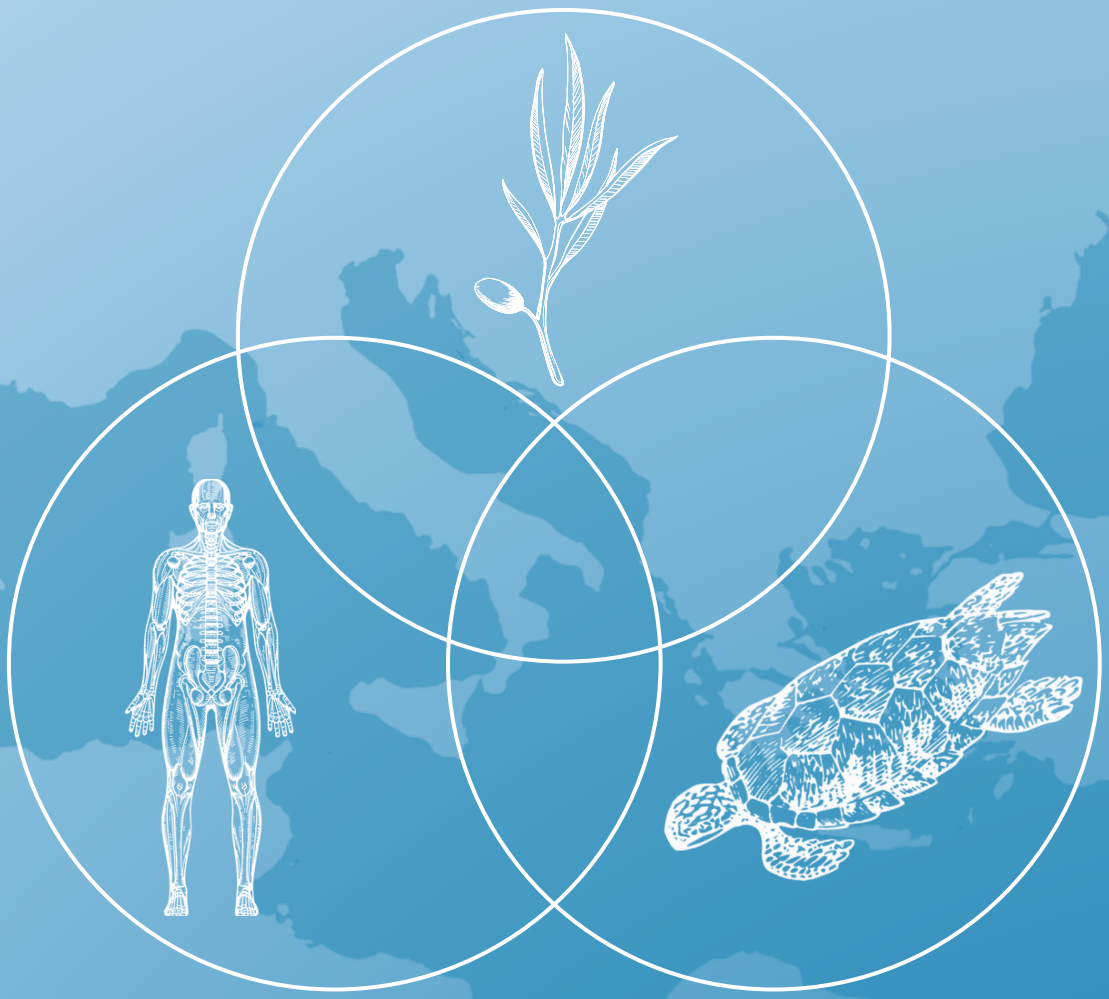

ADVANCING ONE HEALTH IN THE MEDITERRANEAN

A Focus on Marine and Coastal Environments

Insights and key messages from the Technical Workshop on understanding and measuring the One Health nexus in the Mediterranean, organised by Plan Bleu and Université Côte d'Azur

UN environment programme | Mediterranean Action Plan Barcelona Convention | Plan Bleu | UNIVERSITÉ CÔTE D'AZUR | FRANCE 2030

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Introduction

The One Health approach is an integrated and systemic framework that recognises the close interdependence between the health of humans, animals and ecosystems, within their broader social and societal contexts (Figure 1). It calls for coordinated, multisectoral and multidisciplinary action to prevent, detect and respond to risks emerging at the interfaces between these domains.

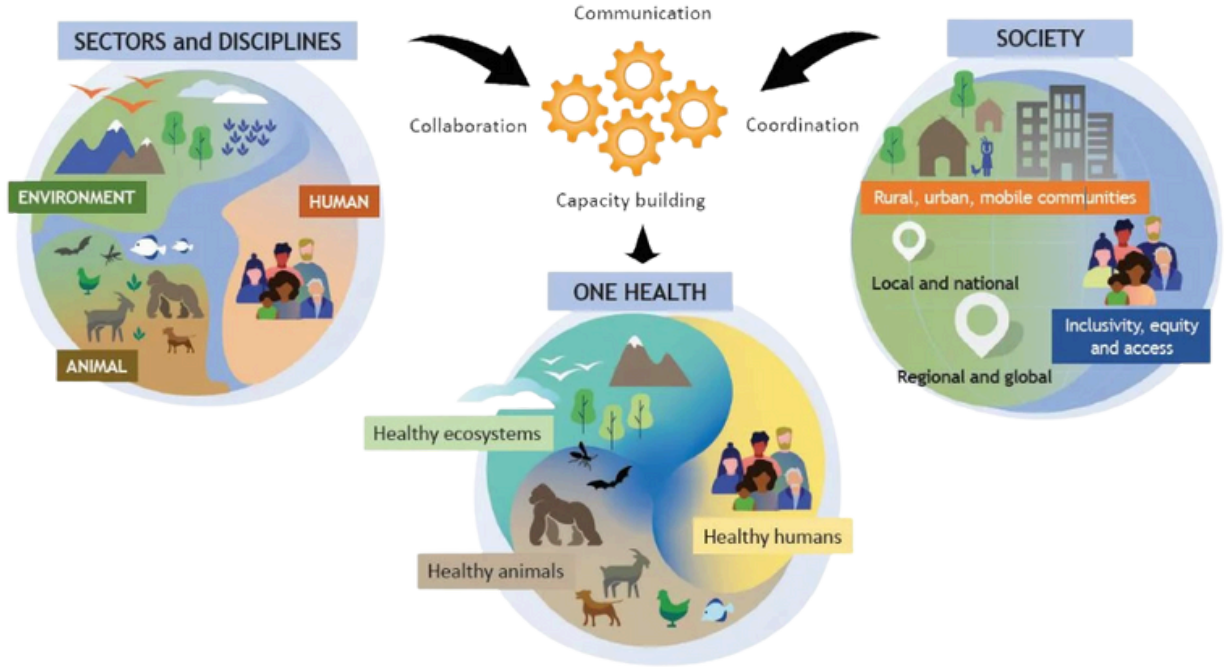


Figure 1: The One Health approach represented in the One Health Joint Plan of Action (2022–2026)

