions. However, existing governance arrangements frequently remain organised around national administrative structures

Transboundary river basins illustrate the need for integrated governance approaches. Effective management requires cooperation among countries sharing water resources, coordinated monitoring systems, joint planning mechanisms, and shared approaches for managing trade-offs among water, energy, food, and ecosystem objectives. Comparative governance assessments of transboundary physical systems indicate that governance arrangements remain restrictive due to institutional fragmentation, limited cross-border communication, uneven governance capacities, and inadequate monitoring systems (Mooren et al. 2024; Susnik et al 2026). Climate adaptation presents challenges for cross-border governance because

vulnerabilities, exposure, and adaptive capacities vary considerably across countries and regions. Although awareness of shared climate risks has increased substantially, policy responses often remain fragmented. Comparative governance studies reveal that successful cross-border adaptation depends on trust-building, shared knowledge systems, effective communication, and adequate institutional resources (Mooren et al. 2024).

Policy fragmentation across sectors, governance levels, and national borders constrains climate resilience more than deficiencies in policy formulation. The most significant governance gap concerns the coordination of existing policies rather than the development of new ones (Papadopoulou et al. 2020; Mooren et al. 2024; Velander 2025).

6.1.3.2 Civil participation

Climate governance increasingly recognizes that effective responses to climate change cannot be achieved solely through governmental action. Civil participation and stakeholder engagement have become key components of adaptation and mitigation strategies (Avellan et al. 2025). Beyond democratic considerations, participation contributes to knowledge generation, policy legitimacy, implementation effectiveness, social learning, and resilience building. Co-creation processes have demonstrated significant potential to improve policy relevance, legitimacy, trust-building, and learning outcomes. Stakeholders possess contextual knowledge regarding local vulnerabilities, resource-use patterns, governance constraints, and implementation opportunities that may not be accessible through conventional planning approaches (Papadopoulou et al. 2025)

Participation enhances the transparency of climate policies by incorporating diverse perspectives, values, experiences, and forms of knowledge into decision-making processes (Brown 2025). Climate interventions frequently involve trade-offs among social, economic, and environmental objectives, creating potential conflicts among stakeholder groups. Inclusive participation can improve transparency, strengthen public trust, and reduce resistance to policy implementation (Adom et al. 2025). Participation strengthens knowledge, motivation, social networks, access to resources, and collective action capacities that are essential for adaptation and resilience (de Voogt et al. 2019). Furthermore, participatory approaches facilitate mutual learning between citizens, scientists, practitioners, and policymakers, thereby enhancing the legitimacy and effectiveness of governance processes.

Emerging governance approaches, including Communities of Practice (CoPs), Living Labs (LLs), and stakeholder co-creation platforms, provide opportunities for knowledge co-production, mutual learning, and enhanced stakeholder engagement. Evidence suggests that such arrangements can support adaptive management by fostering experimentation, continuous learning, and iterative policy adjustment in response to changing environmental and socio-economic conditions. They may also strengthen collective problem-solving capacities and improve cooperation among researchers, policymakers, practitioners, private-sector actors, and citizens. However, their effectiveness depends on factors such as institutional capacity, stakeholder representation, sustained participation, and the availability of resources to support long-term engagement and knowledge exchange (Pekris et al 2025).

Recent literature suggests that science-policy interfaces should evolve toward broader data-to-policy systems that integrate monitoring networks, biodiversity observations, citizen science initiatives, digital technologies, and collaborative knowledge platforms (Langlet-Uranüs et al. 2026). Simultaneously, research on global science-policy interfaces highlights that institutional collaboration remains extensive but fragmented, with significant opportunities for improving coordination, knowledge integration, and policy coherence (Velander 2025).

Local communities possess valuable knowledge regarding environmental change, ecosystem dynamics, risk management, and adaptation practices. Such knowledge can complement scientific evidence, particularly in regions where long-term observational records are limited or where environmental conditions vary significantly across short spatial scales. Decentralized governance arrangements may facilitate the incorporation of local knowledge into climate decision-making by strengthening local autonomy and improving the alignment of policies with place-based conditions. Evidence suggests that intergovernmental

competition can improve environmental governance efficiency, partly through fiscal decentralisation that enhances local decision-making and resource allocation (Li et al. 2025). Local democracy has therefore been identified as an important foundation for effective climate governance and state support for adaptation and risk management (Fischer 2021).

Nevertheless, decentralisation alone does not guarantee meaningful participation. Effective integration of local perspectives requires institutional mechanisms that support dialogue, trust building, capacity development, equitable representation, and technical support for implementation (Baker et al. 2012). While recognition of the importance of local and indigenous knowledge has increased substantially, examples of its systematic incorporation into climate adaptation planning and governance remain relatively limited (Rastogi et al. 2026). Consequently, effective climate governance depends not only on scientific and technical expertise but also on the capacity of institutions to integrate diverse knowledge systems, facilitate collaboration across scales, and support co-produced adaptation pathways.

6.1.4 Governance characteristics: embeds fairness and rights-based approaches

6.1.4.1 Transparency of policies, democracy and public participation

Transparency, integrity, and accountability are essential for a democracy based on the rule of law, promoting good governance, strengthening trust in the policy-making process, and preventing corruption. Transparency and public participation are critical components for environmental management, representing the basic pillars of democratic governance. The transparency of policies, and their role to support public participation came to the fore in the 1990s. According to Ball (2009) transparency can be defined as 'the availability, accessibility, and openness of information to foster accountability, trust, and effective governance'. In the case of climate change for example, the 'modalities, procedures and guidelines' adopted at the Katowice Climate Conference in 2018, established an enhanced transparency framework (Wang and Gao 2023), reinforced with Enhanced Transparency Framework (ETF) under the Paris Agreement's. This requires countries to report on greenhouse gas emissions, progress on Nationally Determined Contributions (NDCs) with the explicit goal of stimulating increased climate ambition over time (Welkmans and Gupta 2021).

Literature identifies three main reasons for transparency in governance: first, the role of transparency as a public value to counter corruption. Transparency is fundamental for democratic governance, and is linked to principles like accountability, public participation, and legitimacy. (Androniceanu 2021 and Rijal 2023). Second, open access to information by supporting society, government, media, and businesses, with policies and regulations of information disclosure that can enhance public trust, independently of the information's content. It fosters citizens' trust in government, which enables a better understanding and compliance with laws and public policy decisions. (Androniceanu 2021; Ripamonti 2024). The presence of Access to Information laws (ATI) is associated with higher perceptions of transparency, although effective implementation and public awareness are crucial for their success (Relly et al 2009). For example, organisations that voluntarily disclose more than legally required are perceived as more trustworthy. (Ripamonti 2024). Greater information transparency also allows for active community participation in public management to ensure policies reflect the actual needs of citizens, therefore enhancing the legitimacy and accountability of decisions (Rijal,2023). Third, transparency is understood as a characteristic of public policy, from the design of policies to the evaluation of organisational actions and programs. It is considered as an attribute for good governance, alongside accountability and effectiveness.

There have been some drawbacks identified on transparency and how increased transparency can, under certain conditions, negatively affect public welfare. This occurs when politicians, seeking re-election, make biased policy choices that prioritise voter perception over what is objectively the optimal policy (Fox). Furthermore, the mere existence of legal frameworks, such as Access-to-Information (ATI) laws, is not by itself sufficient. It is often hindered by a lack of training for civil servants, inconsistent implementation, limited public participation, and a lack of clear internal regulations (Relly et al 2009; Androniceanu 2021).

The Union for the Mediterranean (UfM) promotes transparency via consensus-based decisions, a unique co-presidency, and accountability mechanisms including public reports and independent oversight. Meanwhile, in the northern Mediterranean, the European Union (EU) Treaties enshrine transparency for open decision-making and citizen participation, implemented through key legal instruments on public and environmental matters. Currently, 12 Mediterranean countries and the EU are Parties to the Aarhus Convention, a legally binding framework for environmental information and participation with strong regional efforts to get more Mediterranean countries to join, aiming for broader regional adoption to meet the Sustainable Development Goals (SDGs). In relation to climate change compliance with reporting requirements under the UNFCCC is variable among both developed and developing countries. According to Welkmans et al. (n.d.) and Welkmans and Gupta (2021) developed countries face particular challenges in reporting on the provision of support to developing countries. Challenges to the ETF include the risk of incomplete and incomparable information due to flexibilities, difficulty in assessing heterogeneous NDCs, and the apolitical design which prevents making judgments on a country's level of ambition or achievement.

In relation to the environment and environmental protection, transparency is therefore considered as an important element in relation to key ecosystems like oceans or forests. Cappelleto et al (2021) and MAR1 (2020) refer to 'a transparent and accessible ocean' in the context of the UN Decade of Ocean Science for Sustainable Development (2021-2030). It is one of the societal outcomes for example in relation to data integration and processing in a workflow (collection, validation, aggregation, elaboration) which are crucial to achieving a 'transparent and accessible Mediterranean Sea.', by ensuring the 'complete openness of scientific knowledge'. Andrea (2022), in the context of forest policy, explicitly recommends the creation of a Mediterranean forest inventory, monitoring systems, and big data validation to support afforestation and combat degradation under the Paris Agreement.

However, the efficacy of information is hampered by geographical biases in research. While Cos et al. (2022) and Hassoun et al. (2025) provide evidence of the Mediterranean as a severe climate change hotspot, Hassoun et al. (2025) specifically highlights that risk assessments are compromised by a concentration of data in northwestern Mediterranean countries. This geographic disparity presents a barrier to comprehensive, region-wide transparency in understanding climate risks, which range from ocean acidification to sea-level rise. Conversely, Guet et al. (20xx) show that policy adoption for the Med SECA was successful because policy entrepreneurs raised awareness that detail the negative impacts of shipping emissions, effectively aligning political will with scientific evidence. Finally other authors cite a lack of coherence, excessive bureaucracy (Hamade et al 2018), and policies that are perceived as 'invisible and unclear' (Aboushady et al. 2019), failing to target key sectors like industry and neglecting local needs (e.g. in agriculture), driven by technocratic and security/stability interests, often to the detriment of democracy, human rights, and the rule of law.

This is in line with the increased emphasis on processes for integrating scientific evidence into policymaking, allowing for scrutiny and accountability of policy decisions (Dicks et al. 2014). In this context literature identifies how technologies like E-Government and Open Government Data (OGD) can boost transparency, although their full potential can be hampered due to cultural barriers (e.g. a closed government culture, fear of data misinterpretation) and structural issues (e.g. lack of political will, insufficient resources) (Ruijer and Meije 2020). However, the relationship between data openness and transparency, is complex with several factors that influence this relationship with data quality identified as the most frequently cited determinant for achieving transparency (Matheus and Jansen 2020).

6.1.4.2 Equity and justice

Environmental and climate Justice has become an increasingly central element in relation to environmental degradation and climate change. It recognises the unequal burden that falls on disadvantaged groups, and advocates for policies that reduce social and environmental inequalities. According to the IPCC climate justice has been defined as 'justice that links development and human rights to achieve a human-centred approach to addressing climate change, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate change and its impacts equitably and fairly'. Within this framework

there are a number of aspects that have to be considered. The concept of climate justice, while lacking a universal definition, is essential for guiding efforts, especially since those who have historically contributed the least to climate change are now the most affected. Key aspects highlighted include:

First, distributive justice, defined as the fair allocation of economic and non-economic costs and benefits of climate action and impacts across society and nations which would also cover Inter-generational justice that is fairness in distributing impacts and responsibilities between current and future generations. This is very much linked to social justice, in the just or fair relations within society that seek to address the distribution of wealth, access to resources, opportunity, and support according to principles of justice and fairness.

Second, in the case of procedural justic*e* to ensure all affected groups, especially marginalised communities, have a voice and participate in climate decision-making processes. through equitable participation in decision-making, including who participates and is heard. For example, IPBES (2024) highlights that the underlying causes of biodiversity loss are often rooted in inequitable economic and governance systems, therefore participation and 'stakeholder consultation' are needed to ensure that those most affected by environmental changes can participate during decision-making.

Third, the importance of recognising justice that is respecting diverse cultures, perspectives, and knowledge systems, including Indigenous and traditional knowledge, in climate responses. This aspect has developed particularly thanks to the work of IPBES Values Assessment (2022) as a cornerstone for environmental justice, advocating for the recognition of diverse worldviews beyond market-centric valuations, placing special importance on going beyond pure monetary based economic metrics like GDP to incorporate plural values to include spiritual, cultural, and relational values of nature, which otherwise marginalises indigenous and local communities. Both IPCC and IPBES advocate on the centrality of incorporating Indigenous and Local Knowledge (ILK) as a core component to ensure these perspectives are included in policy design, implementation and evaluation.

Fourth, the aspects of *restorative justice* acknowledge loss and damage which impacts vulnerable communities disproportionately and specifically exacerbates inequalities between the Global North and South. Boyd et al 2024; Temsamani and Bekri (2025). have identified the need for reparative justice and compensation for harm with a call for dedicated, separate funding mechanisms for LandD, distinct from adaptation finance, focusing on practical strategies for enhancing finance in the Mediterranean region. Non-Economic Losses (NELD) are particularly important for the Mediterranean, even though it is complex to quantify non-economic impacts (Boyd et al.2004) and some authors argue for explicitly advocating for the recognition of NELD, such as 'cultural heritage and identity in funding mechanisms (Temsamani and Bekri 2025).

Climate change therefore focuses on the ethical dimensions of climate change, highlighting that those least responsible often suffer most, requiring fair allocation of costs/benefits, respect for diverse cultures, and inclusive governance for solutions like a just transition. In the case of climate change mitigation, literature has identified a number of key elements. The region is experiencing a constant increase in drought, an average annual temperature 1.6°C above pre-industrial levels, and adverse effects on marine and terrestrial life (e.g. sea level rise, acidification). Therefore, the Mediterranean region is highly vulnerable to climate change. Alcaraz et al. (2021), analyse whether the climate commitments under the Nationally Determined Contributions - NDCs) from Mediterranean Basin countries align with the 1.5°C goal of the Paris Agreement. The analysis is based on a Model of Climate Justice incorporating equity criteria (equality and historical responsibility from 1994 to 2017), and concludes that the Mediterranean as a whole, is not on track to meet the 1.5°C goal. By 2030, they will have emitted 77% of their total equitable emissions budget that should last until 2100, and there are significant differences in the degree of ambition when comparing the NDCs of individual countries in the region. Furthermore, according to Dagram and Taskas (2024) to meet the climate objectives it is equally important to consider the need for a just transition in the Mediterranean through a shift from environmentally harmful subsidies to green economic and financial instruments. This pathway, however, requires careful social equity considerations, such as implementing gradual carbon pricing to avoid economic disruption, particularly in Southern and Eastern Mediterranean countries (SEMs).

Furthermore, there is an additional aspect particularly related to southern and Eastern Mediterranean countries, as discussed by Karakir (2024) with a particular focus on Eastern Mediterranean Arab States (EMAS), which include Egypt, Jordan, Lebanon, and Syria., that even though these states are not major contributors to the climate crisis, they lack sufficient resources to cope with its consequences. So, there is an asymmetry in the international order, where the industrialised nations of the Global North are the biggest historical contributors to climate change through cumulative carbon emissions, while the hydrocarbon-rich Arab Gulf states continue to exploit fossil fuel revenues. EMAS suffer more from climatic shocks and are less prepared to respond compared to the Global North and the Arab Gulf states. In the context of the EU part of the Mediterranean, the Clean Energy for All European Package launched by the EU in 2019, provides a legal framework for the creation and management of energy communities. An important development is the recognition of the importance of social benefits in the clean energy transition, aiming to avoid social disparities through energy communities (ECs). A review paper by Urban et al (2025) highlights a gap between the expected social benefits and the dominant technical and economic focus in existing literature.

In the case of climate change adaptation, according to Wilkens (2024) achieving climate justice requires inclusive, sustainable adaptation practices that address structural inequalities and involve affected communities in decision-making. Implementing adaptation measures is complex due to uncertainty about future risks and the limited existing capacities of affected communities. The lack of engagement risks creating further injustices. Climate-just options must address pre-existing socioeconomic and geopolitical vulnerabilities. In the case of adaptation, the IPCC (2022) has pointed out how vulnerability to climate change in the Mediterranean region is strongly affected by equity, and how some specific groups are disproportionately affected which include the elderly, especially women facing significant health risks from heat waves, particularly those with pre-existing conditions like respiratory diseases and women's inclusion in decision-making can improve climate resilience (CGIAR 2024), Children and especially young children in urban areas, and future generations in eastern Mediterranean countries are particularly at risk of food insecurity and scarcity of drinking water and food, aggravated by droughts and flooding. Other vulnerable groups to climate change impacts include poor farmers, urban migrants, and seasonal workers, favouring mobility and migration.

An important aspect relates to migration in the Mediterranean, where according to Mastrorillo et al. (2024) and CGIAR (2024), there is increasing evidence suggesting that climate change amplifies risks and insecurities, leading to increased fragility and conflict. This dynamic exacerbates food insecurity and fosters climate-induced mobility, particularly in highly vulnerable regions like the Mediterranean. The Mediterranean, as seen in *Chapter 2,* faces recurrent droughts, heat waves, and water shortages, with half the global population experiencing water scarcity residing in this region. This strains socio-economic systems and threatens food security through declining agricultural output, with climate change, socio-economic insecurity, and political instability driving both internal and cross-border migration, often forcing people to take unsafe routes. These climate impacts are worsened by governance issues and political instability, as seen with Storm Daniel, which displaced approximately 44,862 individuals and the Derna dam collapse, illustrating the consequences of inadequate infrastructure due to civil conflict. Fernandez and Peek (2024) identify the legal vacuum surrounding people displaced by climate change, while the environmental cause of migration is recognised, climate change is not covered by the 1951 Refugee Statute or its Protocol, leaving victims without a system of legal protections or their own legal personality.

This is an example that more widely refers to the aspect of how to embed fairness and rights-based approach is needed in policy formulation. As the IPCC (2022) identifies linking development and human rights to address climate change, ensuring a human-centred approach that fairly shares impacts, burdens, and benefits, especially for the most vulnerable. For example, in the urban context, Marí-Dell'Olmo et al. (2022) details specific vulnerabilities for Mediterranean cities due to high population density, compact urban design, and low energy efficiency, which exacerbate risks like heatwaves and socio-economic inequalities. The review further identifies key climate threats like Urban Heat Islands (UHI) and extreme weather as major research focuses.

Sekyere et al. (2025) exposes a critical geographic imbalance in research, with minimal representation from some regions despite their high vulnerability. This leads to the conclusion that policies may overlook local realities in developing regions, underscoring the urgent need to strengthen research and collaboration within the Global South to ensure inclusive and resilient urban climate strategies. Abdelazam (2024) identifies the moral responsibility of developed countries to support vulnerable regions.

6.1.4.3 Role of Public-Private Partnerships (PPPs), Public-Common Partnerships (PCPs)

The development of western civilisations is based on a set of regulations with impacts on the Mediterranean Sea region, which represented and laid the foundations for centuries, a forum for trade and exchange of ideas, but which over time ensured for coastal communities' dependence on the resources provided by this sea. People have migrated along and across it since time immemorial, their journeys being facilitated by the sea that lies at its heart, these human contacts and trade links have contributed to stimulating development and creating a common sense of belonging and cooperation.

The Mediterranean has always been a strategic area for the EU, with closer cooperation in the interest of all concerned. In 1995, the adoption of the Barcelona Declaration by the EU and the Mediterranean countries led to the launch of the idea of a Euro-Mediterranean partnership, the 'Barcelona process' of intergovernmental cooperation laying the foundations for the European Neighbourhood Policy that has structured the EU's relations with the Mediterranean countries since 2004 and for the UfM, which covers all EU Member States and the 15 Mediterranean countries: Albania, Algeria, Bosnia and Herzegovina, Egypt, Israel, Jordan, Lebanon, Mauritania, Monaco, Montenegro, Morocco, Palestine, Tunisia, and Türkiye, with Libya as an observer.

Currently, this basin reflects a major characteristic of accelerated population growth, which highlights the emergence of the phenomenon of population densification, excessive urbanisation, an increase in tourism, an intensification of industrial activities, but also the unprecedented increase in intense maritime traffic, a situation that generates an accelerated increase in marine pollution, along with other anthropogenic factors of environmental change, which refer to climate change and the use of unsustainable practices of land, the sea, but also of non-indigenous species.

The Mediterranean Sea is sensitive and vulnerable to pollution due to its specific circulation, its positioning as a key element for climate change, as well as its increased biodiversity, as well as the density of endemic species. So, against the backdrop of historical, accelerated anthropogenic pressures, combined with its natural and specific characteristics, the Mediterranean Sea stands out as one of the most sensitive and affected regions in the world to the phenomenon and intensity of plastic pollution and marine litter.

The sources of marine pollution in the Mediterranean Sea include both point sources (referring to wastewater discharges and discharges from industrial activities) and non-point sources (referring to discharges from agricultural activities and atmospheric deposition). According to Cózar et al. (2015), plastic pollution has become a major concern for the region, and a study in this regard highlights that the Mediterranean Sea contains approximately 12,000 tons of plastic. However, for the Mediterranean Sea, permanent monitoring of marine pollution, through elements of cooperation with Mediterranean states in the EU and outside the EU, must represent the strategic and urgent direction to prevent and limit pollution, as well as its consequences on the entire marine system, and on human health.

In 2020, a report prepared by the United Nations Environment Programme (UNEP) Mediterranean Action Plan (MAP) Plan Bleu on the ecological state of the Mediterranean highlighted the generally unsatisfactory state of the regional environment with regard to air pollution, the quality and quantity of water resources, waste management, but also nature protection. The main marine pollution challenge highlighted is that relating to the existence of waste and its management in many countries, and in this context, international cooperation between EU countries and those outside the EU is fundamental and necessary to address this issue.

For the Mediterranean countries of the EU, policies and action and measure programs have been implemented for several years for an adequate approach to the main pollutants, and the collection of data

and information from the EU countries continues in accordance with the provisions of the Marine Strategy Framework Directive (Directive 2008/56/EC), which establishes a framework for Community action in the field of marine environmental policy and defines concepts such as marine waters, marine strategy, marine region, environmental objective, regional cooperation and pollution, to achieve the objective of helping EU countries to achieve good environmental status (GES). The Directive establishes common principles according to which Member States must develop their own strategies in collaboration with other Member States and third countries, to achieve good ecological status of the marine waters under their jurisdiction. These strategies aim to ensure the protection and restoration of European marine ecosystems and the environmental sustainability of economic activities related to the marine environment' (Bălan 2014, p. 121). 'Member States, in accordance with the provisions of Article 8 of this Directive, shall assess the ecological status of their waters and the impact of human activities on them. The assessment shall include: an analysis of the main characteristics of these waters (physical and chemical characteristics, habitat types), an analysis of the prevailing impacts and pressures, as well as those resulting from human activities that influence the characteristics of these waters, and an economic and social analysis of the use of these waters and the costs of marine environmental degradation'.

Although it still presents a series of vulnerabilities in terms of pollution, the Mediterranean Sea and its region, has a rich mix of nations and cultures and represents, today, a strategic area for the EU and the entire world, but also a location that increases its relevance and importance as a key transit point for natural gas pipelines and liquefied natural gas (LNG) exports. This positioning not only strengthens its role in global energy security but also integrates the Eastern Mediterranean into the dynamics of the international energy market, potentially shaping and shaping energy flows and geopolitical relations for the coming years.

Although the Eastern Mediterranean basin has often witnessed geopolitical turbulence, natural gas has played a relevant role in promoting economic cooperation and strengthening industrial collaboration among its regional actors. The establishment of the Eastern Mediterranean Gas Forum (EMGF), an international organisation with eight member countries (Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Palestine) and three observers (the EU, the United States of America, the World Bank), marked an unprecedented milestone in the process of regional integration in the field.

Therefore, the creation of public-private partnerships in this geographical area, in different sectors of activity, especially in the energy area, brings a series of advantages and mutual benefits that can be obtained from adequate and efficient cooperation throughout the value chain. Being a strategic geographical region that faces numerous common challenges, given their proximity to a considerable common, the idea of establishing cooperation with the development of macro-regional strategies for the Mediterranean region has been present in the EU discourse since the beginning, benefiting from the support of institutions such as the European Committee of the Regions (CoR), the European Economic and Social Committee (EESC) and the European Parliament.

Although a significant number of territorial cooperation initiatives have been developed over the years to help countries work together to address these issues, the differences in development between Mediterranean countries are such that the priorities of the southern Mediterranean countries differ significantly from those of their northern neighbours, which delays reaching a common agreement on a set of priorities and initiatives that would make possible a macro-regional strategic cooperation in the Mediterranean.

This delay and lack of consensus is proving to be challenging, as although the European Council remains open to new cooperation and partnerships under a macro-regional strategy, the lack of any agreement between the countries concerned on the priorities or, indeed, on the geographical scope raises serious questions about the prospects for implementing a macro-regional strategy for the Mediterranean.

This briefing was prepared at the request of a member of the European Committee of the Regions (CoR), in the framework of the Cooperation Agreement between the Parliament and the Committee. Discussions on the development of macro-regional strategic cooperation in the Mediterranean have explored a wide range of different scenarios, from an overall strategy covering the entire region, to three separate macro-regional

strategies or a combination of both approaches. However, progress towards greater macro-regional cooperation in the region has been slow. This has probably been driven by the challenges and uncertainties facing the region as a whole, which include issues such as digital transformation, energy, climate change, migration, mobility and environmental degradation.

Building on the success of the EU's innovative 2009 strategy for the Baltic Sea Region, macro-regional cooperation has been developed in several regions across Europe in recent years. One of the main instruments of the EU for developing and promoting European territorial cooperation, macro-regional strategies (MRS) bring together regions from Member States and third countries that face a common set of challenges and disagreements. Although each macro-regional strategy is unique in terms of the countries it brings together and the scope of its policies, each has the same objective: to ensure coordinated management of problems that can best be addressed together. As regards national policies in Mediterranean countries, some of them have allowed many services to be privatised in recent decades, leaving less responsibility for the management of central and local public administration. This trend has led to an intense debate on which services should be privatised, which should be guaranteed, and which criteria of equity and efficiency should be implemented in their delivery.

The transition from a public water supply and distribution system to a privatized drinking water supply system in one of the main international tourist destinations, such as the Costa Brava (Spain), can be an example of success and good practices in this area and can be included in this context. Research undertaken in the area of water governance focused on identifying and characterising the main water quality protection systems on the Costa Brava in order to explore the different forms of water supply governance and it was found on this occasion that the different interrelationships between the expansion of tourism and the management of water supply infrastructures, technical and financial resources present a series of ambiguities and insufficient elements in the legislative framework of local and regional administrations, a situation that encouraged the entry of private initiatives into the market. Through this process of private initiatives entering the market, there is a stimulation and consolidation of the operationalisation of a larger customer market to promote and develop tourism in the Mediterranean.

The main conclusion reflected is that water governance models in coastal tourist destinations, such as these, are determined not only by territorial needs and priorities, but also by the absence of technical capacity, but also by the identification, development and promotion of business opportunities in the private sector. For this area, a challenge that will continue in the future also refers to the operationalisation of public control mechanisms that maintain and ensure a fair balance of expenses to ensure the maintenance and exploitation not only of water supply, but also of water purification networks. The protection of water resources includes a complex and varied range of activities and initiatives of collaboration and cooperation, manifested in the form of various treaties, conventions or instruments of international bodies. During the meetings of international conferences on the legal protection of inland waters, a series of documents, declarations and principles were outlined and adopted that regulate the need for the protection, administration and efficient and rational management of waters in Europe and the world (Bălan 2014, p. 103).

Although conventional international practice in the field of international water use and cooperation between states in general has evolved rather slowly, the growing interest of states in preventing and reducing pollution and its harmful effects is strongly manifested within international organisations, governmental and non-governmental (Marinescu 2010, p. 204). However, there is no full harmonisation of legal protection regimes, to prevent, combat water pollution, and manage and manage them judiciously, to be able to emphasise the existing protection measures, a series of regulations have been adopted at intra-community level (Făinişi 2005, p.43). For example: the Water Framework Directive (Directive 2000/60/EC) of the European Parliament and of the Council of 23 October 2000 establishing a framework for action for the Community in the field of water policy addresses the implementation of principles such as: the integration of economic aspects in the field of water management and public participation in water management with the establishment of a common objective for all states that after implementation, through the competent national bodies, should aim to achieve 'good ecological and chemical status' (where 'ecological status', under Article 2, point 21 of the Directive, is an expression of the quality of the structure

and functioning of aquatic ecosystems associated with surface waters, classified in accordance with Annex V) (Bălan 2014, p.104). Achieving 'good status' of waters implies ensuring the same living conditions of the aquatic environment for all inhabitants of Europe.

Although the directive is based on the principle of integrating economic aspects in the field of water management and cost recovery for water services, this issue must be treated with caution when the costs are transferred to end users, as a whole or, on the other hand, it is fundamental that for good governance and efficient management in the field there must be clarifications regarding the weight given to water as an essential access resource or as an object that generates profit, but also opportunities for the business environment.

Regarding gas from the Mediterranean, it is an accessible source of energy that plays a fundamental role in supporting life, economic prosperity, but also human progress. In the context of demographic growth and technological development, which determines a sustained increase throughout the value chain of energy demand worldwide, gas stands out as a key resource to meet the objective of energy security. Regionally, the economic benefits of natural gas production in the Mediterranean are significant, with several countries seeing progress as their economies benefit from increased gas revenues, job creation, and access to local and national markets for foreign investment.

Egypt's discovery of significant offshore gas resources was a game-changer, with Zohr and other fields in operation, and Egypt has rapidly expanded its natural gas production and exports, particularly through its LNG terminals, helping to boost and strengthen the national economy. In addition, the gas sector has attracted billions of dollars in foreign investment, further cementing Egypt's position as one of Africa's largest natural gas producers. According to research undertaken by the Hellenic Association for Energy Economics (HAEE), sponsored by the International Gas Union (IGU), since the discovery of the Zohr field, investments in natural gas have increased considerably (from £35 billion in 2015/2016 to £100 billion in 2018/2019 alone), with a clear increase in foreign direct investment (FDI). The expansion of the natural gas sector has also had a significant impact on employment, especially in the upstream oil and gas industry, where approximately 16,000 people were employed in the first three years after Zohr became operational.

The potential of prosumers in the Mediterranean Sea area represents another extremely relevant element that can support and contribute to the development and promotion of the region through actions that must aim at building public-private partnerships for regional and local energy communities, increasing citizens' independence, but also accelerating the approach to energy poverty measures. It is necessary to design and adopt new legal mechanisms that allow and ensure that local and regional authorities fully use energy clusters as necessary and efficient tools for combating climate change, but also for ensuring and maintaining the energy independence of the Mediterranean region.

Both for actions to prevent and combat marine pollution and for combating climate change, actions are necessary to design an adequate legal framework that allows attracting investors and creating high-quality jobs that offer them: stability, dignity and growth. Although a series of programs have been developed over time to train workers in industry and agriculture for a low-emission economy, the contribution and support of the central government, as well as local authorities, is still necessary.

The Strategic Agenda for 2024 –2029 of the EU leaders, as well as the Competitiveness Compass, highlight that the EU's climate ambition must have positive effects for all of humanity, in the sense that it must be encouraged and supported by strong industrial sectors, innovation and investment in order to ensure and maintain European and regional competitiveness, but also to promote the well-being of society and the world in which the world lives. Without a firm political impulse, both the Mediterranean and Europe risk locking in dependence on imported resources and technologies, losing ground to traditional industries, clean technologies and eroding the support and trust of the population. An effective and sustainable climate policy strengthens competitiveness and resilience, while delivering broad benefits and enablers, such as job creation, improved environmental quality and affordable and clean energy.

This is strongly reflected in the European Commission's proposal for a 2040 climate target, which presents climate policy as a major opportunity to strengthen the role of Europe and the Mediterranean as hubs for

clean technology production and circular business models, while limiting dependence on fossil fuel imports. Scaling up renewable energy, electrification, energy and resource efficiency, and circularity are the foundations for decarbonising all sectors of the economy and unlocking and maximising the benefits of the green transition.

The creation of a strategic package of actions for the European Green Deal has facilitated the development of a framework that is required to be robust for the climate transition. Securing and maintaining momentum now depends on designing and designing smart and targeted policies and on the careful implementation of existing provisions. This requires a practical needs-based and holistic approach based on facts and data, a nuanced understanding of how the enabling conditions, such as technology and innovation, social and behavioural changes, infrastructure, finance and governance, are evolving, which will have the effect of further progress.

Evidence-based and data-driven monitoring helps ensure that policy in the Mediterranean region is anchored in clear developments and progress and focuses resources on sectors that offer real value for a competitive and credible transition towards the overall objective of climate neutrality. The EU, in its Clean Industrial Pact, states that 'a strategy is only as good as its effective implementation. This requires robust measurement, monitoring and dialogue, as well as coordinated action at EU level' (European Commission 2025, p. 23). The European Parliament sets this out specifically for industry in its related resolution, calling for 'annual monitoring and reporting on the competitiveness and resilience of industrial ecosystems with reference to progress on transition pathways, so that instruments can be rapidly adapted, with tailored support when needed' (EP 2025b, point 12). Therefore, monitoring is a fundamental and essential tool to identify relevant sectors capable of specific policy interventions and to provide decision-makers in the region with the opportunity to act as a new policy cycle ends and another one enters into force.

6.1.4.4 Policy coherence between disaster risk reduction and climate change adaptation

In Europe and in particular in the Mediterranean, climate change has increased the frequency, intensity and complexity of hazards, also worsening the underlying vulnerability of populations to disasters. In this context, there is an urgent and priority need for countries in this geographical area to adopt a comprehensive approach to disaster and climate risk management, which builds on the synergies between climate action and disaster risk reduction (DRR) and supports systemic efforts to build resilience. Such an approach should be informed by and operationalize the commitments made under the Sendai Framework, the Paris Agreement commitments and the 2030 Agenda for Sustainable Development commitments to promote resilient and risk-informed development.

To understand current progress in implementing this integrated approach, this section examines policy coherence in selected European countries, with a particular focus on four key dimensions of coherence: conceptual, institutional, operational and financial. Despite challenges, particularly in terms of integrating operational coherence at the technical level, progress has been made in terms of coherence between conceptual and operational aspects. In contrast, coherence in institutional and financial aspects is rather limited. Responsibility for risk management often remains siloed between different public institutions, therefore limiting synergies in strategic planning. In some cases, this is further exacerbated by suboptimal coordination mechanisms between institutions responsible for disaster risk reduction and those responsible for climate action.

These findings highlight the need to promote the institutional aspect of coherence, including through platforms that mobilise various governmental stakeholders, with a focus on resilience and the catalytic effect of international strategic processes, such as the development of Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs), and Disaster Risk Reduction Plans. From a financial perspective, despite examples of sound practices—such as mutual financing instruments for disaster risk reduction and climate action—there is insufficient evidence of systematic coherence in the region. This gap underscores the need for more integrated approaches that bridge institutional, financial, and operational divides between climate and disaster risk governance.

Comprehensive Risk Management (CRM) is a holistic approach to managing risks associated with climatic and non-climatic hazards, and this study aims to address and build long-term resilience in the Mediterranean for vulnerable populations and communities, including resilience to loss and damage caused by extreme and slow-onset events. CRM is both explicitly and implicitly integrated into global multilateral treaties, particularly those related to climate change, disaster risk reduction, and sustainable development. For example, the provisions of Article 8 of the Paris Agreement (2015) illustrate comprehensive risk management as an area of cooperation and facilitation that improves understanding, action, and support for loss and damage. It also involves managing the risks associated with extreme and slow-onset events through risk reduction and adaptation actions in the short, medium, and long term. By promoting active collaboration between government institutions, non-state actors, and other stakeholders, CRM ensures that coherence and synergies between climate action and disaster risk reduction measures are sufficiently reflected in planning and implementation frameworks—though current practice often falls short of this ideal.

Coherence between risk reduction and climate action agendas is underpinned by three key aspects. First, in terms of scope, the close thematic interconnection between risk reduction and climate action—both focused on risk reduction and resilience building—means that coherent planning and implementation unlock a systematic approach capable of addressing the accumulation of risks and hazardous events over different time horizons. This interconnectedness allows for a more comprehensive understanding of risk pathways and the development of responses that are robust across multiple temporal and spatial scales. Second, regarding efficiency, coherence ensures that efforts are not duplicated and that limited resources are maximized, ultimately leading to simplified planning and implementation processes and the amplification of resilient outcomes. By aligning institutional mandates, financing streams, and reporting requirements, coherence reduces redundancy and enables more cost-effective use of public and private resources. Third, coherence fosters innovation, as the benefits of mobilising a wide range of expertise and reaching out to diverse stakeholders and sectors include the development and implementation of transformative ways to support and assist countries in coherent risk reduction. This cross-pollination of knowledge and perspectives generates novel solutions that would be unlikely to emerge from siloed approaches, thereby strengthening the overall effectiveness of risk governance in the Mediterranean region.

The analysis of strategic documents in the Mediterranean region reveals that documents focused on disaster risk reduction provide the strongest conceptual basis for coherent action. Most strategies, including multi- and single-hazard disaster risk reduction action plans, are formulated in a form of substantial coherence. Such documents reflect an advanced understanding of the impact of climate change on vulnerability, but also a comprehensive disaster resilience that aims to develop and promote the integration of actions and risk mitigation measures. However, the detailed strategic integration with climate action institutions and strategies is less common, with only five out of nine disaster risk reduction strategies outlining plans with concrete integration measures, remaining specific examples of disaster risk reduction strategies framed exclusively in terms of protection and response.

In terms of conceptual integration, it is weakest at the level of general development planning, highlighting the peripheral role of disaster risk reduction and climate action stakeholders in general scaling-up planning at national level: only three out of 12 such documents provide a solid conceptual basis for coherence. Between these two pillars, documents developed by climate action institutions and international strategic processes, such as for example: National Adaptation Plans (NAPs), National Communications (NCs) and Nationally Determined Contributions (NDCs) reflect approaches of comparable level of conceptual integration, with an adequate level of conceptual recognition limited by the absence of systematic integration and inclusion of DRR in action plans.

6.1.4.5 Recommendations for strengthening coherence

Seising the opportunities of a comprehensive approach to risk management in the Mediterranean requires four key actions, beginning with establishing strategic fit. This involves planning for disaster risk reduction (DRR) and climate action by developing and promoting common strategic processes while integrating

existing mechanisms. Furthermore, resilience must be used as a framework to engage and mobilise diverse stakeholders, including institutions involved in economic and strategic planning, thereby ensuring that risk management becomes embedded within broader development agendas.

The second essential action concerns institutional coordination, which demands breaking down the silos that currently separate institutions responsible for disaster risk reduction (DRR) and climate action. This requires funding and operationalising dedicated platforms for real-time coordination, enabling timely and effective responses to emerging threats. Additionally, it is crucial to involve disaster risk reduction stakeholders in decision-making processes related to climate action, sustainable development, and resilience, ensuring that these policy areas are not developed in isolation but rather inform and reinforce one another.

Third, technical collaboration must be actively promoted and developed through action-oriented technical working groups that share data, develop methodologies, and pool expertise. These collaborative efforts should lead to the development and implementation of programmes and action plans featuring common and concrete measures focused on efficiency, with clearly defined roles, deadlines, and budgets. Such plans must be integrated into all risk mitigation strategies to ensure consistency and coherence across different levels of governance and sectors of activity.

Finally, financial integration constitutes the fourth pillar of this comprehensive approach. It requires embedding risk mitigation principles in government investment decisions, for instance through the adoption of common financial instruments that serve both disaster risk reduction and climate action objectives. Moreover, it is essential to capitalize on integrated financing opportunities offered by international climate change financing programmes, thereby leveraging external resources to complement domestic investments and ensuring that financial flows are systematically aligned with resilience-building goals across the Mediterranean region. These recommendations should be applied according to the context of each country and at different levels. Strengthening resilience requires and implies a comprehensive and adequate understanding of the means of implementation available to address gaps but also challenges and address risks over different time periods.

Public and budgetary financial mechanisms and instruments need to be complemented and updated, while private sector financing needs to be explored to justify resilience. International instruments on disaster risk reduction, adaptation, loss and damage can be leveraged through comprehensive and appropriate risk management approaches. There is a need to capitalize on the widespread concern for proactive risk mitigation in strategic documents on climate action risk reduction, as well as in international strategic processes, to develop and promote joint or coordinated risk mitigation strategies, with integrated steps and clear deadlines. The main challenge for conceptual integration is to capitalise on the diverse calls for proactive risk management that already exist at national level, by bringing together institutions in the concrete planning of actions and measures to be taken. To overcome the marginalisation of risk reduction in general development planning, governments should require the inclusion of both risk reduction and climate action stakeholders in development planning processes, with explicit requirements for their input into policy design and implementation.

A telling example in this regard is that of North Macedonia, where the authorities sought to improve the integration of DRR and climate action concerns into other national planning processes through actions to integrate DRR and climate action into spatial and urban planning in North Macedonia. A key activity in this regard was the development of a guide with methodologies for integrating climate change into spatial and urban planning, which was applied in the development of the upcoming General Spatial Plan (Mary 2020). Additionally, in 2024, the United Nations Office for Disaster Risk Reduction (UNDRR) implemented the Disaster Resilience Scorecard for Cities in three municipalities in the country, collaborating with local stakeholders to develop ‘tools for strategic disaster risk reduction and climate change planning’ (Nedeljković 2024, p.4).

Regarding resilience, it has emerged as a fundamental conceptual framework that works with various stakeholders. The collaborative resilience framework has stimulated mutual collaboration between actors involved in disaster risk reduction and climate action, which is based on the definition of new concepts, but

also on common objectives. The design and increase of resilience to disasters or climate risks, which has a role in facilitating connections with strategic planning within central public authorities, such as infrastructure and the economy, is established as a priority in seven out of nine documents on disaster risk reduction and climate action and in 11 out of 14 internal documents on climate action analysed in the region. In addition, resilience to disasters and climate risks is framed in the region as a relevant part that also includes the risks of economic systems, such as threats and dangers related to energy supply and the existence of risks in the field of national security, such as for example: cyber-attacks.

Cooperation and obligations assumed in the field of resilience represent a common and central theme in the various government sectors in countries such as: Europe and the Mediterranean, which reflects its significant potential to adopt actions with coherent measures through the integration of specialists in working groups that aim to prevent, reduce and combat risks in policy processes at all levels of government. Risk reduction experts and practitioners should also be aware of the diverse conceptual, terminological and practical interpretations of resilience that come from alternative communities of practice, with the possibility of effective risk management over different time periods, but which offer facilities, benefits and opportunities, but which have as their primary objective an integrated approach.

Institutional responsibility for risk reduction remains isolated. DRR activities are carried out by authorities with express mandates for disaster response and civil protection, while climate action remains the exclusive responsibility of ministries with portfolios such as environment and economy. A significant obstacle to achieving coherence is the lack of coordination between government ministries. In addition, the focus on civil protection by DRR institutions has limited integration into overall development planning, with seven out of nine DRR strategies lacking specific details on resource mobilisation by economic authorities. As a result, coherence is more often incidental than structural, characterised by elements of conceptual and operational integration without adequate institutional support. This lack of harmonisation between the different authorities responsible for risk limitation at national level is associated with challenges related to inefficiency and insufficient resources, duplication of work, but also low data and information sharing.

There is a clear need to clarify institutional responsibilities for effective and appropriate coordination of actions in areas of common interest. This can be implemented through national methodologies and guidelines that ensure that strategic planning processes in the field of DRR and climate action take into account the institutional mandate, but also the administrative and technical capacity of the relevant institutions. The development of these methodologies can be managed by DRR institutions, working together through existing coordination tools and mechanisms to reconcile competing initiatives and priorities.

National authorities should design and develop functional and effective coordination mechanisms that bring together stakeholders in the field of disaster risk reduction and climate action. These mechanisms should host joint technical working groups that enable and ensure concrete and adequate coherence in the implementation of areas of common interest, such as early warning systems, resilient agriculture and critical infrastructure. State institutions for coordinating proactive risk reduction, rather than limiting their scope to coordinating and managing disaster preparedness and response. This should include the effective and adequate mandate and allocation of resources for the presence of institutions focused on climate action, as well as on the implementation of agendas focused on areas of common interest, as well as working groups with specific agendas to prioritize actions at the national level that follow joint planning and reporting.

Another example is the role of the National Observatory for Adaptation to Climate Change (ACC) in promoting DRR and Adaptation in Italy. The Italian National Observatory for Adaptation to Climate Change, established in 2024, functions as the permanent governance structure of the National Plan for Adaptation to Climate Change and is responsible for the development and circulation of data and information on climate change, vulnerability profiles, and possible adaptation actions. It is important to note that the Observatory is coordinated by a multi-stakeholder committee that includes representatives from government ministries and the Conference of the Regions, as well as from DRR institutions such as the Civil Protection Department and the Italian National Meteorological Agency.

he strategic frameworks for risk reduction in Europe and the Mediterranean provide a solid foundation for regional cooperation and collaboration, as well as learning on coherence. At a strategic level, the European Forum for Disaster Risk Reduction (EFDRR) Roadmap 2021–2030 codifies the mutual and shared commitments of national governments, establishing that progress towards coherence and capitalisation of global agendas is shared in strategies, actions and commitments at regional, national and local levels' (UNDRR 2021a, p. 6), therefore determining the achievement of coherent and adequate implementation as an approach to enable and ensure effective disaster risk reduction for the entire region.

Similarly, the Strategy for the Development of Cooperation of the Central Asian Countries in the Field of Disaster Risk Reduction for 2022–2030, adopted in 2021, extends the harmonisation of the strategic framework between the states of the region for the development and promotion of joint actions, activities and programs and coordination of risk reduction. Through this leadership, the strategy reflects the need to implement plans of measures to adapt to climate change, to limit its effects and includes among the expected results a 'successful response to climate change' (UNDRR 2021a, p. 7). This positioning is reflected at the institutional level through an adequate coordination relationship between DG-ECHO and DG-CLIMA in the EU. In the Central Asia region, an appropriate institutional venue for coherence is the Centre for Emergency Situations and Disaster Risk Reduction (CESDRR), which incorporates representatives from across the region with the overall objective of developing and promoting initiatives and objectives that pursue common cooperation and collaboration in the field of disaster risk reduction, climate action and prevention and recovery.

6.1.4.6 Operational dimension

The analysis of relevant documents in the field illustrates a solid framework for operational coherence in the region. Overall, 18 out of 23 documents on disaster risk reduction (DRR) and climate action are assessed as exhibiting substantial coherence in this area, characterised by a complex multi-stakeholder strategy development process, with a focus on integration across key sectors and significant areas of operational overlap.

The strategic areas of this operational overlap relate to sectors and domains such as early warning systems, agriculture and water systems, and the resilience of critical infrastructure. Multi-hazard early warning systems play a fundamental role in structuring national emergencies and priorities. These areas reflect consistent strategic priorities in DRR planning, climate action and overall development in the region, and relevant actors benefit from the opportunity to create and establish connections and collaborations through coordinated actions at project level.

National authorities should take action to create technical working groups with representatives from both risk reduction and development planning institutions to share capacities, methodologies and resources in order to connect ongoing risk reduction activities. It is necessary to develop and implement joint action plans as an essential component of the risk reduction strategy, which should encompass both the implementation and monitoring processes of risk reduction and climate action.

Another instructive example refers to the integrated, climate-resilient flood risk management in the Drin River Basin in the Balkans was the implementation of the project 'Integrated, climate-resilient transboundary flood risk management in the Drin River Basin. The project ran from 2019 to 2024, uniting Albania, Montenegro and North Macedonia and was financed by the Adaptation Fund (AF) as part of the 'Disaster Risk Reduction and Early Warning System' sector, demonstrating coherence at the technical level.

The objective of the project was to support riparian countries in implementing an integrated approach to flood risk management in river basins, resilient to climate change, to improve their existing capacity to manage flood risk at regional, national and local levels and to increase the resilience of vulnerable communities in the DRB to climate-induced floods.

One of the outputs of this project aimed to create a customized GIS-based flood risk model and upgrade hydro meteorological monitoring networks, covering the spectrum from flood risk mitigation to climate action. The implementation of this project by UNDP was tailored to ensure the involvement of flood risk

reduction practitioners in the technical teams. Consequently, national interviewees for each of the three countries (Albania, Montenegro and North Macedonia) identified this project as an example of good practice, which combined the activities and expertise of communities in flood risk reduction and climate action in concrete implementation.

6.1.4.7 Climate justice and social equity

The impact of climate change in the Mediterranean, both on land and at sea, is evident not only through scientific data and research but also through its profound adverse effects on all forms of human and non-human life in the region. The steady rise in drought conditions, with current average annual temperatures already 1.6°C above pre-industrial levels, alongside observable changes in precipitation patterns, atmospheric circulation, extreme weather events, sea level rise, and shifts in seawater temperature, salinity, and acidification over recent decades, underscores the urgent need for intensified mitigation and limitation efforts. At the same time, it highlights the necessity of adapting to a rapidly changing climate in the Mediterranean region (MedECC 2020). However, the extensive list of specific challenges and risks posed by climate change stands in stark contrast to the far more complex realities of implementing adequate adaptation measures. On one hand, adaptive capacities are shaped by how risks will evolve in the future, introducing uncertainty about the intensity and frequency of climate impacts, which not only constrains adaptation efforts but also competes with other societal conflicts and resource demands. On the other hand, the successful implementation of adaptation measures is heavily determined by the existing capacities of affected communities and the level of support they receive across different tiers of climate governance.

Currently, those most affected by climate change bear a disproportionate burden: societal actors and communities that have historically and presently contributed the least to greenhouse gas emissions are now among the most severely impacted. Yet, they are not merely passive victims of climate change; they play an essential role in driving successful adaptation strategies, such as water-sensitive urban design, nature-based solutions, and flood forecasting systems, which are already being piloted through specific initiatives in the Mediterranean region. Nevertheless, as climate change and its associated risks continue to intensify, the lack of meaningful engagement in adaptation threatens to generate further injustices; not only between the countries of the northern, southern, and eastern Mediterranean but also within them. The Mediterranean context further amplifies the need for discussions on the rights of nature to gain greater traction, given the accelerating destruction of non-human life, from marine ecosystems to terrestrial biodiversity. These changes cannot be understood solely in socio-economic terms, given the profound significance of nature for traditional lifestyles and the diverse cultural identities across the region.

