

Climate change and the blue economy

A sustainable and equitable blue economy can support climate action

Key messages

- Climate change is already having wide-ranging and severe negative impacts on crucial sectors of the blue economy – fisheries, aquaculture, and tourism.
- Small-scale fishers, fish farmers and fish workers are the largest group of people in the blue economy and hold substantial local and traditional knowledge. They are also some of the most exposed to climate hazards and often lack capacity to respond to them.
- The blue economy can play a significant role in climate change mitigation and adaptation. Nature-based solutions, particularly blue carbon solutions, can contribute to both mitigation and adaptation while offering a range of other co-benefits for people, nature and climate.
- For transformative action on climate and ocean change, social sustainability and equity must be at the heart of climate action and the blue economy, and small-scale actors must be involved in decision-making and planning.

1. What is the blue economy, and why does it matter?

The concept of the 'blue economy' encompasses ocean-based economic activities (see Table 1), as well as the natural assets and benefits provided by marine and other aquatic ecosystems, such as food, water, tourism, climate regulation, and coastal protection.¹ It seeks to unite the economic and social opportunities provided by the ocean with the need for environmental sustainability.

While the term has been widely adopted in national and international policy and investment arenas, blue economy discourses have traditionally focused on economic development, or 'blue growth', often at the expense of environmental sustainability and with even more limited consideration for how the social costs and benefits of ocean use are distributed. Researchers and civil society are increasingly calling for a more socially equitable blue economy – a characteristic that is not compatible with the current trajectory of growth in established or emerging ocean-based industries and thus requires transformative change.² This new emphasis on social sustainability and equity is what can make the blue economy agenda a novel and meaningful way to drive progress towards the Sustainable Development Goals, including climate action.

The total asset base of the blue economy was valued in 2015 at US\$24 trillion.³ The true value is likely to be much

higher since many of the non-market benefits provided by aquatic ecosystems, such as atmospheric regulation and carbon storage, are difficult to quantify. Drawing on these assets, the blue economy has an annual economic value of at least US\$2.5 trillion – which, if it were a country, would make it the seventh largest economy in the world.³ Sectors that currently contribute the most in terms of production value are offshore oil and gas, followed by ocean tourism (which is projected to overtake the former by 2030); while fisheries, aquaculture and their value chains together dwarf all other sectors of the blue economy in terms of numbers of people employed.^{1,4} Around 90% of these people live in the global South and engage in small-scale commercial and subsistence activities, so these sectors are critically important for sustainable development. As well as being reliant on fisheries, Indigenous Peoples and local communities bring substantial local and traditional knowledge to the management of these assets.

2. What are the impacts and challenges?

2.1 Impacts on the ocean

Climate change is altering ocean climate, chemistry, circulation, sea level and ice distribution.⁵ The ocean has been warming since 1970, and since 1993 the rate of warming has likely more than doubled.⁵ This warming has led to deoxygenation, and the increased absorption of CO₂ has also caused acidification. Sea levels are rising at

Table 1. Established and emerging sectors in the blue economy¹

Established	Emerging
Capture fisheries (fishing)	Marine aquaculture (mariculture)
Aquatic food processing	Deep- and ultra-deep-water oil and gas
Shipping	Offshore wind energy
Ports	Ocean renewable energy
Shipbuilding and repair	Marine and seabed mining
Offshore oil and gas (shallow water)	Maritime safety and surveillance
Marine manufacturing and construction	Marine biotechnology
Marine and coastal tourism	High-tech marine products and services
Maritime business services	
Marine research and development and education	
Dredging	

an accelerating rate that, together with increased tropical cyclones and rainfall, are exacerbating coastal hazards such as flooding.⁵

These unprecedented physical changes are having widespread and accelerating impacts on many aspects of nature that support the blue economy – including the biodiversity, structure and function of marine ecosystems – with particularly negative impacts in the tropics.^{5,6} Increasingly, they interact with and compound the effects of other stressors, including overfishing and changes in land and sea use (see Box 1).