The One Health concept can be traced back to the 19th century, when early scientists such as Rudolf Virchow, a German pathologist and anthropologist, recognised the close connections between human and animal health. He introduced the term "zoonosis" and promoted the idea of "One Medicine". This concept re-emerged in the early 2000s in response to global health crises such as avian influenza and SARS, leading to the establishment of the FAO–WHO–WOAH[1] Tripartite Alliance. In 2021, UNEP joined the partnership, forming the Quadripartite.

[1] FAO: Food and Agriculture Organization of the United Nations, UNEP: United Nations Environment Programme, WHO: World Health Organization, WOAH: World Organisation for Animal Health

The One Health approach is currently guided globally by the One Health Joint Plan of Action (2022–2026),[2] which provides a framework for coordinated action across sectors to strengthen prevention, preparedness and response to health threats. Although it was initially applied to address zoonotic diseases, antimicrobial resistance (AMR) and food safety, it has since expanded to recognize environmental determinants–such as climate change, pollution and biodiversity loss– as central drivers and integral components of the framework.

Closely related to One Health, the Planetary Health approach[3] also emphasises the interdependence between human health and natural systems, focusing on the broader ecological and societal boundaries that sustain life on Earth. Both frameworks converge on the necessity of ecosystem protection as a prerequisite for protecting human health and well-being.

Why is One Health relevant for the Mediterranean context?

The Mediterranean region is recognised as a hotspot for climate and environmental change. Its semi-enclosed sea, densely populated coastal zones and shared natural resources make it particularly vulnerable to cumulative pressures. Rising temperatures, air and water pollution, biodiversity loss and resource scarcity are disrupting the balance of ecosystems and directly affecting human health and well-being.[4] Food security and traditional agrarian systems such as wheat, wine and olive oil production are increasingly under stress due to water scarcity and land degradation. At the same time,the Mediterranean diet and lifestyle, widely recognised as one of the best models of healthy and sustainable living, are in decline.

In response to these interconnected challenges, the UNEP/Mediterranean Action Plan (UNEP/MAP) has incorporated One Health principles into its Medium-Term Strategy 2022–2027, emphasizing the interrelations between environmental quality and human health. On the health side, both the WHO Regional Office for Europe and the WHO Regional Office for the Eastern Mediterranean (based in Cairo) support countries in developing national One Health action plans and strengthening intersectoral coordination. At the same time, the European Union is embedding One Health principles across key policy frameworks including the EU Global Health Strategy[5] and the Farm to Fork Strategy,[6] which link food safety, environmental sustainability and public health, reinforcing this integrated vision.

2 One health joint plan of action (2022–2026): working together for the health of humans, animals, plants and the environment: https://www.who.int/publications/i/item/9789240059139

3 For more information: https://planetaryhealthalliance.org/what-is-planetary-health/

4 State of the Environment and Development in the Mediterranean (SoED 2020)

5 European Commission (2022). EU Global Health Strategy: Better Health for All in a Changing World. Brussels.

6 European Commission (2020). A Farm to Fork Strategy for a Fair, Healthy and Environmentally-Friendly Food System. Brussels.

In the Mediterranean, coastal and marine areas are at the frontline of these challenges. They concentrate human settlements, intensive use of marine and coastal ecosystem services (including habitats, food resources and recreation), diverse economic activities and rich biodiversity, making them key spaces for the operationalisation of One Health approaches. This concentration of uses increases exposure of populations and ecosystems to environmental hazards, while uneven institutional and technical capacities across the region further amplify vulnerability.

Addressing challenges such as pollution, soil erosion, water quality, chemical contamination, invasive species and harmful algal blooms is particularly complex, as these issues are often deeply interconnected and can amplify one another. Effective solutions therefore require coordinated efforts across environmental protection, public health, marine management and key economic sectors.

This paper focuses specifically on the application of the One Health approach in marine and coastal environments an angle that is less explored in existing One Health literature but particularly essential for the Mediterranean region.

Objectives of this paper

This technical paper builds on the discussions and outcomes of the Technical Workshop on understanding and measuring the One Health nexus in the Mediterranean, organised by Plan Bleu and Université Côte d'Azur.[7] It aims to:

- Summarise and share the main findings and key messages from the workshop, including concrete cases and good practices illustrating the application of the One Health approach in the region;
- Highlight the key challenges, priorities and opportunities for applying the One Health approach in Mediterranean marine and coastal environments;
- Translate on-the-ground insights and scientific findings into concrete recommendations to strengthen the science–policy–practice interface and foster future cross-sectoral collaboration in the Mediterranean.

7. The workshop took place in Nice on the 2nd and 3rd of October 2025 and gathered around 30 technical experts coming from Mediterranean countries, and in particular members of the MedHAB Network (the Mediterranean Network of Harmful Algae Experts). This work was supported by the French government through the France 2030 investment plan managed by the National Research Agency (ANR), as port of the Initiative of Excellence Université Côte d'Azur under reference number ANR- 15-IDEX-01.

1.Understanding the Mediterranean One Health nexus

The Mediterranean region faces multiple, interlinked environmental and health challenges that illustrate the essence of the One Health nexus. Climate change, pollution, biodiversity loss and land degradation generate combined pressures on marine and coastal systems, with direct and indirect effects on human and animal health. These threats interact, producing cumulative or “cocktail” effects that are difficult to assess and manage, often amplifying risks across sectors and borders through additive and synergistic interactions.

To better understand these complex interconnections, the One Health Technical Workshop organised the analysis around four broad categories of hazards affecting the region:

- Hydrological and geohazards,
- Environmental degradation,
- Chemical contaminants, and
- Biological hazards.

While not exhaustive, this classification helped participants navigate the complexity of the One Health approach and identify the main interconnections between environmental, animal and human health (Table 1).