Although climate activists and affected communities have fought for climate justice for decades, its integration into climate policies by national governments and international organisations often remains as ambiguous as the reference in the Paris Agreement (2015) to ‘the importance for some of them of the concept of ‘climate justice’ when taking action to address climate change.’ While there is no universally accepted definition of climate justice, several key aspects stand out and warrant consideration in the context of climate change adaptation. Despite the vast and diverse field of studies on climate justice, some essential dimensions can be highlighted, which relate to specific indicators: procedural climate justice, which examines decision-making processes regarding climate policies; distributive climate justice, which focuses on the allocation of costs and benefits arising from climate policies; recognition justice, which emphasises the importance of integrating diverse understandings, particularly those of marginalised communities and voices; and intergenerational climate justice, which addresses issues of past, present, and future responsibility and rights (Newell et al. 2021). The principle of shared responsibility is formally reflected in climate policy packages, yet equity and accountability remain majorly absent in a context where Mediterranean communities face severe limitations in their adaptive capacity, given the tense socio-economic and political challenges that shape their possibilities.

These established understandings of climate justice underscore the need for access to finance, meaningful inclusion, and recognition of diverse local perspectives as central features that should define adaptation policies in the Mediterranean region. Moreover, equity demands a critical and active engagement with the

responsibility of countries in the Global North, which have higher historical emissions, as well as other actors that continue to benefit from fossil fuel production and investment, such as oil and gas companies that persist in exploring and exploiting resources, including in the Mediterranean (Le Monde Diplomatique 2024). Contrary to the principles of climate justice, adequate financial resources are considerably lacking for the implementation of comprehensive adaptation measures in the region. Many Mediterranean countries face economic difficulties that severely limit their ability to allocate funds for adaptation, while the costs of necessary infrastructure, technologies, and sustainable capacity-building measures remain prohibitively high, particularly in the politically and economically disadvantaged areas of the southern Mediterranean. Given the significantly ineffective mitigation efforts to date, these adaptation costs are projected to increase substantially by 2050. Although some support exists, such as the EU's European Regional Development Fund, which invests around €1.6 billion in supporting marine protected areas in its Mediterranean member states (European Commission, n.d.), additional financial assistance, especially for the southern and eastern regions, is critically lacking. The global adaptation financing gap—the difference between estimated needs, ranging from US$220 to US$400 billion per year, and actual financing flows of only US$24 billion per year—clearly illustrates the scale of the challenges facing the Mediterranean region (UNEP 2023).

Beyond the financing shortfall, key economic sectors in the region, including agriculture, tourism, and fisheries, are highly sensitive to climate change. Adaptation therefore becomes not only a question of available resources to manage increasing risks but also a challenge in terms of achieving just and equitable transitions in economic practices. Several programmes aim to support Mediterranean development, including the PRIMA Programme and the Mediterranean Interreg Programmes. The PRIMA Programme is built on a Euro-Mediterranean cooperation framework comprising EU Member States, countries associated with Horizon 2020, and Mediterranean partner countries on an equal footing, with co-ownership, co-management, and co-financing, and with the participation of the European Commission under Article 185 of the Treaty on the Functioning of the EU. Its mission is to implement, support, and promote the integration, alignment, and joint execution of national research and innovation programmes within a common strategy to address challenges related to water scarcity, agriculture, and food security. The thematic areas of the PRIMA Programme include integrated and sustainable water resources management for arid and semi-arid Mediterranean areas, sustainable agricultural systems under Mediterranean environmental constraints, and sustainable Mediterranean agri-food value chains for regional and local development. From 2017 to 2031, the EU contribution is expected to reach €330 million, with an additional €384 million from participating States. The budget is allocated as grants, with €10.9 million for water management in the nexus, €10.8 million for agricultural systems in the nexus, €10.8 million for the agri-food value chain in the nexus, €20,000 for the PRIMA Woman Greening Food Systems Prize (two prizes of €10,000 each), and €36 million allocated for multiple themes.

The Mediterranean Interreg Cooperation and Cohesion Programmes are also essential for limiting marine pollution, including marine litter, and for supporting the development of effective and sustainable policies. An analysis of the main challenges and impediments facing the region should be conducted with a view to increasing their effectiveness and broadening their scope. Cooperation and collaboration between Mediterranean countries to develop and implement effective legislation for the prevention and control of marine pollution are fundamental to achieving the objective of significantly limiting waste generation. Initiatives and recommendations on policy and action development, based on research, innovation, and technology for marine pollution prevention and control, should operate at three levels of policy-making: the discovery and characterisation level, where the problem is recognised and initial preventive actions can be initiated; the policy or decision-making level, where the issue is framed within economic and policy dimensions and the legislative framework is determined; and the management level, which involves the implementation of policy decisions and management practices. The fight to prevent and combat marine pollution and climate change in the Mediterranean is fundamental and must be addressed not only by EU countries but by all Mediterranean nations, through both the harmonisation and implementation of regulations and effective cooperation and collaboration in the field.

While these principles of climate justice help to identify inequalities between those already disadvantaged by climate change—those who already pay versus those who should pay for the risks that arise—it is necessary to broaden the perspective on responsibilities by examining other dynamics that impact adaptation and climate justice in the region. First, in the Mediterranean, both adaptation and mitigation suffer from an inappropriate binary perspective that frames adaptation as local and mitigation as global. Although different governance levels shape both mitigation and adaptation practices, the local perspective is often seen as the primary locus of adaptation implementation, despite the fact that all governance levels influence decision-making processes and visions regarding adaptation. Currently, there is a notable lack of implementation across these levels. Adaptation actions in the Mediterranean cannot be addressed within a single national framework, as local procedures are further contested in a region confronted with various types of human mobility, including forced migration due to conflicts and tensions, labour migration, and multiple climate risks simultaneously. Although the vast majority of specialists have highlighted that water and sustainable water management represent major transboundary problems in the region, progress has been limited, and cooperative actions remain scarce. These dynamics and developments underscore that adaptation cannot be approached merely as a place-specific practice of homogeneous actors and communities; rather, it must be analysed through a lens that recognizes adaptation as a highly dynamic framework, impregnated with conflicts, tensions, mobilities, and power relations between and within states.

This perspective highlights the need to analyse and fill gaps in knowledge regarding the often complex relationships between climate change and social dynamics. For instance, rising average temperatures and prolonged drought periods create substantial challenges for agriculture and human health, yet these are often reported exclusively through changes in physical conditions. The gap in the Mediterranean region is further exacerbated by the issues identified as ‘climate hot spots’ and the lack of involvement from both state and non-state actors in adaptation actions. Moreover, most specialists illustrate that implementation gaps are fundamentally unfair to those already affected, and that support for equitable visions and approaches to adaptation remains majorly lacking. Affected communities have limited resources, which are typically obtained through individual projects implemented by national governments and international NGOs. These gaps and shortages significantly contribute to actions that increase existing inequalities and vulnerabilities among groups such as migrants, women, and young people, whose adaptive capacities are already constrained—situations that can only be countered through active support for adaptation. Current dynamics in the Mediterranean reflect a positive trajectory toward climate justice in the context of adaptation. However, this trajectory requires not only a fundamental paradigm shift in the difficult situation faced by vulnerable communities, which are already paying a high price for the inactions and faulty actions of international and national actors, but also a commitment from these actors to respect their obligations, assume responsibility, and effectively operationalize financial support for those in need (Barrett 2013). Climate change actions are increasingly debated in terms of facilities and potential investment opportunities, particularly regarding renewable energies and emerging technologies aimed at preventing and combating climate impacts. Adaptation, however, suffers in many respects because it is often not framed as a generator of returns and benefits compared to investments made in other areas.

6.1.4.8 Transparency of policies, democracy, public participation

Transparency, integrity and accountability are essential premises of a democracy based on the rule of law that promotes good governance and strengthens trust in the policy-making process, therefore increasing the legitimacy and credibility of public institutions by reflecting them as highly relevant political instruments in the act of preventing corruption and bad governance practices. Transparency as a whole is a fundamental process for strengthening accountability and trust in decision-makers, ensuring the disclosure of information on policymaking and spending, while also allowing citizens access to this information.

Monitoring and oversight actions as part of the transparency process are presented as necessary tools to guarantee the accountability of public institutions, while participatory approaches involve civil society in this process. The notion of integrity of public institutions implies the use of their powers for officially authorised and publicly justified purposes. This is also true for the EU, where these interconnected

principles are at the heart of the relations between its institutions and citizens. As such, they benefit from a constitutional basis in the EU Treaties, which strengthen the democratic credibility of the Union by promoting open decision-making, citizen participation, transparency and good administration.

The provisions of the EU treaties establish as a general principle an open decision-making process at the level of the EU, which must be carried out as closely as possible to the citizen, but also in accordance with the requirements and objectives of the population (Article 10(3) of the Treaty on EU, which provides that both citizens and representative associations should have the opportunity to inform and publicly exchange their opinions and ideas in all areas of action of the EU (the provisions of Article 11(1) of the TEU). These provisions are corroborated with the obligation of the institutions to act publicly (Article 15(1) and (2) of the TFEU) and with the right of citizens to access documents and information belonging to the institutions of the EU (Article 15(3) of the TFEU). Transparency and public participation are essential components for environmental issues, representing the basic pillars of democratic governance and the sustainability of a state of law. Public participation implies inclusive and democratic governance, facilitating citizens the opportunity to present and support their perspectives, proposals, observations, recommendations and to contribute to the formulation and implementation of policies, as well as to the development of decisions.

According to Trandafirescu (2012), transparency and public participation play an integral role in upholding and promoting democratic ideals and in ensuring that environmental decisions are supported by a wide range of contributions and considerations, and these principles are fundamental in supporting the achievement of sustainable environmental management and in achieving the objective of identifying a balance between development and environmental conservation goals.

At European level, a relevant directive for this area is Directive 2003/35/EC on public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending Council Directive 85/337/EEC. The text of the directive establishes the requirements and obligations relating to public consultation and the provision of relevant information for plans and programmes which may have an impact on the environment. According to the provisions of the directive, the Member States of the EU must ensure that the population is correctly informed and that it has the opportunity to participate in the decision-making process on environmental programmes and plans of measures which may have significant consequences and effects on the environment.

Another significant instrument with a relevant vocation for this area is Regulation (EC) No. 1367/2006 on the implementation of the Aarhus Convention on access to information, public participation in decision-making and access to justice in environmental matters, which represents a relevant instrument for strengthening global governance and promoting regional collaboration in the field of environmental protection. Grigorescu et al. (2023) state that this regulation establishes the public's right of access to information relating to the environment, the right to participate in the preparation of decisions affecting the environment and the right of access to justice in environmental matters. The design and development of this framework demonstrate the principle according to which the public is offered the possibility and guarantee of being informed on environmental matters and of expressing their opinion on them.

The European legal framework in this area also contains other legal instruments such as, for example: Directive 2011/92/EU on environmental impact assessment and Directive 2001/42/EC on strategic environmental assessment which provide for the conditions necessary to ensure public consultation and information in the process of environmental impact assessment and environmental strategies which provide for the necessary conditions for ensuring public consultation and information in the process of environmental impact assessment and environmental strategies.

These legal instruments contribute to ensuring transparency in environmental decision-making and public participation in these processes and facilitate regional collaboration between EU Member States and promote environmental governance at global level. Environmental transparency and public participation through the European legal framework play a fundamental and strategic role at global level, in strengthening governance, in promoting regional and international collaboration in the field of the environment, but which also establish the necessary conditions for ensuring public consultation and providing relevant information and data in the decision-making process.

Regarding the Mediterranean, it is found that the EU has developed policies of an unequal, Eurocentric nature, based on technocratic and depoliticising interests in the Mediterranean, focusing mainly on the security and stability side to the detriment of democracy, human rights and the rule of law, as the main rules and norms on which the EU is built and which it should promote, as provided for in the provisions of Articles 2 and 3, paragraph (5) of the Treaty on EU.

According to Cebeci (2016), the EU is building the Mediterranean as a diverse space to reproduce its ideal identity vis-à-vis other imperfect Mediterranean, to pursue its own interests and to legitimize its policies. Unilateral and bilateral policy development in the Mediterranean is almost always driven by local stakeholders, in all sectors of activity analysed (energy, industry, climate change, agriculture, water protection, prevention and combating of water pollution. Most of the research and analysis carried out have reflected the major differences and inequalities between the two shores and the ways in which they impact the Mediterranean geographical area. As regards marine pollution, understanding the rationale of the different levels of policy development and implementation is mandatory to address marine pollution in the Mediterranean geographical area. Policies need to address various initiatives and concerns, such as management practices implemented in waste limitation and treatment, tourism, as well as strategies with programmes for the prevention of plastic pollution and river litter management.

A particular emphasis should be placed on the analysis of the strategies used to implement the EU directive on single-use plastics in France, Spain, Italy and Greece and the need to develop a plastic limitation strategy, which would include provisions on market restrictions, efficient waste management, as well as the conclusion of agreements and collaborations between consumers and local and regional producers. All this implies the obligation to undertake continuous and permanent efforts to achieve a good and adequate ecological or environmental status for the Mediterranean Sea. In general, it illustrates the relevance of research, innovation and the development of effective and sustainable environmental policies for unique areas, such as: Mediterranean coastal towns and villages, tourist coastal areas and Mediterranean islands, as well as the urgent obligation to limit the sources of marine pollution in the region. Adequate relevance must be given to the development and implementation of binding policies to limit pollution and meet environmental objectives in coastal towns and villages in the Mediterranean geographical area.

These policies must focus on harmonisation with the strategic objectives of the EU for key sectors, such as consumption patterns, production and waste management, to promote sustainability, prevent and combat pollution, but also climate change. In addition to national policies, local policies must be adapted to the specific needs and requirements of the population and the region, as well as to the effectiveness of collaborations and implementations. Programs with clear objectives and effective monitoring indicators are needed to achieve effective environmental policies, based on scientific evidence and sustainable. Such policies must play a fundamental role in managing natural resources, protecting biodiversity and limiting marine pollution.

However, measuring the effectiveness of these non-binding policies and cooperation agreements can be difficult and complex, especially when compared to binding European directives and regulations that apply to all EU Member States and have specific clear and measurable objectives and targets that support the assessment of their effectiveness. Even if the Euro-Mediterranean Partnership failed and the EU abandoned its approach to building regions towards the Mediterranean and focused on bilateral agreements and trans-Mediterranean relations, a situation that generated the inevitable transformation of the Mediterranean into a conglomerate for risk control and reduction policies, policies must still be created and implemented to develop and promote a space of opportunities and benefits, for areas such as: preventing and combating climate change, preventing and combating pollution of water, air and soil resources, environment, energy and agriculture, research and innovation.

Regarding agriculture and rural development, Hamade et al. (2018) argue that both European and Mediterranean stakeholders prefer bilateral relations between the EU and the partner country, rather than a common Mediterranean area that could be developed and promoted together for the common good of preventing and combating marine pollution, but also of the entire Mediterranean region. On the other hand, according to Roman and Pastore (2018), EU security policies have focused on a perception of the

Mediterranean as a closed location, and this aspect has also been determined by the majority of citizens' and local stakeholders' opinions, especially in countries such as Tunisia and Türkiye, who stated that the Mediterranean was an open area, where people and goods moved freely, but EU policies of a restrictive nature regarding borders and migration have transformed it into a closed area for trade and have instead favoured marine pollution, environmental degradation and determined the emergence and intensification of the phenomenon of climate change.

This situation is due to the perceptions and security interests of EU member states and non-EU states, which has brought to the forefront the issue of coherence in the EU's relations with its Mediterranean partners in major areas, such as trade, migration, energy and the environment, with issues of preventing and combating marine, soil and air pollution, but also climate change. In turn, Aboushady et al. (2019) state that EU policies for the energy and environmental sectors, with its component of preventing and combating marine pollution and climate change, are perceived as policies of an invisible and unclear nature, in the sense that although a series of legal instruments have been developed in this regard, citizens and local communities have not been able to benefit from them, and the effects of implementing these policies, with the operationalisation of platforms or energy, environmental and preventive and combating marine pollution initiatives, which the EU has implemented in the region, have not had the expected and desired results.

A similar situation is also found in the case of citizens and local communities in countries such as Morocco, Lebanon, Egypt and Tunisia who argued that the policy instruments did not target the industrial sector, and marine pollution and water sources in general, as well as air pollution and soil pollution, acquired major connotations. A similar opinion to that of Aboushady et al. (2019) is that of Moisseron and Guesmi (2018), which argues that with regard to the industrial sector in Morocco, the benefits and opportunities of policies with their related instruments could not be identified or quantified in the sector of preventing and combating marine pollution and water, air and soil resources, nor in preventing and combating climate change, which is why they remain generally unknown and invisible, even if small facilities were obtained through European funds in this regard.

As for Tunisia, it is noted that, even though it has benefited from several funds from the EU in the energy and environmental sectors, Tunisian stakeholders could not declare that they are satisfied with the industrial policy and the policy of preventing environmental degradation of the EU in the region. Moisseron et al. (2017) exemplify that for the energy sector, academic and policy research on renewable energy development in the South-East Mediterranean (SEM) region tends to focus on elements related to technical and financial feasibility, completely neglecting social and environmental issues and initiatives', and reporting should be done on how states perceive EU energy policies in the Mediterranean, a situation that would facilitate the drawing and establishment of sustainable and equal relationships between European states and those in the southern and eastern Mediterranean.

Regarding the agricultural and water sectors, local stakeholders have similar perceptions. According to Hamade et al. (2018), the EU's cooperation with national and local stakeholders in the countries of the southern and eastern Mediterranean is difficult and hampered by excessive bureaucracy and complexity due to the existence of legislation with complex procedures and contractual rules, which are unclear and cumbersome, which sometimes come into conflict with the priorities, initiatives and programmes of national governments in the field of energy and the environment. The implementation of EU policies regarding the development and promotion of the agricultural, energy and environmental sectors, in countries such as Egypt, Lebanon, Morocco, and Tunisia is also debated and criticised in terms of inadequate approaches due to the lack of knowledge of the needs, concrete interests, existing gaps in these sectors, as well as their lack of correlation to the national and Mediterranean space.

The implementation of EU policies in the agricultural sector in these countries has had the effect of neglecting local needs and the related technocracy, and local communities, such as for example: members of a fruit and vegetable growing association need to be provided with support and access to larger consumer markets to sell their products, but in return they have only received and benefited from technical

training on agricultural practices through measures and initiatives funded by the EU, but which do not help them sell their local and regional products.

In order to achieve the energy transition in the Mediterranean region, this is not only a matter of competitiveness, but is a fundamental element that aims, among other things, to empower the population, and the future Energy Package for Citizens of the EU is a non-legislative initiative of the European Commission, which focuses on the access of the population and communities to assume an active role. The package aims to empower people to produce and sell their own renewable energy, to maintain and ensure that households and businesses can better manage their energy bills and choose the most suitable energy supplier. The package includes, among other things, measures to support vulnerable people facing energy poverty and measures to promote local actions, seen as a fundamental element in achieving a just and inclusive transition. According to the provisions of this package of measures, every household or business that uses renewable energy supports the energy transition, but also contributes to meeting the EU's objectives regarding energy security, independence and accessibility.

In light of the adoption of this package of measures, the population must be encouraged to engage in transparency and public consultation actions in the process of developing, shaping and implementing national energy transition policies, at the level of each Member State, in the sense that citizens must be invited and encouraged to reflect on the added value of their participation in energy strategies and programs that have as priority themes: acceptance, assumption, responsibility and independence.

All these themes must aim to achieve a rapid and efficient transition that is, above all, fair, but for this, actions and measures are needed to develop stronger instruments to manage the transition with a focus on people, jobs and the environment. The relevance of financing and knowledge transfer are other priority themes for the retraining of workers in heavy industry, with a particular emphasis on a broader component of social change.

Even though the EU wants to develop and promote the energy and environmental sectors through actions regarding the prevention of marine pollution, water resources in general, air, soil, as well as the prevention and fight against climate change and is preparing a new pact, it should still focus on balancing economic and security interests to support civil society, political reforms and inclusive governance, even though in the immediate future, the European Commission will present a new pact for the Mediterranean.

The new pact of the EU must aim to balance economic, security, migration, energy and environmental interests with policies focused on preventing marine pollution and combating climate change, with the overall objective of promoting inclusive governance reforms, through actions to assertively involve allies in both their foreign and domestic policies by creating a group of like-minded pro-democracy actors and by supporting democratic forces, even in the midst of existing disagreements and conflicts. The EU's technocratic and secure approach to the Mediterranean fuels its depoliticising approach, which leaves little room for political action. An important part of this depoliticisation comes from the EU's selective approach to engaging civil society actors, as it tends to cooperate with a co-opted professionalized civil society (a problem already highlighted in the previous section). Interviews with stakeholders in the region lead Dark (2018, p. 13) to argue that 'the EU adopts a technocratic and selective approach in its relations with [civil society organisations], considering them only as agents of service provision and not as actors of political and social change'.

This clearly demonstrates that the EU does not attribute any action to local people in this regard, completely ignoring their potential to create political and social change. This certainly amounts to depoliticisation. It should be noted at this point that some European officials interviewed for the MEDRESET project even described civil society organisations as 'service providers' (Huber and Paciello 2018, p. 10). One interviewee, for example, stated that 'for the EU, civil society organisations are 'fundamental for a pluralistic society and can also be important actors in the field of social services' and that one of the key criteria for working with a group is that they 'provide good services' (Huber and Paciello 2018, p. 10). On the other hand, another interviewee stated that 'the EU works with religious groups 'but always on the basis of the services they can provide' (Huber and Paciello 2018, p. 11). This clearly shows how the

'depoliticised and secured approach of the EU produces and reproduces neoliberal subjects', as argued in WP1 (Cebeci and Schumacher 2016, p. 6).

6.2 Economic valuation and risk assessment

6.2.1 Economic valuation of ecosystem services in Mediterranean agro-ecosystems

Ecosystem services (ES) play a fundamental role in sustaining Mediterranean socio-ecological systems by supporting agricultural production, water regulation, biodiversity conservation, climate resilience, and human wellbeing. In recent decades, the economic valuation of ecosystem services has progressively emerged as an important tool for integrating ecological processes into environmental decision-making, climate adaptation strategies, and sustainable resource management. This section assesses the main ecosystem service valuation approaches applied in Mediterranean agro-ecosystems, discusses their methodological limitations and uncertainties, and identifies emerging directions for more integrated and dynamic valuation frameworks under increasing climate and environmental pressures.

6.2.1.1 Why ecosystem service valuation matters in the Mediterranean context

Mediterranean agro-ecosystems depend strongly on ecosystem services (ES), including water regulation, soil fertility, pollination, climate regulation, erosion control, and biodiversity maintenance. These services sustain agricultural productivity, food security, rural livelihoods, and the resilience of socio-ecological systems across the region (Millennium Ecosystem Assessment (Program) 2005; TEEB 2010). At the same time, Mediterranean ecosystems are increasingly exposed to multiple pressures associated with climate change, land degradation, biodiversity loss, water scarcity, urbanisation, and agricultural intensification. Rising temperatures, recurrent droughts, salinisation, wildfires, and extreme climatic events are expected to alter both the quantity and stability of ecosystem service provision, increasing the vulnerability of Mediterranean agricultural systems and rural territories (IPCC 2022).

Agriculture simultaneously depends on and affects ecosystem services. While agricultural systems rely on regulating and supporting services such as pollination, soil formation, nutrient cycling, and water availability (MEA 2005), intensive agricultural practices may also contribute to ecosystem degradation through habitat loss, soil erosion, groundwater depletion, pollution, and biodiversity decline (Zhang et al. 2007). These interactions generate important trade-offs between short-term productivity gains and long-term ecosystem resilience, particularly in Mediterranean regions characterised by fragile ecological balances and strong resource constraints.

In this context, the economic valuation of ecosystem services has progressively emerged as an important tool for environmental decision-making and policy design (Costanza et al., 1997; Laurans et al. 2013). Ecosystem service valuation aims to make the contribution of ecosystems to human wellbeing more visible within economic and political systems by quantifying, where possible, the benefits provided by ecological processes and the costs associated with their degradation. Such approaches are increasingly mobilised to support climate adaptation strategies, water allocation policies, agroecological transitions, biodiversity conservation, land-use planning, and sustainable resource management in Mediterranean countries (Díaz et al. 2015).

Several conceptual frameworks, including the Millennium Ecosystem Assessment (MEA), The Economics of Ecosystems and Biodiversity (TEEB), and the Common International Classification of Ecosystem Services (CICES), have contributed to structuring ecosystem service assessments and valuation approaches (MEA 2005; TEEB 2010; Haines-Young and Potschin 2012). Although these frameworks differ in their treatment of intermediate and final services, they converge in recognising that ecosystem services constitute a critical interface between ecological processes and socio-economic systems (Fisher et al. 2009; La Notte et al. 2017). In Mediterranean agro-ecosystems, particular attention has been devoted to regulating services, such as pollination and water regulation, due to their essential role in sustaining agricultural production under increasing climatic and environmental stress (La Notte et al. 2017).

However, despite the growing literature on ecosystem service valuation, important methodological and conceptual challenges remain. Many valuation approaches rely on static or accounting-based methods that

may insufficiently capture ecological dynamics, non-linear responses, uncertainty, and long-term climate-related risks (Díaz et al. 2015; Hanley et al. 2015). Moreover, the economic importance of regulating services is often underestimated because many ecosystem functions are weakly represented in markets and difficult to integrate into conventional economic frameworks (Costanza et al., 1997; Laurans et al. 2013). These limitations are particularly important in the Mediterranean region, where ecosystem degradation and climate change are expected to intensify socio-ecological vulnerabilities and increase competition over natural resources.

The following sections assess the main ecosystem service valuation approaches applied in Mediterranean agro-ecosystems, discuss their methodological limitations and uncertainties, and identify emerging directions for more integrated and dynamic valuation frameworks capable of supporting climate adaptation and sustainable policy design.

Table 6.1 | Main ecosystem service classification frameworks used in Mediterranean ecosystem assessments.

Framework	Main categories	Main specificity	Main relevance for Mediterranean assessments
Millennium Ecosystem Assessment (MEA 2005)	Provisioning, regulating, supporting, cultural services	Established the most widely used conceptual framework linking ecosystems and human wellbeing	Frequently used in agro-ecosystem and climate impact assessments
The Economics of Ecosystems and Biodiversity (TEEB 2010)	Provisioning, regulating, cultural, habitat services	Stronger focus on economic valuation and biodiversity-policy integration	Widely mobilised in policy-oriented ecosystem assessments
Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin 2012)	Provisioning, regulating and maintenance, cultural services	Designed to improve consistency in ecosystem accounting and statistical assessments	Increasingly used in European and Mediterranean ecosystem accounting frameworks

6.2.1.2 Main ecosystem service valuation approaches used in Mediterranean agro-ecosystems

Mediterranean ecosystem service valuation studies rely on a wide diversity of methodological approaches, ranging from accounting-based methods and preference valuation techniques to integrated bio-economic and equilibrium models (Table 6.2). However, important differences exist regarding the dimensions of ecosystem services captured, the representation of ecological dynamics, the treatment of uncertainty, and the ability to assess welfare impacts. Existing studies majorly focus on provisioning and regulating services associated with agriculture, water resources, forests, wetlands, coastal ecosystems, and biodiversity conservation under increasing climate and environmental pressures in the Mediterranean region (Campagne et al. 2014; La Notte et al. 2015).

Accounting and market-based approaches remain among the most widely applied valuation methods in Mediterranean agro-ecosystems. These include dependence ratio approaches, replacement cost methods, ecosystem accounting frameworks, and cost-benefit analyses. Such approaches are frequently mobilised to estimate the contribution of ecosystem services, such as pollination, water provision, soil conservation, crop diversification, or coastal protection, to agricultural production and territorial management (Settele et al. 2009; Alcon et al. 2024; Romanazzi et al. 2024). Their main advantage lies in their relatively limited data requirements and their capacity to generate assessments at regional or national scales. For example, ecosystem accounting and biophysical flow approaches have increasingly been used in Mediterranean ecosystem assessments and mapping initiatives (La Notte et al. 2015; Balzan et al. 2018). However, these methods generally rely on static assumptions and often capture accounting or average contribution values rather than marginal welfare impacts or dynamic ecological feedbacks.

Stated preference methods, including contingent valuation and choice experiments, are widely used to estimate non-market ecosystem service values associated with landscapes, biodiversity conservation, agro-

environmental schemes, wetlands, and cultural ecosystem services in Mediterranean rural territories (Bernués et al. 2014; Perni and Martínez-Paz 2017; Rodríguez-Pérez et al. 2020). These approaches are particularly relevant in Mediterranean socio-ecological systems characterised by strong cultural, territorial, and heritage dimensions. Several Mediterranean studies have highlighted the importance of integrating social perceptions, relational values, and stakeholder preferences into ecosystem service assessments (Bernués et al. 2014; Perni and Martínez-Paz 2017; Rodríguez-Pérez et al. 2020). Nevertheless, stated preference approaches remain weakly connected to ecological production mechanisms and are sensitive to several forms of survey-related bias, including hypothetical and strategic bias.

Revealed preference methods, such as travel cost and hedonic pricing approaches, have mainly been applied to tourism, recreation, urban green spaces, and protected areas in Mediterranean coastal and peri-urban systems (Morancho 2003; Martín-López et al. 2009; Blayac et al. 2016). These approaches estimate ecosystem service values through observed market behaviour, such as property prices or recreational expenditures, and therefore provide welfare-consistent estimates grounded in actual preferences. However, their applicability remains limited to ecosystem services generating identifiable market interactions, making them less suitable for regulating and supporting services within agricultural systems.

More advanced modelling approaches, including computable general equilibrium (CGE) models, integrated assessment frameworks, and complex bio-economic production functions, remain comparatively limited in the Mediterranean literature despite their strong analytical potential. These approaches can capture feedbacks, substitution effects, dynamic adaptation processes, and cross-sectoral interactions under climate and environmental change. For example, CGE-based applications in Morocco and at the Mediterranean basin scale have assessed the macroeconomic and welfare implications of water scarcity, climate shocks, and trade adjustments (Roson and Sartori 2012a; Taheripour et al. 2020). Similarly, integrated ecological-economic approaches have been applied to regulating services such as nitrogen retention, water purification, or marine ecosystem services (La Notte et al. 2015).

Finally, only a limited number of studies explicitly model ecosystem services as productive inputs through complex production-function and integrated bio-economic approaches. These frameworks incorporate ecological dynamics directly into agricultural or territorial production systems, allowing ecosystem services to influence output endogenously through interactions with climate, management practices, resource constraints, and farmer behaviour. Mediterranean applications include mechanistic ecological-economic models for olive systems (Ponti et al. 2014) and dynamic bio-economic groundwater valuation models in the Maghreb region (Zaatra et al. 2025). These approaches provide a more accurate representation of marginal ecosystem service values, ecological thresholds, uncertainty, and long-term socio-ecological dynamics. However, their implementation requires extensive ecological, economic, and spatial data, which partly explains their limited diffusion in Mediterranean ecosystem service valuation studies.

Table 6.2 | Comparative overview of ecosystem service valuation approaches applied in Mediterranean agro-ecosystems.

Study	Method	Strengths	Weaknesses	Temporal scale	Spatial scale	Values captured
Ponti et al. (2014)	Complex bio-physical production function (PBDM)	Endogenous ecology–yield–value link; dynamic; captures non-linearities and thresholds	Very data- and model-intensive; crop- and site-specific	Dynamic (climate scenarios)	Farm → basin (Mediterranean olives)	True marginal productivity value of ES
Zaatra et al. (2025)	Dynamic bio-economic production function (DAHBSIM)	Endogenous farmer behaviour; shadow prices; captures risk and constraints	High calibration effort; limited transferability	Long-term dynamic (15+ years)	Farm → aquifer → regional (Maghreb)	Marginal market value of regulating ES (groundwater)
Blili et al. (2025)	Dependence Ratio (DR) + vulnerability indicators	Fine spatial resolution (NUTS-3); harmonised statistics; policy-relevant	Fixed coefficients; static; no marginal or ecological feedbacks	Static (single year)	Departmental (France)	Market-based regulating ES (EVIP)
Gallai et al. -type DR studies (EU/MED)	Dependence Ratio accounting	Simple; comparable across regions; low data needs	Linear, static; risk of overestimation; no welfare basis	Static	National and regional	Market contribution to output
Bernués et al. (2014)	Choice Experiment (CE)	Captures non-market and cultural values; scenario-based	Hypothetical bias; no ES–production causality	Static (scenario)	Local and regional	Use and non-use values (WTP)
Perni and Martínez-Paz (2017)	Choice Experiment (CE)	Estimates marginal WTP; conflict-sensitive	Cognitive burden; no biophysical linkage	Static	Local and regional	Non-market welfare values
Rodríguez-Ortega et al. (2016)	Choice Experiment (CE)	Values agro-environmental services; policy-relevant	Hypothetical bias; static preferences	Static	Regional	Non-market values (HNV farmland ES)
Sgroi et al. (2016)	Contingent Valuation (CV)	Simple WTP estimation; PES relevance	Strategic and embedding bias; no dynamics	Static	Local	Use and non-use values
Molina et al. (2019)	Contingent Valuation (CV)	Captures non-use and existence values	Hypothetical bias; symbolic valuation	Static	Regional	Non-use values
Sy et al. (n.d.)	Deliberative and social choice valuation	Captures legitimacy, norms, collective values	Non-monetary; limited comparability	Process-based	Local and territorial	Socio-cultural and normative values
Alcon et al. (2024)	Social Gross Margin + CBA	Integrates market and non-market values; decision-oriented	ES values exogenous; no marginal productivity	Medium–long term	Farm and regional	Aggregated monetary values
Romanazzi et al. (2024)	Replacement cost + CBA	Policy-oriented; soil-focused; communicable	Cost ≠ welfare value; static	Medium–long term	Watershed	Proxy regulating and provisioning values

Campagne et al. (2015)	Replacement cost (partial) + benefit transfer	Broad ES coverage; low data requirements	Assigned values; no marginality	Static	Regional and coastal	Total Economic Value (proxy)
Castellet-Viciano et al. (2024)	Avoided damage + CBA	Clear fire-prevention narrative	Damage ≠ ES value; static	Medium term	Regional	Proxy regulating values
La Notte et al. (2015)	Ecosystem accounting (SEEA-type)	Strong biophysical realism; accounting consistency	No behavioural or welfare basis	Annual	Regional	Accounting values (regulating ES)
Sebastiani et al. (2021)	Biophysical ES flow × unit value	Quantifies physical ES flows; urban relevance	Exogenous prices; no behaviour	Seasonal and annual	Urban	Proxy monetary values
Kay et al. (2019)	Integrated assessment (biophysical + accounting)	Multi-ES perspective; trade-off analysis	No ES as production input	Medium term	Landscape and regional	Mixed market and non-market proxies
Balzan et al. (2018)	Indicator-based ES mapping	Spatially explicit; planning-oriented	Indicators ≠ economic value	Static	Landscape	Biophysical capacity and flow
Burgos et al. (2017)	Emergy accounting	Systemic perspective; comparability	Constructed values; no marginality	Annual	Regional	Accounting values
Azeñas et al. (2018)	Biophysical performance indicators	Engineering relevance; measurable outputs	No monetisation	Short term	Local	Biophysical outputs
Morancho (2003)	Hedonic pricing (revealed preference)	Based on real market behaviour; avoids hypothetical bias	Limited to urban amenities; use values only	Static	Urban (Spain)	Cultural and regulating ES (amenity values)
Martín-López et al. (2009)	Travel Cost Method (RP)	Welfare-consistent CS estimates; scale-explicit	Site-specific; use values only	Annual and seasonal	Protected area (Spain)	Cultural ES (recreation)
Roson and Sartori (2012b)	Travel Cost Method (RP) with count models	Robust CS estimation; advanced treatment of time and multi-destination trips	Data-intensive; limited to recreation	Annual	Protected area (France, Mediterranean)	Cultural ES (recreation surplus)
Roson and Sartori (2012b)	CGE (water as ES constraint)	Surplus-consistent; economy-wide feedbacks	Water treated exogenously; coarse ecology	Medium–long term	National (Morocco)	Welfare, GDP and sectoral surplus
Roson and Sartori (2012b)	Multi-country CGE	Captures trade spillovers and virtual water	Aggregated sectors; indirect ES valuation	Medium–long term	Mediterranean basin	Total economic surplus
Roson and Sartori (2012b)	GTAP-based CGE (tourism–water nexus)	Cross-sectoral feedbacks; climate relevance	Stylised shocks; weak biophysics	Medium–long term	Mediterranean countries	Welfare and income effects

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6.2.1.3 Main methodological limitations, uncertainties and knowledge gaps

Despite the rapid expansion of ecosystem service valuation studies in Mediterranean agro-ecosystems, important methodological limitations, uncertainties, and knowledge gaps remain. Existing approaches differ substantially in their theoretical foundations, valuation assumptions, spatial and temporal scales, and capacity to represent ecological dynamics and socio-economic interactions. Overall, the Mediterranean literature remains dominated by relatively static, accounting-oriented and sector-specific valuation frameworks, while integrated and systemic approaches capable of capturing long-term socio-ecological dynamics remain comparatively limited.

A first major limitation concerns the predominance of accounting-based and proxy-oriented valuation approaches. Many Mediterranean studies rely on simplified replacement-cost methods, ecosystem accounting approaches, dependence-ratio techniques, cost-benefit analyses, or market-based proxies because these approaches are easier to operationalize and require relatively limited ecological and socio-economic data (Costanza et al., 1997; Campagne et al. 2015; La Notte et al. 2015; Romanazzi et al. 2024). Such methods have been widely applied to assess the economic value of water purification services, erosion control, carbon storage, seagrass conservation, forest services, and hydrological regulation across Mediterranean landscapes (Bellver-Domingo et al. 2018; Burgos et al. 2017; Castellet-Viciano et al. 2024; Mastrorilli et al. 2018). However, these approaches generally estimate average or replacement values rather than marginal or welfare-consistent values. Ecosystem services are frequently represented as fixed coefficients or exogenous environmental stocks, limiting the ability of these methods to capture ecological feedbacks, adaptive responses, substitution mechanisms, and threshold effects.

This limitation is particularly problematic for regulating ecosystem services such as pollination, water regulation, erosion control, biodiversity maintenance, climate regulation, and wildfire prevention, whose functioning depends on complex ecological interactions and non-linear dynamics. Several studies have highlighted that Mediterranean ecosystems are characterised by strong ecological variability and vulnerability to climatic and anthropogenic disturbances, making static valuation assumptions particularly restrictive (Ponti et al. 2014; Sebastiani et al. 2021; Romanazzi et al. 2024). Traditional valuation frameworks often underestimate the systemic importance of regulating services because many ecological processes remain weakly represented in markets and are difficult to monetize using conventional economic tools (Laurans et al. 2013; Díaz et al. 2015).

A second important limitation concerns the weak integration between ecological processes and economic valuation methodologies. Many stated-preference and revealed-preference studies provide useful estimates of recreational, aesthetic, cultural, and biodiversity-related values in Mediterranean rural and coastal landscapes (Bernués et al. 2014; Rodríguez-Ortega et al. 2016; Perni and Martínez-Paz 2017). Similarly, contingent valuation, travel-cost, and willingness-to-pay approaches have been extensively used to estimate the socio-cultural and recreational value of forests, wetlands, agroecosystems, and protected areas (Molina et al. 2019; Sgroi et al. 2016; Campagne et al. 2015). However, these approaches generally remain disconnected from ecological production functions and agricultural decision-making systems. Consequently, they often provide limited insights into the dynamic role of ecosystem services in supporting long-term agricultural productivity, resilience, and climate adaptation.

This issue is particularly visible in the valuation of cultural ecosystem services. Mediterranean cultural landscapes are strongly shaped by long-term interactions between ecological processes, agricultural practices, territorial identities, and social values. Nevertheless, cultural ecosystem services remain among the most difficult ecosystem service categories to conceptualize and operationalize within conventional economic valuation frameworks (Onofri and Boatto 2020). Cultural values linked to heritage, symbolism, identity, spirituality, collective memory, and landscape attachment are often multidimensional, relational, and context-dependent, making them difficult to reduce to monetary metrics alone. Several Mediterranean studies therefore emphasise the need to complement monetary valuation with deliberative, participatory, and socio-cultural approaches capable of capturing plural and socially embedded values (Bernués et al. 2014; Sy et al. 2022).

Another important methodological limitation concerns the treatment of stakeholder heterogeneity and social conflict. Ecosystem services are not perceived uniformly across social groups, territories, or economic sectors. Mediterranean agroecosystems often involve competing uses of land, water, forests, biodiversity, and coastal resources, generating trade-offs between agricultural production, conservation objectives, tourism development, and rural livelihoods. Several studies demonstrate that ecosystem service preferences vary significantly depending on socio-economic characteristics, psychographic profiles, territorial identities, and stakeholder interests (Rodríguez-Ortega et al. 2016; Perni and Martínez-Paz 2017). Consequently, ecosystem service valuation outcomes may differ substantially according to the selected valuation method, aggregation rule, or participatory process. Deliberative valuation studies further reveal that collective preferences can evolve through social interaction and discussion, highlighting the socially constructed nature of ecosystem service values (Sy et al. 2022). These findings challenge the assumption that ecosystem service values can be treated as fixed individual preferences independent of institutional and social contexts.

Scale mismatches also constitute a major source of uncertainty in Mediterranean ecosystem service assessments. Ecosystem services operate simultaneously across multiple spatial and temporal scales, while valuation studies frequently rely on aggregated indicators or generalized coefficients that insufficiently capture local ecological heterogeneity and territorial dynamics (Hein 2009). Pollination services, for example, may generate highly differentiated economic outcomes depending on landscape structure, crop diversity, farming systems, climatic conditions, and pollinator abundance. Water-related ecosystem services similarly involve complex interdependencies between farm, watershed, aquifer, and regional scales (Mastrorilli et al. 2018). Coastal and marine ecosystem services are also highly sensitive to localized ecological degradation and spatial externalities, as illustrated by studies on *Posidonia oceanica* meadows in the Mediterranean Sea (Campagne et al. 2014; Burgos et al. 2017; El Zrelli et al. 2023). Such scale dependencies remain insufficiently represented in many existing valuation frameworks.

A further limitation concerns the insufficient incorporation of climate change uncertainty and long-term socio-ecological dynamics. Mediterranean ecosystems are characterised by high climatic variability and increasing exposure to droughts, salinisation, desertification, biodiversity decline, heatwaves, hydro-climatic extremes, and wildfire risks (IPCC 2022). Nevertheless, many ecosystem service valuation studies remain equilibrium-oriented and assume relatively stable ecological production relationships. This is particularly problematic in Mediterranean agroecosystems where ecological tipping points and irreversible degradation processes may strongly alter ecosystem functioning over time. Several recent studies have highlighted the importance of integrating non-linear ecological responses, species interactions, and climate-sensitive production functions into valuation frameworks (Ponti et al. 2014; Sebastiani et al. 2021; Castellet-Viciano et al. 2024). However, such approaches remain relatively rare because of their high ecological, spatial, and computational requirements.

Data limitations also remain a major constraint for integrated ecosystem service valuation in Mediterranean regions. Long-term ecological monitoring, pollinator surveys, hydrological observations, land-use data, biodiversity indicators, and farm-level socio-economic datasets remain fragmented and unevenly available across Mediterranean countries and territories. This situation limits the calibration and validation of integrated bio-economic and ecological models and reduces comparability across studies and spatial scales. Furthermore, differences in classification systems, indicators, monetary assumptions, and valuation methodologies complicate the synthesis and aggregation of ecosystem service assessments at the Mediterranean basin scale (Campagne et al. 2015; La Notte et al. 2015).

Another important limitation concerns the weak operational integration between ecosystem service valuation and governance processes. Many valuation studies provide estimates of ecosystem service values without sufficiently addressing how these values can be incorporated into decision-making, territorial governance, agricultural policies, or resource management systems. While Payments for Ecosystem Services (PES), ecosystem accounting frameworks, and environmental compensation schemes are increasingly discussed in Mediterranean contexts (Sgroi et al. 2016), important challenges remain regarding institutional implementation, stakeholder legitimacy, policy coordination, and long-term governance

effectiveness. Ecosystem service valuation therefore often remains disconnected from the participatory and institutional dimensions necessary for operational policy integration.

More integrated approaches, including dynamic bio-economic models, ecological-economic frameworks, computable general equilibrium models, and coupled socio-ecological systems modelling, provide important opportunities to overcome some of these limitations (Roson 2012; Ponti et al. 2014; Kaya et al. 2019; Zaatra et al. 2025). These approaches allow the integration of ecological feedbacks, behavioural adaptation, resource constraints, cross-sectoral interactions, and climate uncertainty within dynamic territorial systems. However, their application remains limited in Mediterranean ecosystem service valuation literature due to their substantial data requirements, modelling complexity, and interdisciplinary nature.

Overall, current ecosystem service valuation practices in Mediterranean agroecosystems still tend to underestimate the systemic, dynamic, and socially embedded nature of ecosystem services. Existing approaches often insufficiently capture ecological feedbacks, uncertainty, territorial heterogeneity, governance dimensions, and long-term socio-ecological interactions. Addressing these limitations requires stronger integration between ecological modelling, production economics, climate science, participatory governance, and territorial approaches to better represent ecosystem complexity and support more resilient and sustainable Mediterranean socio-ecological systems.

6.2.1.4 Emerging directions for ecosystem service valuation in the Mediterranean

The growing recognition of the limitations associated with conventional ecosystem service valuation approaches has stimulated the emergence of more integrated, systemic, and transdisciplinary frameworks in Mediterranean agro-ecosystems. Increasing climate uncertainty, water scarcity, biodiversity decline, land degradation, and socio-economic pressures require valuation approaches capable of capturing ecological dynamics, behavioural adaptation, cross-sectoral interactions, and long-term resilience processes (IPCC 2022). As a result, recent developments increasingly move beyond static accounting frameworks toward integrated socio-ecological, bio-economic, and governance-oriented approaches.

One important emerging direction concerns the development of integrated bio-economic and ecological modelling frameworks. These approaches combine ecological processes with agricultural production systems, resource constraints, and economic decision-making to assess how ecosystem service changes affect socio-economic outcomes under different environmental and policy scenarios (Hanley et al. 2015). In Mediterranean contexts, dynamic bio-economic models have increasingly been applied to issues related to groundwater depletion, irrigation management, crop adaptation, and agroecological transitions (Roson 2012; Ponti et al. 2014; Zaatra et al. 2025). By integrating ecological feedbacks, risk, and farmer behaviour, these approaches allow ecosystem services to be treated as endogenous components of socio-ecological production systems rather than as fixed external inputs.

Recent studies also increasingly emphasise the need to analyse ecosystem services through broader socio-ecological systems frameworks capable of integrating governance structures, institutions, local knowledge, and territorial dynamics. In this context, agroecological transitions are progressively analysed not only as technical production changes, but as systemic transformations involving interactions between ecological resources, actors, governance systems, and social networks. Recent work conducted in Algeria using Ostrom's Social-Ecological Systems Framework illustrates this transition toward more integrated and transdisciplinary approaches for understanding agroecological adoption and soil sustainability in arid Mediterranean systems (Cagiran et al. 2026). The study highlights how soil degradation, water scarcity, governance structures, institutional support, farmer training, and social networks interact simultaneously in shaping ecosystem resilience and agroecological transitions. Such approaches increasingly position ecosystem services within broader socio-ecological interactions rather than considering them as isolated ecological outputs.

Another important direction involves the incorporation of climate change and long-term environmental uncertainty into ecosystem service valuation. Mediterranean ecosystems are characterised by high climatic

variability and increasing exposure to droughts, heatwaves, salinisation, desertification, biodiversity decline, and wildfire risks (IPCC 2022). Consequently, there is growing recognition that valuation approaches should move beyond equilibrium assumptions and incorporate non-linear ecological responses, thresholds, adaptation dynamics, and long-term resilience considerations (Hanley et al. 2015; Díaz et al. 2015). Scenario-based modelling, integrated assessment frameworks, and climate-sensitive production functions provide important opportunities to evaluate ecosystem services under future climate and land-use trajectories.

Recent research has also highlighted the importance of participatory and governance-oriented valuation approaches. Ecosystem services are increasingly understood not only as biophysical or economic outputs, but also as socially constructed and territorially embedded processes shaped by stakeholder perceptions, institutional arrangements, and governance systems (Díaz et al. 2015). Deliberative and participatory valuation approaches therefore aim to integrate local knowledge, social preferences, cultural values, and collective priorities into ecosystem service assessments (Sy et al. 2022). Such approaches are particularly relevant in Mediterranean rural territories, where agricultural landscapes often combine ecological, cultural, and heritage dimensions, and where conflicts over water, land use, biodiversity conservation, and rural development are becoming increasingly important.

A further emerging direction concerns the adoption of nexus-based and system-level approaches that explicitly recognize the interdependencies between water, energy, food, ecosystems, and socio-economic systems. Within Mediterranean contexts characterised by strong resource constraints and climate vulnerability, the Water-Energy-Food-Ecosystems (WEFE) nexus framework has progressively emerged as an important analytical and governance approach for addressing trade-offs and synergies between sectors. Integrating ecosystem service valuation into nexus-oriented frameworks allows a better understanding of how ecosystem degradation may propagate across agricultural production systems, water availability, energy demand, food security, and regional economies.

Recent WEFE-oriented strategic planning initiatives in the Mediterranean increasingly combine ecosystem service valuation, participatory governance, climate adaptation, and integrated territorial management within unified socio-ecological frameworks (Nikolaidis et al. 2026). The WEFE nexus Agricultural Transformation Strategy developed for Jordan and Palestine illustrates this evolution by integrating ecosystem restoration, smart irrigation, soil organic matter restoration, circular resource management, renewable energy integration, wastewater reuse, and climate adaptation within a coherent territorial planning framework. The strategy explicitly recognizes agriculture as both a major source of WEFE pressures and a key leverage point for socio-ecological transformation, emphasising regenerative and nature-based approaches as central components of long-term resilience.

Within this perspective, ecosystem services are increasingly evaluated according to their contribution to multiple dimensions simultaneously, including water efficiency, food security, biodiversity conservation, energy resilience, climate adaptation, soil restoration, and socio-economic viability. For example, the Jordan Valley WEFE strategy evaluates smart irrigation systems, soil carbon restoration, rainwater harvesting, decentralized wastewater reuse, and circular nutrient management not only according to direct economic returns, but also according to their impacts on groundwater depletion, ecosystem resilience, climate adaptation, and long-term territorial sustainability. Such approaches represent an important shift toward integrated ecosystem service valuation frameworks capable of capturing cross-sectoral synergies and systemic resilience.