2.2 Impacts on people and ecosystem services

These changes to aquatic systems are reshaping risks and compromising the benefits that the blue economy provides to people, including food security and nutrition, health, income, livelihoods and cultures.^{7,8} Recent estimates indicate that climate-induced declines in ocean health could cost the global economy US\$428 billion per year by 2050 and US\$1.98 trillion per year by 2100.⁵

Ocean-based sectors facing the highest climate-related risk are capture fisheries, aquaculture and tourism.⁶ In addition to the impacts of more extreme weather events on coastal infrastructure, impacts on aquatic species such as reduced productivity and shifting spatial distributions are already affecting each of these sectors.⁶ Impacts on marine ecosystems, such as coral bleaching, are projected to seriously affect the tourism industry globally, with coral reef tourism values expected to decline by at least 90% during this century.⁶

The costs (and sometimes benefits) of ocean changes are unequally distributed across populations and regions. Communities dependent on fisheries are some of the most vulnerable and exposed to hazards such as cyclones and flooding as well as changes in aquatic ecosystems.^{5,6} This is particularly true for Indigenous Peoples and those in tropical developing countries, as well as small island developing states (SIDS), which generally have most of their communities and assets located in low-lying coastal zones and rely heavily on their blue economies.⁶

3. What are the solutions and opportunities for change?

The future of the blue economy depends on ambitious and urgent global actions to build the capacity of natural and human systems to cope with and adapt to the impacts of climate change, and to mitigate further climate change by reducing greenhouse gas emissions (see Box 2 for examples of actions taken by Ireland’s partner countries). Despite facing significant climate risk, the blue economy also provides a range of opportunities for both mitigation and adaptation, many of which are nature-based solutions.⁹

Integrated governance approaches such as marine spatial planning can support effective, efficient and equitable responses; by mapping and identifying the respective roles and interests of different sectors and users of the blue economy, countries can make informed and coordinated decisions about how to use marine resources sustainably while supporting climate adaptation and mitigation.¹⁰ However, all stakeholders must be represented, including

↘ Box 1. Drivers of change to marine ecosystems⁷

Unsustainable and destructive human activities are driving widespread declines in the assets that underpin the blue economy. Direct exploitation of species (mainly fishing) has had the largest relative impact on marine ecosystems over the last 50 years, followed by changes in land and sea use, such as coastal development for infrastructure and aquaculture. In addition to greenhouse gas emissions, untreated urban and rural waste, pollutants from industry, mining and agriculture, oil spills and toxic dumping have reduced marine water quality, often via river networks. Marine plastic pollution has increased tenfold since 1980, affecting at least 267 species, and invasive alien species increasingly impact native species and ecosystem functions.

↘ Box 2. Examples of climate action in the blue economy

Kenya promotes several ocean-based mitigation and adaptation actions, including protecting and restoring blue carbon ecosystems through initiatives such as Payments for Ecosystem Services and seaweed farming enterprises; developing climate-smart fisheries and aquaculture sectors; and protecting small-scale fishers and farmers against climate shocks, for example, through insurance.

The **Seychelles** Marine Spatial Plan Initiative uses an ecosystem-based approach to establish new Marine Protected Areas (MPAs) in conjunction with improved management of its waters. This was financed in part through a debt swap that enabled the Seychelles to redirect a portion of their current debt payments to fund nature-based solutions to climate change.

Mozambique has developed a marine spatial plan that uses scientific assessments of its vulnerability and exposure to climate hazards to inform adaptation and mitigation measures, including where to focus ecosystem protection and restoration measures.

Vietnam aims to reduce emissions by mainstreaming climate considerations in its planning of seaports and promotes efforts to protect, restore and increase mangroves and other blue carbon ecosystems for mitigation and adaptation. It also promotes sustainable aquaculture practices and climate resilience measures, such as fostering information connectivity among fishing ports, boats and storm shelters; and aims to protect coastal communities and infrastructure by creating flood risk maps and taking flood prevention actions for coastal cities.

small-scale fishing communities and Indigenous Peoples, and planning will benefit from using all available information, including Indigenous and local knowledge.^{5,11} Financial constraints to climate action in the blue economy must also be addressed; SDG14 (life below water) has the lowest level of investment of any development goal.

3.1 Climate change adaptation

To minimise the impacts of climate change on the blue economy and wider society, the adaptive capacity of ecosystems, individuals, communities, sectors, nations and regions must be strengthened. The ocean offers huge potential for ecosystem-based adaptation (EbA). This involves protecting and restoring ecosystems that provide natural shoreline protection from climate hazards – for example, wetlands, mangroves, and oyster reefs – as well as building the resilience of ecosystems to climate impacts through biodiversity conservation, and sustainable and adaptive management of resources like fisheries. Networks of Marine Protected Areas (MPAs) are critical tools for supporting EbA, and reducing stressors such as pollution on land and sea will also build resilience.⁵

To adapt effectively, people must have assets to draw on in times of need, the flexibility to switch between adaptation strategies as needed, the ability to organise and act collectively, the capacity to learn to recognise and respond to the effects of climate change, and the agency to decide how to respond.¹¹ Adaptation responses, including EbA, should target the most vulnerable groups in the blue economy: small-scale fishers and fish workers, and particularly women, who tend to engage in informal and undervalued activities such as fish processing and are often left out of policy as a result.