Hydrological and Geohazards

Hydrological and geohazards are among the most visible and disruptive threats in the Mediterranean, shaped by climate change, geomorphology and land-use change. Key hazards include floods, droughts, wildfires and coastal erosion, as well as earthquakes, tsunamis and landslides. These events cause immediate damage to infrastructure and populations and have cascading effects on ecosystems and food security. Floods mobilise contaminants and wastewater, degrading bathing water and seafood quality, while wildfires generate air pollution and soil erosion that affect coastal waters. Resulting health impacts for humans and animals include mortality, injuries, respiratory and cardiovascular diseases due to pollution and extreme events, and mental health effects, with disproportionate burdens in the southern and eastern Mediterranean where adaptive capacity and early-warning systems are limited.

CASE STUDY 1 - Evolution of droughts and wildfires in the Mediterranean over the last thirty years (Plan Bleu)

As a recognised hotspot of climate change, the Mediterranean region is experiencing rising temperatures, declining soil moisture and increasingly severe wildfire seasons. Forest losses linked to wildfires clearly illustrate the impacts of climate change in a region where fires are becoming more frequent, more destructive and more costly.

In 2024, southern Mediterranean countries faced particularly critical losses: between 37 and 83% of their total forest loss was attributed to fires in Algeria, Tunisia, Libya, Cyprus, Lebanon and Israel, followed by Morocco and Spain, where fires accounted for 22 to 37% of forest loss. Although Northern countries like Greece and Türkiye are proportionally less affected, they recorded much larger absolute losses in hectares, highlighting the widespread vulnerability of the entire Mediterranean basin.

At the same time, freshwater availability continues to decline. Over the past three decades, water capture has decreased by 13%, while water withdrawals have increased by 60%, reflecting growing pressure on already scarce water resources. Together, intensifying droughts and increasing wildfire risks demonstrate how climate change is reshaping Mediterranean landscapes, exacerbating pressures on human health, ecosystems and economic activities.

Environmental Degradation

Rapid urbanisation, particularly in coastal zones, combined with unsustainable resource use and production patterns, is altering terrestrial, freshwater and marine ecosystems. Main pressures and hazards include air and water pollution, eutrophication, microplastics, noise and light pollution, and water scarcity, all of which are intensified by land-use change, overfishing, habitat loss and waste mismanagement. These processes reduce ecosystem resilience and amplify health and socio-economic risks. Air and water pollution contribute to respiratory and cardiovascular diseases and can lead to marine organisms including seafood contamination. At the same time, biodiversity loss weakens natural disease control. Degraded ecosystems lose their capacity to provide essential services such as food production, coastal protection and water purification, resulting in economic losses in agriculture, fisheries and tourism.

CASE STUDY 2: Urban environmental degradation and One Health : lessons from Mediterranean Cities

Mediterranean cities concentrate multiple environmental stressors such as dense populations, heavy traffic, rising temperatures and limited green spaces, that interact to shape health outcomes. As emphasised by ISGlobal, “80% of our health is determined by where and how we live[8] ”, highlighting that major health drivers in cities lie beyond the health sector. Healthy cities enable residents to benefit from healthy environments by default, rather than seeking them out.

Air pollution remains one of the leading environmental determinants of premature mortality in cities, particularly due to nitrogen dioxide (NO2) and Particulate Matter. Climate change exacerbates risks with more frequent and intense heatwaves. Urban heat islands contribute to over 4% of summer mortality in European cities, disproportionately impacting vulnerable groups such as older adults, children and low-income communities. Limited green spaces worsen these effects by reducing cooling, recreational opportunities and social cohesion.

ISGlobal’s work demonstrates that integrating One Health principles into urban planning fosters cross-sector collaboration, supports evidence-based decisions, reveals the full economic, social, and health costs of urban choices, and enhances policy coherence. Environmental interventions like expanding green infrastructure, reducing car dependency, improving public transport, and restoring urban biodiversity deliver co-benefits for human, animal, and ecosystem health.

Chemical Contaminants

Chemical contamination is an increasing threat to One Health in the region. Identified hazards include endocrine-disrupting compounds, emerging contaminants (eg trace metals from lithium batteries), heavy metals such as mercury, biotoxins, and residues of pesticides, veterinary drugs, antibiotics and pharmaceuticals. These substances bioaccumulate in the food chain, causing neurodevelopmental, reproductive or hormonal disorders in humans and wildlife. Contaminant accumulation compromises seafood safety and fishery productivity, generating economic losses and trade restrictions, particularly where wastewater treatment and monitoring capacity remain limited.

8. https://pubmed.ncbi.nlm.nih.gov/26526164/

CASE STUDY 3: Chemical Contaminants and ecosystem decline: One Health challenges in the Gulf of Gabès (Tunisia)

The Gulf of Gabès in Tunisia exemplifies the long-term impacts of chronic chemical pollution on marine ecosystems and coastal communities. Once one of the Mediterranean's most productive fishing areas, the gulf has suffered severe ecological degradation from decades of largely untreated industrial discharge, particularly from phosphate-processing plants releasing phosphogypsum, heavy metals, nutrients and acidic effluents.

These pollutants have altered marine habitats, caused a marked decline in seagrass meadows and led to collapsing fish stocks, directly affecting food security and the livelihoods of local fishers. Chemical contamination has also raised major public health concerns. Chemical contaminants such as heavy metals (cadmium, lead, uranium), along with endocrine-disrupting chemicals including xeno-hormones have been detected in seafood. Researchers have reported biological effects including fish masculinisation, reproductive disorders and elevated cancer rates in exposed populations.

The Gulf of Gabès illustrates the tight interconnection between environmental degradation, ecosystem health and human well-being, emphasizing the urgent need for One Health–informed monitoring and regulation. As stressed by Prof. Amel Hamza-Chaffai (University of Sfax): "Anthropogenic pressures on ecosystems are increasing far faster than research in ecotoxicology can follow. Pollution evolves rapidly and exponentially, while ecotoxicological research advances more slowly." This gap is particularly acute for new and emerging chemical contaminants, which evolve quickly and require equally agile regulatory and monitoring systems to protect ecosystems, animals and human health.

Biological Hazards

- The Mediterranean hosts numerous native and non-indigenous species that create biological risks for humans and ecosystems. Major hazards include invasive and poisonous fish (e.g. *Lagocephalus sceleratus*), jellyfish blooms, pathogenic microorganisms (notably Vibrio spp), and toxic or discoloration events linked to harmful algal blooms (e.g. *Ostreopsis*, *dinophysis* or *Alexandrium species*), and mucilage.

Human health impacts range from seafood poisoning and infections to respiratory and skin irritation during algal or jellyfish events. Ecologically, these phenomena disrupt food webs, smother benthic habitats and reduce fisheries yields, with recurrent consequences for tourism, aquaculture and coastal economies.