At the same time, increasing attention is being devoted to the integration of ecosystem service valuation into environmental accounting systems, climate adaptation strategies, biodiversity policies, and agro-environmental schemes. The growing development of ecosystem accounting frameworks, spatially explicit ecosystem service mapping, Earth observation systems, and high-resolution environmental monitoring tools may facilitate more dynamic and territorially differentiated assessments in the future (La Notte et al. 2015). However, important challenges remain regarding methodological harmonisation, uncertainty

management, data interoperability, and the integration of plural ecological, economic, and socio-cultural values into policy frameworks.

To sum up, emerging ecosystem service valuation approaches in the Mediterranean increasingly converge toward integrated socio-ecological perspectives that combine ecological dynamics, economic behaviour, governance processes, climate uncertainty, and territorial resilience within systemic assessment frameworks. These approaches provide important opportunities for improving the representation of regulating ecosystem services, strengthening climate adaptation strategies, supporting agroecological transitions, and enhancing sustainable WEFE-oriented governance across Mediterranean agro-ecosystems.

6.2.1.5 Preliminary key messages and confidence assessment

Accounting-based approaches dominate ecosystem service valuation in Mediterranean agro-ecosystems. Most ecosystem service valuation studies in Mediterranean agro-ecosystems rely on accounting, proxy-based, or static market valuation approaches, including dependence ratios, replacement costs, ecosystem accounting frameworks, and simplified cost-benefit analyses. These methods are widely used because of their relatively low data requirements and their suitability for large-scale assessments. However, they generally estimate average ecosystem service contributions rather than dynamic or welfare-consistent values (*high confidence,* strong agreement across the literature and extensive methodological evidence from Mediterranean valuation studies).

Regulating ecosystem services are likely underestimated in current valuation frameworks. Regulating ecosystem services, such as pollination, water regulation, soil fertility, erosion control, and climate regulation, remain insufficiently represented in conventional economic valuation frameworks because they involve complex ecological interactions, weak market representation, and long-term socio-ecological feedbacks. Consequently, their contribution to agricultural resilience, climate adaptation, and long-term sustainability is likely underestimated in Mediterranean assessments (*medium to high confidence*, broad agreement exists in the literature, although the magnitude of underestimation remains uncertain due to limited dynamic and integrated modelling approaches.

Existing valuation methods insufficiently capture ecological dynamics and climate uncertainty. Most current ecosystem service valuation approaches remain based on relatively static ecological assumptions and equilibrium-oriented frameworks, despite increasing evidence that Mediterranean ecosystems are characterised by non-linear responses, ecological thresholds, climatic variability, and long-term environmental instability. Climate change is expected to intensify these uncertainties through increasing droughts, biodiversity decline, salinisation, and hydro-climatic extremes (*high confidence:* strong evidence from climate science and ecosystem assessment literature supports the increasing importance of uncertainty and non-linear ecological dynamics in Mediterranean socio-ecological systems).

Integrated bio-economic and system-level approaches remain limited but offer strong analytical potential. Only a limited number of Mediterranean studies explicitly integrate ecological processes, economic behaviour, resource constraints, and socio-ecological feedbacks through dynamic bio-economic models, integrated assessment frameworks, or computable general equilibrium approaches. However, these methods provide important opportunities to better represent adaptation processes, cross-sectoral interactions, welfare impacts, and long-term resilience under climate change (*medium confidence:* the analytical potential of integrated approaches is widely recognized, but empirical applications in Mediterranean ecosystem service valuation remain comparatively limited.)

Future ecosystem service valuation frameworks will require greater integration between ecology, economics, climate science, and governance. Improving ecosystem service valuation in Mediterranean agro-ecosystems requires more integrated socio-ecological approaches capable of combining ecological modelling, economic valuation, climate projections, participatory governance, and territorial analysis. Such approaches are increasingly necessary to support climate adaptation, agroecological transitions, sustainable water management, biodiversity conservation, and WEFE nexus-oriented policies across Mediterranean territories (*medium to high confidence*: strong conceptual convergence exists across recent

ecosystem service, climate adaptation, and socio-ecological systems literature, although operational implementation remains uneven across Mediterranean regions.

6.2.2 Assessing the economic costs of inaction

6.2.2.1 Introduction

Cost of Inaction (CoI) refers to analytical approaches that estimate the avoidable economic and welfare consequences of maintaining current development and policy trajectories under climate change, relative to plausible adaptation or risk-reduction pathways. In applied climate policy, CoI is used as a decision-support construct, not as a comprehensive measure of total environmental damage or sustainability loss. It focuses on quantifiable market and non-market impacts that can be linked to delayed or insufficient action, while acknowledging that some long-term, irreversible, or non-monetizable effects may remain only partially captured.

Rather than focusing solely on biophysical trends, CoI frameworks assess climate change in terms of risks, vulnerabilities, and decision-relevant impacts, translating physical change into information usable for adaptation planning, investment prioritisation, and policy design. In the Mediterranean basin—widely identified as a climate change hotspot—CoI assessments therefore play an important role in shaping adaptation strategies and financing debates, even when they represent lower-bound estimates of total welfare loss. Examining both the scientific practices used to generate CoI evidence and the policy frameworks through which this evidence is interpreted is essential to understand why comparable climate pressures are unevenly translated into decision-support across Mediterranean countries, despite shared exposure to warming, water stress, and ecosystem degradation.

CoI frameworks provide counterfactual benchmarks by quantifying the economic consequences of maintaining current trajectories under climate change. For a region warming at approximately 0.45°C per decade—almost twice the global average of about 0.27°C per decade (Zittis et al. 2022)—CoI analysis must translate accelerated climate risks into policy-relevant metrics, while remaining explicit about assumptions, coverage, and limitations. The operational relevance of CoI estimates depends critically on alignment between analytical tools, resource-specific impact assessment methods, and institutional decision-making contexts. This subsection examines Mediterranean CoI research along three interrelated dimensions: (1) mismatches between scientific tools and policy instruments, (2) the need for differentiated assessments reflecting the region's heterogeneous natural resource systems, and (3) opportunities for intra- and extra-regional learning to address persistent science–policy gaps.

6.2.2.2 The Mediterranean tool ecosystem: research capacity versus policy infrastructure

6.2.2.2.1 Scientific tools deployed in Mediterranean CoI research

Mediterranean Cost of Inaction (CoI) assessments documented in the PESETA series, the MEDPRO project, and selected national studies rely on integrated analytical chains combining climate models, sectoral biophysical impact models, and macroeconomic frameworks. For Europe, these chains typically include Computable General Equilibrium (CGE) models such as GEM-E3 and ICES, while broader Mediterranean and EU–MENA comparisons have also relied on global models such as ENVISAGE (Bosello et al. 2010; Ciscar et al. 2011, MEDPRO 2013; Ciscar et al. 2014; Galeotti 2020). While these frameworks allow climate shocks to propagate across sectors and regions, their results are highly sensitive to baseline definitions (e.g. reference socio-economic pathways, productivity trends, policy assumptions) and projection choices (time horizons, discounting, adaptation assumptions), which differ substantially across studies and limit direct comparability of CoI estimates across Mediterranean contexts (MedECC 2020; EEA 2021).

In agriculture, Mediterranean assessments increasingly couple ensembles of General Circulation Models (GCMs) with process-based crop models such as DSSAT and APSIM, which simulate photosynthesis, water stress, and phenological development under Mediterranean climate conditions (Jones et al. 2003; Holzworth et al. 2014; FAO 2021). However, crop impact estimates depend critically on the choice of

climate baselines (historical reference periods), emission scenarios, CO_2 fertilisation assumptions, and management adaptation hypotheses, which vary widely across assessments. These methodological choices—often made implicitly or for data-availability reasons—introduce additional dispersion in results that is not always transparent to policymakers (MedECC 2020; FAO 2021). Moreover, while the data infrastructure required for model calibration is relatively well developed in parts of the northern Mediterranean, it remains uneven or sparse across many areas of the Maghreb, Mashreq, and Balkans, further constraining the robustness and spatial resolution of projections (Plan Bleu 2019; World Bank 2018).

The PESETA studies for Europe illustrate the technical sophistication of this modelling ecosystem, employing up to 15 climate model simulations for selected impact categories (Ciscar et al. 2014; Galeotti 2020). Yet even within PESETA, differences in baseline socio-economic trajectories and adaptation assumptions across impact modules complicate aggregation and comparison. These challenges are amplified in Southern and Eastern Mediterranean assessments: for the 11 countries covered in MEDPRO, data limitations and model resolution did not allow fully disaggregated country-level analysis, and results were derived under heterogeneous baseline and projection assumptions. As a result, CoI estimates across Mediterranean studies are often methodologically consistent within individual assessments but not directly comparable across regions, highlighting how baseline selection and projection hypotheses constitute a central, yet under-acknowledged, constraint in Mediterranean CoI research (MEDPRO 2013; IEMed 2019; MedECC 2020).

6.2.2.2.2 Policy decision-making tools across Mediterranean contexts

Mediterranean policymakers therefore operate within markedly different decision-support environments that mirror the heterogeneity of analytical tools and baseline assumptions underlying Cost of Inaction assessments. EU member states benefit from relatively standardised appraisal frameworks, including formal benefit–cost analysis requirements, economic valuation guidelines distinguishing market-based and non-market valuation methods, and adaptation investment assessments. These frameworks are underpinned by relatively harmonised baseline scenarios and projection conventions, enabling EU-level estimates of adaptation investment needs on the order of €40 billion per year under a 1.5°C pathway, rising to approximately €175–200 billion per year under higher warming scenarios of 3°C –4°C (European Commission 2021; European Environment Agency 2021; European Investment Bank 2021).

In Southern and eastern Mediterranean countries, by contrast, decision-support architectures are more fragmented and less consistently linked to integrated assessment frameworks. While national adaptation strategies exist in many countries—including Morocco, Tunisia, and Egypt—implementation capacity is often constrained by limited technical resources, financing, and the absence of harmonised baseline scenarios and projection tools required to translate climate risks into comparable CoI metrics (Arab Republic of Egypt 2011; Republic of Tunisia 2012; Kingdom of Morocco 2014; IEMed 2019). These constraints are further compounded by diverse structural conditions across the region—ranging from hydrocarbon dependence and rapid urbanisation to governance instability—which call for context-specific policy instruments but are not always supported by locally calibrated and methodologically comparable CoI evidence (World Bank 2022; IMF 2023; MedECC 2023).

This asymmetry is reflected in both the scope and comparability of Cost of Inaction estimates across the Mediterranean, as well as in the underlying baseline and projection assumptions that support them. In the EU, PESETA-based analyses project EU-wide GDP losses on the order of €65–70 billion per year under a high-warming scenario of approximately +5.4°C by the end of the century. Southern European countries account for a disproportionate share of these losses due to combined effects of heat stress, agricultural impacts, reduced labour productivity, and coastal damages (Ciscar et al. 2011, 2014; EEA 2020). Sector-specific results further indicate agricultural yield losses exceeding 10–20% for key crops under +2 to +3°C warming, alongside coastal flood damages increasing by a factor of two to four by mid-century in the absence of adaptation (Ciscar et al. 2014; EEA 2021). These estimates benefit from relatively harmonised

baseline socio-economic trajectories, long time series, and consistent sectoral coverage, which facilitate aggregation and cross-country comparison.

In Southern and eastern Mediterranean countries, by contrast, climate risks are concentrated in highly climate-sensitive sectors—such as agriculture, water supply, coastal infrastructure, and tourism—that play a critical role in employment and livelihoods, even where their direct contribution to GDP is more limited. Across North Africa and parts of the Eastern Mediterranean, agriculture typically employs 20–40% of the labour force while contributing roughly 8–15% of GDP, making drought and water scarcity macro-critical through income, food security, and fiscal channels (FAO 2021; World Bank 2018, 2022). Regional assessments project declines in water availability of approximately 10–30% by mid-century, alongside increases in irrigation water demand of 5–20%, intensifying pressure on already stressed water systems (Plan Bleu 2019; MedECC 2020). In the absence of adaptation, economic losses from water scarcity alone are estimated at around 2–6% of GDP by mid-century in several southern Mediterranean economies (IEMed 2019; World Bank 2020). However, these estimates are often derived under heterogeneous baselines, partial sectoral coverage, and simplified adaptation assumptions, limiting their direct comparability with EU-level CoI results.

Against this background, MEDPRO's macroeconomic estimates for Southern and Eastern Mediterranean countries—typically ranging from −0.04% to −0.14% of GDP by 2050 when considering only selected impact channels such as agriculture and coastal damages—are best interpreted as lower-bound estimates (MEDPRO 2013). These figures primarily reflect methodological constraints, including restricted sectoral scope, coarse spatial resolution, and data gaps, rather than low underlying climate vulnerability (MedECC 2020; World Bank 2022).

The consequence is a persistent imbalance in how CoI evidence informs policy across the Mediterranean. In northern Mediterranean countries, CoI research feeds directly into EU adaptation strategies, national climate legislation, and standardised investment appraisal frameworks. In Southern and eastern Mediterranean countries, governments often engage in international climate finance negotiations with less comprehensive and less methodologically comparable quantitative evidence, despite facing comparable or higher exposure to climate risks—precisely when robust and harmonised CoI estimates are most critical for accessing adaptation finance (OECD 2020; UNFCCC 2021; European Investment Bank 2022).

6.2.2.3 Mediterranean resource heterogeneity: why one-size-fits-all assessment fails

The Mediterranean basin exhibits exceptional ecological, climatic, and socio-economic heterogeneity, which fundamentally limits the applicability of uniform Cost of Inaction (CoI) assessment frameworks. The basin simultaneously encompasses hyper-arid aquifer-dependent systems in North Africa, rainfed and irrigated agricultural mosaics in southern Europe, highly climate-sensitive tourism economies, shared marine ecosystems, and biodiversity hotspots with high endemism. As a result, climate impacts, adaptation pathways, and welfare consequences differ markedly across resource systems, requiring resource-specific CoI methodologies rather than aggregated or generic assessment logics (MedECC 2020; IPCC 2022).

6.2.2.3.1 Mediterranean agricultural systems: adaptation complexity

6.2.2.3.1.1 Regional characteristics

Mediterranean agriculture has historically evolved under conditions of seasonal water scarcity and climatic variability, with dominant cropping systems—such as cereals, olives, grapes, and fruit trees—exhibiting varying degrees of drought tolerance and adaptive management (IEMed 2019; FAO 2021). However, climate projections consistently indicate declining yields for winter and spring crops in southern parts of the basin, alongside increased evaporative demand. Regional assessments estimate that irrigation water demand driven by climate change alone could increase by approximately 4–18% by 2100, rising to 22–74% when demographic and socio-economic drivers are included, with substantial variation across subregions and scenarios (IEMed 2019; MedECC 2020).

6.2.2.3.1.2 Observed and autonomous adaptation

Empirical studies document widespread autonomous adaptation across Mediterranean agriculture, including adjustments in planting dates, crop varieties, irrigation scheduling, and management practices in countries such as Spain, Italy, and Greece (Iglesias et al. 2011; Iglesias and Garrote 2015; IPCC 2022). These long-standing adaptive responses complicate CoI baseline specification: in the Mediterranean context, 'inaction' rarely corresponds to zero behavioural change, as adaptive management has been embedded in agricultural systems over centuries.

6.2.2.3.1.3 Methodological requirements

Agricultural CoI assessment therefore typically combines ensembles of General Circulation Models (GCMs) with process-based crop models calibrated to Mediterranean conditions, feeding biophysical outputs into economic models that quantify farm-level and sectoral impacts (Jones et al. 2003; Holzworth et al. 2014; FAO 2021). Recent advances link agronomic meta-analyses to macroeconomic models to derive more traceable damage functions and social cost estimates (Moore et al. 2017; Ortiz-Bobea et al. 2021). However, such integrated approaches remain unevenly implemented in Mediterranean-specific assessments.

6.2.2.3.1.4 Resource-specific gap

Global agricultural impact studies suggest that adaptation can moderate, but not eliminate, climate damages—projecting average global yield losses of roughly 8% by 2050 even with adaptation, increasing to over 20% by 2100 under high-emissions pathways (Ortiz-Bobea et al. 2021). Mediterranean assessments, including PESETA and MEDPRO, vary substantially in how adaptation is parameterized: some assume static technologies, while others invoke adaptation qualitatively without empirically calibrated effectiveness estimates (Ciscar et al. 2014; IEMed 2019). For policymakers—such as in Tunisia, where MEDPRO estimates GDP losses of approximately −0.26% to −0.41% by 2050—the choice between empirically grounded adaptation scenarios and static baselines critically influences whether adaptation investments appear cost-effective (MEDPRO 2013).

6.2.2.3.1.5 Mediterranean-specific innovation need

CoI assessments require regionally calibrated adaptation effectiveness parameters reflecting Mediterranean realities, such as crop switching, irrigation modernisation, and spatial shifts in production systems. Without such empirics, reliance on global averages risks misrepresenting both adaptation potential and residual damages.

6.2.2.3.2 Mediterranean water resources: scarcity driving conflict

6.2.2.3.2.1 Regional characteristics

Water resources are highly unevenly distributed across the Mediterranean, with chronic scarcity in much of the southern and eastern basin. Regional projections indicate declines in renewable freshwater availability of approximately 10–30% by mid-century, depending on location and scenario, driven by reduced precipitation and increased evapotranspiration (Plan Bleu 2019; MedECC 2020). Model-based syntheses suggest median runoff reductions of about 9% at 1.5°C and 17% at 2°C of global warming (IPCC 2022). Southern and eastern Mediterranean regions already experience structural water deficits, declining groundwater recharge, and increasing saltwater intrusion in coastal aquifers (World Bank 2018; IEMed 2019). Approximately 180 million people in the region currently experience water scarcity under conventional definitions (IEMed 2019).

6.2.2.3.2.2 Methodological requirements

Water-related CoI assessment requires integrating hydrological models with ecosystem services frameworks that capture not only provisioning services but also regulating functions such as water purification, erosion control, and flood mitigation (Brauman et al. 2007; IPBES 2019). Valuation approaches typically combine market pricing for water supply with stated and revealed preference methods for non-market services (Brauman et al. 2007).

6.2.2.3.2.3 Resource-specific gap

Despite methodological advances, water CoI studies in the Mediterranean continue to focus primarily on direct use values—municipal supply and irrigation—while significantly omitting irreversibility of groundwater depletion, ecosystem collapse in intermittent rivers, conflict risks linked to transboundary scarcity, and cultural heritage losses associated with water-dependent settlements (MedECC 2020; World Bank 2020). MEDPRO, for example, excluded water resource impacts entirely, despite water scarcity likely representing a dominant climate risk for several southern and eastern Mediterranean countries (MEDPRO 2013; IEMed 2019).

6.2.2.3.3 Mediterranean marine and coastal systems: shared vulnerability, fragmented governance

6.2.2.3.3.1 Regional characteristics

Marine and coastal systems in the Mediterranean generate a high and spatially interconnected cost of inaction, reflecting dense coastal settlement, shared ecosystems, and limited adaptive buffers. Approximately one-third of the Mediterranean population (around 150 million people) lives in coastal areas, a legacy of the basin's micro-tidal regime and historically limited storm surges that enabled development close to mean sea level (Lionello et al. 2014; IPCC 2022). As a result, maintaining current coastal development trajectories under climate change exposes populations, ports, transport corridors, tourism infrastructure, and cultural heritage to rapidly escalating damages.

Under intermediate emissions pathways, Mediterranean mean sea level is projected to rise by roughly 30–40 cm by 2100, with higher-end outcomes under high-emissions scenarios (Vousdoukas et al. 2020; IPCC 2022). Coastal risk modelling indicates that inaction on adaptation leads to non-linear increases in annual expected damages, as flood frequencies rise and protection thresholds are exceeded. For the EU alone, coastal flood damages are projected to increase from around €1–2 billion per year today to €20–40 billion per year by 2100 under high-emissions scenarios, with southern European Mediterranean countries among the most exposed due to concentrated coastal assets and tourism-dependent economies (Hinkel et al. 2014; Vousdoukas et al. 2018; EEA 2020).

Marine ecosystems face compounding pressures from warming, ocean acidification, overexploitation, pollution, and biological invasions. Fisheries assessments project that climate-driven changes in productivity and species distribution could reduce maximum catch potential in the Mediterranean Sea by approximately 15–35% by mid-century, relative to historical baselines, amplifying existing overfishing pressures (Cheung et al. 2018; FAO 2018). The General Fisheries Commission for the Mediterranean reports that over 75% of assessed fish stocks are already overexploited, implying that delayed adaptation substantially increases the risk of stock depletion and long-term rent losses (GFCM 2020).

The Mediterranean has recorded over 700 non-indigenous marine species, more than half introduced via the Suez Canal, with warming conditions favouring further invasions and persistent ecosystem change (Katsanevakis et al. 2014; Galil et al. 2017). In a semi-enclosed basin, these ecological impacts propagate across borders through currents, migratory species, and shared fish stocks, generating basin-wide welfare losses under fragmented governance arrangements.

6.2.2.3.3.2 Methodological requirements

Assessing the cost of inaction in Mediterranean marine and coastal systems requires valuation frameworks that explicitly compare avoided losses under timely adaptation with damages under delayed or insufficient responses, rather than relying on static damage snapshots that fail to capture the dynamics of climate change and ecosystem degradation. Methodological approaches must be aligned with distinct ecosystem service categories, each demanding tailored valuation techniques that reflect the specific nature of the service in question. For provisioning services, particularly fisheries, bioeconomic models are essential to link climate-driven stock dynamics, harvest behaviour, and long-run rents, especially for shared and straddling stocks that cross national boundaries (Costello et al. 2016; FAO 2018). Empirical evidence demonstrates that delayed fisheries reform under climate change leads to persistent income losses, while

early adaptation can partially preserve rents, highlighting the substantial economic benefits of timely intervention (Costello et al. 2016).

For regulating services, such as coastal protection, avoided-damage and replacement-cost methods are appropriate, comparing the protective functions of natural defences—including wetlands, dunes, and *Posidonia oceanica* meadows—with engineered alternatives such as sea walls and breakwaters (Barbier et al. 2011; Narayan et al. 2017). Studies consistently show that nature-based solutions can significantly reduce flood damages at lower long-term cost, but these benefits are majorly lost under delayed action, as degraded ecosystems lose their capacity to provide effective protection.

For cultural and non-use values, stated-preference methods are required to capture existence, bequest, and cultural heritage values that are irreversibly lost under ecosystem degradation (Hanley et al. 2015). These values are particularly relevant in the Mediterranean, where coastal heritage and landscape identity are central to both human welfare and tourism demand, making their loss not only an ecological but also a cultural and economic tragedy.

Global valuation syntheses demonstrate orders-of-magnitude variation in marine ecosystem service values—ranging from hundreds of USD per hectare per year for open-ocean systems to over one million USD per hectare per year for highly valued coastal ecosystems—underscoring the risks of uncritical benefit transfer and the urgent need for regionally calibrated valuation in Mediterranean CoI assessments (de Groot et al. 2012; Costanza et al. 2014). Such variation highlights that the generic global estimates are inadequate for policy-relevant decision-making in the Mediterranean, and that context-specific, ecosystem-based valuation is essential to accurately capture the costs of inaction and the benefits of timely adaptation in this unique and vulnerable semi-enclosed sea.

6.2.2.3.3.3 Resource-specific gap

Despite methodological progress, marine and coastal costs of inaction remain systematically underestimated in Mediterranean assessments. Marine valuation lags behind terrestrial ecosystems due to monitoring challenges, complex ecological dynamics, and fragmented governance structures (Barbier et al. 2011; Liquete et al. 2013). Empirical valuation and impact evidence is heavily concentrated on European coastal infrastructure, while fisheries productivity losses, marine biodiversity decline, and ecosystem-mediated tourism impacts in southern and eastern Mediterranean countries remain poorly quantified (Ciscar et al. 2014; IEMed 2019).

As a result, major Mediterranean CoI exercises, such as PESETA, primarily capture market-visible coastal damages, while excluding slow-onset, cumulative, and transboundary losses that define the long-term cost of inaction in marine systems. For countries where fisheries and marine-based tourism contribute 15–25% of GDP or employment, this omission implies a structural downward bias in CoI estimates, obscuring the economic case for early adaptation and coordinated basin-wide management (IPCC 2022; World Bank 2022).

6.2.2.3.4 Mediterranean biodiversity: endemism meeting climate velocity

6.2.2.3.4.1 Regional characteristics

The Mediterranean basin is a globally recognised biodiversity hotspot, characterised by high species richness and exceptional endemism, shaped by long-term geological complexity, climatic gradients, and historical isolation (IPBES 2019; Myers et al. 2000; MedECC 2020). These features also make Mediterranean biodiversity particularly vulnerable to climate change. Regional assessments document increasing aridity, more frequent and intense wildfires, and upward and northward shifts in species distributions, as organisms track changing temperature and moisture regimes (MedECC 2020; IPCC 2022).

Model-based projections indicate that over 50% of Mediterranean endemic plant and animal species could qualify for threatened status on the IUCN Red List by the late 21st century (2070–2099) under high-warming scenarios, driven by habitat contraction and climate velocities exceeding species' dispersal capacities (Urban 2015; MedECC 2020). In contrast to more continuous continental systems, many Mediterranean subregions—such as Aegean islands, North African mountain ranges, and Iberian

peninsulas—offer limited climate refugia. For endemic species confined to these areas, climate change implies global extinction rather than local range shifts, generating irreversible losses under inaction.

From a Cost of Inaction perspective, these dynamics imply that delayed adaptation leads to permanent biodiversity loss, with no possibility of recovery once critical thresholds are crossed.

6.2.2.3.4.2 Methodological requirements

Biodiversity contributes to welfare and economic systems through multiple channels, encompassing a diverse array of functions and values that extend far beyond simple resource extraction. These contributions include supporting ecosystem processes that generate essential services, such as pollination, soil formation, and water regulation, which underpin agricultural productivity and ecosystem resilience. Biodiversity also constitutes services directly, providing genetic resources and medicinal potential that are critical for pharmaceutical development, crop improvement, and biotechnology. Furthermore, biodiversity provides non-use values, such as existence, bequest, and cultural identity, which are deeply embedded in the social and cultural fabric of many Mediterranean societies and contribute to human well-being in ways that are not captured by market transactions alone (IPBES 2019; IPCC 2022). Together, these multiple channels of contribution highlight the profound and multifaceted dependence of human welfare and economic systems on the maintenance of biodiverse ecosystems and underscore the substantial costs that would result from their continued degradation and loss.

Economic valuation of biodiversity therefore relies primarily on stated-preference methods—including contingent valuation and choice experiments—to capture non-market and non-use values (Hanley et al. 2015). Recent methodological advances emphasise that biodiversity values are state-dependent and dynamic, increasing as ecosystems become scarcer and more degraded. Meta-analyses indicate that accounting for scarcity and income effects can raise estimated ecosystem service values by over 100%, with combined effects exceeding 150–180% relative to static valuation approaches (Bateman et al. 2011; Dasgupta 2021). For Cost of Inaction analysis, this implies that ignoring dynamic scarcity effects systematically understates long-term welfare losses, particularly in regions such as the Mediterranean where biodiversity loss is considerably irreversible.

6.2.2.3.4.3 Resource-specific gap

Despite its importance, Mediterranean biodiversity loss remains marginal in economic CoI assessments. Computable General Equilibrium (CGE) models commonly used in Mediterranean climate impact studies capture only market transactions, placing option values, existence values, and irreversibility effects outside their descriptive scope (IEMed 2019; MedECC 2020). As a result, biodiversity impacts are either omitted or treated qualitatively, even when they represent the most permanent dimension of climate damage.

This methodological limitation shapes reported priorities. For example, PESETA III identifies heat-related mortality as the dominant welfare impact in southern Europe, largely because mortality can be monetized using established Value of a Statistical Life (VSL) frameworks (Ciscar et al. 2014). Biodiversity loss, by contrast, lacks standardised monetisation within integrated assessment models and therefore appears economically ‘minor,’ despite its irreversible nature. This asymmetry reflects valuation conventions rather than true welfare importance, and risks misguiding adaptation and conservation investment decisions.

Reducing the biodiversity-related cost of inaction in the Mediterranean requires regionally calibrated valuation and modelling approaches that explicitly account for endemism and irreversibility, distinguishing global extinction of Mediterranean-unique species from local extirpation in more connected ecosystems; cultural and identity dimensions, recognising that Mediterranean biodiversity (e.g. olive groves, cork oak landscapes, Mediterranean monk seals) underpins social welfare beyond generic ecosystem service categories; and dynamic scarcity effects, whereby remaining ecosystem services become progressively more valuable as degradation advances under long-term climate change (Bateman et al. 2011; IPBES 2019; MedECC 2020; Dasgupta 2021). Without such innovations, Mediterranean Cost of Inaction assessments will continue to systematically undervalue biodiversity loss, obscuring one of the region’s most profound and irreversible climate risks.

6.2.2.3.5 Mediterranean tourism economies: climate as competitive advantage

6.2.2.3.5.1 Regional characteristics

Tourism is a macro-critical sector for the Mediterranean and a central channel through which the cost of inaction materializes. The region accounts for approximately one-third of global international tourism, hosting around 330 million international tourist arrivals in 2016, with projections of close to 500 million arrivals by 2030 under pre-pandemic trends (UNWTO 2018; IPCC 2022). Tourism directly and indirectly supported around 15% of total employment in the Mediterranean region in the mid-2010s, with France, Spain, Italy, and Greece among the world's leading destinations, and particularly rapid growth observed in Türkiye, Croatia, and Albania between 1995 and 2015 (IPCC 2022).

Mediterranean tourism has historically leveraged a climate-based comparative advantage, marketed around reliable sunshine, warm seas, and predictable summer conditions. However, climate change threatens this advantage through multiple pathways, including excessive summer heat that reduces destination attractiveness and increases health risks, sea-level rise and beach erosion that degrade coastal amenities, water scarcity that constrains hotel, golf, and cruise operations, marine ecosystem degradation, such as algal blooms, jellyfish outbreaks, and seagrass loss, that affects coastal and marine tourism quality, and declining snow reliability that undermines winter tourism in Alpine and Atlas regions (Moreno and Amelung 2009; Gössling et al. 2012; IPCC 2022). Together, these interrelated threats pose significant risks to the economic viability of tourism-dependent communities and highlight the urgent need for adaptation measures to safeguard the sector's future in the Mediterranean basin. From a Cost of Inaction perspective, these pressures imply not only direct tourism losses, but also long-term erosion of market position, as destination competitiveness shifts in response to relative climate conditions.

6.2.2.3.5.2 Methodological requirements

Tourism-related CoI assessment requires methods capable of capturing behavioural responses and market reallocation, rather than relying solely on physical exposure metrics that fail to reflect how tourists and businesses respond to changing conditions. Standard approaches combine revealed-preference techniques, including travel-cost and demand models that link visitation patterns to climate variables such as temperature extremes and precipitation (Moreno and Amelung 2009; Rosselló-Nadal 2014), with stated-preference methods, such as contingent valuation and choice experiments, to estimate willingness to pay for beach width, water quality, and environmental amenities (Hanley et al. 2015). These are complemented by agent-based and destination-choice models, which simulate how tourists reallocate demand across destinations under altered climate conditions, capturing the dynamic and adaptive nature of tourism behaviour (Gössling et al. 2012; Bujosa et al. 2018). For CoI analysis, these tools are essential to quantify foregone rents under delayed adaptation, including losses from declining occupancy rates, shorter stays, and reduced repeat visitation, thereby providing a more comprehensive and policy-relevant estimate of the economic consequences of inaction in the Mediterranean tourism sector.

6.2.2.3.5.3 Resource-specific gap

Despite its importance, tourism remains under-represented and unevenly treated in Mediterranean Cost of Inaction assessments. PESETA-based analyses include tourism impacts but tend to focus narrowly on summer heat stress and winter snow reliability, particularly for European destinations (Ciscar et al. 2014; IEMed 2019). This approach omits several core CoI channels, including competitive dynamics, whereby northern European or higher-latitude destinations gain relative attractiveness as Mediterranean summers become uncomfortably hot—implying that the CoI is not only absolute loss but also loss of market share (Moreno and Amelung 2009; IPCC 2022). It also neglects seasonal reallocation, with potential expansion of spring and autumn tourism partially offsetting summer losses, but only if infrastructure, labour markets, and marketing strategies adapt—costs that are ignored under static baselines (Gössling et al. 2012). Furthermore, ecosystem–tourism linkages are overlooked, such as the degradation of *Posidonia oceanica* meadows and coastal water quality, which directly affect tourist satisfaction, destination image, and return rates but are rarely monetized (Liquete et al. 2013; MedECC 2020). Together, these omissions result in a substantial underestimation of the true costs of inaction in the Mediterranean tourism sector, limiting the policy relevance of existing CoI assessments and their ability to inform effective adaptation strategies.

These omissions are economically consequential. In several Mediterranean economies—including Greece, Croatia, Cyprus, Tunisia, and Morocco—tourism contributes 15–25% of GDP or employment, making tourism-related climate damages macro-critical rather than marginal (IPCC 2022; World Bank 2022). MEDPRO results for the Mediterranean Middle East already suggest that tourism-related GDP losses may exceed agricultural losses, yet the depth of tourism impact modelling remains far more limited than that applied to agriculture (MEDPRO 2013; IEMed 2019).

Reducing the tourism-related cost of inaction in the Mediterranean requires climate-competitiveness models that explicitly couple destination choice behaviour with regional climate differentiation, ecosystem health indicators, and water availability constraints, allowing tourism losses to be assessed in terms of foregone rents and market position, not only physical exposure. Such approaches are essential to recognise tourism as both highly climate-sensitive and strategically central to Mediterranean development trajectories.

6.2.2.4 Learning across the basin: Mediterranean and cross-regional experiences

6.2.2.4.1 Within-Mediterranean knowledge transfer: what can countries learn from each other?

Across the Mediterranean basin, the capacity to conduct Cost of Inaction (CoI) assessments varies widely, reflecting differences in institutional maturity, data availability, and access to standardised analytical frameworks rather than differences in underlying climate risk. Parts of the basin—particularly countries embedded in the EU—operate within relatively mature assessment ecosystems characterised by methodological standardisation, recurrent updates, and institutional continuity. EU-wide initiatives such as the PESETA series have established harmonised approaches to estimating climate damages across sectors, enabling internal comparability and cumulative learning over time (Ciscar et al. 2011, 2014). Complementary projects have expanded sectoral coverage, explored uncertainty explicitly, and strengthened links between impact assessment and adaptation planning, while platforms such as Climate-ADAPT have institutionalized the dissemination of tools, assumptions, and case studies into policy processes (European Environment Agency 2021). Elsewhere in the basin, comparable analytical architectures remain limited or fragmented, despite often higher exposure and lower adaptive capacity. Many Mediterranean countries face acute water scarcity, greater dependence on climate-sensitive sectors, and tighter fiscal constraints, while lacking the integrated modelling capacity and sustained institutional support required for comprehensive CoI assessment (MEDPRO 2013; World Bank 2018; IEMed 2019; IPCC 2022). The resulting gap is not one of awareness but of quantification. Existing estimates frequently cover only a subset of impact channels—typically agriculture and coastal damages—while excluding water scarcity, health, biodiversity, and infrastructure. For example, MEDPRO's projected GDP losses of −0.26% to −0.41% by 2050 for Tunisia explicitly reflect partial sectoral coverage rather than low underlying vulnerability (MEDPRO 2013). More broadly, these figures illustrate how analytical boundaries—shaped by data constraints, methodological scope, and institutional capacity—define what becomes visible in Mediterranean CoI evidence, and so what enters policy debate, even when climate pressures are widely shared across the basin.

The main opportunity for intra-basin learning lies in adapting assessment logic rather than replicating technical complexity, and three principles are particularly relevant in this regard. First, progressive quantification should be prioritized over comprehensive modelling, meaning that southern and eastern Mediterranean assessments need not replicate full CGE or integrated assessment models to be policy relevant. Sectoral damage functions estimated for climatically comparable northern Mediterranean regions—such as agriculture in Italy or Spain—can be adapted using transparent adjustments for crop composition, irrigation dependence, and institutional context (FAO 2021. Iglesias et al. 2011). Second, standardised communication under uncertainty is essential, as policy relevance depends as much on how results are communicated as on methodological sophistication. Translating sectoral impacts into concise, comparable narratives allows CoI evidence to inform planning even where uncertainty is high, thereby reducing the false dichotomy between rigor and usability. Third, joint assessment of shared systems is critical, as many of the Mediterranean's most consequential climate risks—marine fisheries, transboundary

river basins, and migratory species—cannot be meaningfully assessed through isolated national studies. Basin-wide scenarios and shared assumptions would improve consistency, reduce duplication, and better reflect the cross-border nature of inaction costs (FAO 2018; MedECC 2020).

However, limits to transfer are structural as well as technical. Valuation evidence remains geographically skewed: global databases show strong concentration in European ecosystems and sparse coverage in North Africa and the Eastern Mediterranean, constraining reliable benefit transfer (de Groot et al. 2012; Costanza et al. 2014). Differences in species composition, management regimes, and income levels further weaken direct applicability, meaning that even where data exist, their relevance to different socio-ecological contexts cannot be assumed. Institutional asymmetries reinforce these constraints. EU member states benefit from sustained funding, coordinated research programs, and dedicated technical agencies, providing them with the continuity and resources necessary for iterative CoI assessment. Non-EU Mediterranean countries, by contrast, rely on project-based and externally financed support, which rarely allows the continuity required for sustained assessment capacity (IEMed 2019; World Bank 2022). This institutional fragmentation not only limits the production of CoI evidence in the most vulnerable regions but also perpetuates the analytical asymmetries that shape how climate risks are understood and prioritized across the basin. As a result, the gap in CoI assessment capacity is simultaneously a technical, institutional, and political challenge, demanding coordinated efforts to strengthen analytical infrastructure, promote knowledge sharing, and ensure that the costs of inaction are adequately quantified and communicated across all Mediterranean countries, regardless of their institutional or economic circumstances.

6.2.2.4.2 Cross-regional learning: extra-Mediterranean experiences as conceptual templates

Extra-Mediterranean CoI initiatives—such as Austria's COIN project—are best understood not as benchmarks, but as methodological laboratories. Their relevance lies in demonstrating how CoI analysis can be structured under conditions of uneven sectoral maturity. COIN's explicit treatment of uncertainty, its inclusion of all sectors regardless of methodological readiness, and its quantification of adaptation deficits through disaster expenditure analysis illustrate principles directly relevant to the Mediterranean, even if underlying data conditions are not replicable (Steininger et al. 2015; WIFO 2015; IIASA 2016). The core transferable insight is that excluding sectors due to imperfect methods produces greater bias than including them transparently. This contrasts with Mediterranean practice, where assessments tend either to be comprehensive but geographically limited (e.g. PESETA) or geographically broad but sectorally partial (e.g. MEDPRO).

6.2.2.4.3 Integrating global evidence: adaptation does not eliminate inaction costs

Global empirical evidence reinforces the need for this shift. Longitudinal analyses covering over 12,000 regions show that climate change reduces agricultural output by approximately 4–5% per 1°C of warming even after accounting for real-world adaptation, with average yield losses of ~8% by 2050 and ~24% by 2100 under high warming (Ortiz-Bobea et al. 2021). These results suggest that adaptation moderates but does not eliminate losses. For the Mediterranean, combining these adaptation limits with projected irrigation demand increases of 22–74% in already water-scarce systems implies that CoI assessments treating yield loss and water stress independently are likely to understate compounded damages (IEMed 2019).

6.2.2.4.4 Ecosystem services valuation: addressing structural underestimation

Finally, advances in ecosystem service valuation highlight a systematic bias in Mediterranean CoI studies. Dynamic valuation approaches show that accounting for income growth and scarcity can increase estimated values by more than 130%, and up to 180% when biodiversity decline is included (Bateman et al. 2011; Dasgupta 2021). With more than half of Mediterranean endemic species projected to face elevated extinction risk by the late century, static valuation frameworks understate long-term welfare losses (MedECC 2020). While fully integrated ecological–economic models remain limited in the Mediterranean,

even partial adoption of dynamic scarcity adjustments would materially improve CoI realism relative to current practice, where fixed values dominate despite acknowledged irreversibility (MEDPRO 2013).

6.2.2.5 Synthesising gaps through Mediterranean resource-regional realities

6.2.2.5.1 Gap 1: The Basin-wide assessment divide

Mediterranean Cost of Inaction (CoI) research remains structurally incomplete at the basin scale. As noted by regional syntheses, existing studies 'do not provide comprehensive CGE-based assessments covering all impact channels and all Mediterranean countries simultaneously' (MEDPRO 2013; IEMed 2019). In practice, this has produced an uneven evidence landscape: several European Mediterranean countries rely on CGE-based projections—drawing on frameworks such as PESETA—to inform national adaptation strategies, while many southern and eastern Mediterranean countries rely primarily on qualitative vulnerability assessments or partial sectoral quantifications without comparable macroeconomic integration (Ciscar et al. 2011, 2014; MEDPRO 2013).

In international climate finance and policy negotiations, this asymmetry translates into unequal evidentiary leverage. EU-level assessments estimate welfare losses on the order of hundreds of billions of euros over the century under high-warming scenarios when aggregating impacts across sectors and regions (Ciscar et al. 2011; EEA 2020). By contrast, southern and eastern Mediterranean countries often lack similarly comprehensive, quantified CoI estimates, despite facing equal or higher exposure to water scarcity, heat stress, and ecosystem degradation (World Bank 2018; IPCC 2022). The result is not lower vulnerability, but weaker quantitative articulation of inaction costs.

6.2.2.5.2 Gap 2: The Water resource assessment void

Water scarcity is widely identified as the dominant climate risk for much of the Mediterranean, particularly in its southern and eastern parts (Plan Bleu 2019; MedECC 2020). Yet major regional CoI exercises have treated water inconsistently or omitted it altogether. Notably, MEDPRO's 11-country assessment excluded water resources as a distinct impact category, focusing instead on agriculture, coastal systems, and tourism (MEDPRO 2013; IEMed 2019).

This omission is consequential. Approximately 180 million people in the Mediterranean region already experience water scarcity, with southern and eastern Mediterranean countries most affected (Plan Bleu 2019). Climate projections indicate reductions in renewable water availability of roughly 10–30% by mid-century across major parts of the basin, while irrigation water demand is projected to increase by about 5–20% from climate effects alone, and substantially more when demographic and economic drivers are included (Plan Bleu 2019; MedECC 2020; World Bank 2020). In the absence of water-specific CoI estimates comparable in rigor to agricultural or coastal assessments, adaptation budgeting becomes skewed. Decision-makers tend to prioritize sectors with quantified damages, even when water scarcity underpins multiple downstream risks—agricultural losses, energy constraints, urban supply stress, and ecosystem degradation. This creates a systematic bias in resource allocation driven by assessment gaps rather than by underlying vulnerability.

6.2.2.5.3 Gap 3: Marine and fisheries assessment lag

Marine and coastal systems are central to Mediterranean livelihoods, food security, and tourism, yet their contribution to the cost of inaction remains weakly quantified. Globally, marine ecosystem valuation is recognised as lagging behind terrestrial systems due to monitoring challenges, complex governance, and methodological difficulties (Barbier et al. 2011, Liquete et al. 2013). In the Mediterranean, these limitations are particularly acute in southern and eastern coastal zones, where empirical valuation evidence is sparse (de Groot et al. 2012; Costanza et al. 2014).

Available assessments suggest that climate change, combined with overfishing and pollution, could substantially increase the risk of local depletion or collapse for a significant share of exploited fish and invertebrate stocks by mid-century (FAO 2018; Cheung et al. 2018; GFCM 2020). However, major

Mediterranean CoI studies have rarely translated these risks into explicit economic loss estimates for fisheries and marine biodiversity.

In MEDPRO, tourism losses in parts of the Mediterranean Middle East exceeded agricultural losses, implicitly capturing some effects of degraded coastal environments on visitor demand (MEDPRO 2013). Yet fisheries collapse, marine biodiversity loss, and ecosystem-mediated services were not explicitly modelled. As a result, marine-specific adaptation measures—such as sustainable fisheries management, marine protected areas, or pollution control—remain difficult to justify within cost–benefit frameworks, as their avoided losses are not transparently quantified.

6.2.2.5.4 Gap 4: compound and cascading risk blind spots

While the literature increasingly acknowledges that 'combined risks may exacerbate impacts beyond simple additive effects' (IEMed 2019; IPCC 2022), most Mediterranean CoI assessments remain sector-based, aggregating impacts ex post rather than modelling interactions ex ante. The summer of 2022 illustrated these compound dynamics: simultaneous heatwaves, drought, and wildfires affected considerable parts of the Mediterranean. Water scarcity reduced hydropower output in southern Europe; high river temperatures constrained thermal power generation; energy stress increased the cost of desalination; agricultural losses concentrated in already water-limited regions; tourism declined due to extreme heat and wildfire disruptions; and ecosystems experienced cumulative stress exceeding historical thresholds (IPCC 2022; EEA 2023). Sector-by-sector CoI estimates fail to capture such cascading failures, implying that current projections likely understate tail risks relevant for long-term Mediterranean adaptation planning.

6.2.2.5.5 Gap 5: Baseline specification inconsistency

A final structural gap concerns the definition of 'inaction' itself. Mediterranean agriculture and resource management systems have evolved over centuries under climatic variability, embedding autonomous adaptation into baseline practices (Iglesias et al. 2011; FAO 2021). Yet Mediterranean CoI studies adopt heterogeneous baseline assumptions: some assume static technologies and practices, while others implicitly incorporate adaptation without transparent parameterisation (MEDPRO 2013; IEMed 2019).

When CoI estimates rely on inconsistent baseline definitions—such as assuming fixed crop varieties in one country and adaptive switching in another—results become non-comparable even under similar climate trajectories. This undermines cross-country synthesis and obscures whether differences in estimated damages reflect real vulnerability or merely divergent modelling conventions. For the Mediterranean, where learning across countries is essential, unacknowledged baseline heterogeneity represents a fundamental obstacle to coherent regional CoI assessment.

6.2.2.6 Operational recommendations: toward Mediterranean-relevant CoI research

Advancing Mediterranean Cost of Inaction (CoI) research and its use in policy decisions requires a sequenced implementation strategy that reflects the heterogeneous data availability, institutional capacity, and sectoral maturity across the basin. Addressing all gaps simultaneously would risk analytical overload, whereas a phased approach enables early improvements in visibility and comparability, followed by deeper integration and institutionalisation. This sequencing aligns with assessment practice in regions facing accelerating risks under constrained capacities, recognising that progress must be built incrementally to be sustainable and effective.

In the short term, priorities should focus on actions that can be implemented immediately within existing studies, improving transparency and comparability without requiring full CGE–IAM infrastructures. Key actions at this stage include establishing Mediterranean CoI assessment protocols by resource type, specifying minimum methodological standards for each sector. For agriculture, this means using crop-model ensembles with a minimum of multiple GCMs and crop models, incorporating empirically grounded adaptation parameters informed by global evidence showing residual yield losses of approximately eight percent by mid-century even with adaptation, adjusted for Mediterranean crop systems (Gap 5). For water, protocols require hydrological modelling integrated with ecosystem service biophysical metrics and

economic valuation covering purification, flood attenuation, and cultural values, including explicit treatment of transboundary basins (Gap 2). For marine and coastal systems, bioeconomic fisheries models must be combined with coastal damage assessment and marine ecosystem service valuation, recognising the cross-border spillovers inherent in a semi-enclosed basin (Gap 3). For biodiversity and ecosystems, dynamic valuation reflecting scarcity and irreversibility should be introduced, with explicit attention to Mediterranean endemism (Gap 3). Additionally, tiered, Mediterranean-adapted decision-support tools should be created to match national capacities, with Tier 1 comprising rapid assessments using benefit transfer from climatically comparable Mediterranean regions, Tier 2 involving hybrid approaches combining local biophysical modelling with regional valuation benchmarks, and Tier 3 encompassing full modelling chains where data and capacity permit, serving as regional reference points (Gap 1). Finally, transparent baseline documentation should be mandated in all Mediterranean CoI studies, explicitly stating autonomous adaptation assumptions, policy baselines, time horizons, and discount rates, using standardised 'baseline specification tables' (Gap 5). These measures would immediately reduce hidden heterogeneity in assumptions and clarify that many existing CoI estimates represent lower-bound costs of inaction, providing a more honest and policy-relevant foundation for decision-making.

In the medium term, priorities should aim to reduce fragmentation and move toward cross-sectoral coherence, while remaining realistic about persistent data constraints. Key actions at this stage include developing Mediterranean-specific baseline scenarios, aligned with regional demographic trends, water stress trajectories, and land-use dynamics, to support cross-country comparability (Gap 5). Water scarcity should be embedded as a systemic driver across agriculture, energy, urban systems, ecosystems, and tourism, rather than being treated as a standalone sector (Gap 2; Gap 4). Dynamic ecosystem and biodiversity valuation should be implemented, operationalising scarcity-adjusted values to reduce the structural underestimation of long-term losses (Gap 3). Basin-wide CoI pilot assessments should be launched for shared systems, such as Mediterranean fisheries and priority transboundary river basins, using common scenarios and assumptions to build a shared evidence base (Gap 3). Regional data infrastructures should also be strengthened, particularly for monitoring water resources, coastal erosion, ecosystem condition, and climate-sensitive livelihoods (Gap 1). At this stage, partial integration of sectoral CoI results into macroeconomic and fiscal frameworks becomes feasible, enhancing relevance for public investment planning and allowing CoI evidence to inform budgetary decisions and development strategies more directly.

In the long term, objectives involve embedding CoI assessment as a core component of Mediterranean climate governance, supported by sustained data collection and analytical capacity. Strategic goals at this stage include developing integrated, multi-sector CoI frameworks capable of capturing compound and cascading risks across water–energy–food–ecosystem–health systems, moving beyond single-sector analyses to reflect the interconnected nature of climate impacts (Gap 4). Threshold and tipping-point dynamics—such as aquifer salinisation, ecosystem collapse, and agricultural viability thresholds—should be incorporated into CoI damage functions, moving beyond smooth, linear impact assumptions to capture the non-linear and potentially irreversible nature of many climate risks (Gap 4). Distributional analysis should be mainstreamed across CoI assessments, disaggregating impacts within countries by income groups and rural–urban divides, between countries, and across generations, ensuring that the equity dimensions of inaction are made visible and actionable (Gap 1; Gap 4). CoI should be coupled with adaptation pathway analysis, systematically comparing avoided damages against adaptation costs, sequencing options, and residual risks, thereby providing a comprehensive framework for investment decisions (Gap 1). Finally, a permanent Mediterranean CoI observatory or platform should be established under an existing regional institution to coordinate methodologies, updates, validation exercises, and capacity building, ensuring that CoI assessment becomes a sustained rather than project-based activity (Gap 1; Gap 3). Sequencing Mediterranean CoI research in this manner recognises that delays in measurement constitute a form of inaction themselves, as the absence of quantified evidence perpetuates policy inertia and underinvestment in adaptation. By prioritising short-term visibility, medium-term coherence, and long-term integration, CoI research can evolve from fragmented, lower-bound estimates into a cumulative, policy-embedded

assessment system—capable of informing adaptation, investment, and climate finance decisions at a pace commensurate with accelerating Mediterranean climate risks.