Even with significant global efforts to adapt, loss and damage is projected to occur in the blue economy. In many contexts, EbA will only be effective under the lowest levels of warming, and some coastal communities (eg in coral reef environments,

urban atoll islands and low-lying Arctic locations) are likely to reach their adaptation limits before the end of this century, particularly under high emissions scenarios.⁵

3.2 Climate change mitigation

The blue economy has a critical role to play in climate mitigation. Recent analysis suggests that ocean-based mitigation has the potential to reduce emissions by more than 11 billion tonnes of greenhouse gases per annum in 2050, which could close the global emissions gap by up to 25%.⁹ Scaling up ocean-based renewable energy (for example, from offshore winds, tides, and algal biofuels) and decarbonising shipping offer the greatest potential to reduce global emissions; but nature-based solutions, which leverage the ability of marine ecosystems to sequester and store CO₂, offer the most viable and cost-effective mitigation potential in many countries and regions.

The ocean absorbs 25-30% of anthropogenic CO₂ emissions and 93% of the heat trapped by emissions.⁹ Highly productive coastal 'blue carbon' ecosystems – mangroves, salt marshes, and seagrass beds – are particularly effective at capturing and storing carbon, much more so than terrestrial ecosystems. Protecting and restoring these habitats also provides a range of co-benefits, including supporting biodiversity and providing storm protection, many of which also support EbA.⁵ Other options with significant mitigation potential include expanding seaweed aquaculture for low-carbon food, feed, and fuel alternatives, and efforts to shift diets towards sustainably produced 'blue' protein such as farmed bivalves, which are high in nutrition but have lower climate impacts than land-based protein.⁹

4. What to address in your work?

The blue economy should be a key area of intervention within climate action, and every opportunity should be taken to incorporate climate change into your work on the

ocean and blue economy. Efforts to promote a sustainable and equitable blue economy can also drive progress towards other priority areas of work, including food and nutrition, gender equality, and governance. The actions set out below will also support Irish Aid in implementing the Principles for Locally Led Adaptation which were endorsed in 2021.

4.1 Senior policy/leadership level

- Send a strong leadership signal that a sustainable and equitable blue economy is critical for action on climate and nature, and that there is a need to integrate policies and planning across these issues.
- Ensure that all interventions on the blue economy champion transformational progress towards a socially sustainable and equitable blue economy that truly benefits and involves coastal populations, fishers, fish workers, fish farmers, and Indigenous Peoples. This will support prioritisation of blue economy development assistance that maximises synergies with other development goals.
- Identify opportunities for nature-based solutions that support locally-led action in the blue economy when programming action for climate adaptation and mitigation.
- Support the need for (and recognise the impact multipliers of) increased financial investment in SDG14, and the channelling of this finance to the local level.

4.2 Programme/technical staff

- Work with delivery partners to support institutional and cross-sectoral cooperation and coordination, including between relevant government ministries and between countries. Support capacity to connect the blue economy, climate action, nature and poverty reduction agendas so that national and international policy coherence can improve.
- Support governments to take a more integrated, coordinated, and participatory planning approach to the blue economy, such as climate-informed marine spatial planning.

- Encourage governments to incorporate more blue economy solutions for mitigation and adaptation into their nationally determined contributions, and to prioritise EbA within blue economy adaptation strategies.

- Work with delivery partners to support local community-based blue economy initiatives and nature-based solutions to climate change, and to scale up best practices.
- Work with delivery partners to ensure that climate change adaptation measures in the blue economy address power imbalances and inequities linked to gender, labour conditions, tenure rights, market access, migration patterns and stakeholder conflicts.
- Identify opportunities to support partners' knowledge development and capacity to design and implement gender transformative interventions that create equal opportunities for women in the blue economy.

4.3 Delivery partners

- Develop climate action approaches that prioritise meaningful participation of local stakeholders in the blue economy and safeguard their human rights.
- Monitor the impact of climate change adaptation measures for vulnerable groups in the blue economy at different scales and dimensions — including achievements, best practices and possible maladaptation. Adaptation should be an ongoing and iterative process, incorporating flexibility and feedback to learn from past experiences and avert new risks.
- When designing climate and other interventions in the blue economy, recognise that they can have negative social impacts or unintended consequences, and build in measures to avoid or compensate for these.

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