CASE STUDY 4: Biological Hazards and Human–Wildlife Interactions: The Spread of Pufferfish in the Mediterranean

The rapid expansion of the invasive pufferfish (*Lagocephalus sceleratus*), which colonised the Eastern and Central Mediterranean in less than 20 years, illustrates the complex biological hazards emerging at the human–environment interface. Introduced through the Suez Canal, this species has spread widely due to warming sea temperatures, preying on native species and disrupting food webs.

The pufferfish carries tetrodotoxin, a potent neurotoxin, posing direct health risks through accidental consumption. Several fatal poisoning cases have been reported across the region, despite bans on landing and sale. Economic impacts are also substantial, including damaged fishing gear, declining catches of native fish and the costs of necessary control measures.

From a One Health perspective, the pufferfish invasion demonstrates how climate-driven species migration, ecosystem imbalance and human behaviour intersect. Effective responses require coordinated risk communication, fisher training, toxin monitoring in seafood and research on ecological impacts. Some Mediterranean countries have strengthened monitoring networks for invasive species, combining scientific surveys, citizen-science reporting and coordination with regional bodies such as CIESM and GFCM.

As highlighted by CIESM, complete eradication of this species is unlikely. Only mitigation strategies based on integrated science, stakeholder engagement and adaptive management can help Mediterranean communities adapt to this new reality. This case demonstrates the importance of surveillance systems that link biodiversity monitoring, food safety and coastal community engagement to manage emerging biological hazards in a rapidly changing sea.

Table 1: Main One Health hazards in the Mediterranean and their interlinked health, ecosystem and socio-economic impacts

Note: This table was developed based on expert inputs and group discussions during the One Health Technical Workshop. It is not intended to be exhaustive, but rather to illustrate key interlinkages

HAZARD CATEGORY	MAIN SPECIFIC HAZARDS	MAIN HUMAN HEALTH IMPACTS	MAIN ANIMAL HEALTH IMPACTS	MAIN ECOSYSTEM HEALTH IMPACTS	MAIN SOCIO-ECONOMIC IMPACTS
HYDROLOGICAL HAZARDS & GEOHAZARDS	Flood / droughts/ Wildfires / Coastal erosion / tsunamis / Earthquakes	Death, injuries, diseases, sanitary issues in affected areas	Habitat stress, mortality, diseases in affected areas	Loss of ecosystemic functions	Damage to infrastructure, livelihoods, tourism loss, population movements
ENVIRONMENTAL DEGRADATION	Air and water pollution, eutrophication, microplastics, noise and light pollution, and water scarcity	Respiratory and cardiovascular diseases, asthma, cancer risks, neurological and reproductive disorders, foodborne disease	Marine organism mortality, habitat loss Food chain contamination	Biodiversity loss, regime shifts	Decline in fisheries and tourism, loss of value of ecosystem services, public health costs
CHEMICAL CONTAMINANTS	Endocrine disruptors, emerging contaminants, heavy metals, biotoxins, and residues of pesticides, veterinary drugs, antibiotics and pharmaceuticals	Floodborne and airborne diseases such as Neurological, IQ loss, reproductive disorders, cancers, cardio-vascular metabolism disorder, intoxication, bioaccumulation of toxic chemicals	Reproductive effects, fish masculinisation, bioaccumulation of toxic chemicals, death, neurological disorders	Contaminant bioaccumulation, biodiversity loss, changes in the dynamics of population, species decline and extinction	Seafood safety risks, trade loss, tourism loss, public health costs
BIOLOGICAL HAZARDS	Invasive and poisonous fish, jellyfish blooms, pathogenic microorganisms, and toxic or discoloration events linked to harmful algal blooms and mucilage	Shellfish/food poisoning, skin irritation, dermatitis, stinging	Infections, mass mortalities, reproductive impairment,	Food web disruption, species replacement, species niche competition, habitat loss	Fishery losses/catch reduction, Aquaculture site closure, losses for tourism decline and recreational activities, eg beach closure

2.Current status of monitoring and indicators for One Health

Monitoring in the Mediterranean remains largely sectoral and fragmented, reflecting historical divides between environmental, animal and public health systems. Most national and regional programmes were designed for single purposes such as water quality control, disease surveillance, food safety, or biodiversity monitoring and therefore fail to capture the complex interactions at the human–animal–ecosystem interface.

Environmental monitoring under the Barcelona Convention and related EU directives provides valuable information on the state of marine and coastal ecosystems, yet these data are not systematically linked to human or animal health information. Similarly, health surveillance systems focus on clinical or epidemiological aspects without necessarily integrating environmental exposure data. This fragmentation limits the region's capacity to anticipate, detect and respond efficiently to combined hazards and potential resulting disasters, such as those resulting from harmful algal blooms, jellyfish blooms, contaminated seafood, or invasive species occurrences.

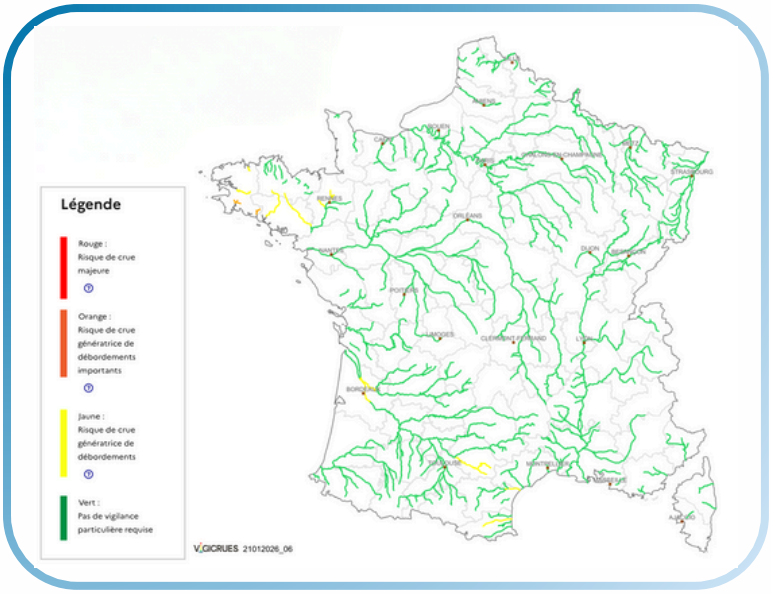
In addition, data availability and quality are uneven across the region. Southern and eastern Mediterranean countries often face limitations in institutional capacity, laboratory capacity, equipment, and long-term funding. Differences in sampling methods and reporting standards further hinder comparability, while data sharing is constrained by institutional barriers and the absence of harmonised protocols for collection, validation and reporting.