6.2.3 Risk financing and insurance instruments

Climate change is increasing the frequency, intensity, and economic impacts of climate-related hazards across Mediterranean countries, including droughts, floods, heatwaves, storms, and wildfires, with major consequences for agricultural production, water availability, food security, rural livelihoods, and public finances (IPCC 2022). In response, risk financing and insurance instruments are increasingly recognized as important components of climate adaptation and resilience strategies, complementing mitigation efforts and ecosystem-based adaptation measures. These instruments aim to reduce the economic consequences of climate shocks through different forms of risk transfer, compensation, liquidity provision, and income stabilisation.

However, the design, implementation, and effectiveness of climate risk financing instruments vary substantially across the Mediterranean, reflecting differences in institutional capacity, insurance market development, fiscal space, data availability, and exposure to climate risks. While EU Mediterranean countries generally rely on more institutionalized agricultural insurance systems supported through the Common Agricultural Policy (CAP), North African Mediterranean countries increasingly experiment with index-based insurance schemes, sovereign disaster financing mechanisms, and donor-supported adaptation finance initiatives.

At the same time, the Mediterranean literature increasingly highlights important limitations in existing climate risk financing systems. Most instruments remain primarily compensatory, focusing on ex post loss coverage rather than on reducing long-term vulnerability and strengthening ecosystem resilience. Moreover, ecosystem services such as soil fertility, water regulation, pollination, landscape heterogeneity, and biodiversity conservation, despite their important role in buffering climate risks, are rarely integrated into insurance pricing, risk assessment, or adaptation financing frameworks. As a result, current systems often insufficiently account for the socio-ecological drivers of vulnerability in Mediterranean agro-ecosystems.

This section assesses the main climate risk financing and insurance instruments currently implemented across Mediterranean countries, their operational mechanisms, institutional and data requirements, and their integration into adaptation and resilience policies. Particular attention is devoted to the relationship between climate risk financing, ecosystem service degradation, and long-term socio-ecological resilience, with the objective of identifying emerging challenges and policy directions for more integrated and ecosystem-sensitive climate risk management frameworks in the Mediterranean.

6.2.3.1 Main assessment findings on climate risk financing in the Mediterranean

Climate-related economic losses are increasing across Mediterranean countries due to the growing frequency and intensity of droughts, floods, heatwaves, storms, and wildfires, particularly in agriculture, water-dependent sectors, and rural territories (IPCC 2022). As a result, climate risk financing and insurance instruments are becoming increasingly important components of adaptation and resilience policies. The literature and policy evidence show a clear expansion of agricultural insurance schemes, public disaster compensation mechanisms, contingency funds, and index-based insurance products, reflecting growing recognition that climate risks generate fiscal and socio-economic pressures that cannot be managed only through ad hoc emergency responses (OECD 2011; European Commission 2017; OECD 2020).

However, the development and effectiveness of climate risk financing instruments remain highly uneven across the Mediterranean. EU Mediterranean countries generally benefit from more institutionalized agricultural insurance systems, supported through the Common Agricultural Policy (CAP) risk management framework. Regulation (EU) 2021/2115 allows Member States to support risk management tools, including insurance premiums, mutual funds, and income stabilisation tools, within their CAP Strategic Plans (Regulation (EU) 2021/2115; European Commission 2017). Spain represents one of the most developed

Mediterranean examples through the Agroseguro public-private co-insurance system, while France, Italy, and Greece rely on different combinations of subsidized insurance, disaster compensation, and CAP-supported risk management tools (OECD 2011; European Commission 2017; OECD 2020).

In contrast, North African Mediterranean countries generally display lower insurance penetration, weaker institutional capacity, and stronger dependence on public intervention and international financial support. Traditional indemnity-based agricultural insurance remains limited in scope and often reaches mainly larger or more commercial farms. As a result, index-based and parametric insurance instruments have gained attention, particularly for drought management in rainfed agriculture and rangeland systems. Morocco has been one of the most cited cases for rainfall-index and drought insurance development, with early feasibility studies and more recent crop-insurance schemes highlighting both the potential and the operational constraints of parametric approaches (Skees et al. 2001; McCarthy 2003).

A major finding emerging from the literature is that most climate risk financing instruments remain primarily compensatory rather than transformative. Existing insurance systems considerably focus on ex post compensation for realized losses rather than on reducing structural vulnerability to climate change or incentivising long-term adaptation (OECD 2011; Cordier 2020; OECD 2020). Insurance payouts are generally triggered by climatic damages, production losses, or income reductions, while limited attention is given to ecological and land-management factors that shape vulnerability, such as soil degradation, groundwater depletion, biodiversity loss, or landscape simplification. Consequently, insurance systems may stabilize income in the short term without necessarily promoting ecosystem-based adaptation or strengthening long-term socio-ecological resilience.

The literature also highlights that ecosystem services remain weakly integrated into climate risk financing frameworks despite their critical role in reducing climate vulnerability. Ecosystem services such as soil water retention, pollination, erosion control, rangeland productivity, landscape heterogeneity, and groundwater recharge function as natural buffers that moderate the impacts of droughts, floods, and climate variability (IPBES 2016; IPCC 2022). However, because these services are rarely quantified within operational risk assessment or insurance pricing models, they remain majorly absent from premium calculation, eligibility criteria, compensation rules, and sovereign risk assessment frameworks. This reflects broader limitations in ecosystem service valuation approaches, where accounting-based and static frameworks still dominate over dynamic socio-ecological and production-based valuation methods (Laurans et al. 2013; IPBES 2016). Another important finding concerns the central role of institutional capacity and data infrastructures. Reliable meteorological observations, long-term climate records, agricultural statistics, hydrological monitoring, remote sensing data, and farm-level yield information are essential for insurance pricing, trigger calibration, and risk assessment, especially for index-based instruments (Skees et al. 2001; McCarthy 2003). EU Mediterranean countries generally benefit from more developed meteorological and statistical infrastructures, whereas many North African Mediterranean countries face more important data gaps and institutional fragmentation. These constraints increase uncertainty and basis risk, especially when climatic indices do not correspond closely to actual farm-level losses (Skees et al. 2001; McCarthy 2003; Belhsen et al. 2025). Finally, climate risk financing is increasingly incorporated into National Adaptation Plans (NAPs) and resilience strategies, but policy integration remains partial. Spain, France, Morocco, and Tunisia refer to insurance or financial risk-sharing as components of agricultural adaptation and disaster preparedness, but these instruments often operate separately from ecosystem restoration, agroecological transition, and ecosystem-based adaptation policies. As a result, risk financing mechanisms still tend to address the economic consequences of climate shocks without sufficiently addressing the ecological and socio-economic drivers of vulnerability.

Concluding, the Mediterranean literature suggests that climate risk financing instruments are becoming increasingly important for managing climate-related economic risks, but their contribution to long-term resilience remains constrained by compensatory logics, limited ecosystem integration, institutional fragmentation, and data gaps. Emerging approaches increasingly call for stronger integration between climate risk financing, ecosystem service valuation, agroecological transitions, and WEFE nexus-oriented adaptation frameworks.

Table 6.3 | Main assessment findings on climate risk financing in the Mediterranean.

Main assessment findings	Evidence from the literature	Confidence level
Climate risk financing instruments are increasingly integrated into agricultural and adaptation policy frameworks across Mediterranean countries.	CAP Regulation (EU) 2021/2115 includes support for insurance premiums, mutual funds and income stabilisation tools; NAPs and resilience strategies increasingly reference financial risk-sharing mechanisms (Regulation (EU) 2021/2115; European Commission 2017; OECD 2020).	*High confidence*
Agricultural insurance systems are more developed and institutionalized in EU Mediterranean countries than in North African Mediterranean countries.	Spain's Agroseguro system is a mature public-private co-insurance model; EU Mediterranean countries benefit from CAP support and stronger insurance institutions (OECD 2011; European Commission 2017).	*High confidence*
Mutual funds and income stabilisation tools exist in the EU policy toolkit but remain less widely used than subsidized insurance.	EU risk management instruments include insurance, mutual funds and income stabilisation tools, but the toolkit has been underused, and implementation remains uneven (Cordier 2020; European Commission 2017).	*High confidence*
Index-based and parametric insurance instruments are expanding, especially for drought management in North African contexts.	Rainfall-index insurance feasibility and demand have been studied in Morocco; more recent drought insurance schemes and parametric approaches continue to be developed (Skees et al. 2001; McCarthy 2003; Belhsen et al. 2025).	*Medium-high confidence*
Most risk financing instruments remain primarily compensatory and weakly connected to long-term vulnerability reduction.	Agricultural risk management literature stresses income stabilisation and loss compensation, while integrated prevention-oriented risk management remains limited (OECD 2011; Cordier 2020; OECD 2020).	*High confidence*
Ecosystem services are rarely integrated into insurance pricing, eligibility criteria, or payout design.	Ecosystem services are widely recognized as resilience-supporting functions, but insurance frameworks still rely mainly on climatic, yield, or income indicators rather than ecosystem-condition indicators (Laurans et al. 2013; IPBES 2016; IPCC 2022).	*Medium-high confidence*
Data gaps, institutional fragmentation, and basis risk remain major operational constraints, especially for index-based insurance.	Index insurance depends on reliable climatic and yield data; mismatch between index triggers and actual losses is a recurrent constraint in Morocco and other data-scarce contexts (Skees et al. 2001; McCarthy 2003; Belhsen et al. 2025).	*High confidence*

6.2.3.2 Main climate risk financing instruments used in the Mediterranean

Climate risk financing instruments used in Mediterranean countries can be grouped into five main categories: subsidised agricultural insurance, index-based or parametric insurance, mutual funds, income stabilisation tools, and public or sovereign disaster risk financing mechanisms. These instruments differ in their objectives, institutional requirements, trigger mechanisms, and capacity to support adaptation. Across the region, subsidised agricultural insurance remains the dominant instrument in EU Mediterranean

countries, while index-based insurance and sovereign risk financing are increasingly explored in North African countries (OECD 2011; European Commission 2017; Cordier 2020; OECD 2020).

Table 6.4 | Main climate risk financing instruments in Mediterranean countries.

Instrument	Main objective	Main Mediterranean application	Main limitation	Key references
Subsidised agricultural insurance	Compensate yield, production, or revenue losses	Widely used in EU Mediterranean countries, especially Spain, France, Italy and Greece	Mostly compensatory; weak incentives for preventive adaptation	OECD 2011; European Commission 2017; OECD 2020
Index-based and parametric insurance	Provide rapid payouts based on rainfall, temperature, vegetation or drought indices	Increasingly promoted in North Africa, especially for drought risk in Morocco and rainfed systems	Basis risk; requires high-quality climate and yield data	Skees et al. 2001; McCarthy 2003; Belhsen et al. 2025
Mutual funds	Pool risks collectively among farmers or producer groups	Available under the CAP framework but less used than insurance	Requires strong governance, trust, and diversified participation	Regulation (EU) 2021/2115; Cordier 2020
Income Stabilisation Tools (ISTs)	Compensate significant drops in farm income	Included in the EU CAP toolkit but limited uptake in Mediterranean countries	High administrative complexity and data requirements	European Commission 2017; Cordier 2020
Public and sovereign disaster risk financing	Provide fiscal liquidity after major shocks	Used through disaster funds, contingency reserves, and externally supported mechanisms	Reactive; often weakly linked to risk reduction	OECD 2020; World Bank 2021

Subsidised agricultural insurance is the most established instrument in EU Mediterranean countries. It is generally supported by public funds because climate risks in agriculture are systemic and highly correlated, making fully private insurance either unavailable or unaffordable for many farmers. Under the CAP framework, Member States can subsidise insurance premiums and support other risk management instruments through their Strategic Plans (Regulation (EU) 2021/2115; European Commission 2017). Spain's Agroseguro system remains the most mature Mediterranean example, combining public support, private insurers, and broad risk pooling (OECD 2011).

Index-based and parametric insurance instruments are increasingly promoted where indemnity-based insurance is difficult to operate because of high loss-assessment costs or limited farm-level data. These schemes rely on predefined indicators, such as rainfall deficits, vegetation indices, or temperature thresholds, to trigger payouts. They can reduce transaction costs and accelerate compensation, but their effectiveness depends strongly on the quality and spatial resolution of the selected index. In Mediterranean agro-ecosystems, basis risk is a major concern because local losses may differ substantially from index-based signals due to soil heterogeneity, topography, crop management, and ecosystem condition (Skees et al. 2001; McCarthy 2003; Belhsen et al. 2025).

Mutual funds and Income Stabilisation Tools are part of the EU risk management toolkit but remain less widely implemented than insurance premium subsidies. Mutual funds can strengthen collective risk sharing, especially within producer organisations or specific sectors, but they require trust, transparent governance, and sufficient financial reserves. Income Stabilisation Tools are broader because they

compensate income losses rather than only yield losses, but their implementation is constrained by data needs, administrative complexity, and limited farmer uptake (European Commission 2017; Cordier 2020).

Public and sovereign disaster risk financing instruments remain important across the Mediterranean, especially for extreme events such as droughts, floods, and wildfires. These instruments include contingency funds, emergency reserves, public compensation schemes, and externally supported disaster risk financing facilities. They can provide rapid liquidity aftershocks, but they often remain reactive and weakly linked to long-term risk reduction. This is particularly problematic when repeated compensation substitutes for preventive investments in ecosystem restoration, water management, soil conservation, and agroecological transition (OECD 2020; IPCC 2022).

6.2.3.3 Comparative implementation patterns across Mediterranean countries

The implementation of climate risk financing instruments differs substantially between EU Mediterranean and North African Mediterranean countries, reflecting contrasts in institutional capacity, insurance market development, fiscal resources, agricultural structures, and adaptation policy frameworks (OECD 2011; OECD 2020). While EU Mediterranean countries generally rely on relatively mature and institutionalised agricultural insurance systems supported through the Common Agricultural Policy (CAP), North African Mediterranean countries depend more heavily on public intervention, pilot programmes, sovereign risk financing mechanisms, and international development support (European Commission 2017; World Bank 2021).

In EU Mediterranean countries, agricultural insurance systems are strongly shaped by the CAP risk management framework established under Regulation (EU) 2021/2115, which allows Member States to support insurance premium subsidies, mutual funds, and Income Stabilisation Tools (ISTs) through their CAP Strategic Plans (Regulation (EU) 2021/2115; European Commission 2017). However, implementation remains highly heterogeneous across countries and sectors (Cordier 2020). Spain constitutes the most developed Mediterranean example through the Agroseguro system, a public-private co-insurance mechanism based on broad risk pooling and substantial public premium support (OECD 2011). The Spanish system provides extensive coverage against droughts, floods, frost, storms, and other climatic hazards and has progressively expanded in response to increasing climate variability and recurrent drought episodes (OECD 2011; OECD 2020). Spain's National Adaptation Plan (PNACC 2021–2030) explicitly identifies agricultural insurance as an important adaptation instrument for reducing climate-related vulnerability in the agricultural sector.

France also relies on a combination of subsidised insurance and public compensation mechanisms, particularly following recent reforms associated with increasing droughts, heatwaves, and late frost events affecting vineyards, cereals, and fruit production systems (OECD 2020). CAP-supported insurance schemes are combined with national solidarity mechanisms and disaster compensation funds. French adaptation policy increasingly recognises the importance of agricultural insurance within broader resilience strategies related to water management, agroecological transition, and soil conservation. Nevertheless, as in Spain, insurance systems remain majorly focused on compensating realised losses rather than rewarding preventive ecosystem-based adaptation measures such as soil restoration, biodiversity enhancement, or landscape diversification (OECD 2020; IPCC 2022).

Italy and Greece display more fragmented implementation patterns, with important regional differences in insurance uptake, coverage levels, and administrative capacity (European Commission 2017). Participation rates are generally higher among commercial and export-oriented producers, while smallholders and diversified farming systems remain less covered. Mutual funds and Income Stabilisation Tools have seen relatively limited implementation due to governance complexity, administrative requirements, and limited farmer familiarity with these instruments (Cordier 2020). In both countries, ad hoc public compensation following droughts, floods, and wildfires continues to play an important role alongside CAP-supported insurance schemes (OECD 2020).

Across EU Mediterranean countries, the literature highlights several common characteristics. First, insurance systems are relatively well institutionalised and strongly supported through public subsidies and public-private partnerships (OECD 2011; European Commission 2017). Second, most schemes primarily address short-term climatic variability and income stabilisation rather than long-term ecological vulnerability and adaptation (Cordier 2020; OECD 2020). Third, ecosystem services and ecosystem condition remain weakly integrated into risk pricing and compensation frameworks. Soil degradation, groundwater depletion, biodiversity loss, and declining landscape heterogeneity are rarely incorporated into insurance design despite their major role in shaping climate resilience (Laurans et al. 2013; IPBES 2016).

In North African Mediterranean countries, climate risk financing systems are generally less developed and operate under stronger fiscal and institutional constraints (World Bank 2021). Traditional indemnity-based agricultural insurance schemes exist in Morocco, Tunisia, and Algeria but remain relatively limited in penetration and sectoral coverage. Insurance access is often concentrated among larger commercial farms, while smallholders remain considerably excluded because of affordability constraints, administrative barriers, weak financial inclusion, and limited trust in insurance systems (McCarthy 2003; World Bank 2021).

As a result, North African countries have increasingly explored index-based and parametric insurance instruments, especially for drought management in rainfed agricultural systems. Morocco has emerged as one of the most advanced regional cases through the development of rainfall-index and vegetation-index insurance products supported by public authorities and international organisations (Skees et al. 2001; McCarthy 2003). These schemes aim to reduce transaction costs and accelerate compensation by linking payouts to objectively measured climatic indicators rather than individual loss assessments. Tunisia and Algeria have also implemented pilot programmes, although coverage remains geographically limited and operational scaling remains constrained by data availability, institutional capacity, and basis risk (Belhsen et al. 2025).

Sovereign disaster risk financing mechanisms also play a more important role in North African Mediterranean countries because fiscal exposure to droughts, food-security crises, and water scarcity is particularly high (World Bank 2021). International financial institutions and development banks frequently support these mechanisms through technical assistance, contingency financing, and disaster-risk facilities. However, these systems often remain reactive and strongly dependent on external funding and donor-supported programmes rather than integrated national resilience strategies.

The literature consistently identifies institutional fragmentation and data gaps as major constraints across North African countries (McCarthy 2003; World Bank 2021). Meteorological monitoring networks, farm-level yield databases, hydrological observations, and ecosystem monitoring systems remain unevenly developed, increasing uncertainty and basis risk in index-based insurance products (Skees et al. 2001; Belhsen et al. 2025). In addition, ecosystem service indicators such as soil organic matter, rangeland condition, groundwater status, or biodiversity metrics are rarely integrated into operational risk assessment systems despite their major role in shaping vulnerability to climate shocks (IPBES 2016; IPCC 2022).

Table 6.5 | Comparative implementation patterns of climate risk financing instruments across the Mediterranean.

Dimension	EU Mediterranean countries	North African Mediterranean countries
Institutional capacity	Relatively strong insurance and regulatory institutions (OECD 2011; European Commission 2017)	More limited institutional and regulatory capacity (World Bank 2021)
Main instruments	Subsidised agricultural insurance under CAP (Regulation (EU) 2021/2115)	Index insurance, public compensation, sovereign financing (McCarthy 2003; World Bank 2021)
Public support	CAP premium subsidies and national co-financing (European Commission 2017)	Strong dependence on public budgets and donor support (World Bank 2021)
Insurance penetration	Relatively high in Spain and France; uneven elsewhere (OECD 2011; OECD 2020)	Generally low, especially among smallholders (McCarthy 2003)
Index insurance development	Emerging but secondary (Cordier 2020)	Increasingly important, especially for drought (Skees et al. 2001)
Main operational constraint	Weak integration with ecosystem-based adaptation (Laurans et al. 2013; IPBES 2016)	Data gaps, basis risk, limited scaling capacity (Belhsen et al. 2025)
Ecosystem service integration	Weak (IPBES 2016)	Very weak (IPCC 2022)
Adaptation policy integration	Increasingly recognised in NAPs and CAP Strategic Plans (European Commission 2017)	Present in NAPs but often fragmented and project-based (World Bank 2021)

6.2.3.4 Main methodological and operational limitations

Despite the increasing development of climate risk financing instruments across the Mediterranean, important methodological and operational limitations continue to constrain their effectiveness. The literature identifies several recurrent challenges related to insurance design, data availability, institutional capacity, affordability, and risk assessment, particularly under increasing climatic uncertainty and ecological degradation.

A first major limitation concerns basis risk in index-based and parametric insurance instruments. Basis risk refers to the mismatch between index-triggered payouts and actual losses experienced by producers (Skees et al. 2001; McCarthy 2003). This issue is particularly acute in Mediterranean agro-ecosystems characterised by strong spatial heterogeneity in climatic conditions, soils, topography, irrigation access, and farming practices. Climatic indicators such as rainfall deficits or vegetation indices may therefore insufficiently capture local production losses and vulnerability patterns. Several studies identify basis risk as one of the principal barriers to farmer trust and large-scale adoption of index-based insurance schemes in North African Mediterranean countries (Skees et al. 2001; Belhsen et al. 2025).

Data limitations also represent a major operational constraint. Effective climate risk financing requires reliable meteorological observations, long-term climate records, hydrological monitoring systems, agricultural statistics, remote sensing products, and farm-level yield data (McCarthy 2003; World Bank 2021). While EU Mediterranean countries generally benefit from more developed climate and agricultural information systems, important gaps remain at finer territorial scales and for specific production systems. In North African Mediterranean countries, sparse meteorological networks, fragmented databases, and discontinuous historical records increase uncertainty in insurance pricing and trigger calibration, limiting the reliability and scalability of both indemnity-based and index-based instruments (World Bank 2021; Belhsen et al. 2025).

The literature also highlights important affordability and accessibility constraints. Climate risk financing instruments often remain concentrated among larger commercial farms, while smallholders and vulnerable rural populations face difficulties accessing insurance because of high premium costs, administrative complexity, weak financial inclusion, and limited awareness (OECD 2020; World Bank 2021). Even in EU

Mediterranean countries where public premium subsidies exist, insurance uptake remains uneven across sectors and territories (European Commission 2017).

Institutional fragmentation constitutes another important operational challenge. Climate risk financing, agricultural policy, water governance, disaster management, and environmental monitoring are frequently managed by separate institutions with limited coordination (OECD 2020; World Bank 2021). This fragmentation complicates the implementation of coherent and integrated climate risk management strategies, particularly in Mediterranean contexts where climate vulnerability results from interconnected socio-economic and ecological processes.

Another important limitation concerns the temporal horizon of existing risk financing systems. Most insurance instruments are primarily designed to manage short-term climatic shocks such as droughts, floods, or heatwaves, while slow-onset processes such as soil degradation, groundwater depletion, salinisation, biodiversity decline, and desertification remain weakly represented in operational risk frameworks (IPCC 2022; IPBES 2016). Consequently, current insurance systems may underestimate long-term vulnerability dynamics and systemic ecological risks.

Finally, ecosystem-service indicators remain majorly absent from operational risk assessment and insurance pricing systems. Existing instruments continue to rely primarily on climatic, yield-based, or income-based indicators, while ecological variables such as soil organic matter, vegetation resilience, biodiversity condition, or groundwater status are rarely incorporated into insurance design (Laurans et al. 2013; IPBES 2016). This limits the capacity of risk financing instruments to differentiate vulnerability according to ecosystem condition and resilience capacity.

Summarising, the Mediterranean literature suggests with *high confidence* that current climate risk financing systems remain constrained by basis risk, data gaps, institutional fragmentation, unequal access, and limited integration of ecological dimensions into operational insurance frameworks.

6.2.3.5 Integration into adaptation policy and ecosystem-based resilience

Climate risk financing and insurance instruments are increasingly integrated into adaptation and resilience policy frameworks across Mediterranean countries. National Adaptation Plans (NAPs), CAP Strategic Plans, and agricultural resilience strategies progressively recognise insurance and financial risk-sharing mechanisms as important tools for managing climate-related economic risks associated with droughts, floods, heatwaves, and water scarcity (European Commission 2017; IPCC 2022).

In EU Mediterranean countries, agricultural insurance is increasingly incorporated into adaptation strategies aimed at stabilising farm income and reducing vulnerability to climatic extremes. Spain's National Adaptation Plan (PNACC 2021–2030) explicitly identifies agricultural insurance as a major adaptation instrument, while France increasingly combines insurance reforms with broader resilience strategies related to water management and agricultural adaptation (OECD 2020). However, ecosystem-based adaptation measures such as agroecological diversification, soil conservation, biodiversity enhancement, and sustainable water management generally remain implemented through separate environmental and rural-development policies rather than through insurance systems themselves.

In North African Mediterranean countries, adaptation plans increasingly recognise the importance of drought insurance, sovereign climate-risk financing, and financial resilience mechanisms, particularly for rainfed agricultural systems and food security (World Bank 2021). Nevertheless, implementation often remains fragmented and strongly dependent on externally supported pilot projects, development-bank financing, and donor-supported programmes. Insurance instruments frequently operate independently from ecosystem restoration programmes, sustainable land-management policies, or long-term territorial resilience strategies.

The literature increasingly emphasises that this separation between insurance systems and ecosystem-based adaptation limits the long-term effectiveness of climate resilience policies (IPBES 2016; IPCC 2022). Ecosystem services such as soil water retention, erosion control, pollination, landscape heterogeneity,

groundwater recharge, and biodiversity conservation significantly reduce climate vulnerability in Mediterranean agro-ecosystems. However, these ecosystem functions are rarely incorporated into insurance pricing, premium subsidies, eligibility criteria, or adaptation financing mechanisms.

As a result, current climate risk financing systems remain predominantly compensatory and only weakly connected to ecosystem stewardship and preventive adaptation. Farms implementing agroecological or ecosystem-based adaptation practices often face similar insurance conditions to farms with more vulnerable production systems. Consequently, existing instruments provide limited incentives for ecosystem restoration, sustainable resource management, or agroecological transition.

Several studies therefore argue for stronger integration between climate risk financing, ecosystem-service valuation, ecosystem-based adaptation, and long-term territorial resilience strategies (Laurans et al. 2013; IPBES 2016). Emerging approaches suggest that insurance systems could progressively evolve toward more resilience-oriented frameworks through differentiated premiums, ecosystem-condition indicators, and incentives linked to sustainable land-management practices.

The WEFE nexus perspective further reinforces the need for integrated climate-risk governance across Mediterranean territories. Climate vulnerability emerges from strong interdependencies between water scarcity, food production, ecosystem degradation, energy systems, and socio-economic inequalities. Consequently, adaptation-oriented risk financing increasingly requires coordination between agricultural institutions, insurance systems, environmental agencies, water authorities, and local stakeholders (World Bank 2021).

6.2.3.6 Synthesis and implications for climate resilience and policy integration

The assessment highlights that climate risk financing and insurance instruments are becoming increasingly important components of climate adaptation strategies across Mediterranean countries. Agricultural insurance systems, index-based instruments, sovereign risk-financing mechanisms, and CAP-supported risk-management tools increasingly contribute to buffering the economic impacts of climate-related shocks, particularly in agriculture and water-dependent sectors (European Commission 2017; OECD 2020; IPCC 2022).

However, the literature consistently indicates that current systems remain dominated by compensatory approaches focused on ex post loss coverage rather than on reducing structural vulnerability and strengthening long-term socio-ecological resilience. Ecosystem services, despite their critical role in moderating climate risks, remain weakly integrated into operational insurance frameworks, adaptation financing, and risk-assessment systems (Laurans et al. 2013; IPBES 2016).

The assessment further suggests that strengthening Mediterranean climate resilience will require greater integration between climate risk financing, ecosystem-service valuation, ecosystem-based adaptation, and territorial governance frameworks. Emerging approaches increasingly call for insurance systems capable of recognising ecosystem condition, incentivising sustainable land-management practices, and supporting agroecological transitions within broader WEFE nexus-oriented adaptation strategies.

Consequently, the Mediterranean literature suggests with *medium to high confidence* that improving the contribution of climate risk financing to long-term resilience will depend on stronger institutional coordination, improved ecological and climatic data systems, and more integrated socio-ecological approaches capable of linking financial risk management with ecosystem resilience and sustainable territorial adaptation.

Table 6.6|Key messages and confidence assessment for climate risk financing in the Mediterranean.

Key message	Confidence level	Main supporting evidence
Climate risk financing instruments are increasingly integrated into adaptation and agricultural policy frameworks across Mediterranean countries.	*High confidence*	CAP reforms, National Adaptation Plans, increasing development of insurance and sovereign risk-financing mechanisms (European Commission 2017; OECD 2020).
Agricultural insurance systems are more developed and institutionalised in EU Mediterranean countries than in North African Mediterranean countries.	*High confidence*	Strong evidence from CAP-supported insurance systems and comparative institutional literature (OECD 2011; World Bank 2021).
Most climate risk financing instruments remain primarily compensatory and weakly connected to long-term ecosystem-based adaptation.	*High confidence*	Strong convergence across climate adaptation and agricultural risk-management literature (Cordier 2020; OECD 2020; IPCC 2022).
Ecosystem services are rarely integrated into insurance pricing, risk assessment, or eligibility criteria despite their important role in reducing climate vulnerability.	*Medium-high confidence*	Consistent evidence from ecosystem-service valuation and resilience literature (Laurans et al. 2013; IPBES 2016).
Data limitations, basis risk, and institutional fragmentation remain major operational constraints, particularly for index-based insurance in North African countries.	*High confidence*	Strong evidence from index-insurance and climate-risk-financing studies (Skees et al. 2001; McCarthy 2003; Belhsen et al. 2025).
Strengthening long-term resilience requires stronger integration between climate risk financing, ecosystem-service valuation, ecosystem-based adaptation, and WEFE-oriented governance approaches.	*Medium-high confidence*	Increasing conceptual convergence across resilience, adaptation, and nexus literature (IPBES 2016; IPCC 2022).

6.2.4 Trade, globalisation, and environmental risk exposure

Climate risk, the environment and trade are interrelated. Indeed, two climate risks can affect and are affected by trade. Physical risks are associated with natural disasters and resulting in output losses, reduced FDI, and reduced trade. Moreover, these risks can also affect trade through their effect on production and therefore countries specialisation (Gouel and Labourde 2021). This is primarily due to higher levels of temperature and by the water stress (Hamududu and Ngoma 2020) that can affect the countries' comparative advantage, especially in the agriculture sector. Second, transition risks arise from the need to adjust regulatory frameworks, production technologies, and energy systems, which potentially weakens comparative advantages in carbon-intensive industries. Hence, trade can affect the environment and climate change through dirty production techniques or carbon emissions due to transport (Brenton and Chemutai 2021). The Mediterranean region stands among the most vulnerable areas to the impacts of climate change given that the region's ecosystem is increasingly facing a serious number of problems such as droughts, heatwaves and rising sea levels (Lionello et al. 2014). In fact, Tekce and Deniz (2016) argue that rising temperatures are *likely* to have a positive impact on mid- to high latitude regions and a negative one on low-latitude countries. This result comes from the fact that moderate warming can enhance agricultural productivity in colder regions, while higher temperatures will exert a negative impact on already warm areas (IPCC 2014). While the Mediterranean region is a mid-latitude area, empirical evidence suggests that climate change has had a deteriorating effect on their economies, mainly through water stress and desertification and land degradation.

Against this background, the objective of this section is to present how trade affects and is affected by environment and climate change. Its objectives are threefold. First, it presents the main theoretical channels helping us understand the dynamics between trade and environment by examining three strands of the literature, namely the effect of trade on the environment, the effect of environmental policies on the

trade structure and finally the nexus between climate and change. Second, it shows the empirical literature examining these different strands. Finally, it analyses some recent developments that are relevant to the Mediterranean countries. The first section focuses on the effects of trade on the environment. The second section investigates the impact of environmental policies on the environment.

6.2.4.1 Effects of trade on the environment

Environmental effects of trade have been widely explored in the literature (Grossman and Krueger, 1993; Copeland and Taylor, 1994; Jayadevappa and Chhatre 2000; Costantini and Mazzanti 2012). Three effects have been identified in literature. First, the scale effect reflects the effect of economic growth on emissions, holding structure and technology constant. It is typically positive given that a higher GDP leads to more production and more emissions. Second, the composition effect measures structural shifts in the economy as trade changes the share of pollution-intensive sectors. This effect can be positive if the economy shifts toward dirty industries. It can also be negative if the country specializes in cleaner sectors. Finally, the technique effect captures changes in pollution intensity, and it is driven by cleaner technologies or stricter regulations. It is typically negative as higher income leads to higher technologies and cleaner production. These effects can also affect the shape of the environmental Kuznet curve (see Figure 6.1). The latter is an inverted U-shape relation between environment and income. It suggests that environmental damage increases at lower income levels, reaches a maximum level (where the scale effect dominates) and declines thereafter (where the composition and technique effects dominate). In other words, economic growth (whether trade-led or not) can improve the environment *above a peak level of income.* The inflection point varies with sources and types of pollution. Since then, a significant body of literature emerged and showed that EKC is confirmed for some pollution measures, for example SO_2 and rejected for some others, especially CO_2.

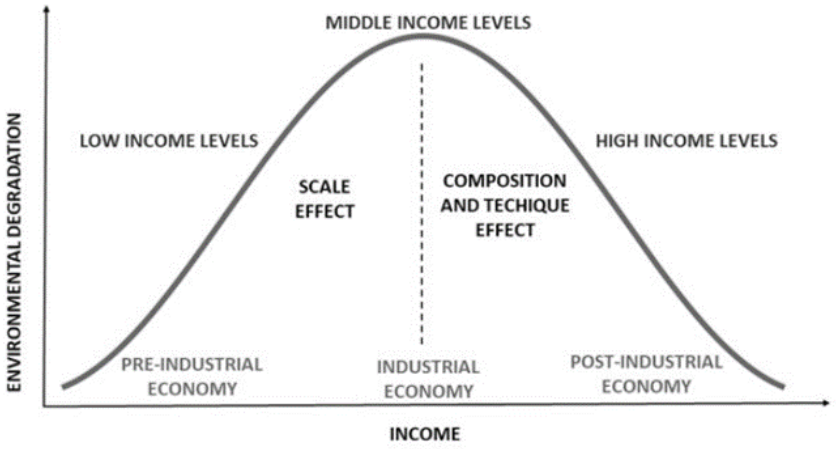

Figure 6.1 | The environmental Kuznet curve. Source: Mitic et al. (2019).

On the empirical front, while the literature on developing countries is considerable, that of the Middle East or Mediterranean countries is rather scant. For instance, Dean (2002) uses a simultaneous–equations system to examine the multiple effects of trade liberalisation on the environment and finds, using Chinese provincial data, that freer trade deteriorates the environment via the terms of trade, but improves it via income growth. Halioglu and Ketenci (2016) confirm also that the EKC hypothesis is validated in the case of some transition countries. For our region of interest, Mahmood et al. (2023) show that EKC is verified in the MENA region with their exports reducing consumption-based CO_2 emissions that are transferred to their trade partner. Moreover, energy-intensive imports of the MENA region deteriorate their environment. Finally, in terms of climate risk, Tekce and Deniz (2016) show that temperature rises have a negative impact on agricultural imports. While the focus in this chapter is on trade, Abdouli and Hammami (2017) show that, whereas foreign direct investment can enhance economic growth in MENA countries, the latter can be

detrimental to the environment. This is why, Gorus and Ben Ali (2021) argue that not only economic globalisation affected environmental problems in the MENA region, but also social and political ones.

6.2.4.2 Effects of environmental policies on trade

On the theoretical front, literature distinguishes between two main strands through which environmental regulations affect trade performance. The first one pertains to the pollution heaven hypothesis (PHH) according to which more stringent regulations in developed countries reduce the availability of their environmental inputs and increase environmental control costs in pollution-intensive sectors (Copeland and Taylor, 1994). Hence, these countries specialize in the production of clean goods while developing countries with less stringent regulations gain comparative advantages in pollution-intensive goods and could turn into pollution havens. This contrasts with the Porter hypothesis that hypothesizes a positive effect of trade on the environment once countries adopt cleaner production techniques (Porter and Van der Linde, 1995).

At the empirical level, several studies examine the impact of climate change and such environmental policies on trade. Being highly dependent on climate-sensitive agriculture, the comparative advantage of Mediterranean countries in North Africa might be affected. In fact, Mamboundou et al. (2024) show that some products can be associated with a very high risk as they are sensitive to water stress and temperature. This includes leguminous vegetables, edible nuts and groundnut oilseeds. Other products are associated with high risk (being sensitive to either water stress or temperature). This includes mainly vegetables (tomatoes, onions, carrots, cucumbers, and artichokes) and some fruits (apples, apricots, cherries, and bananas). Ramirez and Kallarackal (2015) find that flowering and fruiting durations have slightly increased and cool-hour accumulation has shortened, contributing to lower yields in several species. While several Mediterranean countries have a comparative advantage in these products, it is projected that in the medium term, their competitiveness will be affected by rising temperatures, severe weather conditions and water stress.

In terms of the impact of environmental policies on trade, the first strand of literature focuses on environmental laws and treaties. For instance, Nuñez and Martínez-Zarzoso (2019) show that the ratification of Rotterdam and Stockholm Conventions reduces imports when developing importers ratify the latter and when developed exporters ratify the former. In fact, these conventions regulate trade in dangerous substances. Tran (2022) investigates the impact of Kyoto Protocol on the bilateral trade in environmental goods and shows that their exports by Kyoto countries increases by 29–30% after the protocol enters into force. At the multilateral level, the blue economy has also been a concern for trade and the environment. In fact, the recent World Trade Organization Agreement on fisheries subsidies represents a major milestone for ocean sustainability by prohibiting harmful fisheries subsidies to curb the depletion of fish stocks at the global level. It entered into force as two thirds of WTO members deposited their instruments of acceptance. Yet, so far, none of the countries of the southern shore of the Mediterranean deposited their instruments (except for Jordan).

The second strand focuses on the role of trade provisions in trade agreements, with a special focus on deep trade agreements (DTA). The latter refers to agreements that go beyond fostering trade liberalisation but also cover additional policy areas such as the international flows of investment and labour, and the protection of intellectual property rights and environment. In fact, over the last 25 years, the number of DTA that explicitly address environmental issues has increased markedly (Baghdadi et al. 2013 and Aaditya et al. 2020). Generally, the literature has shown that environment related provisions can be effective in limiting the negative impact of trade on the environment if the latter are legally enforceable (Nunez-Rocha et al 2024). Figure 6.2 shows that Mediterranean countries tend to have fewer environmental provisions compared to more developed economies, with most of them not legally enforceable. This clearly shows to what extent most of the trade agreements are rather shallow. Therefore, from a policy perspective, it is important to increase the enforceability of such provisions to mainstream trade policy in environmental policy (WTO 2022).

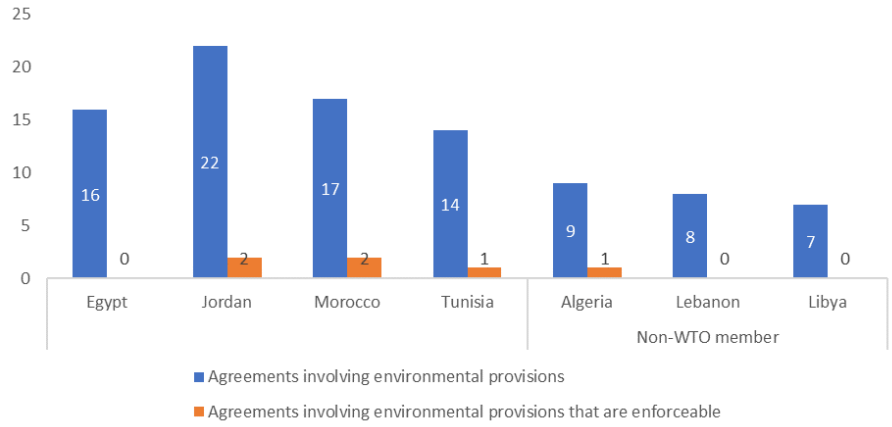

Figure 6.2 | Number of trade agreements involving environmental provisions signed by Mediterranean countries. Source: Trade and Environment Database, TREND
Note: The enforcement dimension covers provisions that regulate the enforcement of environmental regulations stipulated in the trade agreement as well as domestic environmental measures.

Ramzy and Zaki (2018) show that environmental regulations matter for agricultural trade between the EU and Middle East and North Africa countries. Indeed, more stringent environmental regulations stimulate innovative efforts in cost-saving green technologies, lending support to Porter Hypothesis. Yet, among the important trade-environment measures that have been recently implemented is the EU's Carbon Border Adjustment Mechanism (CBAM). The objective of the latter is to limit carbon leakage by putting a carbon price on imported carbon-intensive goods (such as steel, cement, electricity, aluminium, fertilizers) that enter the EU. Figure 6.3 shows that Egypt followed by Tunisia are the most exposed to CBAM measured by the World Bank CBAM exposure index. Abdou et al. (2025) show that, while the average effects of CBAM on Middle East and Central Asia are modest, the region will bear one of the largest financial burdens globally, amounting to US$1.7 billion per year or 14% surcharge on CBAM-covered exports to the EU, which clearly affect their competitiveness and therefore their comparative advantage on the EU market. Magacho et al. (2024) and Berahab and Ddush (2021) show also that the socio-economic implications in Morocco are significantly high. This is why Erdoglu (2025) argues that, generally, while compliance burdens are non-trivial in developing countries, financial and technical assistance are key factors to reduce the negative impact of this measure.

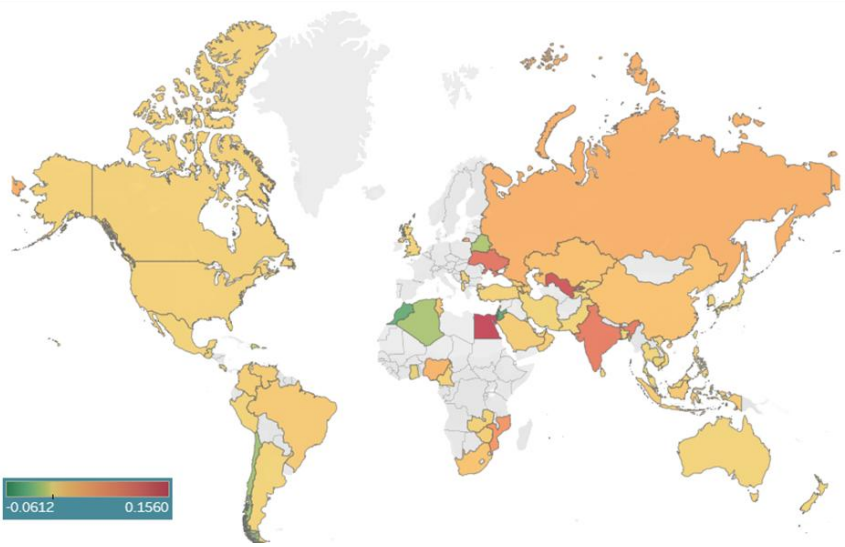

Figure 6.3 | Exposure to Carbon Border Adjustment Mechanism (CBAM). This index refers to the total value of excess carbon payments for all CBAM products as a share of the total value of exports of CBAM goods for the country. Source: World Bank.

6.2.5 Degrowth and post-growth approaches in policy design

6.2.5.1 Regional paradigms: post-growth and sustainability frameworks

Across Mediterranean sustainability debates—spanning regional strategies, national policy frameworks, and academic research—multiple development paradigms coexist and are frequently mobilised simultaneously without explicit differentiation. Policy vocabularies such as *sustainable development*, *circular economy*, and *decoupling* are widely shared across the region, yet they accommodate fundamentally different assumptions about economic growth, wellbeing, and ecological limits (UNEP/MAP 2016; Plan Bleu 2020). This coexistence generates a condition of discursive hybridity, fostering ambiguity in both analytical interpretation and policy design while allowing conflicting agendas to coexist within the same governance architectures (Feola 2019).

To avoid conceptual conflation, it is essential to distinguish development paradigms from sustainability frameworks. Paradigms refer to coherent worldviews defining the role of economic growth, nature, and wellbeing in development trajectories. Sustainability frameworks, by contrast, translate these paradigms into operational policy architectures—strategies, instruments, indicators, and programmes—without necessarily resolving underlying ontological or normative tensions. Mediterranean sustainability governance is therefore best characterised not by conceptual confusion, but by a managed paradigmatic pluralism, in which a dominant macro-regional paradigm structures policy objectives while alternative paradigms persist in academic critique, civil society discourse, and localized practices. Shared policy languages function as 'boundary objects', enabling institutional coexistence without requiring reconciliation of foundational assumptions (Star and Griesemer, 1989).

6.2.5.1.1 Green growth as the dominant regional paradigm

Green growth constitutes the dominant and institutionally embedded development paradigm shaping Mediterranean sustainability governance at supranational and national levels (UNEP/MAP 2016; Feola 2019; Plan Bleu 2020; European Commission 2021). It frames environmental protection as compatible with—indeed conducive to—continued economic expansion through technological innovation, efficiency gains, and market-led structural transformation. This orientation is explicitly codified in the Mediterranean Strategy for Sustainable Development 2016–2025 (MSSD), which defines sustainability as the harmonisation of economic growth with environmental protection (UNEP/MAP 2016, p. 10), and in the UfM's GreenerMed Agenda, which promotes a 'green and circular economy' as a cornerstone of regional cooperation, competitiveness, and job creation (UfM 2021). The paradigm is further reinforced by EU external investment and neighbourhood frameworks that explicitly link green transitions in southern Mediterranean countries to broader economic and geopolitical interests (European Commission 2021).

In practice, green growth materializes through a set of sustainability frameworks aligned with this paradigm, encompassing macro-strategic frameworks, sectoral policy instruments, and regional cooperation mechanisms. Macro-strategic frameworks include national climate, energy, and development strategies, aligned with the Mediterranean Strategy for Sustainable Development through distinct governance mechanisms across the region. In southern and eastern Mediterranean Countries, these take the form of national development strategies linked to international climate finance and donor conditionalities, as exemplified by Morocco's National Sustainable Development Strategy 2020–2030 and Egypt's Vision 2030 (Cairo et al. 2022). In northern Mediterranean countries, they operate through EU-mandated National Energy and Climate Plans and recovery frameworks that explicitly embed green growth objectives within competitiveness, innovation, and employment strategies, such as Spain's PNIEC, France's SNBC, and Italy's PNIEC and PNRR (Plan Bleu 2020; European Commission 2021). Sectoral policy instruments further operationalize environmental objectives through competitiveness-oriented policy tools, including CAP greening measures in EU Mediterranean countries, renewable energy auctions, waste management reforms, and national circular economy roadmaps such as España Circular 2030 and Italy's circular economy decrees (Mavroulidou et al. 2023). Regional cooperation mechanisms also play a significant role, notably UfM-labelled projects, the PRIMA research initiative, and ENI CBC MED

programmes, which predominantly target green innovation, climate-resilient agriculture, and sustainable production systems within a growth-compatible logic (Cots et al. 2019). Together, these frameworks and instruments demonstrate the multi-level governance architecture through which green growth is being operationalized across the Mediterranean basin, though their effectiveness and coherence remain uneven across the region.

6.2.5.1.2 Decoupling as an implicit mechanism within green growth

The internal coherence of green growth frameworks ultimately rests on the assumption of decoupling—that economic growth can be separated from environmental degradation through efficiency gains and technological progress. In Mediterranean sustainability frameworks, this assumption is rarely articulated explicitly, yet it underpins policy instruments ranging from circular economy strategies to climate investment plans. Crucially, the distinction between relative decoupling (efficiency gains) and absolute decoupling (declining environmental pressures in absolute terms) is typically left unspecified. This ambiguity allows green growth frameworks to operate institutionally despite unresolved empirical and theoretical tensions.

Decoupling therefore functions not as a paradigm or a framework, but as a cross-cutting justificatory mechanism embedded within the dominant paradigm. Post-growth and degrowth paradigms challenge this mechanism directly, arguing that efficiency gains observed in Mediterranean economies remain insufficient to offset scale effects in material- and energy-intensive sectors such as mass tourism, transport, construction, and export-oriented agriculture. The absence of explicit engagement with this critique allows sustainability frameworks to preserve coherence at the policy level while deferring resolution of foundational conflicts.

6.2.5.1.3 Circular economy as a sustainability framework, not a paradigm

Within this architecture, the circular economy does not constitute an autonomous development paradigm. Rather, it operates as a sustainability framework—a set of policy tools and strategies whose meaning and objectives are shaped by the dominant paradigm in which it is embedded. In the Mediterranean context, circular economy initiatives are predominantly operationalized as techno-economic instruments supporting green growth. They focus overwhelmingly on waste management, recycling, industrial symbiosis, and eco-innovation, while deliberately avoiding caps on absolute resource use or radical transformations of consumption patterns (Korhonen et al. 2018; Plan Bleu 2020).

The circular economy therefore functions as a boundary object, promising systemic change while preserving the growth imperative. Its conceptual flexibility allows it to be mobilised across paradigmatic positions, yet in practice Mediterranean circular economy roadmaps overwhelmingly reflect green growth interpretations rather than post-growth or degrowth logics.

6.2.5.1.4 Degrowth: a critical paradigm without institutional embedding

Degrowth articulates a fundamentally distinct development paradigm, grounded in the recognition of an irreconcilable conflict between the growth imperative and ecological sustainability in a finite world. It advocates a planned, equitable downscaling of material and energy throughput to secure wellbeing within planetary boundaries, challenging both GDP-centred policy evaluation and efficiency-based environmentalism (Kallis et al. 2018; Hickel 2021; Schmelzer et al. 2022). In the Mediterranean region, degrowth is systematically excluded from formal policy frameworks but has consolidated as a robust paradigm within academic research and social movements, particularly in northern Mediterranean countries such as Spain, Italy, and Greece. This consolidation is closely linked to tourism-led development, ecological overconsumption, and post-crisis austerity dynamics, which have rendered growth-dependent models socially and environmentally contested (Blázquez-Salom et al. 2019; Demaria et al. 2022; Kallis and Varvarousis 2022). Despite its growing analytical and social relevance, degrowth continues to operate primarily outside formal national and supranational policy arenas.

