



# AAC Recommendations for Climate Change Adaptation and Mitigation in Aquaculture

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## **I. Background**

Climate change, largely caused by anthropogenic-driven global warming, is demonstrating its potential to challenge food production systems in the EU that are being impacted by geopolitical turbulence, including aquaculture. To ensure that aquaculture remains environmentally and economically sustainable, sector planners and operators in Europe need to be prepared and equipped to increase their resilience to the negative effects of climate change as well as their adaptability to changing conditions.

The European Climate Law (2021) set into legislation the objective of a climate-neutral EU by 2050 and a reduction of net greenhouse gas (GHG) emissions by at least 55% between 1990 and 2030. The Farm to Fork Strategy is aimed at ensuring that EU food production has a neutral or positive environmental impact as well as mitigating and adapting to climate change. A number of other EU policies and directives, such as the WFD<sup>1</sup>, MSFD<sup>2</sup> and IMP<sup>3</sup>, also consider the issue of climate change in an inland and maritime context. Notably, the 2021 EU strategic guidelines to promote sustainable and competitive EU aquaculture<sup>4</sup> include considerable information on 'Climate-change adaptation and mitigation'. Other EU directives, such as MSP<sup>5</sup>, also recognise the direct linkage between sustainable aquaculture development and the impact of climate change.

The EU has supported a number of ground-breaking studies that examined the potential impact of climate change on European aquaculture and initiated the development of guidance measures and tools for its adaptation and mitigation. Horizon 2020 funded two key projects, CERES<sup>6</sup> and ClimeFish<sup>7</sup>, which resulted in several comprehensive case studies for key aquaculture finfish, shellfish and seaweed species across Europe and a number of guidance documents and tools to assist decision-makers and operators alike.

## **II. Justification**

Short-term climate change impacts arising from extreme events such as floods as well as extreme droughts, diseases, parasites and harmful algal blooms can cause a loss of food production. Climate-driven changes in temperature, precipitation, ocean acidification, hypoxia incidence and prevalence and sea level, among others, are expected to have long-term impacts on the aquaculture sector on different scales.

A climate vulnerability assessment of European aquaculture conducted as part of the CERES project suggests that the direct effects of climate-driven warming (through 2050) will have limited but direct negative impacts on the species currently cultured in most areas, although short-term and highly

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<sup>1</sup> EU Water Framework Directive – integrated river basin management for Europe [https://ec.europa.eu/environment/water/water-framework/index\\_en.html](https://ec.europa.eu/environment/water/water-framework/index_en.html)

<sup>2</sup> EU Marine Strategy Framework Directive [https://research-and-innovation.ec.europa.eu/research-area/environment/oceans-and-seas/eu-marine-strategy-framework-directive\\_en](https://research-and-innovation.ec.europa.eu/research-area/environment/oceans-and-seas/eu-marine-strategy-framework-directive_en)

<sup>3</sup> Integrated Maritime Policy of the European Union <https://www.europarl.europa.eu/factsheets/en/sheet/121/integrated-maritime-policy-of-the-european-union>

<sup>4</sup> Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030 [https://oceans-and-fisheries.ec.europa.eu/ocean/blue-economy/aquaculture/aquaculture-guidelines\\_en](https://oceans-and-fisheries.ec.europa.eu/ocean/blue-economy/aquaculture/aquaculture-guidelines_en)

<sup>5</sup> EU framework for maritime spatial planning <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089&from=EN>

<sup>6</sup> Climate change and European Aquatic RESources <https://ceresproject.eu/>

<sup>7</sup> Climefish project <https://climefish.eu/>



disruptive events are to be expected. Most of the vulnerability of Europe's aquaculture sector stems from effects that are either indirect or related to differences in adaptive capacity based on the method of cultivation. This indicates that the sector will be mainly sensitive to negative developments in feed costs, returns and marketing conditions.

There is limited evidence of the EU aquaculture sector's climate change preparedness and adaptation to date. However, there are strong signs of preparation in terms of forecasting via CERES and ClimeFish, setting up a governance framework according to the new EU guidelines for the sustainable development of EU aquaculture and identifying and funding climate change adaptation and mitigation measures over the next 5–10 years based on Member States' Multiannual National Strategic Plans (MANPs) and EMFAF<sup>8</sup> operation programmes.

Although climate change has the potential to impact the current production patterns of EU aquaculture, it may also provide opportunities for 'realigning' the geography and nature of European aquaculture. On-farm solutions may be employed to promote adaptation to variable or extreme environmental conditions, along with wider solutions such as selective breeding and better biosecurity to build the resilience of aquaculture.

In terms of climate change mitigation, research shows that the greatest opportunities for high-volume reductions in GHG emissions are likely to come from changes in the upstream and downstream parts of the supply chain, particularly the use of low-carbon raw materials for aquafeed. Life cycle assessment approaches, such as the Product Environmental Footprint analysis, will also allow the mitigation intervention points throughout the value chain to be identified. This will, in turn, lead to carbon-related costs to add to conventional commercial factors of decision-making among operators as well as for sustainable aquaculture sector development planning in Member States.

The dependence of aquatic and terrestrial livestock production on high-protein feeds, mainly of terrestrial origin, is a common indirect vulnerability to the impacts of climate change. Crop farming and feed production vulnerable due to their dependence on ample, stable water supplies. Land-based aquaculture is additionally dependent on stable water supplies for the rearing of fish.