Despite these challenges, examples of progress do exist. Several countries operate early-warning systems for flooding risk, harmful algal blooms (HABs) or contaminants in seafood, and networks of scientists and practitioners have demonstrated the value of collaboration and information exchange. One such example is MedHAB, a Mediterranean network of experts launched in 2024 by the University of Côte d'Azur, in partnership with Plan Bleu – Regional Activity Centre of UNEP/MAP, and aligned with the Barcelona Convention, with support from IOC-UNESCO and FAO. MedHAB network brings together experts from 17 Mediterranean countries, and promotes scientific exchange, data sharing, and collaboration on joint projects addressing the occurrence and impact of HABs, with implications for food security and safety, and sustainable coastal economies across the region. However, despite their value, such initiatives remain project-based, with limited funding and insufficient institutional support.

To advance One Health monitoring, the region should build on existing systems while promoting integration across sectors. Priorities include developing shared indicators that reflect interlinkages between environmental quality and health outcomes, improving data interoperability, and encouraging open access to information.

Strengthening capacities for environmental health surveillance and establishing pilot “One Health observatories” in coastal hotspots could provide practical starting points for regional cooperation and help lay the groundwork for regional initiatives similar to the One Health Observatory for Eastern & Southern Africa (COHESA)[9].

CASE STUDY 5: Vigicrues (France): An integrated system for flood and hydrological risk monitoring



Vigicrues[10] is France’s national public information system for monitoring river levels and flood risks. Operated by the Ministry for Ecological Transition and its regional hydrometric services, the system provides continuous surveillance of major rivers through an extensive network of gauging stations across the country.

The platform publishes real-time water level data and flood forecasts, issuing colour-coded alerts that help local authorities and the public prepare for rising river levels. Its warning maps and bulletins are updated regularly and made accessible online, ensuring transparency and rapid dissemination of information.

Although designed primarily for civil protection, Vigicrues reflects key One Health principles. Flooding is a major driver of environmental contamination, the spread of waterborne diseases, chemical dispersion and damage to infrastructure that supports human and animal health. Anticipatory information from Vigicrues supports preparedness across sectors, helping limit both environmental impacts and health risks.

The system also demonstrates the value of coordinated monitoring: river-gauge measurements are interpreted by regional flood-forecasting services, which work closely with meteorological agencies and local authorities to improve response planning. As climate change increases flood frequency and intensity, integrated hydrological surveillance such as Vigicrues is becoming an essential component of climate and health resilience strategies.

9. https://onehealthobservatory.org/
10. https://www.vigicrues.gouv.fr/

CASE STUDY 6: The Mediterranean Network of Harmful Algal Bloom Experts (MedHAB)

MedHAB

The Mediterranean basin hosts 46 toxin-producing microalgal species harmful to humans, 29 ichthyotoxic species[11] and 11 biotoxin groups including 6 regulated[12] posing significant challenges to the region's aquaculture and fishery sector. Non-toxic algal blooms are also responsible for mucilage formation or water discoloration, leading to considerable impacts on tourism, the largest sector of the marine economy along the Mediterranean Sea. As demand for marine resources–driven by seafood production and tourism–continues to rise, the impact of harmful algal blooms (HABs) on human activities is expected to intensify. In the context of climate change, the emergence of some harmful species in the Mediterranean is particularly alarming. These include benthic species of the genera Gambierdiscus and Ostreopsis[13].

Addressing these issues through a One Health lens requires strong international collaboration among researchers studying HABs within this shared basin, considering links between environmental, animal and human health. The Université Côte d'Azur, in partnership with Plan Bleu – Regional ActivityCenter of UNEP/MAP and aligned with the Barcelona Convention, and with the support of the Intergovernmental Oceanographic Commission (IOC-UNESCO) and the Food and Agriculture Organization (FAO), launched a network of experts across the Mediterranean region: MedHAB.

MedHAB, a pan-Mediterranean initiative, was launched in June 2024 and currently comprises 64 members from 17 countries. Being a self-sustaining network, the members have been meeting remotely to establish its operational framework and identify shared needs and priorities. This network aims to provide a dynamic platform

for fostering scientific exchanges, facilitating data sharing, and promoting collaboration on joint projects and publications. By bringing together scientists from across the basin, MedHAB seeks to enhance the understanding of HAB occurrences and their impacts, while supporting food safety, food security, and sustainable economies in Mediterranean countries. Through this One Health approach, MedHAB not only improves the scientific understanding of HABs and their drivers, but also promotes equitable access to data and coordinated regional action to protect ecosystems, animal health and human well-being.

More information can be found in Harmful Algal News N°78,
https://hab.iocunesco.org/harmful-algae-news/

11. Hallegraeff GM et al 2021. Commun Earth Environ 2:117. doi.org/10.1038/s43247-021-00178-8

12. Barnouin, G., El Hourany, R., Record, N. R., Bajc, Z., Kennedy, J., Lafitte, A., & Bottein, M. Y. D. (2025). Marine biotoxins in Mediterranean seafood: Environmental occurrence and food safety concerns. Ecotoxicology and Environmental Safety, 303, 119032.

13. Zingone A et al 2021. Harmful Al-gae 102:101843. doi.org/10.1016/j.hal.2020.101843

3.Vulnerabilities, exposures and adaptive capacity

Vulnerability to One Health hazards in the Mediterranean varies widely across geographies, populations and ecosystems, shaped not only by exposure to hazards but also by differences in adaptive capacity. Coastal areas remain the main convergence zones of risk, as they host most of the region's population and economic activities while concentrating pollution sources and the impacts of climate change (Figure 2).