Mediterranean degrowth scholarship and practice concentrate on several interconnected thematic areas. Tourism-intensive and urbanized regions are a primary focus, critiquing socio-ecological externalities and exploring alternatives such as tourism degrowth (Fletcher et al. 2019). Island and coastal contexts are also prominently examined, analysed as frontlines of biophysical limits and laboratories for post-growth resilience (Kallis 2011). Additionally, agri-food and agroecological systems receive significant attention, where food sovereignty and peasant agriculture movements emphasise localisation, sufficiency, and commons governance (Gonzalez de Molina and Toledo 2014). Even in municipalities often cited as progressive—such as Barcelona's superblock initiatives—policies integrate selected elements, including urban commons and traffic reduction, while carefully avoiding the politically contentious degrowth label and maintaining alignment with higher-level growth-oriented objectives. Degrowth therefore remains a critical-external paradigm, shaping debate without institutional formal embedding (March 2018).

6.2.5.1.5 Agrowth and post-growth: evaluative and bridging discourses

Agrowth, defined as policy indifference toward GDP growth in favour of direct wellbeing and ecological indicators (van den Bergh 2017), remains virtually absent from Mediterranean governance. Both northern and southern Mediterranean policy frameworks continue to treat GDP growth as essential for employment, social stability, and fiscal sustainability (UNEP/MAP 2016; World Bank 2021). In SEMCs, this is reinforced by demographic pressures and macroeconomic adjustment programmes prioritising growth-led stabilisation (Jägerskog et al. 2019). Agrowth therefore functions primarily as a theoretical evaluative stance, not a policy paradigm.

Post-growth operates instead as a bridging discourse, encompassing degrowth, agrowth, and wellbeing economics. Particularly in northern Mediterranean civil society and transdisciplinary research, it reframes policy goals toward resilience and wellbeing without directly confronting the growth imperative, creating discursive openings within mainstream sustainability arenas (Latouche 2015; Buch-Hansen 2018).

6.2.5.1.6 Geographic and scalar asymmetries

Agrowth is defined as policy indifference toward GDP growth in favour of direct wellbeing and ecological indicators (van den Bergh 2017)—remains virtually absent from Mediterranean governance. Both northern and southern Mediterranean policy frameworks continue to treat GDP growth as essential for employment, social stability, and fiscal sustainability (UNEP/MAP 2016; World Bank 2021). In SEMCs, this is reinforced by demographic pressures and macroeconomic adjustment programmes prioritising growth-led stabilisation (Jägerskog et al. 2019). Agrowth therefore functions primarily as a theoretical evaluative stance, not a policy paradigm.

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In southern and eastern Mediterranean Countries, sustainability governance is considerably embedded within developmentalist frameworks where economic growth is treated as instrumental to poverty reduction, sectoral modernisation, social stability, and fiscal viability, rendering explicit post-growth discourse politically and institutionally untenable. This does not imply an absence of sustainability action. On the contrary, SEMCs have undertaken significant climate adaptation and environmental management efforts—particularly in water governance, climate-resilient agriculture, renewable energy deployment, and ecosystem protection—often under conditions of acute climate vulnerability and limited responsibility for global environmental degradation. Alongside these formal policy responses, vernacular sustainability practices persist—traditional irrigation systems, collective grazing regimes, and informal repair and reuse economies—embodying principles of sufficiency and communal governance that remain weakly recognised within dominant policy narratives (Davis 2006; Bessa 2019).

6.2.5.1.7 Synthesis: fragmentation without transition

Mediterranean sustainability governance is therefore defined by paradigmatic fragmentation without transition. Green growth dominates macro-policy orientations and financial flows; circular economy and decoupling function as enabling frameworks and policy mechanisms within this paradigm; post-growth and degrowth articulate alternative visions that remain majorly external to formal institutional arrangements. Shared sustainability vocabularies create a veneer of consensus while obscuring unresolved conflicts over ecological limits, distributive equity, and the purpose of economic activity (Swyngedouw 2010; Scoones et al. 2018; Swyngedouw 2018; Newell and Simms 2020). This managed pluralism enables discursive innovation but constrains transformative action, reinforcing structural inequalities and increasing the risk of abrupt, crisis-driven ecological adjustments (Plan Bleu 2020; MedECC 2020).

6.2.5.2 Sectoral transitions: water, energy, urban, and circular systems

While the preceding section clarified the paradigmatic landscape structuring Mediterranean sustainability governance, sectoral transitions unfold primarily through sustainability frameworks, regulatory instruments, and implementation mechanisms, rather than through explicit paradigm choice. Water, energy, urban, and circular economy transitions are therefore best analysed as framework-driven transformations, operating under heterogeneous ecological, institutional, and developmental constraints, and only indirectly shaped by broader paradigmatic orientations.

Across the Mediterranean, these sectoral frameworks mobilise shared vocabularies—efficiency, resilience, decarbonisation, circularity—while significantly sidestepping explicit engagement with questions of scale, sufficiency, or absolute limits.

6.2.5.2.1 Water systems: adaptation, efficiency, and institutionalized constraints

Water governance constitutes the most constraint-driven sectoral transition in the Mediterranean, shaped by increasing scarcity, climate change, and competing demands across agriculture, urban systems, and ecosystems. Contemporary water sustainability frameworks prioritize efficiency gains, supply diversification, and risk management, including irrigation modernisation, desalination, wastewater reuse, and non-revenue water reduction (MedECC 2020; Plan Bleu 2020; FAO 2021).

These approaches are firmly grounded in relative decoupling logics, aiming to reduce water intensity per unit of output while preserving development objectives, particularly in agriculture and tourism-dependent economies (OECD 2018; World Bank 2021). However, empirical studies consistently show that efficiency gains are frequently offset by rebound effects and expanding demand, especially under climate stress (Grafton et al. 2018; Koncagül et al. 2020).

Alongside these modern frameworks, Mediterranean water systems retain long-standing collective governance arrangements—rotational irrigation, communal aquifers, customary allocation rules, and agro-pastoral coordination—which explicitly regulate access and use. While rarely framed as sustainability innovations, these institutions operationalize absolute constraints and collective limitation, offering governance logics that contrast sharply with efficiency-centred policy designs (Bessa 2019; Davis 2006; Ostrom 2010).

The coexistence of these two logics, technocratic efficiency and institutionalized limitation, illustrates a core tension within Mediterranean water transitions: adaptation strategies advance without fully integrating mechanisms for regulating scale.

6.2.5.2.2 Energy systems: decarbonisation-led transition with demand blind spots

Energy transitions in the Mediterranean are primarily structured through decarbonisation and diversification frameworks, emphasising renewable deployment, grid integration, and energy efficiency. This orientation dominates both EU Mediterranean countries, via Green Deal instruments, and SEMCs, through climate finance, export-oriented renewable projects, and energy security strategies (European Commission 2021; MedECC 202; IRENA 2022;).

Sectoral policy instruments often focus on technological substitution, while questions of absolute energy demand, material intensity, and rebound effects remain weakly institutionalized (Kallis et al. 2018; Hickel 2021). Empirical assessments of Mediterranean energy transitions highlight that renewable expansion often proceeds in parallel with rising total energy demand, limiting emissions reductions and increasing land and material pressures (Capellán-Pérez et al. 2019; Giannetti et al. 2020). From a sectoral perspective, the key limitation is not the absence of ambition, but the narrow framing of sustainability frameworks, which prioritize supply-side transformation while under developing demand moderation, sufficiency instruments, and distributional considerations—especially salient in energy-import-dependent SEMCs (Bouzarovski et al. 2021).

6.2.5.2.3 Urban systems: service provision, resilience, and partial reframing

Urban sustainability transitions in the Mediterranean are driven primarily by frameworks focused on service provision, resilience, and liveability, including public transport expansion, energy-efficient buildings, climate adaptation, and waste management (EEA 2021; Plan Bleu 2020).

In northern Mediterranean cities, these frameworks are sometimes complemented by interventions compatible with sufficiency principles—traffic reduction, public space reallocation, shared infrastructures—yet these remain sectorally bounded and spatially limited, rather than constituting systemic urban transformation (March 2018; Calvário and Velegrakis 2020).

In SEMCs, urban sustainability strategies prioritize infrastructure deficits, informality management, and climate adaptation, constrained by fiscal capacity and rapid demographic growth (UN-Habitat 2020; World Bank 2021). Informal repair, reuse, and collective service arrangements contribute substantially to circularity and resilience, yet remain weakly recognised and poorly supported within formal urban policy frameworks (Simone 2019; Niang et al. 2020).

6.2.5.2.4 Circular economy: cross-sector framework without scale regulation

The circular economy operates across the Mediterranean as a cross-sector sustainability framework, structuring policies on waste, materials, industrial symbiosis, and product design. National and regional roadmaps—particularly in EU Mediterranean countries—emphasise recycling, secondary materials markets, eco-design, and innovation-led competitiveness (Korhonen et al. 2018; Plan Bleu 2020; Mavroulidou et al. 2023;).

Despite its prominence, empirical evaluations show that Mediterranean circular economy strategies rarely address absolute material throughput or consumption levels, focusing instead on efficiency and value retention within existing production systems (Giampietro and Funtowicz 2020; D'Amato et al. 2021). As such, circularity functions primarily as an enabling and legitimising framework, improving environmental performance while preserving growth-oriented sectoral trajectories.

6.2.5.2.5 Synthesis: sectoral progress under constrained frameworks

Across water, energy, urban, and circular systems, Mediterranean sectoral transitions exhibit measurable progress in efficiency, resilience, and service delivery, particularly where institutional capacity and finance are strong. However, their transformative potential is constrained by, at least, three structural limitations. First, there is a predominant reliance on relative decoupling indicators, combined with the absence of operational mechanisms that translate ecological thresholds into economically and socially viable policy constraints. Second, there is limited institutionalisation of demand-side and sufficiency-oriented instruments, which restricts the ability to address consumption patterns at their source. Third, persistent North–South asymmetries in vulnerability, fiscal space, and infrastructural baselines continue to shape the uneven distribution of both risks and adaptive capacities across the basin (Plan Bleu 2020; MedECC 2020; UNDP 2022). Consequently, sectoral sustainability frameworks tend to mitigate risks and improve performance at the margin, but they do not yet provide integrated mechanisms capable of reconciling long-term ecological constraints with economic viability and social objectives in Mediterranean development trajectories.

6.2.5.3 Governance transformations: commons, coordination, and democracy

Governance transformations constitute one of the most dynamic—and contested—dimensions of Mediterranean sustainability transitions. Across countries and sectors, significant efforts have been undertaken to improve participation, coordination, and institutional effectiveness. At the same time, persistent mismatches between local governance innovation and dominant national or supranational policy frameworks continue to limit the depth and scalability of these transformations.

6.2.5.3.1 Commons-based governance: tangible advances with structural fragilities

In several northern Mediterranean countries, governance reforms have moved beyond consultative participation toward the formal recognition of collective management arrangements. Italy provides some of the most advanced and well-documented examples. In Naples, the civic uses framework legally recognises collective stewardship of urban assets, while in Bologna, collaboration pacts institutionalize co-management between municipalities and citizen groups across public spaces, services, and cultural assets (Iaione and Foster 2022). Empirical assessments indicate that these commons-based arrangements have generated tangible benefits, including reduced municipal maintenance burdens, strengthened social cooperation, and expanded access to shared services and spaces—particularly in previously under-served neighbourhoods—although such outcomes remain context-dependent and vulnerable to real-estate dynamics and tourism-driven valorisation (Apostolopoulou and Adams 2015; Iaione 2016; Micciarelli 2017; Béal et al. 2019).

In southern and eastern Mediterranean Countries (SEMCs), collective governance takes different institutional forms. In Algeria, Morocco, and Tunisia, customary water and land institutions—such as agdal systems, foggara/qanat irrigation, and collective rangelands—continue to regulate access through negotiated limits and collective enforcement. These arrangements have contributed to long-term resource resilience under climatic stress and remain embedded governance capacities rather than residual or informal practices (Davis 2006; Dominguez et al. 2012; Bessa 2019). However, unlike their northern counterparts, these institutions generally lack formal legal empowerment and remain weakly integrated into national planning, water allocation regimes, and agricultural policy, limiting their influence over investment decisions and climate adaptation strategies (Plan Bleu 2020).

Across the Mediterranean basin, commons-based governance arrangements face shared structural vulnerabilities. In urban, coastal, and tourism-intensive areas, community-managed spaces frequently lack robust protection against land market pressures, speculative redevelopment, and tourism-led valorisation. Empirical studies from Southern Europe—particularly Spain, Italy, and Greece—demonstrate how participatory and commons-oriented initiatives become exposed to displacement when urban regeneration and tourism expansion accelerate, revealing persistent tensions between local governance innovation and real-estate-driven development trajectories (Apostolopoulou and Adams 2015; Béal et al. 2019; Anguelovski et al. 2022). Comparable pressures are widely reported across Mediterranean coastal regions characterised by land scarcity and tourism dependence, including in SEMCs, where informal and collective arrangements face similar exposure in the absence of strong land-use regulation and tenure security (Plan Bleu 2020; MedECC 2020).

Finally, taken together, these dynamics reveal a structural gap between localized governance innovation and macro-level land, tourism, and real-estate regulation. This gap constrains the durability and scalability of commons-based arrangements across the Mediterranean, regardless of whether governance capacity emerges through formalized urban commons or long-standing customary institutions.

6.2.5.3.2 Multi-level coordination: progress in instruments, gaps in alignment

Mediterranean governance has made notable progress in multi-level coordination mechanisms, particularly through regional and transboundary initiatives. Programs such as PRIMA, ENI CBC MED, and UfM-labelled projects have improved cooperation on water efficiency, renewable energy, and sustainable agriculture, especially by facilitating knowledge exchange and pilot implementation across countries (Cots et al. 2019; UfM 2021).

Taken together, available evidence indicates that regional cooperation instruments have contributed to technical and administrative capacity building in southern and eastern Mediterranean Countries, supported partial harmonisation of standards and monitoring frameworks, and mobilised climate and development finance for infrastructure and innovation. At the same time, assessments consistently point to uneven outcomes and a predominance of technical and project-based impacts, with limited effects on structural transformation or distributive equity (UNEP/MAP 2016; Plan Bleu 2020; OECD 2021; World Bank 2021; UfM 2021; Cairo et al. 2022).

Yet coordination gaps persist. Project-based cooperation often prioritizes technological performance and competitiveness, while governance objectives related to redistribution, demand moderation, or long-term collective control remain secondary. Southern partners frequently face conditionalities that narrow policy choice, particularly where donor priorities emphasise export-oriented renewables, efficiency gains, or agri-food value chains over local livelihood resilience (Sorman et al. 2022).

At the national level, sectoral ministries often operate in silos. Water, energy, urban development, and tourism policies are rarely aligned through integrated territorial governance frameworks, despite clear interdependencies—most visibly in coastal regions where water scarcity, energy demand, urbanisation, and tourism converge (MedECC 2020).

6.2.5.3.3 Democratic participation: institutionalisation without full empowerment

Across the Mediterranean basin, participation has expanded primarily as a governance framework—encompassing consultation procedures, partnerships, co-management tools, and stakeholder engagement requirements—rather than as a paradigmatic shift in how development objectives and trade-offs are defined. In EU Mediterranean countries, participatory elements are increasingly embedded in local climate mitigation and adaptation planning, sustainable urban mobility planning, and urban regeneration processes, notably through formal stakeholder consultation and engagement requirements attached to Sustainable Urban Mobility Plans, climate adaptation strategies, and integrated urban development frameworks (European Commission 2020; EEA 2021).

These participatory mechanisms have delivered concrete functional benefits for climate and environmental policy. Empirical assessments indicate improvements in policy legitimacy, local acceptability, and implementation effectiveness, particularly for measures involving behavioural change, land-use adjustment, and service reorganisation—such as low-emission zones, modal shift policies, urban greening, flood-risk management, and water demand management. In this sense, participation has strengthened the operational feasibility of mitigation and adaptation measures, reduced social resistance and facilitated learning between administrations and affected stakeholders (EEA 2021; Plan Bleu 2020).

At the regional level, Mediterranean strategies and implementation agendas also institutionalize stakeholder participation as a recurring enabling principle. The Mediterranean Strategy for Sustainable Development explicitly frames inclusive governance, stakeholder engagement, and multi-actor coordination as cross-cutting conditions for advancing climate resilience, biodiversity conservation, and sustainable resource management, while Plan Bleu assessments document the diffusion of participatory mechanisms across environmental, water, and territorial policies (UNEP/MAP 2016; Plan Bleu 2020).

However, across both northern and southern Mediterranean contexts, a consistent structural pattern emerges: participation is more institutionalised than empowering. While participatory mechanisms contribute positively to the design, acceptance, and localized effectiveness of climate mitigation, adaptation, and conservation measures, they only partially redistribute strategic decision-making power over land-use change, large-scale infrastructure choices, tourism development models, and long-term resource allocation. These domains—critical for aggregate emissions pathways, ecosystem pressure, and spatial exposure to climate risks—remain majorly shaped by incumbent planning systems, investment logics, and macroeconomic constraints.

Mediterranean assessments repeatedly underline this gap, noting that advances in participatory governance coexist with the persistence of structural drivers of environmental pressure, including coastal

urbanisation, tourism intensification, real-estate dynamics, and uneven fiscal capacity. As a result, participation tends to improve how policies are implemented more than what scale or direction of transformation is pursued (Plan Bleu 2020; MedECC 2020; ICMPD 2021).

In southern and eastern Mediterranean Countries (SEMCs), participatory governance has also progressed, often through decentralisation reforms, climate adaptation programmes, and donor-supported development interventions. Community-based projects in water management, municipal services, neighbourhood upgrading, and rural development have expanded local involvement and strengthened technical and administrative capacities, particularly for climate adaptation, ecosystem stewardship, and service delivery under resource constraints (Barthel et al. 2019; Berriane and Aderghal 2020; Koncagül et al. 2020; Elloumi et al. 2021; Fatorić and Seekamp 2021).

These arrangements have proven valuable for context-sensitive adaptation, risk management, and conservation practices—especially where local knowledge, collective action, and maintenance capacity are decisive. Yet their influence on investment priorities, mitigation scale, and long-term development trajectories remains constrained by fiscal dependence on central authorities, limited local revenue autonomy, and project-based conditionalities. Participation therefore expands procedurally and functionally, while decisional authority over the most climate-relevant structural choices remains only partially devolved (Plan Bleu 2020; World Bank 2021; UNDP 2022).

6.2.5.3.4 Synthesis: governance advances confronting structural limits

Mediterranean governance transformations show clear progress in institutional capacity, coordination practices, and procedural inclusion, particularly at local and sectoral levels. Commons-based arrangements, participatory instruments, and regional cooperation frameworks have broadened governance responses to environmental and social pressures, improving policy implementation, stakeholder engagement, and adaptive capacity across diverse national contexts.

At the same time, empirical assessments across the Mediterranean basin show that these governance advances—while improving coordination, implementation capacity, and local outcomes—operate within persistent structural constraints, including land-use dynamics, sectoral growth dependence, fiscal frameworks, and multi-level policy misalignment, which limit their capacity to reorient aggregate development trajectories (Plan Bleu 2020; MedECC 2020; EEA 2021; UNDP 2022).

First, collective and participatory governance arrangements remain weakly protected from land, real estate, and tourism market dynamics, especially in urban and coastal areas. Where governance innovations are not embedded in binding spatial planning, tenure protection, or macro-sectoral regulation, their outcomes remain contingent and reversible. Second, vertical coordination remains partial. Local and sectoral innovations frequently coexist with—rather than reshape—national and regional policy frameworks, reflecting the difficulty of aligning localized experimentation with macroeconomic planning, investment cycles, and fiscal constraints. Third, governance instruments largely prioritize efficiency, resilience, and adaptation, while mechanisms addressing scale, cumulative impacts, and aggregate demand remain limited. Performance improvements therefore tend to occur within relative metrics, without systematic arbitration between economic expansion, social objectives, and ecological constraints. Finally, enduring asymmetries in fiscal space, administrative capacity, and bargaining power shape governance possibilities across the Mediterranean. Northern countries generally operate with greater regulatory and financial room for experimentation, while southern and eastern Mediterranean Countries face tighter development, employment, and financing constraints despite high climate vulnerability.

Taken together, current governance reforms primarily optimize sustainability performance within existing development frameworks rather than redefine those frameworks. This reflects not a failure of governance innovation, but a mismatch between the scale of governance instruments and the structural drivers shaping Mediterranean socio-ecological systems. Strengthening Mediterranean sustainability governance therefore requires institutional arrangements that connect local and sectoral innovation to binding, multi-

level decision frameworks where economic priorities, social distribution, and ecological constraints are explicitly negotiated.

6.2.5.4 Economic and labour transitions: instruments, distribution, and justice

Mediterranean climate adaptation, mitigation, and biodiversity conservation increasingly rely on economic instruments—prices, taxes, incentives, and compensation schemes—and on labour transitions concerning skills, employment quality, and social protection (European Commission 2022; World Bank 2023). This dual approach is central to regional strategies, which advocate integrating market-based mechanisms with active labour policies to foster a green and just transition (OECD 2021). Sector-specific analyses, such as in water and agricultural management, confirm the growing centrality of these instruments for incentivising adaptation (Iglesias et al. 2022). Across the basin, the central governance challenge is not the absence of technical policy instruments, but the difficulty of implementing them in ways that avoid regressive distributional effects while still delivering durable mitigation, adaptation, and conservation outcomes. This challenge is shared across the region, but it manifests under markedly different structural conditions between northern and southern and eastern Mediterranean countries, reflecting disparities in income levels, fiscal space, institutional capacity, and exposure to climate risks (Cramer et al. 2018; MedECC 2020; Plan Bleu 2020).

6.2.5.4.1 Economic instruments: differentiated constraints and policy space

In northern Mediterranean countries, price-based reforms—energy pricing, carbon taxation, water tariffs, and environmental charges—are typically implemented within relatively mature welfare systems and regulatory environments. Empirical evidence suggests that where such instruments are paired with transparent compensation mechanisms (targeted transfers, social tariffs, investment in public services), they can contribute to emissions reductions and resource efficiency while maintaining social acceptance (OECD 2018; World Bank 2021; Bouzarovski et al. 2021). However, even in these contexts, distributional tensions persist, particularly in rural areas, tourism-dependent regions, and low-income urban households facing rising energy and housing costs (García de Jalón et al. 2022; Bierbaum and Fay 2023).

In Southern and Eastern Mediterranean Countries (SEMCs), the political economy of economic instruments is more constrained. Higher baseline poverty, energy and food price sensitivity, and limited fiscal capacity narrow the scope for price reforms without immediate social backlash. Empirical studies of water and energy pricing reforms in North Africa and the Eastern Mediterranean document how affordability concerns, institutional trust deficits, and weak compensation systems have led to delayed implementation, partial rollbacks, or dilution of reform ambition—directly affecting the credibility and durability of climate policy (World Bank 2021; Choukri et al. 2022; UNDP 2022). These constraints are amplified by exposure to climate stressors—water scarcity, drought, coastal flooding—that raise adaptation needs precisely where policy space is most limited (MedECC 2020).

This contrast is particularly evident in water governance. Across the basin, water pricing and tariff reforms aim to improve efficiency and signal scarcity. In northern Mediterranean contexts, such reforms are increasingly embedded within integrated river basin management and land-use regulation frameworks, although rebound effects remain a concern. In SEMCs, evidence shows that where institutional controls over scale, cropping patterns, and land use are weak, pricing can induce shifts toward high-value, water-intensive production, offsetting conservation gains and complicating adaptation objectives (OECD 2018; Varela-Ortega et al. 2021; Bertule et al. 2022). Mediterranean assessments therefore emphasise that adaptation is advancing unevenly, constrained by cumulative demand pressures and fragmented governance across sectors and scales (MedECC 2020; Plan Bleu 2020).

Energy subsidy reform and carbon or energy pricing display similar asymmetries. In northern Mediterranean countries, reforms are increasingly framed within just transition strategies that combine decarbonisation with social protection and regional support. In SEMCs, where energy subsidies have historically played a stabilising social role, reform efforts face higher political sensitivity and require

carefully sequenced compensation and trust-building measures to avoid undermining climate objectives (Bouzarovski et al. 2021; AlShehhi and AlMeer 2023; European Commission 2023).

Payments for ecosystem services (PES) and conservation incentives further illustrate differentiated feasibility. While discussed across the basin, their operational effectiveness depends on tenure security, monitoring capacity, and administrative coordination—conditions more unevenly met in SEMCs. Where these prerequisites exist, PES-type instruments can support biodiversity conservation and climate adaptation simultaneously, particularly in watersheds, rangelands, and coastal zones exposed to erosion and flood risks (Schirpke et al. 2020; Arfaoui and Nunes 2023). Where they do not, risks of elite capture and limited ecological additionality remain high (MedECC 2020).

6.2.5.4.2 Labour transitions: shared pressures, unequal adjustment capacity

Labour transitions linked to decarbonisation, water management, buildings, transport, and circular systems pose basin-wide challenges, but adjustment capacity differs markedly. In northern Mediterranean countries, labour-market institutions and vocational training systems provide greater scope for managing reallocation, albeit imperfectly. In SEMCs, where informality, youth unemployment, and demographic pressure are more pronounced, climate and environmental transitions intersect with urgent employment needs, increasing the risk that 'green jobs' narratives overstate inclusive employment potential unless backed by active labour-market policies and social protection (Rigolini 2022; Fritz and Koch 2023; Mastrorillo et al. 2024).

OECD and Mediterranean-focused analyses show that green transitions reshape task profiles across sectors, increasing demand for technical and maintenance skills while displacing employment in carbon-intensive activities. Without anticipatory training systems and labour standards, these shifts risk reinforcing precarity, particularly in regions dependent on seasonal tourism, agriculture, and construction (OECD 2021; Hana et al. 2023; Conefrey et al. 2023). This challenge is especially acute in SEMCs, where large-scale infrastructure investments—renewables, grids, desalination, coastal protection—often outpace institutional capacity to ensure decent work and inclusive labour outcomes.

6.2.5.4.3 Implications for climate mitigation, adaptation, and conservation

The Mediterranean literature converges on a clear conclusion: economic and labour instruments can support mitigation, adaptation, and environmental conservation when designed as integrated policy packages, combining price signals, compensation mechanisms, targeted investment, and institutional capacity-building. However, the feasibility and distributive consequences of such packages differ substantially across northern and southern Mediterranean contexts. Where instruments are implemented as isolated technical reforms—without adequate safeguards, credible reinvestment in resilience and ecosystems, or attention to labour-market adjustment—their environmental effectiveness and political durability are weakened. This pattern is repeatedly documented in Mediterranean coastal and water-risk contexts, where climate exposure is high and social acceptance is central to sustained policy implementation (MedECC 2020; Plan Bleu 2020; Iglesias and Garrote 2022).

6.2.5.5 Political-economic constraints: lock-ins, contradictions, and barriers

Sustainability transitions in the Mediterranean region are increasingly shaped by entrenched political-economic constraints, including sectoral path dependencies, spatial inequalities, and long-standing vested interests. Multiple studies highlight how land-based economic growth models—especially those centred on real estate, tourism, and infrastructure—pose contradictions between environmental ambitions and economic logics. For instance, urban climate initiatives in cities like Barcelona, Tangier, and Antalya often coexist with real estate-driven peri-urban expansion, which undermines environmental justice and climate adaptation outcomes (Ridolfi et al. 2017; Kourkouridis et al. 2024).

The tourism sector remains a central structural lock-in. Despite the promotion of sustainable tourism initiatives (e.g. eco-labels, green certifications), empirical research shows that such measures only marginally mitigate high resource intensities associated with mass tourism. They seldom address systemic

drivers such as excessive visitor numbers, land commodification, and social displacement (Scalamonti 2024; Moncada et al. 2024). Moreover, tourism's expansion continues to be prioritized in national recovery strategies, reinforcing unsustainable dynamics (Ridolfi et al. 2021).

In the agri-food domain, transitions are impeded by the persistence of export-oriented, water-intensive models, incentivized through policy frameworks like the Common Agricultural Policy (CAP) and external trade agreements. These create significant inertia that limits experimentation with diversified and agroecological systems, especially in water-stressed regions such as southern Morocco, Spain, and Tunisia (Frija et al. 2025; Moragues-Faus 2016; Schwemmlein 2025).

Similarly, energy systems in the Mediterranean face deep structural constraints. Fossil fuel dependencies, subsidized energy pricing, and outdated infrastructure continue to define investment landscapes in countries like Algeria, Egypt, and Türkiye. While renewable initiatives have gained traction, several scholars caution against overly technocratic or market-driven framings, which often neglect equity concerns and fiscal constraints in southern and eastern Mediterranean states (Tagliapietra 2020; Haddad et al. 2022; Fronteddu 2023).

Across sectors, dominant sustainability strategies such as the circular economy strategies and green growth paradigm significantly prioritize efficiency gains over systemic transformation. Recent analyses argue these frameworks reduce environmental intensity but fail to lower absolute material and energy throughput in key sectors like mobility and construction (Domènech et al. 2021; Sorman et al. 2022; Zacharou-Otapasidou 2020). At the local level, promising transformative initiatives—e.g. energy cooperatives in Sardinia or agroecological biodistricts in Italy—highlight the potential of alternative models. However, their impact remains limited by governance fragmentation, legal rigidity, and lack of fiscal autonomy at the municipal scale (Fronteddu 2023; Imami et al. 2025). Participatory approaches often face tokenisation within bureaucratic channels, which limits transformative reach (Hamadeh 2025). Governance fragmentation further compounds challenges, especially where metropolitan coordination is weak or regional platforms lack binding authority. While regional cooperation through bodies like the UfM has facilitated capacity-building, its non-binding mechanisms limit policy coherence (UfM 2021; Scalamonti 2024). External donor programs often favour technocratic and managerial interventions over redistributive or democratic reforms.

Finally, distributional justice and North–South asymmetries remain underexplored in Mediterranean transition discourses. While degrowth and post-growth debates are gaining traction in western Europe, growth imperatives dominate in the southern Mediterranean due to youth unemployment, debt, and development gaps. If climate policies are not paired with explicit redistributive mechanisms, they risk exacerbating existing inequalities (Bouzarovski et al. 2021; Roberts et al. 2021; UN ESCWA 2023).

6.2.5.6 Strategic roadmap to Mediterranean transitions

Taken together, the Mediterranean experience suggests that sustainability transitions are constrained less by a lack of policy instruments or experimentation than by the absence of a shared understanding of the region's systemic challenges and of sequenced transition pathways capable of aligning short-term feasibility with medium- and long-term transformation. Across the basin, countries operate with partially divergent diagnoses of priority risks—ranging from climate exposure and water scarcity to employment, fiscal stability, and geopolitical vulnerability—which translates into fragmented policy objectives and weak incentives for sustained coordination. As a result, sustainability policies have tended to accumulate incrementally—through efficiency gains, adaptation measures, participatory mechanisms, and pilot initiatives—without being articulated into a coherent temporal strategy that clarifies what can be achieved immediately, what requires institutional maturation, and what demands deeper structural change.

This fragmentation is reinforced by enduring obstacles to regional coordination. Asymmetric development levels, heterogeneous institutional capacities, uneven exposure to climate and economic shocks, and governance architectures that privilege national sovereignty over basin-scale problem-solving all limit the emergence of shared transition trajectories. In the absence of a commonly negotiated framing of

Mediterranean sustainability challenges, coordination efforts remain considerably procedural or project-based, constraining their capacity to generate cumulative and transformative effects across countries and sectors.

These observations have direct implications for policy positioning and coordination across the Mediterranean basin. In the short term, transition credibility depends primarily on strengthening the social and political robustness of existing instruments. This involves designing economic reforms—such as pricing mechanisms, subsidy adjustments, or regulatory standards—in ways that explicitly integrate compensation, transparency, and trust-building, and that visibly link revenues to climate adaptation, resilience, and ecosystem protection objectives. At this stage, coordination gains are most realistically achieved through pragmatic alignment of standards, monitoring frameworks, and implementation capacities, rather than through attempts at paradigmatic convergence.

In the medium term, the literature points to the need for consolidation of governance structures. Sectoral and local innovations—whether in water management, energy systems, urban policy, or ecosystem stewardship—require stronger vertical integration into national planning, fiscal frameworks, and investment strategies. This phase is less about introducing new policy tools than about re-scaling existing ones: embedding local experimentation within binding spatial planning, strengthening cross-sector coordination in high-pressure zones such as coastal areas and river basins, and progressively integrating broader indicators of wellbeing and resilience into decision-making processes. At the regional level, this implies a gradual shift from project-based cooperation toward more durable coordination arrangements for managing shared resources and risks, while remaining attentive to the differentiated development constraints faced by northern and southern Mediterranean countries.

Over longer-term horizons, achieving durable sustainability outcomes will depend on addressing issues that remain politically sensitive but cannot be indefinitely deferred. These include managing aggregate material and energy demand, clarifying governance over land, housing, and infrastructure, and strengthening redistributive and care-oriented policy frameworks in ways compatible with climate adaptation and social cohesion. For the Mediterranean region, this also entails progressively operationalising basin-scale perspectives—on ecosystems, mobility, and energy—through institutional arrangements that move beyond voluntary cooperation, while remaining sensitive to sovereignty concerns and development asymmetries.

Framed in this way, Mediterranean sustainability transitions do not require a uniform or immediate shift toward post-growth paradigms. Rather, they call for strategic sequencing: aligning short-term policy feasibility with medium-term governance reform and long-term structural orientation. Such sequencing offers a pragmatic route toward improved policy coordination across the basin, enabling countries to pursue context-specific development objectives while progressively converging on shared ecological constraints and social priorities. The following section therefore proposes a phased strategic roadmap—short, medium, and long term—designed to strengthen Mediterranean policy coherence without presuming premature paradigm convergence.

6.2.6 Synthesis: comparative insights and regional gaps

[PLACEHOLDER: section to be drafted] Objective: To synthesise findings across subsections, identifying common trends, differences, and coordination needs within the Mediterranean context.
Approach: Cross-case comparative analysis based on literature and case study evidence.
Key points to address:

- Compare the degree of methodological uptake, institutional capacity, and policy integration across countries.
- Identify common implementation barriers, such as data gaps or limited financial resources, especially in non-EU states.
- Propose areas for enhanced regional coordination, shared tools, and cross-border investment aligned with ecosystem-based goals.

6.3 Climate finance mechanisms

[PLACEHOLDER: Reviews existing funding and financing mechanisms and suggests pathways for equitable, transparent, and impactful climate finance.]

6.3.1 Climate finance – key concepts and scope

[PLACEHOLDER: the content of the whole subsection will be completed]

6.3.1.1 Introduction (context, scope, key concepts)

- The Mediterranean climate emergency and financial deficit: Highlight that the Mediterranean Basin is warming 20% faster than the global average, making it a severe climate hotspot. Establish that introducing robust climate finance mechanisms is both the critical barrier and enabler, specifically in unlocking capital for transboundary mitigation (emissions reduction) and adaptation (coastal and marine resilience) efforts
- Compliance and alignment with the Paris Agreement: Frame an analytical overview of how southern and northern Mediterranean nations are faring regarding their Nationally Determined Contributions (NDCs). Identify the gaps between current regional policies and the global goal to limit warming to 1.5°C, while highlighting policy disparities across the basin's fragmented jurisdictions.
- The role of environmental and ecological restoration: Expand the introduction to explicitly include nature-based solutions and ecosystem restoration under frameworks like the UfM GreenerMed Agenda 2030. Point to the necessity of financing the rehabilitation of Mediterranean wetlands, forests, and marine protected areas as a dual-action strategy that naturally stores carbon while building regional resilience.
- Climate Adaptation, Resilience, and the Global Goal on Adaptation (GGA): Address the urgent imperative to enhance regional resilience against severe impacts like water scarcity, extreme heat, and sea-level rise. Frame the analysis around the UNFCCC Global Goal on Adaptation (GGA) framework and indicators to evaluate how local adaptation plans align with measurable global metrics for reducing vulnerability.
- Financing Objectives and Mobilisation Instruments: Define the region's mobilisation targets, looking at how to bridge the severe public-private adaptation funding gaps using mechanisms championed by the UfM (UfM) and the EU's Pact for the Mediterranean. Specifically introduce the strategic roles of blended finance structures—such as combining public resources with private capital via Plan Bleu—and innovative green bonds, credit guarantees, and concessional loans designed to de-risk investments in climate-resilient infrastructure.

6.3.1.2 Structured glossary of key terms

6.3.1.3 Financing mechanisms and de-risking instruments

- Blended finance: the strategic use of development finance (public and multilateral funds) to mobilise additional commercial private capital, reducing risks for private investors in complex regional projects.
- Green bonds: fixed-income financial instruments specifically earmarked to raise capital for projects with environmental benefits, such as renewable energy deployment or ecosystem rehabilitation.
- Concessional loans: Loans extended on terms substantially more generous than market loans, usually through below-market interest rates or grace periods, common in North-South development cooperation.

- Credit guarantees: a commitment where a third party (such as a multilateral development bank) promises to pay a lender if a borrower defaults, de-risking investments in politically or economically unstable Mediterranean regions.

6.3.1.4 Policy, risk, and compliance metrics

- Nationally Determined Contributions (NDCs): non-binding national plans highlighting climate actions, including climate targets for greenhouse gas emission reductions, under the Paris Agreement.
- Belém adaptation indicators: the set of 59 global indicators adopted at CMA 7 (under the UAE-Belém work programme) used to measure global progress toward achieving the GGA targets.
- EU taxonomy: a robust classification system establishing a list of environmentally sustainable economic activities, guiding European climate investments across its six core objectives.

6.3.2 Background considerations

6.3.2.1 Broader macroeconomic landscape in the Mediterranean and the existing international financial architecture in relation to climate finance.

[PLACEHOLDER: content will be assessed]

6.3.2.2 International and regional Climate Finance Architecture in the Mediterranean

[PLACEHOLDER: content will be assessed]

6.3.2.3 Climate Finance, Just Transition, and Just resilience

[PLACEHOLDER: content will be completed and updated]

- Just transition: a framework that ensures the transition to a low-carbon economy is fair and inclusive, actively supporting workers, vulnerable communities, and industries negatively impacted by decarbonisation.
- Just resilience: an approach to climate adaptation that ensures resilience measures are distributed equitably, preventing marginalised populations from bearing a disproportionate share of climate risks or adaptation costs.
- Climate justice: a concept framing climate change as an ethical and political issue [26], rather than one that is purely environmental, highlighting that those least responsible for emissions often suffer the worst consequences.
- Socially inclusive green economy: An economic model promoted by regional frameworks like the UfM GreenerMed Agenda [27] that seeks to reduce environmental risks and ecological scarcities while simultaneously enhancing human well-being and social equity.

Financing mechanisms and target-directed instruments

- EU Just Transition Mechanism (JTM): a key tool under the European Green Deal providing targeted financial support [28] to alleviate the socio-economic impact of the transition in the most affected European-Mediterranean territories.
- Just Energy Transition Partnerships (JETPs): intergovernmental financing mechanisms that channel multilateral donor funding to accelerate the phase-out of fossil fuels while protecting affected livelihoods, highly relevant to North-South Mediterranean energy cooperation.

[26] https://www.un.org/sustainabledevelopment/blog/2019/05/climate-justice/
[27] https://ufmsecretariat.org/ufm-environment-agenda/
[28] https://commission.europa.eu/topics/regional-and-urban-policy/just-transition-mechanism_en

- Social impact bonds: a pay-for-success funding instrument where private investors provide upfront capital for public social services—such as clean energy retraining programs—and are repaid by the state if specific social outcomes are achieved.
- Microfinance for Adaptation (MEbA): small-scale financial products targeting micro-entrepreneurs and smallholder farmers in vulnerable sectors like Mediterranean agriculture, enabling them to invest in localized, low-cost resilience measures.

Regional compliance and vulnerability indicators

- Socio-Economic vulnerability index: a metric used to identify population segments—such as coastal fishing communities or informal workers—that lack the economic capacity to absorb the financial shock of climate impacts.
- Gender-responsive climate finance: a financing mandate ensuring that resource allocation actively addresses the distinct vulnerabilities of women [29] to climate change while maximising their role in mitigation, adaptation, and green job creation.
- UfM social and economic inclusion agenda: a regional framework that aligns Mediterranean green economic transitions with youth employment, female empowerment, and the reduction of territorial inequalities across the basin.

6.3.3 Assessment of current financial flows in the Mediterranean

[PLACEHOLDER: assessments to be drafted]

The choice made here in classifying and analysing finance is made explicit, in recognition that different approaches are possible. The IPCC public/private criteria are followed, though grey zones are acknowledged to exist (Ref. Box 15.1).

(in line with AR7 WGII Scoping). Finance flows: public and private investments at domestic and international levels, examining current flows, effectiveness, and accessibility. Trends on finance and specifically on climate finance in the Mediterranean.

Methodological framing and typology choice: explicitly declare the analytical framework selected to classify and evaluate climate finance flows across the basin.

- Acknowledge that while multiple overlapping methodologies exist globally, this chapter adopts the official standard IPCC criteria [30].
- Categorise all financial assets strictly into public finance and private finance structures.
- Note the operational complexities and ‘grey zones’ inherent in this binary split—cross-referencing Ref. Box 15.1—to account for overlap in state-owned enterprise spending or regulated market mechanisms.
- Align the methodology explicitly with the IPCC AR7 WGII Scoping guidelines to ensure forward-looking policy relevance.

Mapping regional finance flows: evaluate the mobilisation, direction, and systemic barriers of financial resource deployment across Mediterranean jurisdictions.

- Investment levels: map both domestic and international financial commitments distributed across the northern, southern, and eastern Mediterranean sub-regions.
- Effectiveness: measure how successfully funded initiatives achieve targeted emissions reductions, structural adaptation benchmarks, and biodiversity baselines.

[29] https://www.greenclimate.fund/projects/gender
[30] https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-15/

- Accessibility: analyse the ease with which local governments, NGOs, and regional developers can access international climate funds (e.g. GCF [31]), identifying institutional bottlenecks or high administrative barriers.

Macro trends in mediterranean climate finance: trace the trajectory of green funding patterns across the basin over time.

- Assess historical and current trends, spotlighting the systemic imbalance where mitigation projects heavily outpace funding for adaptation.
- Highlight the financial variations between EU member states (benefiting from centralized mechanisms like the EU Just Transition Fund [32]) and non-EU southern Mediterranean nations heavily reliant on external multilateral development banks (MDBs).

6.3.3.1 Mitigation

[PLACEHOLDER: assessment in progress]

6.3.3.2 Adaptation

[PLACEHOLDER: section to be drafted based on following bullet points]

- The Adaptation financing gap: detail the structural undersupply of dedicated adaptation capital in the Mediterranean, a basin facing rapid desertification, agricultural stress, and severe coastal erosion.
- The Global Goal on Adaptation (GGA) integration: connect regional funding targets to the global framework, evaluating how local projects align with Article 7.1 of the Paris Agreement [33] metrics
- Sectoral distribution of adaptation funds: Break down where adaptation money is spent in the region, focusing on water security, infrastructure resilience, and coastal defence.
- Barriers to private adaptation capital: Outline why private investors avoid adaptation projects (e.g. long payback periods, lack of direct revenue generation) and how public policies can reverse this trend.[END PLACEHOLDER]

Box 6.1: Hybrid, blended, and co-financed instruments (case study: PRIMA)

De-risking through collaboration: define how blending public subsidies with private loans minimizes investor risk for regional climate-resilient initiatives.

- Co-financing mechanics: examine how shared financial models foster cross-border asset building between EU and non-EU Mediterranean partners.
- The PRIMA model: highlight the Partnership for Research and Innovation in the Mediterranean Area (PRIMA) as a prime example of co-financing, showing how it pools regional funds to scale up sustainable water management and climate-smart agriculture.

Box 6.2: Classification by operational scope (national, local, international)

- International flows: map macro-level capital originating from multilateral funds, foreign direct investment (FDI), and international development banks.
- National budgets: analyse central government allocations, green sovereign bonds, and national climate funds dedicated to meeting country-level NDCs.
- Local and subnational financing: assess municipal budgets, local microfinance mechanisms, and community-driven initiatives addressing immediate, localized climate vulnerabilities.

[31] https://www.greenclimate.fund/about
[32] https://commission.europa.eu/topics/regional-and-urban-policy/just-transition-mechanism_en
[33] https://unfccc.int/topics/adaptation-and-resilience/workstreams/gga

6.3.4 Financing needs, gaps and drivers

AR7 Financing needs in the Mediterranean (est. quantified financing needs and for what, by when link to cost of inaction and advantages of investing now rather than in the future; transformational finance).

The notion of financing needs for climate is complex because it encompasses several dimensions and because estimations depend substantially on targets that involve socio-economic and equity considerations. As a result, caution should be exercised in interpreting existing estimates for policy implications, including estimation of gaps and possible interventions to address them.

A first dimension to consider are the categories of mitigation, adaptation, as well as projects with mixed impacts or cobenefits. For mitigation, one aspect to consider is obviously the cost of building infrastructures (in the broad sense, including low-carbon energy plants, low-carbon transportation) to meet projected demand and to replace existing capacity.

In this regard, the literature does not offer a consistent estimate for the MEDEC area. Some rough estimates can be inferred by adding up country level NDC and other estimates and by downscaling regional level estimates (e.g. south EU).

However, the estimation of needs depends substantially on the scenario of projected demand trajectory, which in turn depends on assumptions which are not free of value judgment (refer to e.g. IPCC AR6 Low demand scenario).

Moreover, it is well established on the conceptual side, that the economic success of mitigation investments depends on enabling environments. Hence, it is important to note the if policy intervention is reduced to meeting financing needs without a broader analysis (which comprises both the economic side ('general equilibrium' and network effects) and the political economy side, it is a reduced chance of success.

6.3.4.1 Gaps

[PLACEHOLDER: to be assessed]

6.3.4.2 Drivers

[PLACEHOLDER: to be assessed]

6.3.5 Pathways and approaches to accelerate alignment of financial flows with long-term global goals

Scope: defining the alignment framework (Article 2.1c)

- Operationalising article 2.1(c): define the scope around the Paris Agreement mandate to make financial flows consistent with a pathway toward low greenhouse gas emissions and climate-resilient development.
- Cross-border scope: frame the analysis across both EU Mediterranean member states (bound by strict green finance criteria) and non-EU southern and eastern Mediterranean countries (dependent on external transition finance).
- Systemic scope: expand the boundary beyond dedicated 'climate finance' to analyse the broader financial system, including public budgets, banking sectors, and foreign direct investment (FDI) trends in the region.

Evidence: current status of alignment in the Mediterranean

- The investment gap: document empirical evidence showing the current mismatch between required capital and actual investment levels for achieving regional 2030 and 2050 climate goals.
- Fossil fuel subsidies vs. green capital: map tracking data on remaining fossil fuel subsidies and high-carbon investments in the Mediterranean basin compared to renewable energy and adaptation funding.

- MDB portfolio alignment: review data on how regional Multilateral Development Banks—specifically the European Investment Bank (EIB)[34]and the European Bank for Reconstruction and Development (EBRD)[35] are successfully aligning their lending portfolios with 1.5°C pathways.
- UfM technical assessments: integrate findings from the UfM reports[36] regarding tracking gaps and data fragmentation in climate finance reporting across the southern Mediterranean.

Assessment: catalysts and barriers to acceleration

- Policy and regulatory drivers: evaluate the effectiveness of introducing the EU Taxonomy[37] and green banking regulations to shift private capital away from climate-negative activities in the basin.
- De-risking and scalability: assess how effectively blended finance and sovereign green bonds are being used to scale up deployment in high-risk, low-income sub-regions.
- Institutional bottlenecks: identify the core barriers preventing rapid alignment, such as weak local capital markets, political instability, and a lack of standardised project pipelines in vulnerable coastal areas.

6.3.5.1 Financing pathways to climate justice

[PLACEHOLDER: content will be completed]

- Operationalising equity in Mediterranean finance: establish how the principles of Common But Differentiated Responsibilities (CBDR) translate into concrete financial allocations between the wealthier northern shores and the vulnerable southern and eastern shores.
- Just resilience and vulnerability-targeted capital: propose financial mechanisms designed to bypass bureaucratic bottlenecks and directly reach marginalised populations, such as smallholder farmers facing desertification or coastal fishing communities hit by marine ecological degradation.
- Addressing loss and damage funding: explore how the international Loss and Damage Fund can be integrated into Mediterranean financial pathways to compensate for irreversible climate impacts that surpass adaptation limits.
- Inclusive governance of financial flows: outline frameworks to ensure that local communities, civil society, and youth organisations have an active voice in deciding how adaptation and ecological restoration funds are prioritised and spent.
- Equitable distribution of the triple dividend: ensure that the economic, social, and environmental benefits (the 2nd and 3rd dividends) are not captured solely by wealthier regions, but are systematically directed toward marginalised populations on the southern and eastern Mediterranean shores.
- Cross-section linkage (Just Transition): directly cross-reference Section 6.3.2.3, showing how funding, the Triple Dividend of Adaptation provides retraining and job security for workers transitioning away from climate-vulnerable sectors like traditional agriculture or fossil-fuel-reliant industries.[END PLACEHOLDER]

Box 6.3: Monetising resilient returns: the triple dividend of adaptation in Mediterranean coastal ecosystems

Traditional financial assessments often fail to capture the full economic value of adaptation investments, leading to a systemic underfunding of resilience projects relative to mitigation. To address this market failure, the Triple Dividend of Adaptation framework redefines project returns across three distinct layers: avoided losses, economic optimisation, and social-environmental co-benefits.