In terms of mitigating the EU's contribution to GHG emissions, moving to a low-carbon approach is vital to reduce the dependence on high-protein feeds and the metabolic characteristics of the livestock species involved. It may be noted that the emissions intensities of most finfish are between 4 and 6 CO<sub>2</sub>-e/kg carcass weight (cw), which is in a similar range to most terrestrial production, at least of monogastrics (eg. pig and poultry). Emissions from bivalves which, are not dependent on feed inputs, are very much lower except in cases where the bivalves are hatchery and nursery produced – indeed in the same ball-park as foods based on plant proteins - whilst that of ruminants is high; whereas those of beef and sheep are over 40 CO<sub>2</sub>-e/kg cw and 30 CO<sub>2</sub>-e/kg cw respectively (MacLeod et al., 2020).

In some Member States, climate related events have already hit aquaculture production, for example, through floods, drought increased problems with fungal infections in hatcheries due to higher water temperatures. The particular producers that have been hit have gained hands-on experience and competence on real impact and how to mitigate future events. This is an untapped resource of

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<sup>8</sup> European Maritime, Fisheries and Aquaculture Fund [https://oceans-and-fisheries.ec.europa.eu/funding/emfaf\\_en](https://oceans-and-fisheries.ec.europa.eu/funding/emfaf_en)

knowledge and could be gathered and disseminated to other farmers in other countries and to the research community.

### **III. Recommendations**

The AAC provides the following recommendations to support the EU's transition to a climate change–resilient and low-carbon aquaculture sector. These are intended to complement the EU's guidelines for sustainable aquaculture development (2021–2030) as well as future AAC activities in this area, particularly those related to 'Climate change impacts on aquaculture activities in Europe'.

#### Advice to the European Commission

1. Provide specific guidance through the Open Method of Coordination<sup>9</sup> for aquaculture, or develop other mechanisms (e.g. the EU's new Aquaculture Assistance Mechanism<sup>10</sup>) for collecting the experience of aquaculture farmers already impacted by climate change and through research studies that can fill information gaps or support climate change adaptation and mitigation. These may include the following:
  - a. A practical decision-making tool for aquaculture SMEs to adapt their operations to the short- and long-term impacts of climate change. Language issues should be addressed.
  - b. Rapid impact forecasting and impact assessment methodologies for key biogeographic areas / production systems so that businesses can anticipate and respond to short-term, often seasonal, extreme events and environmental perturbations
  - c. Information on how climate change–induced environmental impacts might affect social, economic and legal systems and how these can be mitigated
  - d. Mechanisms for including climate change adaptation and mitigation in the Maritime Spatial Planning (MSP) Directive and the River Basin Management Plans decided in the framework of the Water Framework Directive (WFD) and their updates (see point 2)
2. MSP initiatives and their updates should include spatial management for more resilient systems, such as offshore or hyphenated pens, as well as promote integrated multitrophic aquaculture systems and their coexistence with other maritime economic activities.
3. EU-wide research needs to be conducted, such as via Horizon Europe, on new aquaculture systems and technologies, both in marine and freshwater environment, to build the resilience of finfish and shellfish strains adapted to changing environmental conditions and better adapted, if less-used, species that can fill new niches under different climate change scenarios.
4. Promote the development of aquaculture clusters, associations and other collective mechanisms that facilitate greater commercial resilience to the impacts of climate change on individual operators and SMEs.

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<sup>9</sup> Open Method of Coordination [https://oceans-and-fisheries.ec.europa.eu/system/files/2019-08/2019-06-12-aquaculture-evaluation\\_en.pdf](https://oceans-and-fisheries.ec.europa.eu/system/files/2019-08/2019-06-12-aquaculture-evaluation_en.pdf)

<sup>10</sup> Aquaculture Assistance Mechanism to support EU sustainable aquaculture [https://cinea.ec.europa.eu/news-events/news/new-aquaculture-assistance-mechanism-support-eu-sustainable-aquaculture-2022-07-29\\_en](https://cinea.ec.europa.eu/news-events/news/new-aquaculture-assistance-mechanism-support-eu-sustainable-aquaculture-2022-07-29_en)



5. Consider the possibility of conducting Life Cycle Analyses, including Product Environmental Footprint assessments, across all EU aquaculture operations. Given the strong SME component in EU aquaculture, cumulative or group assessments could be considered for smaller operations.

6. Related to the point above, metrics to evaluate and award climate change mitigation progress in the EU aquaculture sector need to be developed. This could be linked to specific EMFAF support.

Advice to the EU Member States

7. Member States should link climate change–related strategies in their Multi Annual National Plans to their EMFAF Operational Programmes as well as associated measures and actions. At the strategic level, this might include conducting national aquaculture carbon footprint analyses to identify strategic options for reducing the global warming potential of aquaculture, such as supporting (i) circular and low-carbon aquafeed production or (ii) shorter processing and value-adding chains/routes and (iii) decarbonisation of aquaculture vessels and aquaculture facilities.

8. In relation to the point above, monitoring indicators should be established for the evaluation of EMFAF-funded climate change–related actions in data collection by Member States. This process can be supported by the Fisheries and Aquaculture Monitoring, Evaluation and Local Support Network (FAMENET)<sup>11</sup>.

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<sup>11</sup> FAMENET (Fisheries and Aquaculture Monitoring, Evaluation and Local Support Network) [https://oceans-and-fisheries.ec.europa.eu/funding/famenet\\_en](https://oceans-and-fisheries.ec.europa.eu/funding/famenet_en)



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