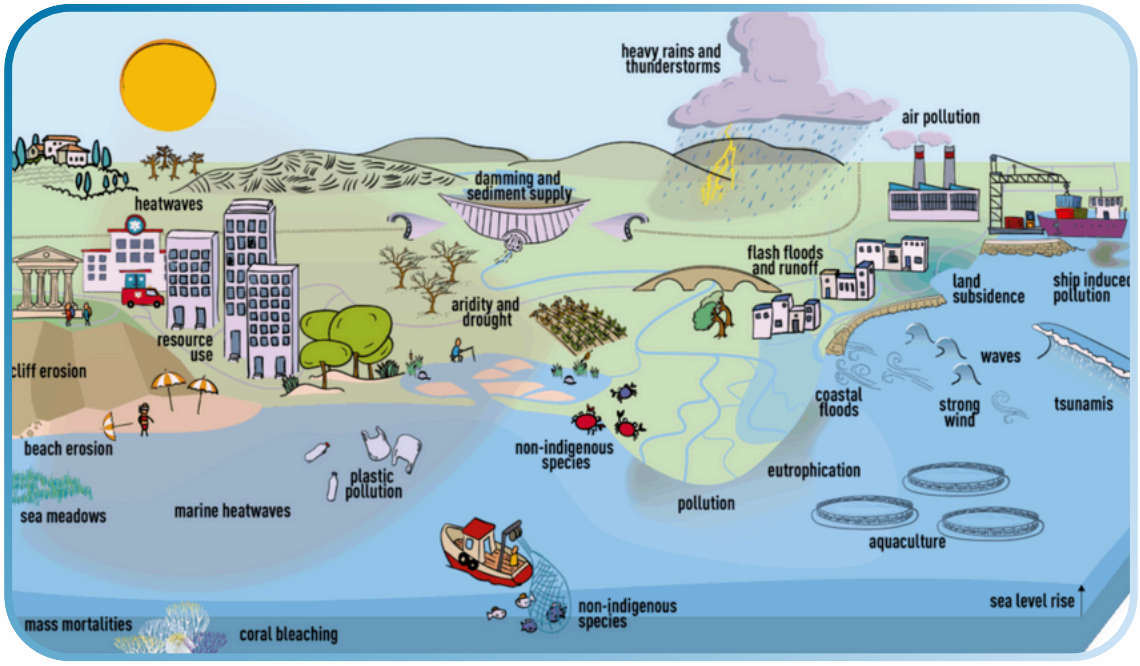


Figure 2: The coastal zone and drivers of environmental and climate change

Source: MedECC, 2024: Climate and Environmental Coastal Risks in the Mediterranean. [Djoundourian, S., Lionello, P., Llasat, M.C., Guiot, J., Cramer, W., Driouech, F., Gattacceca, J.C., Marini, K. (eds.)]. MedECC Reports. MedECC Secretariat, Marseille, France, 306 pp., doi: 10.5281/zenodo.13754020 ttps://www.medecc.org/special-report-climate-and-environmental-coastal-risks-in-the-mediterranean/#:~:text=urgent%20need%20for%20coordinated%20adaptation%20and%20mitigation

Coastal and socio-economic dimensions. Cities and deltas face overlapping pressures such as heatwaves, water scarcity, flooding, marine pollution and harmful algal blooms that jointly threaten health and livelihoods. Rural and fishing communities are similarly exposed to ecosystem degradation and declining natural resources. In many southern and eastern Mediterranean countries, limited infrastructure, institutional capacity and access to early-warning systems further amplify One Health risks.

Ecosystem vulnerabilities. Warming, acidification, eutrophication and pollution are eroding marine resilience and facilitating the spread of non-indigenous species and pathogens. Sensitive habitats such as wetlands, lagoons and seagrass meadows are losing their capacity to filter pollutants and buffer coastal hazards, with cascading effects on food webs and human well-being.

Differential exposure and vulnerability. One Health risks are unevenly distributed across populations as a result of differences in exposure, vulnerability and adaptive capacity. Poorer communities, small-scale fishers and seasonal workers often experience higher exposure to environmental hazards, combined with greater socio-economic vulnerability and more limited capacity to anticipate, cope with and recover from impacts. Gender, age and occupation further shape risk patterns for example, outdoor workers are more exposed to heat stress, while children are particularly vulnerable to air and chemical pollution.

Figure 3: Disaster Risk Management (source: https://www.un-spider.org/risks-and-disasters/disaster-risk-management)

Building resilience. Reducing vulnerability requires integrated risk management that strengthens adaptive capacity at multiple levels. Enhancing early-warning systems, spatial planning and ecosystem restoration, combined with education and community awareness, can improve preparedness and response while helping to reduce inequalities in exposure and impacts. In line with international disaster risk frameworks, this approach recognises that risk results from the interaction between hazards, exposure and vulnerability, and can be reduced through preventive and coordinated action.

4.Governance challenges and coordination mechanisms for One Health in the Mediterranean

Effective implementation of the One Health approach in the Mediterranean requires stronger coordination across multiple sectors, disciplines, and governance levels, including closer collaboration between environmental, health and marine authorities, as well as key economic actors operating in coastal and marine areas (Figure 4). Although awareness of One Health is growing, institutional and regulatory frameworks remain fragmented, and most countries are still developing mechanisms to bridge the gap between environmental and health policies. This section provides a brief diagnosis of the main governance challenges that hinder cross-sectoral integration and highlights a few examples of coordination mechanisms and good practices emerging across the region.

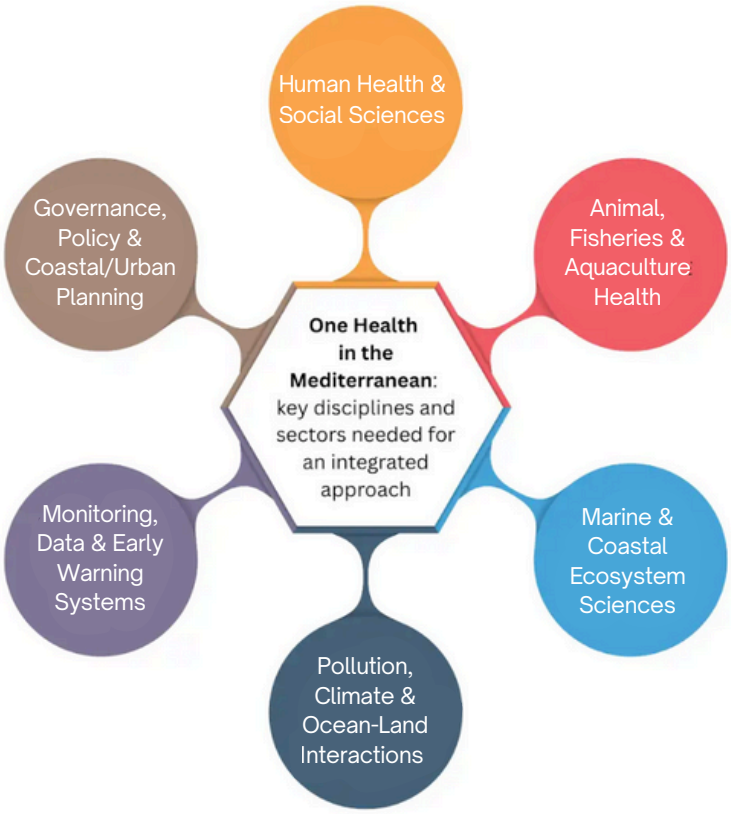


Figure 4: Key disciplines and sectors needed for an integrated One Health approach in the Mediterranean

Fragmented institutional landscape

At the regional level, the UNEP/Mediterranean Action Plan provides an established platform for environmental cooperation under the Barcelona Convention. However, connections with health authorities and the public health sector are still limited. The WHO Regional Office for Europe and FAO have supported countries in developing One Health action plans, but these initiatives often focus on zoonoses, food safety, or antimicrobial resistance, with limited integration of environmental determinants and marine dimensions.