[34] https://www.eib.org/en/index.htm
[35] https://www.ebrd.com/who-we-are.html
[36] https://ufmsecretariat.org/climate-finance/
[37] https://joint-research-centre.ec.europa.eu/projects-and-activities/sustainable-finance/eu-taxonomy_en

6.3.5.2 Financing enabling environments

[PLACEHOLDER: content will be completed]

- Defining the adaptation enabling environment: establish that an 'enabling environment' consists of the legal, institutional, regulatory, and technical frameworks required to transform adaptation needs into bankable, commercially viable, or structurally sound projects.
- Strengthening regulatory and policy frameworks:
- Standardising risk disclosures: mandate climate-risk reporting and vulnerability assessments for corporations and commercial banks operating in the Mediterranean, using frameworks aligned with the EU Taxonomy [2] and Task Force on Climate-related Financial Disclosures (TCFD).
- Mainstreaming adaptation into public procurement: incorporate strict climate-resilience and the triple dividend framework into all public infrastructure tenders (e.g. port upgrades, water grids) to ensure public funds act as a baseline for private alignment.
- Overcoming project preparation barriers (technical capacity):
- Financing project preparation facilities (PPFs): detail how multilateral development banks (such as the EIB [3] and EBRD) can fund early-stage project preparation—such as feasibility studies and environmental impact assessments—which are often too expensive for local Mediterranean municipalities.
- Bridging the metrics gap: develop standardised adaptation metrics beyond simple carbon accounting (e.g. tracking 'avoided economic losses' or 'people with secured water access') to give institutional investors clear, comparable data on resilience performance.
- De-Risking architecture and financial structuring:
- Deploying targeted blended finance structures: optimize the use of public concessional capital and credit guarantees from international funds like the Green Climate Fund (GCF) [5] to absorb first-loss positions, lowering the political and macroeconomic risk for private investors in the southern and eastern Mediterranean.
- Sovereign resilience bonds and insurance pools: Promote the issuance of national resilience bonds earmarked strictly for adaptation enabling actions, while exploring regional climate-risk insurance pools to protect local economies against sudden-onset disasters (e.g. catastrophic flash floods).
- Cross-Border Knowledge Transfers and Governance:
- Leveraging north-south co-financing frameworks: utilize platforms like PRIMA [6] and the UfM [7] to transfer technical expertise, smart-agriculture data, and water-management regulatory blueprints from the northern shores to the southern shores.
- Localized and bottom-up interventions: ensure that technical assistance funds are directed toward building the capacity of local microfinance institutions, enabling them to design and deploy specialized Microfinance for Adaptation (MEbA) products for smallholder farmers and coastal communities.

Box 6.4: De-risking architecture: typology of financial guarantees for Mediterranean adaptation investments

Private institutional investors often avoid funding Mediterranean adaptation projects due to high perceived macroeconomic, political, and operational risks—particularly in non-EU southern and eastern shores. To mobilise private capital, Multilateral Development Banks (MDBs) like the EIB and EBRD, alongside global funds like the Green Climate Fund (GCF), deploy targeted credit and risk guarantees. These instruments alter the risk-return profile of resilience projects without requiring full public financing.

6.3.5.3 Emerging and innovative business models and financing approaches

[PLACEHOLDER: content will be completed]

- The shift from grant reliance to capital mobilisation: establish the core financial thesis of the section: Mediterranean adaptation must transition from static public grants to scalable, return-generating business models that structure the Triple Dividend into predictable cash flows attractive to private markets.
- Debt-for-climate and debt-for-nature swaps (macro-regional restructuring)
    - Mechanics: financial transactions where a sovereign country's foreign debt is forgiven or reduced in exchange for local currency commitments to fund specific domestic climate adaptation and ecological restoration projects.
    - Mediterranean application: tailored for heavily indebted southern and eastern Mediterranean nations facing intense climate stress (e.g. Egypt, Lebanon or Tunisia).
    - The business model: international creditors or multilateral banks buy back sovereign debt at a discount. The savings are channelled into a local trust fund dedicated entirely to large-scale adaptation assets, such as national water grid modernisation or the restoration of degraded coastal wetlands.
- Outcome-based and pay-for-success financing (resilience bonds):
    - Environmental Impact Bonds (EIBs): private investors provide the upfront capital required to build resilient infrastructure. If the project meets or exceeds predefined adaptation metrics (e.g. millions of cubic meters of flash-flood water successfully retained or absorbed), the public sector or an international donor pays the investors a financial bonus.
    - Mediterranean application: deployed in urban coastal zones (such as Barcelona, Marseille, or Alexandria) to fund nature-based solutions (NbS). Private funds build urban 'sponge city' networks and green riverine corridors. The municipality repays investors out of the city's avoided emergency expenditures from flood damages.
- Parametric and index-based risk transfer (rapid liquidity mechanisms):
    - Mechanics: insurance instruments that do not require lengthy post-disaster loss assessments. Instead, they trigger automatic, rapid financial payouts the moment a specific physical parameter is breached (e.g. a specific temperature threshold for a heatwave or a precise millimetres-per-hour rainfall metric for flash floods).
    - Mediterranean application: used to shield vulnerable sector value chains, such as smallholder olive groves, citrus orchards, and coastal aquaculture networks across the basin.
    - The business model: aggregators (like regional agricultural cooperatives or PRIMA-backed hubs) pool regional risks to lower premium costs. When a severe drought index is triggered, automated payouts are instantly distributed to farmers, allowing them to purchase drought-resilient feeds, water-trucking services, or repairs before systemic asset collapse occurs.
- Monetisation of Ecosystem Services (PES) and blue carbon:
    - Blue carbon markets: quantifying and certifying the carbon sequestration capacity of marine ecosystems like *Posidonia oceanica* seagrass meadows and coastal salt marshes.
    - Mediterranean application: Commercialising the third dividend of adaptation to fund coastal resilience.
    - The business model: Private developers and conservation NGOs partner with local governments to restore degraded marine protected areas. The verified carbon credits generated by the seagrass are sold on international voluntary carbon markets. The revenue streams are then recycled back to fund the long-term physical maintenance of the coastal storm-buffering infrastructure.
- Microfinance for Ecosystem-Based Adaptation (MEbA):
    - Mechanics: providing small-scale, target-directed microloans, micro-insurance, and technical training directly to small businesses and rural smallholders who lack access to traditional corporate banking.

- Mediterranean application: Addressing localized adaptation and climate justice in rural Mediterranean farming systems suffering from severe land degradation and desertification.
- The Business model: local microfinance institutions (MFIs), backed by concessional funding from the EIB or GCF, provide microloans specifically bundled with climate-smart technologies. A farmer borrows funds to install solar-powered drip irrigation or purchase drought-resilient seed varieties, reducing operational default risk while building baseline regional resilience.[END PLACEHOLDER]

6.4 Enabling factors

[PLACEHOLDER]. This section aims to explore transformative education and social learning to support environmental action. Promotes environmental literacy, transformative education, and effective communication as pillars of long-term resilience and behavioural change.

6.4.1 Transformative education and social learning

6.4.1.1 Climate literacy and transformative education

Looking ahead, transformative education and social learning in the Mediterranean will need to evolve from fragmented initiatives toward systemic, lifelong learning architectures.

One of the most innovative aspects of the MedECC approach is the systems approach that incorporates both climate change and environmental degradation as two sides of the same coin. The joint workshop between the IPCC and IPBES (Pörtner et al 2021) in the previous cycle reflected this integrated thinking and the new push to align the conventions from UNFCCC, the CBD and the UN SDGs.

Recent research underscores that the climate and biodiversity crises are deeply intertwined, requiring synergistic policy frameworks to avoid negative trade-offs and maximize mutual benefits (Boran and Pettorelli 2024). A key milestone was the Kunming-Montreal Global Biodiversity Framework (GBF), which includes specific targets, such as Targets 8 and 11, designed to minimize climate impacts on nature and enhance ecosystem-based mitigation (Lade et al. 2025). Conversely, the Paris Agreement formally recognizes the importance of conserving carbon sinks, such as forests, in its Article 5 (Gupta and Singh 2023).

Table 6.7 | Comparative table of CBD and Paris agreement in terms of targets set.

Global Biodiversity Framework (GBF) Target	Paris Agreement Article	Integration Point and Recent Advances
Target 8: Minimize climate change impacts on biodiversity and increase its resilience.	Art. 7 (Adaptation): Increase adaptive capacity, strengthen resilience, and reduce vulnerability.	Both frameworks promote climate resilience through nature. It is proposed that NBSAPs and NDCs share ecosystem-based adaptation objectives (Boran and Pettorelli 2024; Pettorelli et al. 2026).
Target 11: Restore and maintain nature's contributions to people (ecosystem services).	Art. 5 (Carbon Sinks): Conserve and enhance sinks and reservoirs of greenhouse gases (forests).	Recognizes the critical role of forests and wetlands in capturing carbon. The INCA concept reinforces this by going beyond nature-based solutions (Kumar et al. 2025; Folkard-Tapp et al. 2025).
Target 18: Eliminate or reform incentives, including subsidies, harmful for biodiversity.	Art. 2 and 4 (Finance and Mitigation): Align financial flows with low emissions and ambitious mitigation goals.	Reforming fossil fuel and harmful agribusiness subsidies is key to unlocking funds for both climate and biodiversity, addressing structural drivers (Aleksandrova et al. 2024; Folkard-Tapp et al. 2025).

Targets 1 and 2: Spatial planning and restoration of 30% of degraded ecosystems.	Art. 4.13 (Transparency): Provide transparent information on mitigation actions and land use.	Proposes using the Enhanced Transparency Framework (ETF) for countries to report the status of natural sinks coherently to both conventions (Pettorelli et al. 2026).

A concrete step forward was taken at UNFCCC COP28 in 2023, where a joint declaration on 'Nature, Climate and People' was issued to align national plans, such as NDCs and NBSAPs (Boran and Pettorelli 2024). Furthermore, the concept of Integrated Nature-Climate Action (INCA) has been proposed to address structural drivers, such as harmful subsidies (Goal 18 of the GBF), going beyond traditional nature-based solutions (Folkard-Tapp et al. 2025). However, challenges remain in technical implementation and reporting transparency (Pettorelli et al. 2026).

This aligns with the integrated approach adopted in the 'sustainability' area, which is now establishing itself as a field. Sustainability science is an integrative discipline that analyses the dynamic interactions between social and natural systems to address the 'wicked problems' of complex global challenges. Unlike traditional, isolated approaches, this science adopts a systemic perspective that recognizes that biophysical, socioeconomic, and political processes are inextricably linked (Oxley and Lemon 2003). This approach manifests itself at three levels: content integration, such as the SDGs; methodological integration, which uses systems thinking to cross disciplinary boundaries and foster transdisciplinary cooperation with non-academic actors; and institutional integration, which incorporates sustainability into the management and culture of organisations (Wicke et al. 2024). This approach is characterised by its focus on interdisciplinary and transdisciplinary cooperation, moving beyond simple observation to the co-creation of solutions with stakeholders (Arranz et al 2024).

Prominent examples include the governance of the Water-Energy-Food-Ecosystems (WEFE) nexus in the Mediterranean, where diverse social and cultural values are incorporated to transform resource management beyond mere technical efficiency (Garau et al. 2026). Another example is the 'landscape products' framework, which links food systems with landscape ecology by connecting global consumers with the sustainability of local production areas, such as wine from the Douro Valley (García-Martín et al. 2021). Furthermore, decision support tools have been developed in regions such as the Argolid Valley in Greece, which use mathematical models to explore 'possible futures' rather than trying to predict a single outcome (Oxley and Lemon 2003).

In this context education is gradually evolving from climate awareness to systems literacy where capacity building will increasingly focus on understanding interdependencies between climate, biodiversity, water, food, and society, moving beyond siloed environmental topics toward integrated socio-ecological thinking.

Integrative sustainability education focuses on equipping individuals to become agents of change by addressing the 'wicked problems' of global sustainability. A key pedagogical strategy in this field is the application of Albert Bandura's social learning theory, which emphasises that learning occurs through observation, imitation, and social reinforcement.

In education, this theory is put into practice through several integrative approaches:

- Observational learning and modelling: transdisciplinary education allows students to observe and interact with non-academic stakeholders, such as resource managers or local farmers, in real-world contexts like the Water-Energy-Food-Ecosystem (WEFE) nexus.
- Developing self-efficacy: challenge-based learning (CBL) and long-term projects empower students to solve actual community problems, building their confidence (self-efficacy) to cross disciplinary boundaries and handle complexity.
- Social reinforcement and collaboration: Team-Based Learning (TBL) fosters shared responsibility. Students from diverse backgrounds (e.g. biology, economics) learn from each other's perspectives, reinforcing the collaborative behaviours necessary for sustainability work.

- Reciprocal Determinism: this principle suggests that individuals, behaviours, and environments are mutually influential. Therefore, institutions must not only teach sustainability but also model it through their own operations and culture, creating a supportive environment for behavioural change.

These methods move beyond theory, using social settings and environments to foster the specific integrative skills required to manage the interconnected biophysical and socio-economic challenges of the modern world.

Therefore, in this framing, experiential and place-based learning is the norm. Field schools, Living Labs, farm-based learning, and coastal observatories are expected to complement formal education, grounding abstract climate knowledge in territorial realities and lived experience.

In this context, continuous training systems will be required to accompany adaptive transitions in agriculture, water management, urban planning, and energy systems, especially under accelerating climate uncertainty, bringing a life learning approach for farmers, professionals and policy makers.

Experiential and place-based learning are not merely as pedagogical options, but as the essential norm for addressing contemporary climate challenges. Education transcends traditional classrooms to integrate with territorial realities through Field Schools, Living Labs, and coastal observatories, grounding abstract knowledge in lived experience. According to Ceseracciu et al. (2023), rural Living Labs function as 'living systems' and social learning spaces where researchers and local communities co-create knowledge to manage climate uncertainty. This is exemplified by the 'Rurality Hub' in Val di Vara, where cultural heritage and territorial identity are leveraged as tools for revitalisation against rural desertification, proving that abstract knowledge only gains validity when connected to the essence of a place (Del Soldato and Massari 2024).

Furthermore, ancestral systems such as the *agdal* in Morocco or the *hima* in Lebanon demonstrate how learning based on historical experience and traditional rules allows for the resilient management of natural resources amidst climatic variability (Plieninger et al. 2023). [1] These practices highlight that local ecological knowledge is vital for biocultural conservation. In the realm of formal education, curricula are beginning to incorporate these territorial realities; for instance, geography education in Spain now integrates the 'climate emergency' by analyzing local risks and social vulnerability, encouraging students to act as committed citizens within their own environments (Enke and Budke 2023). Finally, Ricart et al. (2024) emphasise that successful water management in the Mediterranean depends on transdisciplinary approaches that empower local stakeholders, transforming the perception of risk into a real adaptive capacity rooted in the daily experience of the territory. Under accelerated climate uncertainty, continuous learning is essential for the adaptive transition in agriculture and water management in the Mediterranean.

Likewise, the farmer's direct experience is vital; Ricart et al. (2023) emphasise that the exchange of social learning with water managers reduces the vulnerability of the system. For specific sectors such as viticulture, Prada et al. (2024) highlight the need to shift from reactive to preventative strategies through a constant flow of scientific and technical knowledge that ensures crop sustainability in the face of rising temperatures and droughts.

Reducing educational inequalities across the Mediterranean will mean addressing North–South and rural–urban divides in access to climate education will remain a critical challenge, requiring regional cooperation and digital learning platforms. This is a structural challenge requiring robust regional cooperation and the deployment of digital learning platforms to bridge the North–South and rural–urban divides. Ininou (2025) observes that while northern Mediterranean countries benefit from significant investments in green skills, southern and eastern regions often grapple with outdated curricula and the 'brain drain' of skilled youth. To address these disparities, Ininou (2025) recommends establishing 'Mediterranean Green Tech Training Hubs' and enhancing digital infrastructure to provide equitable access to quality environmental materials.

The implementation of the 'Mediterranean Sea Literacy' (MSL) framework by Mokos et al. (2020) serves as a vital cross-national tool to harmonise climate and ocean education across the basin's diverse cultures.

Furthermore, Koulouri et al. (2022) highlight that current ocean science education is fragmented, necessitating a shift toward standardised curricula that empower future citizens to make informed decisions. By leveraging regional partnerships and scientific integrity, these initiatives aim to preserve democratic discourse and foster sustainable resilience throughout the region.

The research highlights a positive correlation between scientific knowledge and the ability to adopt pro-environmental behaviours in the face of climate change. However, a disconnect is observed between data acquisition and personal motivation among students. Authors such as Papagiannaki et al. (2024) underscore that self-confidence and faith in science are stronger predictors of adaptive competence than mere school knowledge. Similarly, Leve et al. (2023) emphasise the need for interdisciplinary teacher training that overcomes common misconceptions. Finally, Koulouri et al. (2022) and Mokos et al. (2020) highlight the importance of adapting education to regional contexts, such as the Mediterranean basin, to foster an ocean-literate citizenry.

6.4.1.2 Citizen science and co-creation

[PLACEHOLDER: content will be completed]

From information transmission to sense-making, communication strategies will increasingly need to help citizens interpret uncertainty, trade-offs, and long-term risks, rather than simply disseminating scientific facts. In relation to expert and scientific knowledge this has been particularly relevant e.g. to the nexus and trade-offs as highlighted by the MedECC WEFE nexus Special report (MedECC 2024) to ensure internal rigorous standards to present the scientific knowledge grounded in an evaluation of underlying evidence and agreement. The use of 'calibrated uncertainty language' is therefore applied to consistently evaluate and communicate uncertainties that arise from incomplete knowledge or disagreement within the scientific community.

Furthermore, recently the inclusion of 'Indigenous knowledge' and 'local knowledge', alongside scientific literature, recognizes these diverse knowledge systems as important and distinct forms of expertise that contribute to the current understanding of climate change and environmental degradation. Therefore, multilingual and culturally embedded communication on Mediterranean diversity requires communication strategies adapted to language, cultural references, and social values, avoiding one-size-fits-all approaches—as discussed later in Section 6.4.4.2 on cultural heritage- as a mobilising narrative). Diverse knowledge systems, such as Indigenous and Local Knowledge (ILK), are vital for enhancing scientific credibility and political relevance. Authors like Tengö (2014) emphasise that bridging these systems through a 'multiple Evidence Base' approach enriches ecosystem governance. Meanwhile, Whyte (2017) highlights that recognising Indigenous leadership ensures climate justice and relational accountability.

Indigenous and Local Knowledge (ILK) represents the skills, philosophies, and understandings developed by societies with long histories of interaction with their natural surroundings. Both the IPCC and IPBES have increasingly integrated these knowledge systems to enhance the scientific credibility and political relevance of biodiversity and climate assessments. Indigenous Knowledge (IK) is specific to a location's unique ecology, culture, and history, passed down through generations via oral traditions, community participation, and kinship networks. It views knowledge as relational, deeply connecting human experiences to territory and ecological systems. Local Knowledge (LK) refers to the understandings and skills developed by individuals and populations specific to where they live, informing day-to-day activities and governance decisions.

The integration of ILK is a core component of both intergovernmental bodies, though their approaches and history of engagement differ. IPBES actively involves ILK through its conceptual framework and a dedicated Task Force. It has established 'ILK liaison groups' for each assessment to coordinate work across chapters. Their 2019 Global Assessment was a landmark in incorporating Indigenous perspectives and was endorsed by the UN Permanent Forum on Indigenous Issues (IPBES 2019). Meanwhile the IPCC has gradually acknowledged ILK, moving from limited coverage in AR4 (2007) and AR5 (2014) to significant progress in AR6. The Special Report Ocean and Cryosphere in a Changing Climate (SROCC) explicitly characterised how

these systems complement scientific knowledge in assessing changes (IPCC 2019). Both bodies face structural and epistemological barriers, such as the perceived 'anecdotal' nature of ILK by some participants and the procedural reliance on peer-reviewed literature, which can marginalise orally transmitted knowledge.

The IPCC AR6 Cross-Chapter on the Mediterranean (Ali et al. 2022) emphasises the critical need for improved research, monitoring, and the 'sharing and co-production of knowledge' to support climate adaptation practices and reduce vulnerability (Nguyen et al 2019).

This is particularly in the southern and eastern parts of the Mediterranean Basin, where there is incomplete knowledge of climate impacts and risks (Cramer et al 2018). It creates a barrier in these sub-regions to implementing effective adaptation plans, identifying a 'need for implementable plans with enhanced and cooperative research and monitoring capacities'.

Meanwhile IPCC AR6 WGII emphasises the importance of 'arenas of engagement' are identified as the settings, places, and spaces—such as governmental, economic, political, and knowledge-technology arenas—where societal actors interact to influence development. Sites where key actors from government, civil society, and the private sector interact. These interactions are important to generate 'societal choices' that determine the nature and course of development.

In this setting the role of the media island social media is critical as an actor that influences the design and navigation of Climate Resilient Development Pathways (CRDPs), working alongside other actors like science and holders of local and Indigenous knowledge where the quality of interactions—such as the degree of inclusion and empowerment of diverse perspectives—determines whether societal choices lead toward or away from CRD. Fragmented or exclusionary interactions may result in development pathways that exacerbate vulnerability.

Another key factor as implementation moves further towards scale is the fundamental role of the private sector. The contemporary landscape of corporate environmental communication is increasingly defined by two divergent and problematic strategies: greenwashing and greenhushing. While both phenomena represent a significant disconnect between a company´s actual environmental performance and its public disclosures, each occupies opposite ends of the transparency spectrum.

In several recent reports IPBES has addressed the issue, where issues related to disinformation, misinformation and greenwashing and more recently greenhushing are acknowledged. Current debates are related to risks to credibility and the challenges of maintaining trust in science and policy advice in a 'post-truth' political environmental change (Gustafsson and Hysing 2023). This is conceptually related to greenwashing, where superficial or misleading claims about environmental action are used to maintain the status quo or avoid deeper transformation.

Greenwashing involves the strategic misrepresentation or exaggeration of ESG (Environmental, Social, and Governance) performance to mislead stakeholders and secure not validated reputational advantages (Taddeo et al. 2026). Organisations practicing greenwashing are often described as 'vocal brown firms'—those that 'do not walk the talk' (Dias et al. 2025). As noted by Sharma (2025), this behaviour reinforces a 'green myth' where current policy frameworks appear sufficient despite ongoing ecological degradation. Some firms disseminate extensive, potentially misleading, information to project a transparent image while maintaining poor operational standards (Taddeo et al. 2026). This not only increases information asymmetry but also fosters widespread consumer scepticism, ultimately making greenwashing financially costly, as markets interpret this misalignment as a persistent reputational risk (Taddeo et al. 2026).

Conversely, greenhushing refers to the deliberate act of under-communicating or remaining silent about legitimate environmental efforts (Khan et al. 2026). Unlike greenwashing, this practice is typically adopted by 'silent green firms' that possess a high sustainability commitment but maintain low communication levels (Dias et al. 2025). The primary driver for greenhushing is often defensive: a fear of being accused of greenwashing or facing public backlash if efforts are perceived as insufficient (Khan et al. 2026). Furthermore, Gatti (2023) highlights that this silence may stem from a lack of confidence in internal data or

the belief that sustainability is an intrinsic value rather than a marketing tool. While greenhushing may shield a company from immediate scrutiny, it creates a 'transparency gap' that prevents stakeholders from making informed choices and hinders the company's ability to capitalize on its genuine green identity (Khan et al. 2026).

Ultimately, both practices can potentially undermine authentic progress. While greenwashing deceives through over-promotion, greenhushing undermines through silence, and both strategies impede the collective transition toward meaningful environmental conservation (Sharma 2025).

Last but not least is the role of citizens is central to climate change mitigation and adaptation. Citizen science and co-creation are expected to become central pillars of environmental monitoring and governance, provided their institutional integration is strengthened. Citizen science is defined as a form of research collaboration that involves volunteers in producing authentic scientific research, typically in collaboration with professional scientists or scientific institutions. This participatory approach strengthens a community's adaptive capacity by involving them in different stages of the research lifecycle, allowing for the generation of knowledge that is better suited to local contexts. As explored by Sones et al. (2024), this methodology is particularly effective for capturing diverse perspectives on urban environments and engaging residents in neighbourhood improvements.

The classification of these collaborative efforts is often based on the level of cognitive involvement from the participants. According to Daniel and Fernandes (2024), the first level is known as crowdsourcing, which requires minimal involvement as citizens act primarily as data collectors, facilitating access to data or research sites through a one-way flow of information. A step further is distributed intelligence, where citizens engage in simple interpretation activities, participating in data collection and related tasks with support from experts.

Higher levels of engagement lead to participatory science, where citizens have high involvement and participate in defining the research question, designing methodologies, and analysing data alongside professional scientists. The most collaborative and advanced model is extreme citizen science, often described as co-creation. In this model, participants are involved in every phase of the process: they define the problems and methods, gather and analyse data, and ultimately publish or utilize the results. While this extreme level represents the highest form of collaboration and empowerment, it remains less common in documented studies due to the intensive time and resources required for successful implementation.

Citizen science serves as a vital tool for climate justice by transforming marginalised residents from passive subjects into active co-creators of data and solutions. This participatory approach empowers communities traditionally bypassed by formal research, allowing them to bridge the gap between technical scientific models and their own lived local realities. By engaging in data collection, citizens strengthen their social capital and adaptive capacity, which are critical for surviving and recovering from climate-induced crises. Furthermore, community-led observations provide the 'public values' necessary to ensure that hazard mitigation policies reflect the actual needs of vulnerable populations. Ultimately, these co-production processes help address historical inequities and challenge entrenched power asymmetries in environmental governance.

Box 6.5: Citizen science and water quality

Citizen science is revolutionising the way water quality is monitored by transforming the public into a global network of active 'human sensors' that extend the reach of traditional scientific infrastructure. According to El Serafy et al. (2021), integrating citizen-collected data into wider frameworks like the GEO AquaWatch initiative allows for a more holistic characterisation of highly dynamic aquatic ecosystems, facilitating actionable management decisions.

A cornerstone of this modern approach is the synergy between community participation and Earth Observation (EO). Saleem et al. (2024) explain that while satellite imagery provides large-scale coverage, it often requires ground-level validation to correct for atmospheric interference. Volunteers using mobile applications like EyeOnWater and HydroColor provide essential 'ground-truth' data on watercolour and

clarity, which researchers use to calibrate satellite algorithms for measuring chlorophyll-a and turbidity. This collaboration effectively bridges the gap between high-tech remote sensing and localized environmental reality.

The democratisation of for example Internet of Things (IoT) technology has further empowered these initiatives. Saleem et al. (2024) highlight that low-cost sensor networks and crowdsourcing apps allow for near real-time data acquisition in remote or underserved areas. This technical utility is most evident in catchment modelling. Starkey et al. (2017) demonstrated that community-based observations of rainfall and river levels are vital for running physically based models like SHETRAN. Their research proved that local volunteers capture the timing and magnitude of flash floods more accurately than traditional radar or sparse official gauges, which often underestimate localized peak discharge.

Ultimately, the strength of citizen science lies in its methodological flexibility. As reviewed by Ramírez et al. (2023), these projects range from high-precision monitoring using shared sensors to extensive spatial surveys utilising simple colorimetric strips. By combining these diverse efforts with professional data assimilation, scientists can identify pollution hotspots and build environmental resilience more effectively than ever before.

Box 6.6: Manual for citizen and stakeholder engagement in adaptation planning- the case of the EU Mission on adaptation

This DIY Manual serves as a practical guide for regional and local authorities to effectively engage citizens and stakeholders in climate adaptation planning. Developed by MIP4Adapt, it aligns with the six steps of the Regional Adaptation Support Tool (RAST), offering structured methodologies to enhance policy relevance and credibility. The manual emphasises four key pillars: clear communication, active engagement, facilitating connections, and enabling collective action. It includes specialized tools, best practices, and thematic flyers to ensure inclusive processes, particularly for vulnerable groups and the private sector. Ultimately, it aims to build social resilience and ensure a 'whole-of-society' approach where no one is left behind in the climate transition.

Tool Type	Use Examples and Applications	Academic and Technical References
Stakeholder Mapping and Analysis	Use of influence-interest matrices to define responsibility and consultation roles.	RESIN Methodology: Guide for social network-based prioritization. Reed et al. (2009): Stakeholder analysis typologies for environmental management.
Communities of Practice (CoP)	Peer-to-peer learning spaces in the Digital Water City project to address technological and climate challenges in the water sector.	Wenger et al. (2002): Fundamental framework for cultivating communities of practice. Iyalohme et al. (2013): Need for geographic CoPs for adaptation solutions.
Climate Assemblies	In-depth deliberative processes in Bologna and Scotland where representative citizens propose climate neutrality policies.	KNOCA Guidance: European standards for the design of deliberative assemblies. OECD (2020): Report on the 'deliberative wave' and new democratic institutions.
Green Participatory Budgeting	Direct allocation of public funds by citizen vote, as in Lisbon, where 15% of the budget is allocated to climate action.	Participatory Budgeting Theory of Change: Tool for understanding impacts on communities and governments. Sintomer et al. (2012): Global models of participatory budgeting.
Awareness Campaigns	Behaviour change initiatives such as 'The Netherlands Lives with Water' to increase flood risk perception.	IPCC Handbook (2018): Evidence-based climate change communication strategies. Manuti (2013): Research on the fluctuation of social awareness levels.
Co-creation Workshops	Use of the 'World Café' method to identify adaptation options and resolve	Kaner (2014): Guide to group dynamics for participatory decision-making (Divergence vs.

	sectoral conflicts between agriculture and water management.	Convergence). MSP Guide (Wageningen): Framework of 60 tools for multi-stakeholder platforms.
Citizen Science	Public involvement in monitoring environmental variables (e.g., water levels or biodiversity) through apps and sensors.	ENJOI Project: Standards and principles (SPIs) for reliable science communication with citizen impact. ScienceUs & AGORA projects: Cases of massive data collection.

6.4.2 Communication and the challenge of misinformation

[PLACEHOLDER: content will be completed]

In an era of information overload and contested narratives, communication will play a decisive role in shaping societal responses to climate and environmental change. A few areas are particularly important in terms of current and future challenges and opportunities which include disinformation, the way complex information is communicated, the coproduction of knowledge that incorporate diverse knowledge systems and ensuring arenas of engagement for all key actors. After COVID 19 and with the parallel development of information technology, with research and publications on misinformation and disinformation in climate and environmental issues have increased exponentially over the last few years (Morales and Piñeiro Moral 2025; Scantanburlo and Zollo 2025; Wang et al 2025). According to Ozdemir and Springer (2022) disinformation has become a 'pandemic within a pandemic' with convergence of COVID-19 and digital transformation of health care, climate emergency, and pervasive human–computer interaction in all facets of life as an era of post-truth.

According to the UN misinformation refers to the accidental spread of inaccurate information, meanwhile disinformation has the intent to deceive and spread inaccurate information to do serious harm. Disinformation can be spread by state or non-state actors and can affect a broad range of human rights, undermining responses to public policies and trust in institutions while amplifying polarisation e.g. in times of emergency like extreme floods (Bodoque et al 2016). A similar classification exists according to the Council of Europe (2025a, 2025b) distinguishing between 'misinformation' as false content shared without intent to harm, 'disinformation' as false content deliberately spread to deceive. and 'malinformation' genuine information manipulated or decontextualized to cause harm (Council of Europe 2025a). This also includes the identification of key policy pillars: strengthening research and monitoring; advancing media and information literacy and empowering users; supporting quality journalism and fostering media resilience; safeguarding the integrity of elections; and ensuring competitiveness and accountability within the digital ecosystem. In addition, these measures are grounded in four foundational principles that member states are called upon to observe: freedom of expression, international co-operation, multi-stakeholder engagement and long-term trust-building (Council of Europe 2025b)

There are initiatives to monitor misinformation like the monthly monitoring by the European Digital Media Observatory (EDMO) a fact-checking network shows climate is a persistent disinformation topic. EDMO's monitoring is especially useful because it identifies the kinds of narratives that recur across countries' conspiracy claims e.g. on geoengineering, renewables, etc. These narratives clearly demonstrate that the issue also sometimes seeks to undermine climate policies and everyday transition measures, as well as challenging climate science itself.

The IPCC AR6 (IPCC AR6 WGIII, Chapter 18) does not specifically address issues related to disinformation and misinformation but rather it looks at it from the perspective of reliable solid scientific information and arenas of engagement where different actors interact- as discussed earlier in Section 6.4.1. Both MedECC MAR1however,xus special report (MedECC 2020, 2024) do not assess the role of information and disinformation, however both do look at the role of information for deliberative democracy processes and decision support systems on the nexus (Lawford et al 2019). For example, decisions supported by geospatial or IoT increasingly used in agriculture or data used by municipalities, and this requires coproduction processes (Van den Burgh, et al 2019). However, together with the increased capacities in

relation for example to global observation, this need to also be complemented- According to scientific literature art, culture, and storytelling as transformation tools where artistic expression, heritage narratives, and visual storytelling can help translate abstract climate (see as discussed earlier in Section 6.4.4.2 on cultural heritage as a mobilising narrative).

Therefore, there is increased research on the root causes and the role of trusted intermediaries like local actors, journalists, educators, farmers' organisations, and cultural institutions that become crucial relays for credible climate narratives. In this context. Article 19 of the Universal Declaration of Human Rights [38] and article 19 (1) of the International Covenant on Civil and Political Rights [39] have both called for responses to the spread of disinformation to promote and protect and not to infringe on individuals' freedom of expression and freedom to seek, receive and impart information, as established by expressions that take the form of irony, satire, parody or humour and erroneous interpretation of facts or events. Such speech must not be unduly restricted under the guise of combating disinformation. According to the UN (A/77/287 [40]), freedom of expression also covers critical speech, including speech that questions societal norms. According to Scampatti et al (2025) disinformation could be considered a systemic risk to individuals, institutions, and to the enjoyment of human rights.

Research on climate-related misinformation and disinformation increasingly emphasises the complexity of these narratives and their sources. Treen et al. (2020) establish that climate change misinformation is closely linked to scepticism, denial, and contrarianism. Expanding on this, a scoping review by Tommasi et al. (2025) of 85 studies identified 17 thematic clusters, revealing that current research prioritizes social media, political denialism, and inoculation strategies, while often neglecting fact-checking and non-western perspectives. Regarding the content of these narratives, Palau-Sampio and Crisostomo Flores (2024) identify three central strategies: denial of scientific evidence (Szalay-Szandtner 2020; Gwiazdon 2023; Broda and Strömbäck 2024; Farias and Barrow 2025), distortion of science, and the attribution of ulterior motives to climate action—often tied to conspiracy theories involving meteorology and natural phenomena. These campaigns primarily circulate via social media (52.5%) and websites and pseudo-media (25.8%). Furthermore, Magallón-Rosa and Sánchez-Torres (2024) emphasise the need for a cross-cutting perspective to distinguish between obstructionist, denialist, and sceptical narratives, while simultaneously addressing the resulting citizen apathy, disconnection, and information anxiety

To this end strategies to address disinformation include a few measures like media literacy, specialized training for journalism and communication professionals, as well as the creation of institutional collaboration networks. For example, recommend an interdisciplinary, multi-pronged approach involving science communication, education, and policy to build public and ecosystem resilience against false scientific claims (Magallón-Rosa and Sánchez-Torres 2024). More recent work by Massey-Chase, Akehurst and Alvis (2026) indicate the risks of apathy and opposition and in the case of the recommend making a positive case for climate action, include climate impacts up the agenda, to build trust through effective, people- facing policies and to future proof policy**.**

There is the added complication that there is evidence that various actors produce and finance to amplify disinformation. As noted by Martin (2024), disinformation has evolved from a domestic political issue into a critical challenge for global governance. This has also been identified by the UN (2022) since disinformation can have a variety of motives, including political, ideological or commercial, or a combination thereof. Furthermore, when used by those with power and influence, it can undermine trust in public institutions and contribute to polarising societies and exacerbating social divisions, therefore 'creating fertile ground for populism and authoritarianism to flourish'. The operational way in which social media works—such as homophily, polarisation, and echo chambers, create the right conditions for the spread of misinformation and disinformation. Additionally, underlying belief systems, social norms, and psychological heuristics, such

[38] https://www.un.org/en/about-us/universal-declaration-of-human-rights

[39] https://www.ohchr.org/en/instruments-mechanisms/instruments/international-covenant-civil-and-political-rights

[40] http://undocs.org/en/A/77/287

as confirmation bias, further contribute to its dissemination. With certain sectors of the population particularly impacted like for example youth (Szalay-Szandtner 2020), mis/disinformation pollution disproportionately affects disadvantaged groups.

'Information pollution' as called by Sinanoglu and Breuer (2024) poses significant challenges to democracy by undermining informed decision-making and threatening social cohesion. This is now further complicated by the scalability (Van Alstyne 2022) and amplification of these processes due to artificial intelligence (AI), including the generation of deep fakes, and the manipulation of public perception (see Box 6.1 on the Valencia DANA case). Sander (2025) examines the intersection of climate change and AI through a rights-based lens, highlighting three key challenges: the difficulty of translating abstract rights into concrete technical standards; the tension between individual rights discourses and collective societal impacts; and the risk of marketized managerialism, particularly corporate capture driven by Big Tech's dominance in AI supply chains.

Addressing disinformation demands a multifaceted strategy encompassing media literacy, specialized training for communication and journalism professionals, and the establishment of robust institutional collaboration networks. Magallón-Rosa and Sánchez-Torres (2024) advocate for an interdisciplinary framework that synthesizes scientific communication, education, and public policy to enhance the resilience of both the media ecosystem and the general public against fraudulent scientific claims. Furthering this discourse, recent research by Massey-Chase examines counter-disinformation initiatives, highlighting a shift from content-based regulation toward the governance of digital platforms. These efforts align with broader international movements to ensure information integrity, exemplified by the Global Digital Compact—a framework negotiated by UN member states during the Summit of the Future to define the standards for a secure digital future. The Global Initiative for Information Integrity on Climate Change, led by the UN, UNESCO, and Brazil, combats climate disinformation and protects scientific integrity. Key efforts include a Global Fund with special focus on the Global South, international endorsement of the Declaration on Information Integrity, and integrating truth-protection measures into the UN Framework Convention on Climate Change. Morocco serves as a proactive leader in the Global Initiative for Information Integrity on Climate Change, joining other nations in committing to the UN's Declaration on Information Integrity on Climate Change. While northern Mediterranean countries and the EU reinforce these standards across the European border, southern Mediterranean nations coordinate their regional climate strategies through the UNFCCC Regional Climate Center for the Middle East and North Africa (RCC MENA).

Collaborating with technology companies and the private sector can bolster international regulatory frameworks. The UN Guiding Principles on Business and Human Rights [41], States should compel companies to conduct human rights due diligence, improve transparency, engage civil society, and empower users.

The Mediterranean region faces distinct challenges regarding disinformation, necessitating localized strategies rather than broad, generalized approaches. In the Iberian Peninsula (Portugal and Spain), Morais and Piñeiro-Naval (2025). argue that academic research frequently overlooks community-specific factors, highlighting an urgent need for regional perspectives to combat disinformation effectively. Similarly, Hoffman (2025) looking at Spain and Brazil emphasises that environmental and climate denialism necessitates strengthened democratic frameworks and more efficient legislation to counter manipulative narratives.

In the Eastern Mediterranean, institutional responses vary. Angin (2025) examines public administration in Türkiye, noting a direct correlation between rapid technological transformation and the vulnerability of state institutions to disinformation, which has prompted the development of specific institutional counter-mechanisms. Migration also serves as a critical vector in this region. Katsaounidou et al (2025) and Saridou et al. (2025) look at Cyprus, Greece, and Malta which analysed journalism students' perceptions, revealing that while students are adept at identifying disinformation cues, migration-related narratives still

[41] https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf

significantly exacerbate social polarisation. These authors suggest that tailored media literacy interventions are essential for these countries.

Meanwhile, the environmental sector in Italy shows a different obstructionist pattern. Grasso (2024) details how in Italy institutional actors, fossil fuel lobbyists, and media allies utilize anti-scientific narratives and greenwashing to delay climate action, shifting responsibility away from corporate entities. These studies demonstrate that combating disinformation in the Mediterranean requires tailored approaches that integrate media literacy, scientific integrity, and legislative reform to address the distinct sociopolitical realities of each nation.

Box 6.7: A case study of misinformation and disinformation: the extreme flood 'DANA' in Valencia, Spain (October 2024)

The 2024 DANA storm in Spain triggered a volatile disinformation ecosystem, where false narratives leveraged 'paltering'—the biased use of real data—and 'diagonalism,' which linked social discontent with extremist ideologies (López-Carrión and Llorca-Abad 2025; Martínez-Guijarro and Cárdenas-Rica 2026). This disinformation was coordinated, not organic, specifically targeting institutions like AEMET and the government to erode public trust (López-Carrión and Llorca-Abad 2025). Dissemination was multimodal: while X and TikTok served as primary origins, WhatsApp functioned as a critical tool for secondary amplification (Climent-Ferrer et al. 2026). Platforms distinctively triggered specific emotional responses—fear and sadness on X, versus anger and disgust on TikTok, often amplified by manipulative audiovisual content (Arcos, Rosso and Salaverría 2025). Public interest, trackable via Google Trends, peaked significantly by November 8, 2024 (Sedeño Alcántara 2025).

While citizen solidarity networks demonstrated greater communicative agility than official bodies during the crisis (Castro-Martínez et al. 2025; Serrano-Lara et al. 2026), disinformation inflicted tangible harm, particularly in vulnerable sectors such as tourist accommodations in flood-prone areas (De la Osada Saurí 2025). These dynamics are not isolated to climate emergencies, as similar patterns of misinformation appear in sectors with high technical complexity, such as food (Paniagua Rojano et al., 2025).

Academic investigation into these events reveals persistent research gaps caused by algorithmic opacity and the difficulty of tracking organised networks within encrypted messaging channels. To address these challenges, experts argue that future crisis management must move beyond reactionary measures. Primarily, there is an urgent need to implement multimodal verification strategies that can replicate the format of original hoaxes (Climent-Ferrer et al. 2026). Concurrently, authorities are urged to strengthen real-time institutional communication, adapt territorial planning to climate change, and strictly reinforce the accountability of digital platforms (López-Carrión and Llorca-Abad 2025; Mar-Beguería et al. 2026). Furthermore, fostering media literacy is critical to helping citizens critically navigate 'echo chambers.' Ultimately, a successful response requires a joint effort between increased algorithmic transparency and technological improvement to safeguard information integrity during times of crisis. [42]

6.4.3 Behavioural change

Environmental and climate policies in the Mediterranean increasingly depend not only on their technical effectiveness, but also on their social acceptability and capacity to trigger behavioural change across societies. Climate adaptation, biodiversity conservation, water management, renewable energy deployment, and agroecological transitions frequently require changes in production practices, consumption patterns, land-use systems, and collective resource governance. However, growing evidence suggests that even technically efficient measures may face resistance when they are perceived as socially

[42] 'Approaches that seek simple solutions to this complex problem are likely to censor legitimate speech that is protected under international human rights law. Such overbroad restrictions are likely to exacerbate societal ills and increase public distrust and disconnections, rather than contribute to the resolution of underlying problems' (UN A/77/287, http://undocs.org/en/A/77/287).

unfair, economically threatening, culturally incompatible, or institutionally imposed (Suchman 1995; IPCC 2006; Del Corso et al. 2015;).

The Mediterranean region presents challenges for behavioural and social transitions because environmental vulnerabilities intersect with strong territorial identities, historical inequalities, socio-economic fragilities, and increasing climate pressures. Water scarcity, agricultural transformation, tourism development, coastal protection, wildfire management, and renewable-energy projects increasingly generate tensions between environmental objectives and local socio-economic priorities (Houdret et al. 2017; Roson and Sartori n.d.). As a result, public acceptance, trust in institutions, and stakeholder participation have progressively emerged as central dimensions of environmental governance and climate resilience across Mediterranean societies.

The literature increasingly highlights that social acceptability depends on multiple dimensions of legitimacy, including regulatory legitimacy associated with formal rules and institutions, normative legitimacy linked to perceptions of fairness and collective values, and cognitive legitimacy referring to the social recognition of environmental transitions as necessary and meaningful (Hodgson 2006; J. Del Corso and Képhaliacos 2017). In Mediterranean rural and coastal territories, behavioural change is therefore strongly influenced by social interactions, collective learning processes, and participatory governance mechanisms capable of building trust, reducing conflict, and strengthening shared ownership of environmental policies.

In this context, participatory governance approaches, Living Labs, Communities of Practice, and deliberative platforms are increasingly promoted as mechanisms for facilitating collective adaptation and strengthening the social legitimacy of environmental transitions (Stone et al. 2025). These approaches aim to move beyond top-down policy implementation by involving citizens, farmers, local authorities, scientists, and civil society actors in the co-design, experimentation, and evaluation of climate and environmental solutions (Dwyer et al. 2020; Stone et al. 2025; Vatn 2005). Across Mediterranean territories, such collaborative processes are increasingly recognised as important enablers of behavioural change, social cohesion, and long-term socio-ecological resilience.

This section assesses the main drivers of social acceptability and behavioural change in Mediterranean environmental transitions, examines the role of participatory and deliberative governance mechanisms, and discusses emerging approaches aimed at strengthening collective engagement, institutional legitimacy, and adaptive capacity under accelerating climate and ecological change.

6.4.3.1 Governance, social acceptance, and adaptive capacity in Mediterranean socio-ecological transitions

Climate adaptation and sustainability transitions in the Mediterranean are not determined solely by technological innovation or economic investment capacity. A growing body of literature highlights that governance quality, institutional legitimacy, social acceptance, and collective adaptive capacity constitute central determinants of the success or failure of adaptation pathways across Mediterranean socio-ecological systems (Grothmann and Patt 2005; Adger et al. 2013; MedECC 2020). Across the region, climate change increasingly interacts with pre-existing structural vulnerabilities, including water scarcity, territorial inequalities, weak institutional coordination, land degradation, demographic pressures, and resource conflicts, making governance dynamics a central dimension of resilience building (Ferragina et al. 2010; MedECC 2020).

Recent Mediterranean assessments emphasise that adaptation policies often fail not because of a lack of technical solutions, but because of limited social legitimacy, fragmented governance systems, insufficient stakeholder participation, and weak integration between local knowledge and institutional decision-making (Cramer et al. 2020). The Mediterranean Basin is characterised by strong socio-cultural diversity, territorial heterogeneity, and unequal institutional capacities between northern and southern countries, which generate highly differentiated adaptation dynamics and governance responses. As highlighted by MedECC (2020), adaptation policies in the Mediterranean increasingly require approaches capable of integrating

environmental, social, cultural, and institutional dimensions simultaneously, particularly in sectors such as water management, agriculture, energy transition, biodiversity conservation, and coastal governance.

A first major finding emerging from the literature concerns the central role of social acceptance and cultural legitimacy in shaping adaptation trajectories. Adaptation measures frequently involve transformations of production systems, resource use practices, territorial governance arrangements, and behavioural norms, which may generate resistance when perceived as incompatible with local identities, values, or livelihood systems (Adger et al. 2013). Climate adaptation is therefore not only a technical or economic process, but also a cultural and political process involving competing perceptions of risk, fairness, responsibility, and development pathways. Mediterranean rural territories are particularly sensitive to these dynamics because agricultural systems, landscapes, and resource management practices are often deeply embedded in local cultural identities and historical socio-ecological relationships.

The literature also highlights that adaptive capacity cannot be reduced exclusively to economic or infrastructural resources. Psychological, cognitive, institutional, and social dimensions strongly influence the ability of actors to adopt adaptive behaviours and support transitions (Grothmann and Patt 2005). Perceived adaptive capacity, trust in institutions, access to information, and collective learning processes significantly affect the willingness of individuals and communities to engage in adaptation measures. In Mediterranean contexts characterised by recurrent droughts, wildfire risks, water conflicts, and increasing climatic uncertainty, adaptation therefore depends not only on technological solutions but also on governance structures capable of building trust, legitimacy, and stakeholder engagement.

Water governance constitutes one of the clearest examples of these governance challenges in the Mediterranean. Water scarcity, groundwater overexploitation, competing sectoral demands, and climate-induced reductions in water availability increasingly intensify tensions between agricultural, urban, industrial, tourism, and environmental uses (Ferragina et al. 2010; Cramer et al. 2020). Several studies show that fragmented governance structures, institutional overlaps, and limited stakeholder participation frequently constrain the implementation of integrated water management strategies. In many Mediterranean countries, adaptation policies remain strongly sectoral and reactive, while climate risks increasingly require integrated and anticipatory governance approaches capable of managing trade-offs across scales and sectors.

The literature further indicates that participatory governance and stakeholder co-production mechanisms are becoming increasingly important for enhancing adaptation legitimacy and implementation capacity. Participatory approaches facilitate social learning, improve the integration of local and scientific knowledge, and strengthen the social acceptability of adaptation measures (Tourais and Videira 2021). In Mediterranean socio-ecological systems, where resource management often involves multiple competing actors and institutional levels, deliberative governance approaches can reduce conflicts and improve collective ownership of adaptation strategies. Living Labs, participatory platforms, and multi-actor governance structures have therefore progressively emerged as important instruments for supporting agroecological transitions, water governance, ecosystem restoration, and climate adaptation across Mediterranean territories.

Recent Mediterranean adaptation literature increasingly converges toward systemic governance perspectives recognising that climate resilience depends on the capacity to coordinate ecological, economic, institutional, and social dimensions simultaneously (Cramer et al. 2020). This evolution reflects broader transitions from sectoral and technocratic adaptation models toward more integrated socio-ecological governance frameworks. Such approaches emphasise the importance of adaptive governance, institutional flexibility, social learning, and multi-level coordination in managing climate uncertainty and complex environmental change.

Consequently, the literature suggests with *high confidence* that governance quality, institutional legitimacy, stakeholder participation, and social acceptance constitute central determinants of adaptation effectiveness and resilience building in Mediterranean socio-ecological systems. While technical adaptation solutions are increasingly available, their implementation remains strongly conditioned by governance

structures capable of integrating ecological sustainability, social legitimacy, and territorial realities within long-term transition pathways.

Table 6.8 | Synthesis of evidence on governance, social acceptance, and adaptive capacity for Mediterranean adaptation policy.

Main assessment finding	Evidence from literature	Main implication for Mediterranean adaptation	Confidence level
Governance fragmentation reduces adaptation effectiveness	(Ferragina et al. 2010; Adger et al. 2013; Cramer et al. 2020)	Need for integrated multi-level governance and cross-sector coordination	*High*
Social acceptance strongly conditions adaptation uptake	(Grothmann and Patt 2005; Adger et al. 2013)	Adaptation policies require stakeholder legitimacy and participation	*High*
Adaptive capacity depends on institutional and cognitive factors, not only economic resources	(Grothmann and Patt 2005; Cramer et al. 2020)	Capacity-building and trust are central components of resilience	*Medium-High*
Water governance conflicts are intensifying under climate stress	(Ferragina et al. 2010 ; Cramer et al. 2020)	Climate adaptation requires integrated water governance frameworks	*High*
Participatory governance improves legitimacy and implementation of adaptation strategies	(Adger et al. 2013; Tourais and Videira 2021 ; Korhonen-Kurki et al. 2025)	Living Labs and co-production approaches can strengthen resilience	*Medium-High*
Current governance systems remain majorly sectoral and reactive	(Cramer et al., n.d.)	Transition toward adaptive and systemic governance frameworks is needed	*High*

6.4.3.2 Social legitimacy, collective action, and environmental transitions

The literature reviewed provides strong evidence that the success of environmental transitions in Mediterranean agro-ecosystems depends not only on technological innovation or economic incentives, but also on the existence of socially legitimate governance arrangements capable of mobilising collective action. Across different environmental domains, including water management, agroecological transitions, biodiversity conservation, and climate adaptation, stakeholder acceptance, trust, and participation consistently emerge as critical determinants of implementation success.