At the national level, responsibilities for health, environment, water, fisheries, agriculture, and marine and coastal management are typically distributed among multiple ministries and agencies operating under distinct mandates and timelines. This sectoral organisation results in duplication of efforts, fragmented data collection and weak coordination mechanisms, hindering a systemic approach to emerging risks.

Barriers to cross-sectoral action

Several barriers continue to hinder progress toward integrated One Health governance in the Mediterranean.

- **Institutional and political fragmentation:** Persistent administrative silos, overlapping mandates and competition for resources limit coordination both within and across countries. The absence of harmonised frameworks and uneven enforcement of regulations further weakens coherence at the regional level.

- **Limited data and monitoring capacities:** While most countries have established environmental legislation, monitoring coverage and enforcement vary considerably. Significant gaps remain in analytical capacity and in the harmonisation of methodologies, especially concerning emerging contaminants such as PFAS, endocrine disruptors and pharmaceuticals.

- **Weak science–policy–governance interfaces:** Data and scientific knowledge are fragmented across sectors and countries, with few well-established mechanisms for translating findings into decision-making. For emerging issues, monitoring systems remain short-term and project-based, and the absence of standardised indicators limits basin-wide assessment.

- **Unequal technical and financial capacities:** North–south disparities persist in expertise, infrastructure and long-term investment, reinforcing dependence on external projects rather than sustained national systems.

- **Limited communication and public awareness:** Scientists, policymakers and practitioners often "speak different languages." Risks linked to invisible or delayed threats such as chemical contamination receive less attention than visible crises, while public-health messages must balance hazard awareness with the nutritional benefits of seafood.

These obstacles reinforce a reactive rather than preventive or anticipatory culture, in which health and environmental crises are managed separately after they occur, instead of through joint, risk-informed strategies that tackle their underlying drivers.

Emerging good practices

Despite persistent barriers and a lack of consolidated initiatives, several examples across the Mediterranean demonstrate that cooperation for a One Health perspective is moving forward. In Spain, a National One Health Platform[14] brings together health, agricultural and environmental authorities to coordinate risk management and policy development. The Canary Islands' monitoring programme for ciguatoxins in fish[15] illustrates how targeted surveillance supports seafood safety and public-health protection.

In Italy and France, established programmes for bathing water and seafood safety monitoring such as Italy's National Bathing Water Monitoring Programme and Integrated Control Plan (PNIA)[16], and France's REPHY–REPHYTOX network[17] provide operational examples of cross-sectoral coordination between environmental and health authorities.

More recent networks such as MedHAB (currently focused on international capacity building and standardized practices, joint characterization of harmful algal species and toxins in the Mediterranean, and public risk perception and vulnerability studies) and CIESM participatory science networks including Jellywatch[18] and regional initiatives on non-indigenous species, demonstrate the value of engaging scientists, fishers and local observers in monitoring biological hazards and promoting knowledge exchange across the Mediterranean.

Beyond the region, initiatives like the "Room for the Rivers" programme in the Netherlands[19] illustrate how harmonised spatial planning and ecosystem-based risk reduction can simultaneously enhance flood protection, support ecosystem restoration and generate public health benefits, offering inspiration for integrated coastal resilience approaches in the Mediterranean.

14 https://onehealthplataforma.es/

15 https://climate-adapt.eea.europa.eu/en/metadata/case-studies/control-of-ciguatera-poisoning-in-canary-islands-spain#:~:text=The%20monitoring%20programme%20to%20determine,is%20in%20place%20since%202015.

16 https://www.portaleacque.salute.gov.it/PortaleAcquePubblico/?lang=it

17 https://www.ifremer.fr/en/sanitary-quality-0

18 https://ciesm.org/our-science/programs/jellywatch/

19 https://www.rijkswaterstaat.nl/en/projects/iconic-structures/room-for-the-river

Large Mediterranean wetlands also provide valuable examples of nature-based solutions that reinforce One Health objectives. As highlighted in the Mediterranean Wetlands Outlook by Tour du Valat 2025[20], wetlands act as natural buffers against extreme weather, reducing flood risks, stabilising coastlines, mitigating drought impacts and filtering pollutants before they reach the sea. Well-managed wetlands such as the Camargue, the Ebro Delta or the Gediz Delta demonstrate how ecosystem restoration can strengthen climate change adaptation, protect biodiversity and contribute to public health by improving water quality and reducing exposure to contaminants. Their integration into coastal planning therefore represents a strategic opportunity for advancing preventive and cross-sectoral One Health action.

Finally, growing attention should be given to the economic dimension of One Health, notably the cost of inaction on pollution and ecosystem degradation. Recent studies illustrate these links: for example, the report of the Minderoo-Monaco Commission on plastics and human health[21] highlighted that plastics contribute to disease, disability, premature death, and significant economic costs, including lost productivity Similarly, assessments of methylmercury (MeHg) exposure from Mediterranean seafood consumption[22] suggest an annual economic loss exceeding €10 billion due to IQ reduction and related impacts on human capital. Integrating such socio-economic evaluations into policy and planning can help reveal the true costs of environmental degradation and the benefits of preventive, cross-sectoral action.

Strengthening regional cooperation

To operationalise One Health across the Mediterranean, it is essential to build on existing regional frameworks rather than create parallel structures. The Barcelona Convention and its protocols on land-based pollution, biodiversity and coastal management already provide relevant entry points for integration.

Enhancing coordination also requires stronger science–policy–practice interfaces, ensuring effective information flows between researchers, practitioners and decision-makers at both national and local levels. At the regional scale, progress can be accelerated by establishing cooperation platforms and communities of practice, supporting joint projects and pilot sites, and promoting data-sharing and interoperability agreements among institutions and countries.