Evidence from Mediterranean countries suggests that many adaptation and sustainability initiatives fail not because of technical limitations, but because proposed measures are perceived as externally imposed, insufficiently adapted to local realities, or incompatible with stakeholders' priorities and institutional contexts. Studies on climate adaptation and environmental governance, therefore, increasingly emphasise social legitimacy as a prerequisite for long-term behavioural change and policy effectiveness (Grothmann and Patt 2005; Adger et al. 2013).

This finding is particularly relevant in the Mediterranean Basin, where environmental challenges often involve common-pool resources such as water, rangelands, forests, fisheries, and biodiversity. In such contexts, individual actions generate collective consequences, creating coordination problems that cannot be effectively addressed through market mechanisms alone. The extensive literature on collective action demonstrates that sustainable resource management depends on the ability of actors to establish shared rules, mutual trust, social norms, and collective monitoring mechanisms (Ostrom 1990, 2009).

Empirical evidence from recent Mediterranean Living Lab initiatives reinforces these conclusions. Within the NATAE project, Living Labs implemented across North African countries demonstrated that agroecological transitions were facilitated when farmers, researchers, public authorities, and value-chain actors jointly identified local challenges and co-developed strategic options adapted to local socio-

ecological conditions. The process of collective diagnosis and co-design contributed not only to identifying technical solutions but also to strengthening stakeholder ownership and legitimacy of proposed transitions (Caulfield et al. 2025).

Similar conclusions emerge from the DIONYSUS project, where Action Panels were established as multi-actor governance platforms to co-design Water-Energy-Food-Ecosystem (WEFE) adaptation solutions across Mediterranean demonstration sites. The DIONYSUS methodology explicitly recognises that adaptation pathways cannot be designed solely through expert-driven approaches and instead require continuous interaction among stakeholders representing different sectors, interests, and institutional levels. Through iterative processes of exploration, experimentation, and evaluation, Action Panels seek to create shared understanding, facilitate learning, and increase the legitimacy of adaptation decisions (Bonomelli and Prosperi 2024).

Evidence from innovation-oriented Living Labs in Sicily further highlights the importance of collective learning processes. (Timpanaro et al. 2024) show that adoption of enabling technologies depends not only on economic profitability but also on the existence of collaborative networks, trust relationships, knowledge exchange mechanisms, and opportunities for co-creation between farmers, researchers, technology providers, and public institutions. The Living Lab environment functions as a social infrastructure that reduces uncertainty and facilitates innovation uptake.

Taken together, the reviewed evidence suggests with *high confidence* that social legitimacy and collective action constitute enabling conditions for successful environmental transitions in Mediterranean socio-ecological systems. While technological innovations, financial incentives, and regulatory frameworks remain important, their effectiveness is significantly enhanced when embedded within participatory governance arrangements that promote trust, shared ownership, and stakeholder engagement.

6.4.3.2.1 Assessment statement

Assessment finding: There is *high confidence* that environmental transitions in Mediterranean agro-ecosystems are more likely to succeed when adaptation measures, agroecological innovations, and resource management strategies are co-developed through participatory processes that strengthen social legitimacy and collective action.

Evidence base: Strong and consistent evidence from Mediterranean governance studies, Living Lab experiences, WEFE nexus initiatives, and common-pool resource management literature (Ostrom, 1990; Reed 2008; Adger et al. 2013; Bonomelli and Prosperi 2024; Timpanaro et al. 2024; Caulfield et al. 2025).

Policy implication: Adaptation and sustainability policies should invest not only in technological solutions but also in participatory governance mechanisms that foster stakeholder engagement, trust-building, co-learning, and collective decision-making.

6.4.3.3 Participatory governance, Living Labs, and co-creation platforms

The literature reviewed provides growing evidence that participatory governance mechanisms play a critical role in operationalising sustainability transitions within Mediterranean socio-ecological systems. While environmental policies have traditionally relied on top-down regulatory approaches, recent experiences suggest that complex challenges such as climate adaptation, biodiversity conservation, water scarcity, and agroecological transformation require governance arrangements capable of integrating diverse forms of knowledge, reconciling competing interests, and facilitating collective learning processes.

A consistent finding emerging from both scientific literature and policy-oriented initiatives is that governance constitutes a central determinant of the effectiveness of environmental interventions. The recent UNU-FLORES and PRIMA policy brief on Resource nexus standardisation argues that fragmented governance structures remain one of the principal obstacles preventing nexus approaches from generating tangible impacts despite their growing scientific and policy relevance. The brief explicitly identifies governance as the mechanism through which trade-offs are managed, synergies are created, and

stakeholder participation is institutionalized across sectors and scales. Furthermore, it recommends the establishment of stakeholder engagement protocols, participatory decision-making mechanisms, and governance standards as prerequisites for successful Resource nexus implementation (Brouwer et al. 2026).

Within this context, Living Labs have emerged as one of the most widely adopted participatory governance approaches in Mediterranean sustainability initiatives. Living Labs provide structured environments where farmers, researchers, public authorities, private actors, civil society organisations, and citizens jointly identify problems, co-design solutions, test innovations, and evaluate outcomes under real-world conditions. Rather than functioning solely as innovation platforms, Living Labs increasingly serve as governance arenas that facilitate negotiation, knowledge co-production, and adaptive decision-making (Leminen et al. 2012; Schuurman et al. 2015; Stone et al. 2025).

Evidence from Mediterranean agroecological and climate adaptation projects supports this assessment. In the NATAE project, Living Labs facilitated the identification of locally adapted agroecological pathways through iterative interactions among farmers, scientists, extension services, and policymakers. These processes contributed not only to technological innovation but also to the development of shared visions and collective ownership of transition strategies (Caulfield et al. 2025). Similarly, the EcoFuture project used a Transnational Living Lab involving Jordanian and Palestinian stakeholders to jointly evaluate alternative WEFE interventions through participatory multi-criteria analysis. The resulting Agricultural Transformation Strategy explicitly recognizes stakeholder engagement and collaborative governance as essential conditions for successful implementation (Nikolaidis et al. 2026).

Parallel developments can be observed in WEFE nexus governance initiatives. The EcoFuture strategy concludes that long-term transition success depends on institutional coordination mechanisms, operational agencies, training hubs, monitoring systems, and adaptive management structures capable of supporting continuous learning and policy adjustment. Governance is therefore framed not as a supporting component but as a strategic enabler of systemic transformation (Nikolaidis et al. 2026).

Comparable governance innovations have been developed through Action Panels and multi-actor platforms established within WEFE nexus projects. These platforms seek to facilitate dialogue among stakeholders operating across water, energy, food, and ecosystem sectors while enabling the co-creation of scenarios, indicators, and policy options. Such approaches recognize that sustainability transitions emerge through iterative processes of experimentation, negotiation, and learning rather than through linear policy implementation (Tourais and Videira 2021; Korhonen-Kurki et al. 2025).

Taken together, the evidence suggests with *high confidence* that participatory governance arrangements significantly improve the capacity of Mediterranean socio-ecological systems to design, implement, and sustain environmental transitions. Living Labs, Action Panels, and other co-creation platforms contribute not only to stakeholder engagement but also to the production of context-specific knowledge, the management of trade-offs, and the strengthening of institutional legitimacy. Their importance appears particularly pronounced in WEFE nexus contexts, where multiple sectors, governance levels, and stakeholder groups must coordinate actions under conditions of uncertainty and resource scarcity.

6.4.3.3.1 Assessment statement

Assessment finding: There is *high confidence* that participatory governance mechanisms, including Living Labs, Action Panels, and multi-actor co-creation platforms, constitute critical enabling conditions for successful environmental transitions in Mediterranean socio-ecological systems.

Evidence base: Strong and consistent evidence from Mediterranean Living Lab experiences, WEFE nexus initiatives, agroecological transition projects, and recent policy assessments on nexus governance (Schuurman et al. 2015; Caulfield et al. 2025; Stone et al. 2025; Brouwer et al. 2026; Nikolaidis et al. 2026).

Policy implication: Future Mediterranean adaptation, biodiversity, and WEFE policies should move beyond consultation-based participation and institutionalize permanent multi-actor governance platforms capable of supporting co-design, experimentation, learning, and adaptive decision-making.

6.4.3.4 Governance implications for Mediterranean climate adaptation and sustainability transitions

The literature reviewed highlights that governance is not simply one component among others within Mediterranean adaptation and sustainability strategies, but rather the enabling condition that determines whether technical innovations, policy instruments, and environmental interventions can be effectively implemented and sustained over time. Across the Mediterranean Basin, climate change increasingly interacts with pre-existing challenges related to water scarcity, biodiversity decline, land degradation, demographic pressures, and institutional fragmentation, creating complex socio-ecological problems that cannot be addressed through sectoral approaches alone (Cramer et al. 2020; IPCC 2022).

A consistent finding emerging from the assessment is that governance fragmentation remains one of the principal barriers to effective adaptation and sustainability transitions. Responsibilities related to water management, agriculture, biodiversity conservation, energy planning, rural development, and climate adaptation are often distributed across multiple institutions operating with different objectives, planning horizons, and regulatory frameworks. This institutional fragmentation limits coordination, reduces policy coherence, and frequently prevents the identification and management of trade-offs across sectors (Ferragina 2010; Cramer et al. 2020). These challenges are particularly visible within WEFE nexus contexts, where decisions taken in one sector often generate unintended consequences in others.

The assessment also demonstrates that social legitimacy and stakeholder acceptance are critical determinants of implementation success. Adaptation measures, agroecological transitions, ecosystem restoration programmes, and resource management reforms are more likely to succeed when stakeholders perceive decision-making processes as transparent, inclusive, and responsive to local realities (Grothmann and Patt 2005; Adger et al. 2013). Conversely, policies developed through top-down approaches often face resistance, lower adoption rates, and weaker long-term effectiveness. The evidence therefore suggests that legitimacy should be considered a central dimension of adaptation governance rather than a secondary social consideration.

Participatory governance mechanisms increasingly emerge as effective responses to these challenges. Living Labs, Action Panels, stakeholder platforms, and co-creation processes provide institutional spaces where scientific knowledge, local expertise, policy objectives, and stakeholder priorities can be integrated into collective decision-making processes. Experiences from Mediterranean agroecological transitions, WEFE nexus initiatives, and climate adaptation projects demonstrate that these approaches strengthen trust, facilitate social learning, improve policy ownership, and increase the operational feasibility of proposed interventions (Reed 2008; Bonomelli and Prosperi 2024; Caulfield et al. 2025; Brouwer et al. 2026).

The reviewed evidence further suggests that future Mediterranean adaptation strategies will require governance systems capable of managing uncertainty, learning from experience, and adjusting interventions over time. Traditional command-and-control approaches are often insufficient to address rapidly evolving socio-ecological conditions characterised by climate uncertainty, non-linear environmental responses, and competing stakeholder interests. Adaptive governance approaches, which combine stakeholder participation, continuous monitoring, knowledge co-production, and iterative decision-making, therefore appear particularly relevant for enhancing resilience in Mediterranean socio-ecological systems (Ostrom 2009).

Finally, the assessment highlights the growing importance of governance within WEFE nexus approaches. Recent Mediterranean experiences increasingly recognise governance not as an additional pillar alongside water, energy, food, and ecosystems, but as the integrative mechanism through which synergies are identified, trade-offs are managed, and collective action is coordinated. As highlighted by recent nexus policy initiatives, governance structures capable of fostering cross-sectoral dialogue, stakeholder engagement, and institutional coordination are essential prerequisites for operationalising sustainability transitions across Mediterranean territories (Brouwer et al. 2026; Nikolaidis et al. 2026).

So, the literature indicates with *high confidence* that strengthening governance capacities, enhancing stakeholder participation, improving institutional coordination, and promoting adaptive and participatory decision-making constitute fundamental priorities for increasing the effectiveness of climate adaptation and sustainability policies in the Mediterranean region.

Table 6.9 | Main governance assessment findings for Mediterranean socio-ecological transitions.

Assessment finding	Main supporting evidence	Confidence level
Governance fragmentation remains a major barrier to adaptation and sustainability transitions	Ferragina (2010); Cramer (2020); IPCC (2022)	*High*
Social legitimacy strongly influences adaptation uptake and policy effectiveness	Grothmann and Patt (2005); Adger et al. (2013)	*High*
Collective action is essential for managing common-pool resources and environmental transitions	Ostrom (1990); Ostrom (2009)	*High*
Participatory governance mechanisms improve stakeholder ownership, trust, and implementation capacity	Stone (2015); Bonomelli and Prosperi (2024); Caulfield et al. (2025)	*High*
Living Labs and multi-actor platforms constitute promising governance innovations for Mediterranean transitions	Stone (2015); Bonomelli and Prosperi (2024); Caulfield et al. (2025); Brouwer et al. (2026)	*Medium-High*
WEFE nexus implementation requires stronger cross-sectoral governance arrangements	Brouwer et al. (2026); Nikolaidis et al. (2026)	*High*

6.4.3.4.1 Key Message 1—Governance quality and institutional coordination are critical determinants of climate adaptation effectiveness in the Mediterranean

The success of climate adaptation and sustainability transitions in Mediterranean socio-ecological systems depends not only on technological and financial resources but also on the ability of governance systems to coordinate actors, sectors, and policy objectives. Governance fragmentation, weak cross-sectoral coordination, and institutional silos remain major barriers to addressing interconnected challenges related to water, food, energy, ecosystems, and climate change.

Confidence level: *high confidence*

Rationale: Strong agreement and extensive evidence from Mediterranean climate assessments, water governance studies, and sustainability transition literature (Cramer 2020; Ferragina 2010; IPCC 2022).

6.4.3.4.2 Key Message 2—Social legitimacy, collective action, and stakeholder participation are essential for successful environmental transitions

Environmental and climate adaptation policies are more likely to be implemented and sustained when stakeholders perceive decision-making processes as legitimate, transparent, and responsive to local needs. Evidence from Mediterranean adaptation initiatives, agroecological transitions, and resource management programmes indicates that participatory governance approaches strengthen trust, social acceptance, collective action, and long-term implementation capacity.

Confidence level: *high confidence*

Rationale: Strong evidence from adaptation, collective action, and participatory governance literature, supported by Mediterranean experiences with Living Labs, Action Panels, and multi-actor platforms (Ostrom, 1990; Adger et al. 2013; Caulfield et al. 2025; Bonomelli and Prosperi 2024).

6.4.3.4.3 Key Message 3—Adaptive and participatory governance frameworks are emerging as key enablers of Mediterranean sustainability transitions

Recent Mediterranean experiences demonstrate that Living Labs, co-creation platforms, and WEFE nexus governance approaches provide effective mechanisms for integrating scientific knowledge, stakeholder perspectives, and policy objectives across sectors and scales. Strengthening such adaptive governance arrangements will be essential for improving climate resilience, managing uncertainty, and supporting long-term sustainability transitions throughout the Mediterranean region.

Confidence level: *high confidence*

Rationale: Consistent evidence from Mediterranean governance initiatives, WEFE nexus projects, and policy assessments highlighting the role of adaptive, multi-level, and participatory governance in addressing complex socio-ecological challenges (Cramer et al. 2020; Brouwer et al. 2026; Nikolaidis et al. 2026).

6.4.4 Environmental diplomacy and cultural heritage linkages

Environmental diplomacy and cultural heritage are expected to play an increasingly prominent role in fostering cooperation across the Mediterranean as climate impacts intensify. The region's long-standing intercultural exchanges and scientific interconnectedness provide a solid foundation for diplomatic approaches that integrate environmental governance with cultural narratives and shared values. As emphasised in regional science diplomacy reports, scientific collaboration and cultural dialogue frequently reinforce one another, operating as two sides of the same coin, to build trust, foster dialogue, and support collective problem-solving across borders (Gual Soler and Pérez-Porro 2021). Linking environmental action with cultural heritage therefore offers both a pragmatic and symbolic pathway for strengthening regional cooperation under conditions of climate stress.

6.4.4.1 Climate as a shared diplomatic entry point

The Mediterranean is widely recognised as a climate change hotspot, with mounting exposure to extreme heat, water scarcity, wildfires, and ecosystem degradation (MedECC 2020, Ali et al. 2022). These shared vulnerabilities generate forms of functional interdependence, creating incentives for cooperation even where political relations remain strained (IPCC AR6 WGIII, Chapter 14, Patt et al. 2022). The IPCC AR6 assessment notes that participation in the transboundary networks and sub-national alliances is increasingly associated with the adoption of climate policies at national and local levels, reinforcing the idea that shared climate risks create structural incentives for cooperation even outside formal diplomatic arenas. Recent polycrisis governance crisis research similarly finds that intertwined and accelerating risks foster new collaborative configurations–flexible, non-hierarchical, and often informal spaces of cooperation that take shape when traditional diplomatic mechanisms are insufficient (Prantl and Ramasubramanian 2025). In the Mediterranean, these new collaborative configurations increasingly take the form of multi-level, transnational, and soft institutional spaces, where climate pressures act not only as threats but also as shared diplomatic entry points for dialogue, coordination, and problem solving.

Recent analyses of Mediterranean cooperative governance reinforce this idea. Aubarell Solduga, (2024) shows that the Euro-Mediterranean region has evolved into an intricate network of actors–regional governments, cities, knowledge networks, EU programmes, and sea-basin initiatives–that increasingly collaborate across administrative and political boundaries to address common challenges, including water scarcity, climate impacts, and sustainability transitions. These cooperative structures are described as 'soft spaces'–flexible, relational, and constantly evolving territorial configurations where multiple levels of governance intersect and where actors jointly find solutions to shared problems (Aubarell Solduga 2024). These 'soft spaces' mirror the liminal institutional arenas envisioned by Prantl and Ramasubramanian (2025) in their study on international cooperation in times of polycrisis and demonstrate how Mediterranean actors are already engaging in environmental diplomacy through transboundary alliances, knowledge networks, and post-regional governance mechanisms. As Aubarell Solduga (2024) argues, Mediterranean cooperation increasingly unfolds through post-regional governance configurations where

states, regions, cities, and knowledge institutions interact in flexible and relational ways shaped by overlapping crises. Climate pressures intensify this dynamic by creating shared risks that cut across political boundaries.

Another key dimension is that the Mediterranean region is also shaped by a distinctive Mediterranean climate identity, which serves as a narrative resource complementing other cultural commonalities such as the Mediterranean diet. Climate identities—understood as common perceptions of environmental realities that help articulate shared regional identities—can foster greater willingness to cooperate, particularly when adaptation challenges are similar across territories that may be politically distant. This identity-based framing also enables new opportunities for transregional cooperation, especially when separation is geographical rather than political. The Mediterranean Climate Action Partnership (MCAP) [43] exemplifies this approach: it brings together territories with a Mediterranean climate—a bioclimatic zone extending beyond the basin to regions such as California, central Chile, the Western Cape, and southern Australia—and conceptualises them as a global community of Mediterranean-climate regions facing comparable ecological pressures and adaptation needs. This shared climate identity complements the role of cultural heritage in diplomacy and introduces a form of ecological belonging that can be strategically leveraged. Taken together, these elements illustrate how climate itself becomes a shared diplomatic resource.

Nevertheless, the extent to which climate pressures translate into cooperation depends on broader geopolitical dynamics. Environmental interdependence exclusively creates incentives for cooperation but does not eliminate geopolitical tension.

6.4.4.2 Cultural heritage as a mobilising narrative

Cultural heritage–material, immaterial, and landscape-based–plays a distinctive role in shaping Mediterranean cooperation, offering narrative resources that can mobilise collective action in ways that purely risk-based framings often cannot. As noted in the previous section (Section 6.4.4.1), climate change vulnerabilities are shared across the regions, but transforming these vulnerabilities into sustained cooperation requires narratives that emphasise meaning and shared belonging. Cultural heritage provides precisely this kind of integrative framing. Cultural values, symbols, and practices can help reframe climate responses positively, shifting discourse away from sacrifice and towards collective care, identity, and long-term continuity (Culture and Climate Action 2025).

Mediterranean Cultural Heritage (MCH) therefore functions as a diplomatic resource. Bombico and Dias Garcia (2025) show that MCH–ranging from shared landscapes and seascapes to rituals, foodways, and historical circulation routes–has been increasingly mobilised in European and Mediterranean cooperation frameworks to foster dialogue, legitimacy, and a sense of regional cohesion. Furthermore, there is a growing academic and policy interest in MCH, particularly in relation to sustainability transitions and environmental challenges, which suggest that cultural heritage narratives can help articulate common Mediterranean policy agendas (Bombico and Dias Garcia 2025).

A key example is the Mediterranean diet, recognized by UNESCO as Intangible Cultural Heritage and widely understood as a shared cultural symbol. The Mediterranean diet encapsulates the interplay between food systems, ecological limits, cultural identity, and the concept of commensality—the act of eating together—which links environmental conditions, traditional knowledge, and social practices (Medina 2009). This heritage practice strengthens collective identity and social resilience, offering an entry point for engaging societies in sustainability transformations (Medina 2021).

From a diplomacy perspective, cultural heritage complements scientific and policy cooperation since culture and science diplomacy often operate together as mutually reinforcing tools that enable trust-building, cross-border networks, and shared problem-solving (Gual Soler and Perez-Porro 2021).

[43] https://www.medclimate.org/

6.4.4.3 Cities and regions as diplomatic actors

City-to-city and region-to-region partnerships are expected to increasingly complement state-level diplomacy in the Mediterranean, especially in the domains of climate adaptation and resilience. As noted in previous section 6.4.4.1, climate pressures in the Mediterranean increasingly give rise to multi-level and transboundary forms of cooperation, often emerging in flexible or 'soft' governance configurations. Within this evolving landscape, cities and regions have become central diplomatic actors, not merely implementing agents.

The Mediterranean Basin hosts over 500 million people, with a high concentration of urban settlement, and urban populations are projected to continue rising throughout the century (Ali et al.2022). These trends heighten exposure to extreme heat, water scarcity, coastal flooding, and cascading socio-economic risks, making cities and regions central sites of climate vulnerability, and therefore central actors in climate cooperation.

As emphasised in IPCC AR6 WGIII Chapter 14, subnational governments are already critical implementers of adaptation and are deeply embedded in transnational networks that shape climate policy diffusion and capacity building. These networks contribute significantly to climate governance outcomes, particularly by closing implementation gaps, facilitating knowledge sharing, and enabling action even when national frameworks are fragmented or politically constrained.

Mediterranean governance research further underscores this dynamic. Aubarell Solduga (2024) describes the regions as a post-regional governance system in which cities, regions, knowledge institutions, and civil society interact across administrative and political boundaries to address urgent shared challenges, including those related to environmental change. Cities and regions in the Mediterranean often inhabit precisely these arenas, working together out of necessity, driven by shared risks rather than political alignment (Prantl and Ramasubramanian 2025).

In this context, city diplomacy has become an increasingly important instrument, experiencing a rapid expansion of its activity across the region, where cities leverage partnerships to address climate impacts, migration pressures, inequalities, and deficits in service provision (Kihlgren Grandi 2022; Romans i Torrent 2023). Even in a politically fragile environment, municipal cooperation has persisted through peer-to-peer networks supported by international organisations and European municipalities, demonstrating resilience of subnational diplomacy. Institutionalized municipal networks further strengthen these dynamics. MedCities, one of the region's longest-standing inter-municipal alliances, facilitates peer learning, technical cooperation, and joint planning across diverse Mediterranean cities.

These subnational dynamics align with the broader science diplomacy principles, which emphasise the importance of knowledge bridges, cross-border communities of practice, and multi-actor coalitions for sustaining cooperation in the Mediterranean (Gual Soler and Perez-Porro 2021). Cities and regions are at the core of such coalitions: they are close to affected populations, directly responsible for key adaptation functions, and often more agile than national governments in experimenting with innovative policy tools. Urban areas concentrate vulnerabilities, but they also concentrate the social, institutional, and infrastructural capacities necessary for transformative climate action. Subnational diplomacy therefore provides a pragmatic means of advancing cooperation even where geopolitical tensions continue to limit state-level engagement (Romans i Torrent 2023).

6.4.4.4 UNESCO and heritage sites as climate laboratories

UNESCO's 2025 Culture and Climate Action report emphasises that heritage sites can function as living laboratories for adaptation, combining scientific monitoring, community engagement, and traditional ecological knowledge. Many UNESCO sites—World Heritage properties and Biosphere Reserves—are located in climate exposed coastal zones or environmentally sensitive cultural landscapes, making them prone to facing escalating risks from sea-level rise, extreme heat, coastal erosion, salinisation, and

biodiversity loss (MAR1, IPCC AR6 WGII CCP4). This makes them priority locations for testing ecosystem-based adaptation, sustainable tourism models, and resilience planning for historic urban environments.

Beyond material heritage, Mediterranean intangible cultural heritage—such as agro-ecological practices and the Mediterranean diet—also provide relevant adaptive knowledge (Medina 2021).

6.4.4.5 Strengthening Mediterranean identity through ecology

[PLACEHOLDER FOR SECOND ORDER DRAFT: assessment will be completed]

6.4.5 Synthesis: building societal capacity for transformation

The evidence assessed across this chapter highlights that building societal capacity is a central condition for enabling climate adaptation and sustainability transitions in the Mediterranean. While technological innovation, ecosystem restoration, and regulatory reforms remain indispensable, their effectiveness depends fundamentally on the social and institutional conditions under which they are deployed. Across Mediterranean socio-ecological systems, education, citizen participation, communication, and governance emerge not as isolated enabling factors, but as mutually reinforcing dimensions of transformation capacity (MedECC 2020; IPCC 2022).

A first major synthesis finding concerns the need to move beyond fragmented interventions toward systemic enabling strategies. The reviewed evidence shows that climate literacy, citizen engagement, participatory governance, and institutional coordination reinforce one another and cannot be addressed independently. Education strengthens environmental awareness and systems thinking, while communication shapes trust, legitimacy, and collective understanding. Participatory processes facilitate stakeholder ownership and social acceptance, and governance provides the institutional framework through which adaptation pathways are translated into action. Weaknesses in one of these dimensions often undermine the effectiveness of the others. Limited climate literacy can reduce the quality of participation, poor communication increases vulnerability to misinformation and social polarisation, and fragmented governance reduces the effectiveness of collective action. This suggests that societal transformation capacity should be understood as an integrated system of interdependent capabilities rather than a set of isolated interventions (Reed 2008; IPBES 2019).

A second synthesis finding concerns the central role of social legitimacy in enabling behavioural and institutional transitions. Across the Mediterranean, adaptation increasingly requires profound transformations in agricultural systems, water allocation regimes, biodiversity conservation strategies, and energy systems. However, the literature consistently shows that even technically robust solutions may fail when they are perceived as externally imposed, socially inequitable, or disconnected from local realities (Adger et al. 2013). Social legitimacy therefore emerges as a critical prerequisite for successful implementation. Citizen science initiatives, Living Labs, and multi-actor governance platforms provide important institutional spaces where legitimacy can be built through dialogue, co-design, and shared learning processes (Leminen et al. 2012; Schuurman et al. 2015; Voytenko et al. 2016). The evidence assessed suggests with *high confidence* that policies developed through participatory and socially legitimate processes are more likely to achieve durable behavioural change and stronger long-term policy ownership.

A third synthesis finding concerns the growing importance of knowledge pluralism and adaptive learning under conditions of uncertainty. Mediterranean climate change is characterised by deep uncertainty, non-linear ecological responses, and strong territorial heterogeneity, requiring governance systems capable of integrating multiple forms of knowledge. The increasing recognition of citizen science, local knowledge systems, and participatory co-production reflects an important evolution toward more inclusive and territorially grounded adaptation strategies (IPBES 2019). At the same time, the growing prevalence of misinformation, greenwashing, and contested environmental narratives reinforces the strategic importance of communication as a pillar of resilience. Building societal capacity therefore requires not only generating knowledge but also strengthening society's ability to interpret uncertainty, assess trade-offs, and

distinguish credible information from manipulation. In this context, social learning and collective knowledge production become essential components of adaptive capacity (Reed 2008; IPCC 2022).

A fourth synthesis finding concerns the transformation of governance itself. The evidence reviewed in this chapter indicates that traditional sectoral and command-and-control governance models are increasingly insufficient to address the interconnected challenges of climate adaptation, biodiversity loss, water scarcity, food security, and energy transitions. These challenges require governance systems capable of managing complexity, coordinating across sectors, and adapting over time. In this context, adaptive governance and nexus-based governance approaches are emerging as particularly relevant for the Mediterranean region (Ostrom 2009; UNU-FLORES and PRIMA 2026). Experiences from Living Labs, Action Panels, and WEFE nexus initiatives demonstrate that governance is increasingly understood as a dynamic process of continuous experimentation, negotiation, and learning rather than as a static institutional arrangement (Bonomelli and Prosperi 2024; Caulfield et al. 2025; EcoFuture 2026).

Taken together, the assessment suggests that investments in social and institutional capacities will be as important as investments in technological innovation or physical infrastructure for strengthening Mediterranean resilience. This is particularly relevant in a region characterised by high climate vulnerability, strong socio-cultural diversity, and significant asymmetries in institutional capacity between northern and southern countries. Building societal capacity therefore requires strengthening formal education systems, enhancing climate communication strategies, institutionalising participatory governance mechanisms, and improving cross-sectoral coordination at multiple scales.

Regional cooperation emerges as a particularly important enabling factor for reducing fragmentation and strengthening mutual learning across Mediterranean countries. Despite their diversity, Mediterranean socio-ecological systems face common challenges related to drought, water competition, biodiversity decline, land degradation, and socio-economic vulnerability. Mechanisms such as transnational Communities of Practice, regional Living Labs, and cross-border WEFE governance platforms can accelerate learning, improve policy coherence, and facilitate the transfer of context-specific solutions across territories (UNU-FLORES and PRIMA 2026; EcoFuture 2026). In this sense, the Mediterranean increasingly constitutes a laboratory for socio-ecological transformation, where innovative governance approaches and societal responses to climate and environmental change can generate lessons of broader relevance beyond the region.

Overall, the literature indicates with *high confidence* that strengthening societal capacity through integrated education, communication, participation, and governance will be fundamental for enabling climate adaptation and sustainability transitions in the Mediterranean. Future policy frameworks should therefore move beyond sectoral and technocratic approaches toward more adaptive, inclusive, and systemic governance models capable of supporting long-term resilience under accelerating climate and environmental change.

Key synthesis messages

Societal transformation in the Mediterranean requires moving beyond technological adaptation toward integrated social and institutional capacity-building. Climate adaptation and sustainability transitions depend not only on technological innovation and ecosystem management, but also on investments in education, communication, participation, and governance. These enabling conditions are deeply interconnected and should be addressed systemically rather than through fragmented interventions *(high confidence).*

Building resilience under climate uncertainty requires plural, participatory, and adaptive knowledge systems. Effective adaptation increasingly depends on combining scientific knowledge with local knowledge, citizen science, and co-produced learning processes. Strengthening climate literacy, improving communication, and countering misinformation are essential for enabling informed collective decision-making and adaptive learning in Mediterranean socio-ecological systems *(high confidence).*

The Mediterranean provides a strategic arena for experimenting with integrated socio-ecological transformation pathways. The diversity of Mediterranean vulnerabilities, governance systems, and socio-ecological contexts makes the region a critical space for testing innovative models of participatory governance, WEFE nexus coordination, and societal adaptation. Lessons emerging from these experiences may provide transferable insights for other climate-vulnerable regions *(medium to high confidence*).

6.5 Monitoring, evaluation, and policy effectiveness

[PLACEHOLDER: This section is currently being developed; substantive content and final analysis will be added in the next iteration. Reviewers' early feedback on structure and direction is nonetheless welcome.]

A policy should never be mistaken for a monument chiselled into permanence. It tends to be a living document, revised and adapted as circumstances shift and new challenges emerge (Cattivelli 2021). Strategies designed to shield shorelines, aquifers, and vulnerable economies from the disruptive force of climate change only retain their legitimacy if a critical question is asked: Did they hold their ground? Did they deliver tangible benefits? Did they alter the trajectory of vulnerability? (Vilà-Cabrera et al. 2018).

For the Mediterranean, the credibility of climate and environmental action plans depends on the original design quality and whether their measures are taken repeatedly once deployed. Effective climate and ecological policy demand initial ambition and efficient re-examination to provide answers: do outcomes align with initial expectations, do resources yield planned value most effectively, and are there chances to adjust the plan when evidence dictates? (Klostermann et al. 2015; Assimacopoulos et al. 2025).

Monitoring, evaluation, and learning (MEL) are not simple checklists. Instead, MEL is a guidance instrument, orienting decision-makers toward what is actual and functioning and recalibrating the situation. Section 6.5 deals with abstract plans still on the drafting board but with the resonances of measures already set in motion: their consequences, results, and failures (EEA 2018).

MEL frameworks can provide that discipline. They ensure that mitigation and adaptation strategies remain responsive, efficient, relevant and fair amid volatile social and ecological conditions. As the Mediterranean is undergoing accelerating transitions, monitoring and evaluation are considered tools of survival that would allow policies to breathe, bend, and, when necessary, be remade (DesirMED 2024).

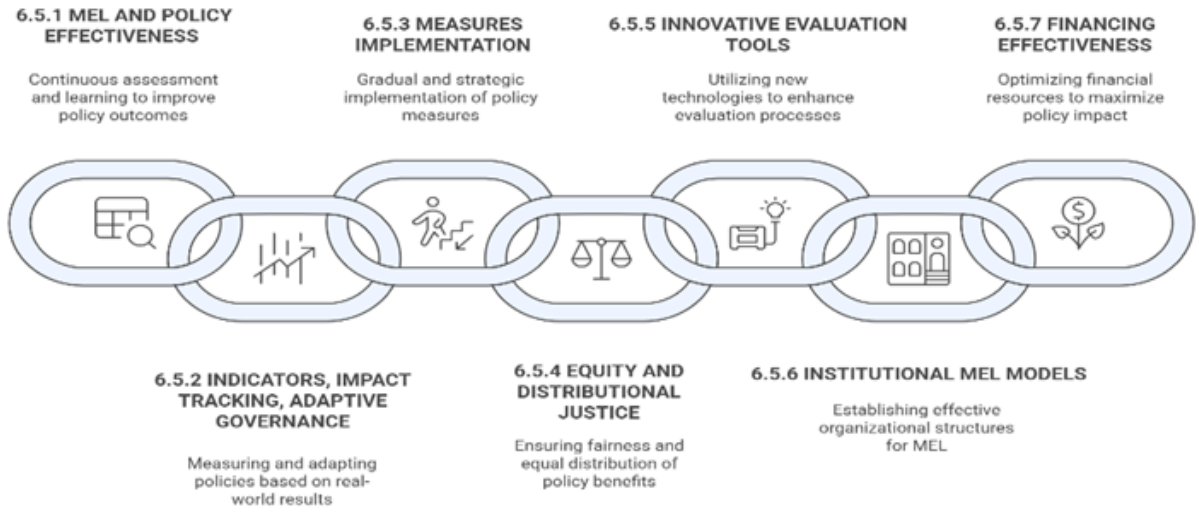

Figure 6.4 |Framework for monitoring, evaluation, and policy effectiveness.

Therefore, Section 6.5 does not revisit the mechanics of policy design itself, but rather its aftermath: how societies measure progress, judge effectiveness, trace ripples of impact, and revise what once seemed settled. Special attention is paid to constructing meaningful, measurable indicators, the practice of adaptive

governance, and the pathways and lessons learned via which small-scale initiatives can grow into broader transformations. It builds upon earlier discussions by centring specifically on ex-post evaluation and the dynamics of collective learning (Assimacopoulos et al. 2025).

6.5.1 Monitoring, evaluation, and policy effectiveness

[PLACEHOLDER: section currently being developed, substantive content and final analysis will be added in the next iteration. Reviewers' early feedback on structure and direction is nonetheless welcome.]

6.5.1.1 Chains of impact and storylines

The impact of policies in the climate context is a chain reaction: it starts with resources (inputs) that feed the system and activities that produce outputs, leading to spark outcomes that will finally crystallise as ultimate impacts. Mapping this sequence highlights fragile links, potential gaps, high interdependences and risk pathways, and points where funding mysteriously evaporates with limited or no real impacts (Bours, McGinn and Pringle 2015).

Yet statistics alone are insufficient, unless combined with Storylines. Storylines are necessary to contextualise how policies unfold in practice. For instance, how do adaptation funds dedicated to coastal defence projects translate into improved resilience against storm surges, gradually lowering socio-economic vulnerability? (MedECC 2020). Storylines humanise impact chains and reveal pathways of unintended consequences.

Such approaches help identify bottlenecks where implementation fails despite adequate financing and other resources. In Mediterranean contexts, monitoring frameworks have revealed mismatches between adaptation investments and observed outcomes, particularly in the water and agriculture sectors (Nadin and Roberts 2018).

[PLACEHOLDER: figure as an Impact Chain Diagram (Inputs → Activities → Outputs → Outcomes → Impacts) with Mediterranean-specific examples (e.g. Coastal protection funds → dike construction → reduced storm surge → lower insurance losses). PRIMA Actions might be helpful here. [END PLACEHOLDER]

6.5.1.2 Looking back - ex-post policy analysis

Evaluating only at the design stage is not enough, especially in a highly dynamic region such as the Mediterranean. Policies need to be examined and judged in hindsight. Retrospective assessment prevents old mistakes from masquerading as models. It helps policymakers avoid repeating ineffective measures and refine design for future cycles (Klostermann et al. 2015). Better understanding lessons learnt will reflect on more adapted future policies and better, meaningful use of the resources. Examples of helpful questions to be asked:

- Did retrospective analysis of National Adaptation Plans (NAPs) offer genuine relief in drought-ridden Mediterranean landscapes, or merely outline a vision never realised? (EEA 2018)
- Did renewable energy subsidies meaningfully shrink emissions, or were they mirages dressed as achievements? For instance, evidence from Spain's renewable energy market shows that while initial subsidies spurred rapid deployment, retroactive regulatory changes undermined investor confidence and long-term stability (del Río and Mir-Artigues 2012).

[PLACEHOLDER:

- a table on Comparative Ex-post Evaluation Cases: NAPs in Mediterranean countries. Columns: policy, initial objective, evaluation findings, lessons. Feedback from PRIMA and NEXTMED would be helpful with real cases.
- A best practice box: an example from a Mediterranean country - initial success, later distortion due to retroactive regulatory changes.[END PLACEHOLDER]

6.5.1.3 Learning and reflexivity

Mechanisms for double-loop learning go beyond efficiency, with more profound questions: are the policy objectives still appropriate under shifting conditions? (Argyris and Schön 1996). In the Mediterranean, climate governance frameworks increasingly recognise the need for reflexivity to adapt to rapid environmental and socio-economic change (Jordan and Turnpenny 2015).

Embedding iterative feedback and learning mechanisms requires constant dialogue across ministries, civil society, and the wider public, not as one-off reviews, but as a steady pulse (Dilling and Lemos 2011). Reflexivity allows policies to evolve rather than stagnate, ensuring their continuing relevance.

6.5.2 Indicators, impact tracking, adaptive governance

6.5.2.1 Indicators

A climate policy indicator is 'a quantitative or qualitative variable that provides a simple and reliable means to measure achievement, reflect the changes connected to an intervention, or help assess the performance of a policy or programme' (OECD DAC 2010). In climate adaptation and mitigation, indicators translate complex processes into measurable targets that allow monitoring, evaluation, comparison, and accountability (EEA 2018).

Indicators gain value when they are SMART- Specific to the context, can be measured, Achievable, relevant, realistic, and bounded in time (UNFCCC 2014). Indicators help policymakers move beyond rhetoric to measurable action in the adaptation and mitigation domain. Types of standard forms: (Adger et al. 2003; Ford et al. 2013, EEA 2018)

- Process indicators track inputs and activities (e.g. % of climate funds disbursed, % of adaptation projects initiated relative to national targets.
- Outcome and Impact indicators measure the medium- and long-term effects of adaptation and mitigation policies on ecosystems, economies, and societies (e.g. % of reduction in flood damages, % households with water security, number of communities with stable agricultural production despite drought, % decrease in GDP losses from extreme weather events).
- Equity indicators (e.g. % of distribution of adaptation benefits across vulnerable groups, such as women, smallholder farmers, coastal communities).

[PLACEHOLDER: indicator to illustrate might be added]

Challenges of playing with indicators include data availability and accuracy, political resistance to transparency, and difficulty attributing observed outcomes directly to specific policies (Brooks et al. 2011).

[PLACEHOLDER: suggestion to add a table to illustrate the typology of indicators, definitions or explanations, with Mediterranean-relevant examples. [END PLACEHOLDER]

6.5.2.2 Impact tracking systems

- Regional climate observatories and open data platforms act as shared watchtowers for adaptation progress. For instance, the EU Climate-ADAPT Platform provides a repository of adaptation case studies, national strategies, and progress reports for Member States, including Mediterranean countries (EEA 2020). National Monitoring, Reporting, Verification (MRV) Systems enable countries to track % of greenhouse gas (GHG) reductions and quantify the adaptation co-benefits (UNEP 2021).
- Harmonisation across the north-south Mediterranean is essential. Disparities in institutional capacity risk creating uneven baselines and fragmented evaluation. Promoting standardised metrics and joint regional observatories allows countries to read from the same guidebook, enhancing comparability and collective learning (Nadin and Roberts 2018).

6.5.2.3 Adaptive governance

- Indicators and tracking systems are more useful when embedded within systemic and flexible adaptive governance frameworks that allow policies to evolve with new knowledge. Adaptive governance emphasises cycles of observe → review → recalibrate (Folke et al. 2005).
- Small pilot projects serve as living laboratories, generating evidence that can be translated into the national strategies. This reflexive process, scaling lessons from the local to the systemic level, ensures that Mediterranean adaptation remains robust under uncertainty (Dilling and Lemos 2011).
- Predictive climate scenarios and risk outlooks should be routinely incorporated into national and regional adaptation policies and plans updates.

[PLACEHOLDER: best practice box to illustrate Spain's National Adaptation Plan 2021–2030 integrates scenario-based risk assessments for agriculture and coasts, updating measures every five years.[END PLACEHOLDER]

6.5.3 From modest steps to larger ripples - measures implementation

Scaling-up refers to deepening the expected impact by expanding the coverage or intensity of an intervention. For instance, a local pilot in a domestic region might evolve into the country's national policy if backed by suitable political commitment, available institutional capacity, and secured financing (Hartmann and Linn 2008). Scaling up ensures that lessons from early experiments translate into systemic impact across the Mediterranean.

[PLACEHOLDER: best practice box: Morocco's solar irrigation programme, a pilot in the 2000s, scaled into a national scheme under the Plan Maroc Vert. These solar irrigation pilots in Morocco have gradually been mainstreamed into national water and agriculture strategies, reflecting state investment and donor engagement (Benouniche et al. 2014).]

Scaling-out refers to replicating successful interventions in different locations or contexts. This requires careful adaptation to local conditions, ensuring contextual fit and avoiding maladaptation (Gundel et al. 2001).

[PLACEHOLDER: Best practice box: Spain–Tunisia wetland restoration transfer—knowledge exchange facilitated by EU regional cooperation projects. A Mediterranean example is the transfer of coastal wetland restoration practices from Spain to Tunisia. While techniques such as dune stabilisation and wetland re-flooding proved successful in Valencia, their replication in Tunisia required adjustment to different ecological, social, and governance realities (MedECC 2020).]

Barriers to scaling

[PLACEHOLDER: section to be assessed and completed]
Section will be drafted based on references (Adger et al. 2003; Petersen and Pedersen 2010; Nunan et al. 2012, Mimura et al. 2014).

- Technical (data gaps, lack of infrastructure, local adaptation of solutions).
- Institutional (fragmented governance, short political cycles).
- Financial (limited access to climate finance at the local level).
- Social (community acceptance, equity concerns, contextual fit).

Suggested figure: Pathway diagram of scaling-up (Pilot → Policy integration → National roll-out → Regional coordination).
Add best practice box: examples from the Mediterranean [END OF PLACEHOLDERs]

6.5.4 Equity and distributional justice in evaluation

Policies that appear technically effective yet distribute gains unfairly risk eroding social trust and legitimacy (Schlosberg 2007). Evaluations must spotlight not only impact but also who shoulders costs and who reaps resilience, with special consideration of vulnerable groups and areas, such as low-income households,

migrant communities, women in agriculture, and coastal fishers who often face disproportionate climate risks in the Mediterranean (Adger et al. 2006).

Citizen-centred evaluation frameworks can help expose uneven benefits and empower marginalised voices in climate governance (Pelling and Garschagen 2019). Such approaches emphasise distributive, procedural, and recognitional justice, ensuring climate policies do not replicate inequalities.

6.5.5 Innovative evaluation tools

Traditional monitoring frameworks are increasingly complemented by innovative tools that capture real-time data and enhance accuracy.

- Remote sensing and Earth observation satellites provide fine-scale monitoring of land use change, drought, and sea-level rise in Mediterranean basins (Forkel et al. 2019).
- Big data and Artificial Intelligence (AI) allow the integration of diverse datasets, from climate models to social media, for early risk detection and impact attribution (Rolnick et al. 2022).
- Machine learning applications in agriculture and water management are enabling predictive evaluation of climate impacts (Khaki and Wang 2019).
- Citizen science adds participatory perspectives, such as democratising evaluation, local flood mapping, or biodiversity monitoring (Bonney et al. 2016).

6.5.6 Institutional models of MEL

Institutional arrangements shape how MandE results are perceived. Independent monitoring agencies offer credibility but may lack integration with policymaking. Government-led evaluation systems ensure ownership but risk politicisation. International or regional bodies (e.g. UfM, UNEP/MAP) can harmonise methodologies and foster comparability across borders (OECD 2020), but they may offer higher costs and more bureaucratic procedures.

Balancing and harmonising these models is essential to guarantee legitimacy and effectiveness (Howlett and Ramesh 2014). In the Mediterranean, hybrid arrangements, where national agencies report into regional observatories, may offer the most effective compromise.

6.5.7 Financing effectiveness

[PLACEHOLDER: section to be drafted]
Complementing Section 6.3 by focusing on value-for-money evaluations: the accurate measure is how much climate benefit each euro generates (Brown et al. 2011). Approaches include:

- Cost-benefit analysis (e.g. avoided flood damages vs. cost of dikes).
- Cost-effectiveness analysis (lowest cost per unit of emissions avoided).
- Climate return on investment (ROI) metrics are increasingly used by international climate funds (UNEP 2021).

Such exercises help Mediterranean countries align national evaluations with global frameworks under the Paris Agreement's Global Stocktake (UNFCCC 2022). [END OF PLACEHOLDER]

References

[PLACEHOLDER: the references will be completed for the second order draft]

Aaditya, M.; Rocha, N.; and Ruta, M. (2020). 'Handbook of Deep Trade Agreements", World Bank.

Abdou, M., Dudu, H., Gerling, K., Kadissi, D., 2025. Macroeconomic Exposure to the EU's Carbon Border Adjustment Mechanism: The Case of the Middle East and Central Asia, IMF Working Paper No: WP/25/182 Washington, DC.

Abdouli, M., & Hammami, S. (2017). The impact of FDI inflows and environmental quality on economic growth: an empirical study for the MENA countries. Journal of the Knowledge Economy, 8(1), 254-278.

Aboushady, N., et al. (2019). Assessing EU–Mediterranean Policies in the Fields of Industry and Energy from a Bottom-Up Perspective. MEDRESET Policy Papers, No. 7 (January). http://www.medreset.eu/?p=13780

Adger, W. N., Barnett, J., Brown, K., Marshall, N., & O'Brien, K. (2013). Cultural dimensions of climate change impacts and adaptation. In Nature Climate Change (Vol. 3, Number 2, pp. 112–117). https://doi.org/10.1038/nclimate1666

Adger, W.N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world. Progress in Development Studies, 3(3), 179–195.

Adger, W.N., Paavola, J., Huq, S., & Mace, M.J. (2006). Fairness in Adaptation to Climate Change. MIT Press.

Alcon, F., Albaladejo-García, J. A., Martínez-García, V., Rossi, E. S., Blasi, E., Lehtonen, H., Martínez-Paz, J. M., & Zabala, J. A. (2024). Cost benefit analysis of diversified farming systems across Europe: Incorporating non-market benefits of ecosystem services. Science of the Total Environment, 912. https://doi.org/10.1016/j.scitotenv.2023.169272

Aleksandrova, M., Banerjee, A., Cunha, M. I., Rodríguez de Francisco, J. C., Brüntrup, M., & Malerba, D. (2024). Fostering justice across the Rio Conventions: Emerging levers for cooperation and coordination (Policy Brief No. 31/2024). German Institute of Development and Sustainability (IDOS).

Angın, C. (2025). A new dilemma for Turkish public administration: Combating disinformation in the context of public policy. Kent Akademisi Dergisi, 18(5), 2719-2740. https://doi.org/10.35674/kent.160128

Arcos, I., Rosso, P., & Salaverría, R. (2025). Divergent Emotional Patterns in Disinformation on Social Media? An Analysis of Tweets and TikToks about the DANA in Valencia.

Argyris, C., & Schön, D. (1996). Organisational Learning II: Theory, Method, and Practice. Addison-Wesley.

Arranz, I., Batllori, E., Linares, C., Ripple, W. J., & Bonada, N. (2024). Integrative research of Mediterranean climate regions: a global call to action. Environmental Conservation, 1-8. https://doi.org/10.1017/S0376892924000067

Assimacopoulos, D. et al. (2025). Advancing climate change adaptation in Greece: development and assessment of the national Monitoring & Evaluation system. Journal of Environmental Planning and Management.

Azeñas, V., Janner, I., Medrano, H., & Gulías, J. (2018). Performance evaluation of five Mediterranean species to optimize ecosystem services of green roofs under water-limited conditions. Journal of Environmental Management, 212, 236–247. https://doi.org/10.1016/j.jenvman.2018.02.021

Baghdadi, L., Martínez-Zarzoso, I. and Zitouna, H. (2013), "Are RTA with Environmental Provisions Reducing Emissions?", Journal of International Economics 90, 378-390.

Bălan, L. L. (2014). Protection of the atmosphere, water and soil at international, European and national levels. Bucharest: University Publishing House. ISBN 978-606-28-0081-9.