20 https://tourduvalat.org/en/publications-en/mediterranean-wetlands-outlook-3-mwo-3/

21 https://annalsofglobalhealth.org/collections/the-minderoo-monaco-commission-on-plastics-and-human-health

22 https://www.sciencedirect.com/science/article/pii/S0048969724081105

5. Pathways forward for One Health in the Mediterranean

The One Health approach offers a powerful framework for addressing the interconnected challenges of health, environment and development in the Mediterranean. However, its implementation is complex, requiring a long-term vision and a shift from conceptual understanding to practical cross-disciplinary cooperation across institutions. Building on the discussions from the Technical Workshop on Advancing One Health in the Mediterranean: A Focus on Marine and Coastal Environments, several priorities and pathways for regional action emerge.

Regional priorities

Strengthen integration across human, animal and ecosystem health.

Promote institutional collaboration between environmental, health, marine and agricultural authorities to ensure that One Health considerations are systematically included in environmental policies, coastal planning and pollution prevention measures. Foster stronger participation of local actors including medical professionals, coastal managers, local communities and fishers and industry stakeholders to support cross-sectoral coordination and community engagement.

Develop harmonised indicators and monitoring frameworks.

Advance integrated monitoring that connects environmental, animal and human health data. Develop a set of Mediterranean-relevant One Health indicators, focusing on feasible domains such as coastal water quality, HAB occurrence and toxicity, seafood safety metrics and contaminant burdens, drawing on international guidance. Strengthen monitoring enforcement and develop simple bioindicators and cost-effective tools for routine monitoring, particularly in data-limited areas.

Invest in early warning, prevention and preparedness.

Strengthen multihazard early-warning systems that link environmental observation networks with public-health alerts, particularly for HABs, invasive species and chemical pollution events. Pilot integrated monitoring sites in coastal hotspots and expand the use of digital platforms, remote-sensing products and satellite-derived datasets (e.g. Copernicus Marine Service, EMODnet) to enhance forecasting and response.

Promote education, awareness and communication.

Build One Health literacy among professionals, students and the general public through interdisciplinary training, communication campaigns and participatory science initiatives. Increase awareness among medical doctors and health authorities about the health risks associated with environmental degradation and seafood contamination. Encourage the use of social and behavioural sciences to better understand risk perception and promote positive engagement.

Strengthen governance and cooperation mechanisms.

Establish a Mediterranean One Health Platform to facilitate data and knowledge sharing, enhance coordination among institutions, foster dialogue across sectors, and support the design of joint initiatives that promote harmonisation across the region. In the medium term, the development of a One Health Fund or dedicated financing facility could be envisaged to sustain joint projects, pilot actions and regional capacity-building efforts, ensuring equitable access to resources particularly for southern and eastern Mediterranean countries.

CASE STUDY 7 – Advancing One Health Literacy to Address Risks Through Higher Education

Higher education plays a pivotal role in advancing One Health by equipping future professionals with transdisciplinary skills to manage interconnected risks. Within this context, the MSc in Environmental Hazards and Risks Management at Université Côte d'Azur provides integrated training that combines environmental sciences, risk analysis, and systems thinking.

During the workshop Advancing One Health in the Mediterranean, MSc RISKS students actively engaged alongside scientists, practitioners, and stakeholders. Their participation helped bridge academic knowledge with real-world One Health challenges affecting coastal environments and human populations.

Through project-based learning, students contributed to discussions on environmental hazards, early warning systems, and crisis management. They also collaboratively produced a podcast aimed at communicating One Health risks to a wider audience. In parallel, they worked on developing a prototype bulletin for an environmental alert system.

These outputs demonstrated the capacity of higher education to translate scientific knowledge into operational and communication tools. The initiative highlights how universities can function as innovation hubs that connect research, education, and stakeholder engagement. Overall, this case illustrates the strategic role of higher education in strengthening One Health approaches in the Mediterranean region.

23 https://univ-cotedazur.fr/formation/offre-de-formation/msc-in-environmental-hazards-and-risks-management

Key actions to advance implementation

Moving toward an operational One Health framework in the Mediterranean will require coordinated action around several enabling dimensions:

Data sharing and interoperability

Adopt common standards for data collection and exchange among health, environmental and marine agencies, supported by digital platforms and open-data principles. Promote transparency and public access to monitoring results to build trust and awareness.

Cooperation mechanisms and pilot sites.

Encourage joint initiatives that bring together environmental and health institutions around specific hazards, using pilot coastal areas as demonstration sites for integrated risk management. Share and capitalise on successful experiences to consolidate and scale up these pilots into sustained One Health mechanisms across the region.

Capacity development and literacy.

Strengthen education, training and technical capacity for monitoring, risk assessment and communication. Promote interdisciplinary curricula and short courses on One Health and marine environmental health in universities and technical institutes.

Economic valuation and policy integration.

Incorporate the health and well-being dimensions of environmental degradation into cost–benefit analyses and national planning instruments. Highlight the economic and social costs of inaction, as well as the savings and co-benefits of preventive environmental measures.

Conclusion

The One Health approach provides a unifying framework for addressing the complex and interconnected challenges facing the Mediterranean region. By recognising the interdependence of human, animal and ecosystem health, it encourages a shift from fragmented, sectoral responses toward preventive, integrated and system-wide solutions.

In the Mediterranean, where climate change, pollution and biodiversity loss converge on a semi-enclosed sea shared by 22 countries this integrated vision is particularly urgent. Applying One Health principles to marine and coastal environments offers a highly relevant and innovative perspective for the region.

Realising this vision is a challenging task. It requires building on existing regional frameworks and fostering stronger collaboration among environmental, health and marine actors. Alongside FAO and WHO, the Barcelona Convention and UNEP/MAP system play a crucial role in strengthening cooperation between Mediterranean countries, providing a dedicated regional platform for integrated environmental governance and coordinated action.

By strengthening science–policy–practice interfaces, harmonising monitoring systems, investing in capacity development and integrating economic valuation into decision-making.the Mediterranean region can fully translate the One Health vision into effective, coordinated action.

Recent global developments reinforce this momentum. At COP 30 in Belém, the dedicated Health Day brought together UNFCCC Parties and partners to endorse the Belém Health Action Plan and highlight the twin imperatives of climate adaptation and health system resilience. Simultaneously, a coalition of major philanthropies the Climate and Health Funders Coalition, comprising more than 35 foundations including the Wellcome Trust, the Gates Foundation and the Rockefeller Foundation announced a landmark US $300 million commitment toward climate–health solutions. These developments mark a significant step forward: health is now being firmly embedded at the heart of the global climate agenda, creating new opportunities and resources for Mediterranean One Health initiatives to align with, and benefit from, this growing international momentum.

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