Balzan, M. V., Caruana, J., & Zammit, A. (2018). Assessing the capacity and flow of ecosystem services in multifunctional landscapes: Evidence of a rural-urban gradient in a Mediterranean small island state. Land Use Policy, 75, 711–725. https://doi.org/10.1016/j.landusepol.2017.08.025

Barrett, S. (2013). Local level climate justice? Adaptation finance and vulnerability reduction. Global Environmental Change, 23(6), 1819–1829.

Bellver-Domingo, Á., Fuentes, R., Hernández-Sancho, F., Carmona, E., Picó, Y., & Hernández-Chover, V. (2018). Monetary valuation of salicylic acid, methylparaben and THCOOH in a Mediterranean coastal wetland through the shadow prices methodology. Science of the Total Environment, 627, 869–879. https://doi.org/10.1016/j.scitotenv.2018.01.303

Benouniche, M., Kuper, M., Poncet, J., & Hartani, T. (2014). Making the user visible: Analysing irrigation practices and farmers' logic to explain actual drip irrigation performance. Irrigation Science, 32, 405–420.

Berahab, R., & Dadush, U. (2021). What will be the effect of the EU's Carbon Border Tax on Morocco, and how should Morocco react? Policy Paper, Policy Center for the New South.

Bernauer, T., and Böhmelt, T. (2020). International conflict and cooperation over freshwater resources. Nature Sustainability, 3(5), 350–356.

Bernués, A., Rodríguez-Ortega, T., Ripoll-Bosch, R., & Alfnes, F. (2014). Socio-cultural and economic valuation of ecosystem services provided by Mediterranean mountain agroecosystems. PLoS ONE, 9(7). https://doi.org/10.1371/journal.pone.0102479

Blayac, T., Hamadé, F., & Salles, J. M. (2016). Valuing the recreational services of a marine and terrestrial natural protected area: A travel cost analysis of Port-Cros National Park. In Revue d'Economie Politique (Vol. 126, Number 1, pp. 127–153). Editions Dalloz Sirey. https://doi.org/10.3917/redp.261.0127

Blili, Y., Abou Nader, E., Pavez, I., Prosperi, P., Harbouze, R., Kyrgiakos, L. S., Kleisiari, C., Vasileiou, M., Angelopoulos, V., Vlontzos, G., & Kleftodimos, G. (2025). Assessing the economic impact of insect pollination on the agricultural sector: A department-level case study in France. Environmental and Sustainability Indicators, 28. https://doi.org/10.1016/j.indic.2025.100944

Bodoque, J. M., Amérigo, M., Díez-Herrero, A., García, J. A., Cortés, B., Ballesteros-Cánovas, J. A., & Olcina, J. (2016). Improvement of resilience of urban areas by integrating social perception in flash-flood risk management. Journal of Hydrology, 541, 665–676. https://doi.org/10.1016/j.jhydrol.2016.02.005

Bonney, R., et al. (2016). Next steps for citizen science. Science, 343(6178), 1436–1437.
Bonomelli & Prosperi, (2024). Practical guidelines for the co-design of WEFE operational adaptation solutions. DIONYSUS project report, European Union through the PRIMA Programme Section 1 under Grant Agreement no. 2341
Bonomelli, S. and Prosperi, P. (2024).Living Labs as participatory governance mechanisms for agroecological transitions in Mediterranean farming systems: lessons from multi-actor innovation platforms. Agricultural Systems, 224, 104089. https://doi.org/10.1016/j.agsy.2024.104089
Boran, I., & Pettorelli, N. (2024). The Kunming–Montreal Global Biodiversity Framework and the Paris Agreement need a joint work programme for climate, nature and people. Journal of Applied Ecology, 61(9), 1991–1999. https://doi.org/10.1111/1365-2664.14721
Bours, D., McGinn, C., & Pringle, P. (2015). Monitoring and Evaluation of Climate Change Adaptation: A Review of the Landscape. SEA Change & UKCIP.
Brenton, P. and V. Chemutai. 2021. The Trade and Climate Change Nexus: The Urgency and Opportunities for Developing Countries. Washington, DC: World Bank.
Broda, E., & Strömbäck, J. (2024). Misinformation, disinformation, and fake news: Lessons from an interdisciplinary, systematic literature review. Annals of the International Communication Association.
Brooks, N., Anderson, S., Ayers, J., Burton, I., & Tellam, I. (2011). Tracking adaptation and measuring development. IIED Climate Change Working Paper No. 1.
Brouwer, F., Rhouma, A., Karthe, D., Autino, A., Daher, B., Guenther, E., Mohtar, R., Huber-Lee, A., Virk, Z. T., Laspidou, C., Nagabhatla, N., Ringler, C., Vrachioli, M., & Jacobson, M. (2026). What "Nexus"? Towards Resource Nexus Standardisation (Policy Brief No. 01/2026). United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), Dresden, Germany, and PRIMA Foundation, Barcelona, Spain.
Brown, J., Bird, N., & Schalatek, L. (2011). Climate finance effectiveness: A framework for tracking. ODI Working Paper.Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. Annual Review of Environment and Resources, 30, 441–473.
Burgos, E., Montefalcone, M., Ferrari, M., Paoli, C., Vassallo, P., Morri, C., & Bianchi, C. N. (2017). Ecosystem functions and economic wealth: Trajectories of change in seagrass meadows. Journal of Cleaner Production, 168, 1108–1119. https://doi.org/10.1016/j.jclepro.2017.09.046
Cagiran, S. S., Bourceret, A., & Drogue, S. (2026). From soil to society: A transdisciplinary assessment of farmers' adoption of agroecology through the social-ecological systems framework in Algeria. Land Use Policy, 165. https://doi.org/10.1016/j.landusepol.2026.107995
Campagne, C. S., Salles, J. M., Boissery, P., & Deter, J. (2014). The seagrass Posidonia oceanica: Ecosystem services identification and economic evaluation of goods and benefits. Marine Pollution Bulletin, 97(1–2), 391–400. https://doi.org/10.1016/j.marpolbul.2015.05.061
Castellet-Viciano, L., Hernández-Chover, V., & Hernández-Sancho, F. (2024). The economic and environmental impact of fire preventive strategies in the Mediterranean region. Journal of Environmental Management, 371. https://doi.org/10.1016/j.jenvman.2024.123095
Castro-Martínez, A., Torres-Martín, J.-L., & Villena-Alarcón, E. (2025). When Authorities' Response Fails and Citizens Act: Social Media Responses to the DANA Disaster in Spain. International Journal of Disaster Risk Science, 16, 980–992.
Cattivelli, V. (2021). Climate Adaptation Strategies and Associated Governance: A Mediterranean macro-region perspective. Sustainability, 13(5):2810.
Caulfield, M., Prosperi, P., Marraccini, E., Debolini, M., Lamine, C., Bellon, S., Sarthou, J.-P. and Bui, S. (2025). Living Labs and multi-actor co-creation processes for agroecological transition pathways in Mediterranean farming systems: evidence from the NATAE project. Agronomy for Sustainable Development, 45, 27. https://doi.org/10.1007/s13593-025-00976-4
Caulfield, M., Van de Ven G. W.J., Reinhard-Kolempas M., Aatig S., Chattou, Z., Echchgadda, G., Boudedja, K., Oulmane, A., Comptour, M., Benmoussa, S., Galanis, C., Belhouchette, H., Kleftodimos, G., Sidya Fall, C., Zouari, I., Benmoussa, H., Jallouli, S., Koussani, W. (2025). Strategic options for agroecological transitions. NATAE project report, EU Horizon Grant Agreement no. 101084647. https://doi.org/10.5281/zenodo.14732038
Cebeci, M., and Schumacher, T. (2016). The EU's Constructions of the Mediterranean (2003–2017) (WP1). MEDRESET.
Ceseracciu, C., Branca, G., Deriu, R., & Roggero, P. P. (2023). Using the right words or using the words right? Re-conceptualising living labs for systemic innovation in socio-ecological systems. Journal of Rural Studies, 104, 103154.
Climent-Ferrer, J. J., Solanes, J. E., Martí-Testón, A., Moriniello, F., Muñoz, A., & Gracia, L. (2026). Crisis Disinformation and Verification Dynamics in the València 2024 DANA. Electronics, 15(11), 2358.
Copeland, B.R. and M.S. Taylor, "North-South Trade and the Environment," Quarterly Journal of Economics, 109 (1994): 755-87.
Corso, J. Del, & Képhaliacos, C. (2017). Trans-actions discursives et changement institutionnel pour le développement durable.
Costantini, V., & Mazzanti, M. (2012). On the green and innovative side of trade competitiveness? The impact of environmental policies and innovation on EU exports. Research policy, 41(1), 132-153.
Costanza, R., de Groot, R., Farberk, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O, R. V, Paruelo, J., Raskin, R. G., Suttonkk, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. In NATURE (Vol. 387).
Council of Europe (2025b) Resisting Disinformation; 19 building blocks to strengthen information integrity
Cózar, A., Sanz-Martín, M., Martí, E., González-Gordillo, J. I., Ubeda, B., Gálvez, J. Á., Irigoien, X., and Duarte, C. M. (2015). Plastic accumulation in the Mediterranean Sea. PLoS ONE, 10(4), 1–12. https://doi.org/10.1371/journal.pone.0121762

Cramer, W., Guiot, J., Fader, M., Garrabou, J., Gattuso, J.-P., Iglesias, A., Lange, M. A., Lionello, P., Llasat, M. C., Paz, S., Peñuelas, J., Snoussi, M., Toreti, A., Tsimplis, M. N., & Xoplaki, E. (2018). Climate change and interconnected risks to sustainable development in the Mediterranean. Nature Climate Change, 8(11), 972–980. https://doi.org/10.1038/s41558-018-0299-2

Cramer, W., Marini, K., & Guiot, J. (2020). Current situation and risks for the future First Mediterranean Assessment Report (MAR1) Edited by.

Daniel, A. D., & Fernandes, J. (2024). Promotion of community resilience: Do citizens have a role to play? Local Environment, 29(8), 987–1003. https://doi.org/10.1080/13549839.2024.2345621

Dark (2018). [MEDRESET stakeholder interviews], p. 13.

De la Osada Saurí, D. (2025). La exposición del turismo al riesgo: El caso de estudio de la DANA 2024 en València. Cuadernos de Geografía, 114–115, 545–578.

Dean, J. M. (2002). Does trade liberalization harm the environment? A new test. Canadian Journal of Economics/Revue canadienne d'économique, 35(4), 819-842.

Del Corso, J. P., Kephaliacos, C., & Plumecocq, G. (2015). Legitimizing farmers' new knowledge, learning and practices through communicative action: Application of an agro-environmental policy. Ecological Economics, 117, 86–96. https://doi.org/10.1016/j.ecolecon.2015.05.017

Del Río, P., & Mir-Artigues, P. (2012). Support for solar PV deployment in Spain: Some policy lessons. Renewable and Sustainable Energy Reviews, 16(8), 5557–5566.

Del Soldato, E., & Massari, S. (2024). Creativity and digital strategies in support to Mediterranean food cultural rural areas. EuroMed Journal of Business, 19(1), 113-137.

DesirMED project. (2024). Policy Brief #1: Transformational Governance for Climate Adaptation and Resilience in the Mediterranean. DesirMED consortium.

Dias, L. P. C., Bagatini, F. Z., & Perin, M. G. (2025). Green "Under-Communication:" A Systematic Literature Review on Greenhushing. Brazilian Journal of Marketing, 24(Special Issues), 1474–1506.

Díaz-Maroto Oro, R. (2026). From Discourse on X to urban protest: Emotions, polarization, and public space in Torre Pacheco. Comunicación y Hombre, (22), 209–226.

Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., Larigauderie, A., Adhikari, J. R., Arico, S., Báldi, A., Bartuska, A., Baste, I. A., Bilgin, A., Brondizio, E., Chan, K. M. A., Figueroa, V. E., Duraiappah, A., Fischer, M., Hill, R., … Zlatanova, D. (2015). The IPBES Conceptual Framework - connecting nature and people. In Current Opinion in Environmental Sustainability (Vol. 14, pp. 1–16). Elsevier. https://doi.org/10.1016/j.cosust.2014.11.002

Dilling, L., & Lemos, M.C. (2011). Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. Global Environmental Change, 21(2), 680–689.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive). OJ L 327, 22.12.2000.

Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (Strategic Environmental Assessment Directive). OJ L 197, 21.7.2001, pp. 30–37.

Directive 2003/35/EC providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending Council Directive 85/337/EEC. OJ L 156, 25.6.2003, pp. 17–25.

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive). OJ L 164, 25.6.2008, pp. 19–40.

Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (Environmental Impact Assessment Directive), as amended. OJ L 124, 25.4.2014, pp. 1–18.

Dwyer, J., Short, C., Berriet-solliec, M., Déprés, C., Lataste, F. G., Hart, K., & Prazan, J. (2020). Fostering resilient agro-food futures through a social-ecological systems framework: Public–private partnerships for delivering ecosystem services in Europe. Ecosystem Services, 45. https://doi.org/10.1016/j.ecoser.2020.101180

Dzebo, A., Shawoo, Z., & Browne, K. (2025). Does Policy Coherence Make National Implementation of Global Sustainability Agendas More Successful? Annual Review of Environment and Resources, 50, 539–562.

EcoFuture (2026).
Nikolaidis, N., Lilli, M., Rozakis, S., Troullaki, K., Koukianaki, E., Albalawneh, A., Aljaafreh, S., Al Naimat, M., Al-Rkebat, R., Hamdi, L., Halasah, S., Jayousi, A., Ajrami, A., Attili, S. and Thaher, N. (2026). A WEFE Nexus Agricultural Transformation Strategy for Jordan and Palestine. EcoFuture Project Deliverable. PRIMA Programme.

EEA (2020). Climate-ADAPT: European Climate Adaptation Platform. https://climate-adapt.eea.europa.eu

EEA(2018). Monitoring and evaluating climate change adaptation at local and regional levels: Learning from international experience to develop an M&E methodology. EEA Report No. 20/2018

El Serafy, G. Y. et al. (2021).Integrating Inland and Coastal Water Quality Data for Actionable Knowledge. Remote Sensing, 13(15), 2899.

El Zrelli, R., Hcine, A., Yacoubi, L., Roa-Ureta, R. H., Gallai, N., Castet, S., Grégoire, M., Courjault-Radé, P., & Rabaoui, L. J. (2023). Economic losses related to the reduction of Posidonia ecosystem services in the Gulf of Gabes (Southern Mediterranean Sea). Marine Pollution Bulletin, 186. https://doi.org/10.1016/j.marpolbul.2022.114418

Enke, K. A., & Budke, A. (2023). Preparing students for a changing world: How geography curricula in Europe are tackling climate change. Frontiers in Education, 8, 1216780.

Erdogdu, E. (2025). The carbon border adjustment mechanism: Opportunities and challenges for non-EU countries. Wiley Interdisciplinary Reviews: Energy and Environment, 14(1), e70000.

European Commission (n.d.). MPA-ADAPT: Preparing the Mediterranean region for the impacts of climate change (European Regional Development Fund project). https://ec.europa.eu/regional_policy/en/projects/Croatia/mpa-adapt-preparing-the-mediterranean-region-for-the-impacts-of-climate-change
Făinişi, F. (2005). The main community regulations adopted in the field of transport for the protection of the environment. Revista de Drept Comercial, No. 1, Bucharest, p. 43.
Farias, L., & Barros, D. (2025). Climate Change Denial. In P. Almeida (Ed.), The Oxford Handbook of Climate Action.
Fernandes, A.; Rocha, N.; and Ruta, M. (2021). "The Economics of Deep Trade Agreements", Center for Economic Policy Research, World Bank Group.
Ferragina, Eugenia., Scoullos, Michael., & Narbona, Cristina. (2010). Environmental and sustainable development in the Mediterranean. ISS.
Ferreira, C. S. S., Destouni, G., & Kalantari, Z. (Eds.). (2024). Environmental Sustainability in the Mediterranean Region: Challenges and Solutions. Springer Nature.
Fisher, B., Turner, R. K., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. Ecological Economics, 68(3), 643–653. https://doi.org/10.1016/j.ecolecon.2008.09.014
Folkard-Tapp, H., Boran, I., Chan, S., Dombrowsky, I., Penney, T. L., Bazely, D., & Pettorelli, N. (2025). Beyond Nature-based Solutions: The case for Integrated Nature-Climate Action. Journal of Applied Ecology, 62, 2478–2486.
Ford, J.D., Berrang-Ford, L., & Paterson, J. (2013). A systematic review of observed climate change adaptation in developed nations. Climatic Change, 118(2), 381–395.
Forkel, M., et al. (2019). Monitoring vegetation dynamics in the Mediterranean Basin using remote sensing. Remote Sensing of Environment, 224, 441–456.
Garau, E., de Abreu, G., Perez-Ramirez, I., Schütze, N., Farhat, Y. A., Loureiro, J., & Castro, A. J. (2026). Diverse values of nature can drive transformative change in the WEFE nexus governance in Mediterranean countries. Sustainability Science, 21, 283–303.
García-Martín, M., Torralba, M., Quintas-Soriano, C., Kahl, J., y Plieninger, T. (2021). Linking food systems and landscape sustainability in the Mediterranean region. Landscape Ecology, 36, 2259–2275.
Gatti, L. (2023). Greenhushing: A Systematic Literature Review.
Gatti, L. (2023). Greenhushing: A Systematic Literature Review. University of Trento.
Gertrúdix, M., Arribas, C. M., y Codesido-Linares, V. (2024). Disinformation as an obstructionist strategy in climate change mitigation: a review of the scientific literature. xxxx
Gorus, M. S., & Ben Ali, M. S. (2021). Globalization and Environmental Pollution: Where Does the MENA Region Stand?. In Economic Development in the MENA Region: New Perspectives (pp. 161-179). Cham: Springer International Publishing.
Gouel, C. 2022. "Measuring Climate Change Impacts on Agriculture: An Equilibrium Perspective on Supply-Side Approaches. NBER Working Paper 30279. National Bureau of Economic Research, Cambridge, MA.
Government of Spain. (2020). Plan Nacional de Adaptación al Cambio Climático 2021–2030 (PNACC). Ministerio para la Transición Ecológica y el Reto Demográfico.
Grasso, M., Levantesi, S., & Beqja, S. (2024). Climate obstruction in Italy: From outright denial to widespread climate delay. In R. J. Brulle, J. T. Roberts, & M. C. Spencer (Eds), Climate Obstruction Across Europe (pp. 268–293). Oxford University Press.
Grigorescu, A., Munteanu, I., Dumitrica, C. D., and Lincaru, C. (2023). Development of a Green Competency Matrix Based on Civil Servants' Perception of Sustainable Development Expertise. Sustainability, 15(18), 13913. https://doi.org/10.3390/su151813913
Grossman, G. M., & Krueger, A. B. (1993). Environmental Impacts of a North American Free Trade Agreement. In P. M. Gerber (Ed.), The US–Mexico Free Trade Agreement (pp. 13–56). MIT Press.
Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. Global Environmental Change, 15(3), 199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002
Gundel, S., Hancock, J., & Anderson, S. (2001). Scaling-up and out: Achieving widespread impact through agricultural research. ODI Agricultural Research & Extension Network Paper 114.
Gupta, H., & Singh, N. K. (2023). Climate Change and Biodiversity Synergies: A Scientometric Analysis in the Context of UNFCCC and CBD. Anthropocene Science.
Gwiazdon, K. (2023). Saving Democracy: Denying the Alternate Reality of Climate Denialism. In The Routledge Handbook of Applied Climate Change Ethics (pp. 231–247). Routledge.
Haines-Young, R., & Potschin, M. (2012). Common International Classification of Ecosystem Services (CICES, Version 4.1). www.cices.eu
Halicioglu, F., & Ketenci, N. (2016). The impact of international trade on environmental quality: The case of transition countries. Energy, 109, 1130-1138.
Hamade, K., et al. (2018). EU Policies on Agriculture and Rural Development in the MENA. MEDRESET Policy Papers, No. 4 (November). http://www.medreset.eu/?p=13667
Hamududu, B.H., and H. Ngoma. 2020. "Impacts of Climate Change on Water Resources Availability in Zambia: Implications for Irrigation Development. Environment, Development and Sustainability 22 (4): 2817–2838.
Hanley, N., Breeze, T. D., Ellis, C., & Goulson, D. (2015). Measuring the economic value of pollination services: Principles, evidence and knowledge gaps. Ecosystem Services, 14, 124–132. https://doi.org/10.1016/j.ecoser.2014.09.013
Hartmann, A., & Linn, J. (2008). Scaling Up: A Framework and Lessons for Development Effectiveness from Literature and Practice. Wolfensohn Center for Development, Brookings.
Hein, L. (2009). The Economic Value of the Pollination Service , a Review Across Scales. (Tansley 1935), 74–82.
Hodgson, G. M. (2006). What Are Institutions?

Hodgson, G. M. (2006). What Are Institutions?
Hoffman, A. (2025). Los impactos de las fake news en los estados democráticos y los impactos ambientales paralelos en Brasil y España. Sostenibilidad: Económica, Social y Ambiental, (7), 1–43.
Houdret, A., Kadiri, Z., & Bossenbroek, L. (2017). A New Rural Social Contract for the Maghreb? The Political Economy of Access to Water, Land and Rural Development. Middle East Law and Governance, 9(1), 20–42. https://doi.org/10.1163/18763375-00901003
Howlett, M., & Ramesh, M. (2014). The two orders of governance failure: Design mismatches and policy capacity issues. Policy Sciences, 47, 317–338.
Huber, D., and Paciello, M. C. (2018). [MEDRESET stakeholder interviews], pp. 10–11.
IPBES (2019).Global Assessment Report on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Bonn, Germany.
IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. H.-O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, & B. Rama (Eds.). Cambridge University Press, Cambridge, UK and New York, NY, USA. https://doi.org/10.1017/9781009325844.
Iyalohme, F. O., et al. (2013). Need for geographic CoPs for adaptation solutions.
Jayadevappa, R., & Chhatre, S. (2000). International trade and environmental quality: a survey. Ecological economics, 32(2), 175-194.
Jordan, A., & Turnpenny, J. (2015). The Tools of Policy Formulation: Actors, Capacities, Venues and Effects. Edward Elgar.
Kaner, S. (2014). Facilitator's guide to participatory decision-making (3rd ed.). Jossey-Bass.
Katsaounidou, A., Saridou, T., Siamtanidou, E., Kotenidis, E., Dimoulas, C., & Veglis, A. (2025). Resilience to Mis- and Disinformation in Greece: An Analysis of News Engagement and Information Verification Skills. Journalism and Media, 6(3), 138. https://doi.org/10.3390/journalmedia6030138
Kay, S., Graves, A., Palma, J. H. N., Moreno, G., Roces-Díaz, J. V., Aviron, S., Chouvardas, D., Crous-Duran, J., Ferreiro-Domínguez, N., García de Jalón, S., Măcicăşan, V., Mosquera-Losada, M. R., Pantera, A., Santiago-Freijanes, J. J., Szerencsits, E., Torralba, M., Burgess, P. J., & Herzog, F. (2019). Agroforestry is paying off – Economic evaluation of ecosystem services in European landscapes with and without agroforestry systems. In Ecosystem Services (Vol. 36). Elsevier B.V. https://doi.org/10.1016/j.ecoser.2019.100896
Khaki, M., & Wang, G. (2019). Machine learning for monitoring and predicting agricultural drought in Mediterranean climates. Agricultural and Forest Meteorology, 276–277, 107608.
Khan, N., Nieto-García, M., Acuti, D., & Viglia, G. (2026). An Investigation of How and Why Organizations Enact Greenhushing. Journal of Advertising Research, 66(1), 150–173.
Klostermann, J. et al. (2015). Towards a framework to assess, compare and develop adaptation monitoring in Europe. Environmental Science & Policy, 54: 136–146.
KNOCA Guidance. (n.d.). European standards for the design of deliberative assemblies. Knowledge Network on Climate Assemblies.
Korhonen-Kurki, K., D'Amato, D., Belinskij, A., Lazarevic, D., Leskinen, P., Nylén, E. J., Pappila, M., Penttilä, O., Pitzén, S., Pykäläinen, N., Turunen, T., & Vikström, S. (2025). Transformative governance: Exploring theory of change and the role of the law. In Earth System Governance (Vol. 23). Elsevier B.V. https://doi.org/10.1016/j.esg.2024.100230
Kumar, R., Karmakar, R., Singh, N. S., Verma, D., Gururani, P., & Mitra, D. (2025). Forest and wetland conservation in a changing climate: Global trends and local actions. Environment Conservation Journal, 26(4), 1521–1534.
La Notte, A., Liquete, C., Grizzetti, B., Maes, J., Egoh, B., & Paracchini, M. (2015). An ecological-economic approach to the valuation of ecosystem services to support biodiversity policy. A case study for nitrogen retention by Mediterranean rivers and lakes. Ecological Indicators, 48, 292–302. https://doi.org/10.1016/j.ecolind.2014.08.006
Lade, S. J., Amellina, A., Gotangco Gonzales, C. K., Armstrong McKay, D. I., deClerck, F., Lenton, T. M., ... & Rockström, J. (2025). A climate-biodiversity funnel that accelerates action towards global goals (Preprint). EarthArXiv.
Lade, S. J., Amellina, A., Gotangco Gonzales, C. K., Armstrong McKay, D. I., deClerck, F., Lenton, T. M., & Rockström, J. (2025). A climate-biodiversity funnel that accelerates action towards global goals (Preprint). EarthArXiv.
Laurans, Y., Rankovic, A., Billé, R., Pirard, R., & Mermet, L. (2013). Use of ecosystem services economic valuation for decision making: questioning a literature blindspot. Journal of Environmental Management, 119, 208–219. https://doi.org/10.1016/j.jenvman.2013.01.008
Lawford, R. G. (2019). A Design for a Data and Information Service to Address the Knowledge Needs of the Water-Energy-Food (W-E-F) Nexus and Strategies to Facilitate Its Implementation. Frontiers in Environmental Science, 7, 56.
Le Monde Diplomatique (2024). [Mediterranean]. https://mondediplo.com/2024/06/09mediterranean
Le Prestre, P. (Ed.) (2017). Towards Continental Environmental Policy? North American Transnational Networks and Governance. Albany: SUNY Press, p. 123.
Leminen, S., Westerlund, M. and Nyström, A.-G. (2012). Living Labs as Open-Innovation Networks. Technology Innovation Management Review, 2(9), 6–11. https://doi.org/10.22215/timreview/602
Leminen, S., Westerlund, M., & Nyström, A.-G. (2012). Technology Innovation Management Review Living Labs as Open-Innovation Networks. www.timreview.ca
Leve, A.-K., Michel, H., & Harms, U. (2023). Implementing climate literacy in schools—What to teach our teachers? Climatic Change, 176, 134.
Lionello, P., Abrantes, F., Gacic, M., Planton, S., Trigo, R., & Ulbrich, U. (2014). The climate of the Mediterranean region: research progress and climate change impacts. Regional Environmental Change, 14(5), 1679-1684.

López-Carrión, A. E., & Llorca-Abad, G. (2025). Desinformación durante la crisis producida por la DANA de 2024 en España: análisis, características, tipologías y desmentidos. Revista Mediterránea de Comunicación, 16(2), e29303.
Magacho, G., Espagne, E., & Godin, A. (2024). Impacts of the CBAM on EU trade partners: consequences for developing countries. Climate Policy, 24(2), 243-259.
Magallón-Rosa, R., & Sánchez-Torres, M. (2024). Disinformation and climate crisis: Challenges and proposals for the future. Catalan Journal of Communication & Cultural Studies, 16(2), 167–176.
Mahmood, H., Saqib, N., Adow, A. H., & Abbas, M. (2023). FDI, exports, imports, and consumption-based CO2 emissions in the MENA region: spatial analysis. Environmental science and pollution research, 30(25), 67634-67646.
Manuti, A. (2013). Research on the fluctuation of social awareness levels.
Mar-Beguería, J., Sebastián-López, M., Kratochvíl, O., & de Miguel González, R. (2026). Climate Change and Geography Education: A Qualitative Study of Expert and Novice Teachers' Conceptions and Geographical Thinking. European Journal of Geography, 17(2), S.200–S.220.
Marinescu, D. (2010). Treatise on Environmental Law (4th ed., revised and added). Bucharest: Universul Juridic, p. 204.
Marshall, G. R. (2015). A social-ecological systems framework for food systems research: Accommodating transformation systems and their products. International Journal of the Commons, 9(2), 881–908.
Martín-López, B., Gómez-Baggethun, E., Lomas, P. L., & Montes, C. (2009). Effects of spatial and temporal scales on cultural services valuation. Journal of Environmental Management, 90(2), 1050–1059. https://doi.org/10.1016/j.jenvman.2008.03.013
Martin, L. L. (2024). Global Governance Confronts the Onslaught of Disinformation. Perspectives on Politics, 22(1), 7-10.
Martínez-Guijarro, D., & Cárdenas-Rica, M. L. (2026). Desinformación durante la DANA en Valencia (España): análisis de la composición estructural y emocional de los bulos. Austral Comunicación, 15(03), e01516.
Massey-Chase, B., Akehurst, S., & Alvis, S. (2026). Apathy and opposition: Understanding the real threats to net zero. IPPR.
Mastrorilli, M., Rana, G., Verdiani, G., Tedeschi, G., Fumai, A., & Russo, G. (2018). Economic evaluation of hydrological ecosystem services in Mediterranean river basins applied to a case study in southern Italy. Water (Switzerland), 10(3). https://doi.org/10.3390/w10030241
MedECC (2020). Cramer, W., Guiot, J. and Marini, K. (eds.). Climate and Environmental Change in the Mediterranean Basin – Current Situation and Risks for the Future. First Mediterranean Assessment Report. Union for the Mediterranean, Plan Bleu, UNEP/MAP, Marseille, France.
Míguez-González, M. I., & Dafonte-Gómez, A. (2026). El ecosistema híbrido de la comunicación en desastres naturales: Producción, alcance y tipología de emisores en Instagram durante la DANA de 2024 en España. Revista de Comunicación, 25(1), 221–242.
Millennium Ecosystem Assessment (Program). (2005). Ecosystems and human well-being : synthesis. Island Press.
Mimura, N., Pulwarty, R.S., Duc, D.M., Elshinnawy, I., Redsteer, M.H., Huang, H.Q., ... & Nkem, J.N. (2014). Adaptation planning and implementation. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. IPCC WGII.
Mitić, P., Kresoja, M., & Minović, J. (2019). A literature survey of the environmental Kuznets curve. Economic Analysis, 52(1), 109-127.
Moisseron, J.-Y., and Guesmi, K. (2018). European Policies in the Industry Sector in Morocco: A Bottom-up Assessment. MEDRESET Working Papers, No. 28 (November). http://www.medreset.eu/?p=13721
Moisseron, J.-Y., et al. (2017). Assessing EU-Mediterranean Policies in the Fields of Industry and Energy from a Bottom-up Perspective. MEDRESET Methodology and Concept Papers, No. 8 (October). http://www.medreset.eu/?p=13461
Mokos, M., Cheimonopoulou, M. T., Koulouri, P., Previati, M., Realdon, G., Santoro, F., Mogias, A., Boubonari, T., Gazo, M., Satta, A., Ioakeimidis, C., Tojeiro, A., Chicote, C. A., Papathanassiou, M., & Kevrekidis, T. (2020). Mediterranean Sea Literacy: When Ocean Literacy becomes region-specific. Mediterranean Marine Science, 21(3), 592–598.
Molina, J. R., Zamora, R., & Rodríguez y Silva, F. (2019). The role of flagship species in the economic valuation of wildfire impacts: An application to two Mediterranean protected areas. Science of the Total Environment, 675, 520–530. https://doi.org/10.1016/j.scitotenv.2019.04.242
Morais, R., and Piñeiro-Naval, V. (2025). The presence of regional and local aspects about disinformation in scientific production in Spain and Portugal: a review. Publicado en Doxa Comunicación.
Morancho, A. B. (2003). A hedonic valuation of urban green areas. Landscape and Urban Planning, 66(1), 35–41. https://doi.org/10.1016/S0169-2046(03)00093-8
Nadin, R., & Roberts, E. (2018). Monitoring and evaluation of climate change adaptation: Methodological approaches. Adaptation Watch Working Paper.
Newell, P., et al. (2021). Toward transformative climate justice: An emerging research agenda. WIREs Climate Change.
Nguyen, H. Q. & others. (2019). Co-designing climate adaptation pathways for communities at risk: A case study of Can Tho City, Vietnam. Sustainability, 11(6), 1666.
Nikolaos Nikolaidis, Maria Lilli, Stelios Rozakis, Katerina Troullaki, Evangelia Koukianaki, Abeer Albalawneh, Safa Aljaafreh, Maram al Naimat, Raha Al-Rkebat, Luma Hamdi, Suleiman Halasah, Anan Jayousi, Ashraf Ajrami, Shaddad Attili, Nash'at Thaher 2026. A WEFE Nexus Agricultural Transformation Strategy for Jordan and Palestine, EcoFuture Project, pp133.
Nunan, F., Campbell, A., & Foster, E. (2012). Environmental mainstreaming: The organisational challenges of policy integration. Public Administration and Development, 32(3), 262–277.
Nunez-Rocha, T., Martinez-Zarzoso, I., and Zaki, C. (2024) "What Type of Trade is Promoted by Environmental Provisions in Trade Agreements?", Annals of Economics and Statistics, No.156 (December 2024), pages 207-236.
OECD (2020). Climate Change: Assessing Progress on MEL Systems. Paris: OECD Publishing.
OECD DAC (2010). Glossary of Key Terms in Evaluation and Results Based Management. Paris: OECD Publishing.
OECD. (2020). Catching the deliberative wave: Innovative citizen participation and new democratic institutions. OECD Publishing.

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge, United Kingdom. ISBN: 978-0521405997

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419–422. https://doi.org/10.1126/science.1172133

Oxley, T., and Lemon, M. (2003). From social-enquiry to decision support tools: towards an integrative method in the mediterranean rural environment. Journal of Arid Environments, 54(3), 595–617.

Özdemir, V., & Springer, S. (2022). Decolonizing knowledge upstream: New ways to deconstruct and fight disinformation in an era of COVID-19, extreme digital transformation, and climate emergency. OMICS: A Journal of Integrative Biology, 26(5), 247–269.

Paniagua Rojano, F. J., et al. (2025). Desinformación en el sector alimentario. Estudio de casos publicados en Maldita, Newtral y EFE Verifica.

Papagiannaki, K., Kotroni, V., & Lagouvardos, K. (2024). Assessing the Effects of Citizen Climate Literacy and Attitudes on Their 'Greening' Behaviour in a Climate Change Hotspot Region of the Eastern Mediterranean. Climate, 12(9), 146. https://doi.org/10.3390/cli12090146

Paris Agreement (2015). United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Pelling, M., & Garschagen, M. (2019). Put equity first in climate adaptation. Nature, 569, 327–329.

Perni, Á., & Martínez-Paz, J. M. (2017). Measuring conflicts in the management of anthropized ecosystems: Evidence from a choice experiment in a human-created Mediterranean wetland. Journal of Environmental Management, 203, 40–50. https://doi.org/10.1016/j.jenvman.2017.07.049

Petersen, E.H., & Pedersen, S.M. (2010). The economics of scaling-up agricultural technologies. Agricultural Economics, 41(5), 441–453.

Pettorelli, N., Folkard-Tapp, H., & Williams, J. (2026). Could the enhanced transparency framework help align the climate and biodiversity agendas? Ecological Solutions and Evidence, 7, e70226.

Pettorelli, N., Folkard-Tapp, H., & Williams, J. (2026). Could the enhanced transparency framework help align the climate and biodiversity agendas? Ecological Solutions and Evidence, 7, e70226.

Plieninger, T., Abunnasr, Y., D'Ambrosio, U., Guo, T., Kizos, T., Kmoch, L., Topp, E., & Varela, E. (2023). Biocultural conservation systems in the Mediterranean region: The role of values, rules, and knowledge. Sustainability Science, 18, 823–838.

Ponti, L., Gutierrez, A. P., Ruti, P. M., & Dell'Aquila, A. (2014). Fine-scale ecological and economic assessment of climate change on olive in the Mediterranean Basin reveals winners and losers. Proceedings of the National Academy of Sciences of the United States of America, 111(15), 5598–5603. https://doi.org/10.1073/pnas.1314437111

Pörtner, H.-O., Scholes, R. J., Agard, J., Archer, E., Bai, X., Barnes, D., Burrows, M., Chan, L., Cheung, W. L. (William), Diamond, S., Donatti, C., Duarte, C., Eisenhauer, N., Foden, W., Gasalla, M. A., Handa, C., Hickler, T., Hoegh-Guldberg, O., Ichii, K., … Ngo, H. (2021). IPBES-IPCC co-sponsored workshop report on biodiversity and climate change (Version 2). Zenodo. https://doi.org/10.5281/ZENODO.5101133

Ramirez, F., and J. Kallarackal. 2015. Responses of Fruit Trees to Global Climate Change. Cham, Switzerland: Springer

Ramírez, S. B. et al. (2023).Citizen science approaches for water quality measurements. Science of the Total Environment, 897, 165436.

Ramzy, M. and Zaki, C. (2018) "Do Environment Regulations Matter for EU-MENA Trade?" Applied Economics, vol. 50(39), pages 4197-4221.

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., ... & Quinn, C. H. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. Journal of Environmental Management, 90(5), 1933–1949.

Reed, M.S. (2008). Stakeholder participation for environmental management: A literature review. Biological Conservation, 141(10), 2417–2431. https://doi.org/10.1016/j.biocon.2008.07.014

Regulation (EC) No. 1367/2006 on the application of the provisions of the Aarhus Convention on access to information, public participation in decision-making and access to justice in environmental matters to Community institutions and bodies. OJ L 264, 25.9.2006, pp. 13–19.

RESIN Methodology. (n.d.). Guide for social network-based prioritization.

Ricart, S., Villar-Navascués, R., Reyes, M., Rico-Amorós, A. M., Hernández-Hernández, M., Toth, E., Bragalli, C., Neri, M., & Amelung, B. (2024). Water–tourism nexus research in the Mediterranean in the past two decades: A systematic literature review. International Journal of Water Resources Development, 40(1), 57–83.

Rodríguez-Pérez, C., Molina-Montes, E., Verardo, V., Artacho, R., García-Villanova, B., Guerra-Hernández, E. J., & Ruíz-López, M. D. (2020). Changes in dietary behaviours during the COVID-19 outbreak confinement in the Spanish COVIDiet study. Nutrients, 12(6), 1–19. https://doi.org/10.3390/nu12061730

Rolnick, D., et al. (2022). Tackling Climate Change with Machine Learning. ACM Computing Surveys, 55(2), 1–96.

Roman, E., and Pastore, F. (2018). Analysing Migration Policy Frames of Tunisian Civil Society Organizations: How Do They Evaluate EU Migration Policies? MEDRESET Working Papers, No. 14 (June). http://www.medreset.eu/?p=13554

Romanazzi, G. R., Ottomano Palmisano, G., Cioffi, M., Leronni, V., Toromani, E., Koto, R., De Boni, A., Acciani, C., & Roma, R. (2024). A Cost–Benefit Analysis for the Economic Evaluation of Ecosystem Services Lost Due to Erosion in a Mediterranean River Basin. Land, 13(9). https://doi.org/10.3390/land13091512

Roson, R., & Sartori, M. (2012b). Working Paper Series-ISSN 1973-0381 Climate Change, Tourism and Water Resources in the Mediterranean: A General Equilibrium Analysis. www.iefe.unibocconi.it

Roson, R., & Sartori, M. (n.d.). Water Scarcity and Virtual Water Trade in the Mediterranean.

Saleem, U. & others. (2024). Citizen Science Applications for Water Quality Monitoring. A Review. EGUsphere [Preprint].

Sander, B. (2025). Confronting risks at the intersection of climate change and artificial intelligence: The promise and perils of rights-based approaches. Netherlands Quarterly of Human Rights, 43(2), 104–131. https://doi.org/10.1177/09240519251336962

Saridou, T., Giomelakis, D., Kotenidis, E., Mallia, M., Noti, M., Maniou, T., & Veglis, A. (2025). Exploring journalism students' perceptions of disinformation in the Mediterranean region: A cross-national study on migration narratives in Greece, Cyprus and Malta. Online Information Review, 49(7), 1407–1425.

Scantamburlo, T., and Zollo, F. (2025). A Scoping Review of Misinformation Research: Definitions, Conceptualizations, and Measurement Approaches ACM1559-114X/2026/2-ART https://doi.org/10.1145/3796546

Schlosberg, D. (2007). Defining Environmental Justice: Theories, Movements, and Nature. Oxford University Press.

Schmeier, S. (2013). Governing International Watercourses: River Basin Organizations and the Sustainable Governance of Internationally Shared Rivers and Lakes. Routledge, London.

Schuurman, D., De Marez, L. and Ballon, P. (2015). Living Labs: a systematic literature review. In Proceedings of Open Living Lab Days 2015, Istanbul, Turkey.

Sedeño Alcántara, C. (2025). Interés público y desinformación en tiempos de crisis: El caso de la DANA de 2024 en España. Revista Internacional de Relaciones Públicas, 30(15), 103–122.

Serrano-Lara, J. J., Pitarch-Garrido, M. D., & Picó-Garcés, M.-J. (2026). Emerging citizen digital networks in the face of the climate crisis. Radiography of Solidarity Initiatives in the Valencia DANA flooding catastrophe 2024. Partecipazione e Conflitto, 19(1), 17–38.

Settele, J., Gallai, N., Vaissière, B. E., & Salles, J.-M. (2009). Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecological Economics, 68(3), 810–821. https://doi.org/10.1016/j.ecolecon.2008.06.014

Sgroi, F., Foderà, M., Dana, L. P., Mangiapane, G., Tudisca, S., Di Trapani, A. M., & Testa, R. (2016). Evaluation of payment for ecosystem services in Mediterranean forest: An empirical survey. Ecological Engineering, 90, 399–404. https://doi.org/10.1016/j.ecoleng.2016.02.004

Sharma, N. (2025). Breaking the Green Myth: Unveiling the Challenges in Environmental Conservation and Sustainable Growth. American Journal of Business Practice, 2(11), 56–68.

Sinanoglu, S., & Breuer, A. (2024). Countering information pollution to protect democracy (No. 29/2024). IDOS Policy Brief.

Sintomer, Y., Herzberg, C., & Röcke, A. (2012). Participatory budgeting worldwide: A new cosmopolitan democracy? Journal of Public Deliberation, 8(1), 33.

Soler Sanz, G., Aloy Mayo, M., & Rosso, P. (2026). Computational Multimodal Analysis of Polarized Political Discourse After the DANA in Valencia. Corpus Pragmatics, 10(12).

Sones, M., Holden, M., Kestens, Y., King, A. C., Rennie, M., & Winters, M. (2024). (Dis)connected by design? Using participatory citizen science to uncover environmental determinants of social connectedness for youth in under-resourced neighbourhoods. BMC Public Health, 24(1), 3104. https://doi.org/10.1186/s12889-024-20597-4

Spampatti, T., Pillai, R., Globig, L. K., Sternisko, A., & Van Bavel, J. J. (2025). Disinformation is a systemic risk to human rights: Input to the study on the impact of disinformation on the enjoyment and realization of human rights.

Starkey, E. et al. (2017).** Demonstrating the value of community-based ('citizen science') observations for catchment modelling and characterisation. Journal of Hydrology, 548, 801-817.

Stone, T. F., Alami, S., Bach, J. L., Bindelle, J., Busse, M., Ciaccia, C., Rivera-Ferre, M. G., López-García, D., Kozar, R., Plaas, E., Ramos-García, M., Schwarz, G., Thorsøe, M. H., & Berg, T. R. (2025). Agroecology Living Labs to transform food systems: a critical review at the science-policy-society nexus in Europe. In Agroecology and Sustainable Food Systems. Taylor and Francis Ltd. https://doi.org/10.1080/21683565.2025.2560915

Suchman, M. C. (1995). Managing Legitimacy: Strategic and Institutional Approaches. The Academy of Management Review, 20(3), 571. https://doi.org/10.2307/258788

Sy, M., Figuières -Hélène, C., & De Wit, R.-V.-R. H.-R. (n.d.). Valuation of Ecosystem Services and Social Choice: The Impact of Deliberation in the context of two different Aggregation Rules. Retrieved www.faere.fr

Szalay-Szandtner, R. G. Climate Change Denialism and the Rights of Future Generations. Treen, K. M. D. I., Williams, H. T., & O'Neill, S. J. (2020). Online misinformation about climate change. Wiley Interdisciplinary Reviews: Climate Change, 11(5), e665.

Taddeo, S., Regoli, A., Weber, O., & Carè, R. (2026). Green Talk, Costly Walk: The Financial Cost of Greenwashing. Business Strategy and the Environment, 1–21.

Taheripour, F., Tyner, W. E., Haqiqi, I., & Sajedinia, E. (n.d.). Water Scarcity in Morocco. Retrieved www.worldbank.org/gwsp

TEEB. (2010). Mainstreaming the economics of nature. In Environment. http://www.iges.or.jp/jp/news/topic/pdf/1103teeb/teeb_synthesis_j.pdf

Tekce, M., & Deniz, P. (2016). The impacts of climate change on agricultural trade in the MENA region. Research in World Economy, 7(2), 1-14.

Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P., & Spierenburg, M. (2014). Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple Evidence Base Approach. AMBIO, 43(5), 579–591.

Timpanaro, G., Foti, V. T., Cascone, G., Trovato, M., Grasso, A., & Vindigni, G. (2024). Living Lab for the Diffusion of Enabling Technologies in Agriculture: The Case of Sicily in the Mediterranean Context. Agriculture (Switzerland), 14(12). https://doi.org/10.3390/agriculture14122347

Tomassi, A., Falegnami, A., & Romano, E. (2025). Disinformation in the Digital Age: Climate Change, Media Dynamics, and Strategies for Resilience. Publications, 13(2), 24.

Tourais, P., & Videira, N. (2021). A participatory systems mapping approach for sustainability transitions: Insights from an experience in the tourism sector in Portugal. Environmental Innovation and Societal Transitions, 38, 153–168. https://doi.org/10.1016/j.eist.2021.01.002

Tran, T. M. (2022). International environmental agreement and trade in environmental goods: the case of Kyoto Protocol. Environmental and Resource Economics, 83(2), 341-379.
Trandafirescu, B. C. (2012). The Relations between International Conventions on International Trade Contracts. Contemporary Readings in Law and Social Justice, 4(2), 1020–1027.
Treen, K. M. D. I., Williams, H. T., & O'Neill, S. J. (2020). Online misinformation about climate change. Wiley Interdisciplinary Reviews: Climate Change, 11(5), e665.
UN. (2022). Countering disinformation for the promotion and protection of human rights and fundamental freedoms (A/77/287).
UNEP (2021). Adaptation Gap Report 2021. Nairobi: United Nations Environment Programme.
UNEP (2023). Adaptation Gap Report 2023. United Nations Environment Programme. https://www.unep.org/resources/adaptation-gap-report-2023
UNFCCC (2014). Handbook on Measurement, Reporting and Verification for Developing Country Parties. Bonn: UNFCCC Secretariat.
UNFCCC (2022). Report of the Technical Dialogue of the First Global Stocktake. Bonn: UNFCCC Secretariat.
United Nations. (2022). Countering disinformation for the promotion and protection of human rights and fundamental freedoms (A/77/287). UN.
UNU-FLORES and PRIMA (2026). What “Nexus”? Towards Resource Nexus Standardisation. Policy Brief No. 01/2026. United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), Dresden, Germany; PRIMA Foundation, Barcelona, Spain.
Van Alstyne, M. (2022). Free speech, platforms & the fake news problem.
Vatn, A. (2005). Rationality, institutions and environmental policy. Ecological Economics, 55(2), 203–217. https://doi.org/10.1016/j.ecolecon.2004.12.001
Vilà-Cabrera, A., Coll, L., Martínez-Vilalta, J. & Retana, J. (2018). Forest management for adaptation to climate change in the Mediterranean basin: A synthesis of evidence. Forest Ecology and Management, 407:16-22.
Urban Living Labs for sustainability and low-carbon cities in Europe: Towards a research agenda. Journal of Cleaner Production, 123, 45–54. https://doi.org/10.1016/j.jclepro.2015.08.053
Voytenko, Y., McCormick, K., Evans, J. and Schliwa, G. (2016). Urban Living Labs for sustainability and low-carbon cities in Europe: Towards a research agenda. Journal of Cleaner Production, 123, 45–54. https://doi.org/10.1016/j.jclepro.2015.08.053
Wang, J., Zhai, Y., & Shahzad, F. (2025). Mapping the terrain of social media misinformation: A scientometric exploration of global research. Acta Psychologica.
Wehbe, M., Salmoral, G., & López-Gunn, E. (2026). DIY Manual on engaging stakeholders and citizens in climate adaptation: Tools, good practices, and experiences. EU Mission on Adaptation to Climate Change. European Union, Brussels
Wenger, E., McDermott, R., & Snyder, W. M. (2002). Cultivating communities of practice: A guide to managing knowledge. Harvard Business School Press.
Whyte, K. (2017). Indigenous Climate Change Studies: Indigenizing Futures, Decolonizing the Anthropocene. English Language Notes, 55(1–2), 153–162.
Wicke, B., Moll, H. C., y Rebel, K. T. (2024). Integrative sustainability education: emerging concepts and approaches. Journal of Integrative Environmental Sciences, 21(1), 2395226.
Wood, T. J., Holland, J. M., Hughes, W. O. H., & Goulson, D. (2015). Targeted agri-environment schemes significantly improve the population size of common farmland bumblebee species. Molecular Ecology, 24(8), 1668–1680. https://doi.org/10.1111/mec.13144
World Trade Organization (2022). World Trade Report 2022. WTO, Geneva.
Zaatra, A., Kleftodimos, G., Requier-Desjardins, M., & Belhouchette, H. (2025). Economic valuation of groundwater over-exploitation in the Maghreb. Ecological Economics, 230. https://doi.org/10.1016/j.ecolecon.2024.108499
Zhang, W., Ricketts, T. H., Kremen, C., Carney, K., & Swinton, S. M. (2007). Ecosystem services and dis-services to agriculture. Ecological Economics, 64(2), 253–260. https://doi.org/10.1016/j.ecolecon.2007.02.024
Zheng, S., Li, H., Fang, T., Bo, G., Yuan, D., & Ma, J. (2022). Towards citizen science. On-site detection of nitrite and ammonium using a smartphone and social media software. Science of The Total Environment, 815, 152613.