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Scientific evidence does not support oyster farming as a marine carbon dioxide removal strategy for climate mitigation

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Chen et al. (1) investigated the role of oysters in the carbon cycle using mesocosms deployed in a pond. They showed that oyster suspension feeding and biodeposition may, at low stocking densities, increase the production of organic carbon in the water column, with an apparent accumulation in the sediment. The authors conclude that oyster farming is a scalable solution for marine carbon dioxide removal (mCDR).

While their study addresses an important topic, its restricted timing and duration, poor representation of oyster farming conditions, as well as biases in interpretation and unsupported claims, prevent it from supporting such conclusions.

Regarding the timing and duration of the study, three points should be noted. First, measurements were conducted only between June and October, when conditions are favorable for photosynthesis, overestimating annually integrated CO₂ uptake. Full seasonal coverage, including winter periods when conditions are more heterotrophic, is needed to provide a reliable estimate of the carbon budget (2, 3).

Second, Chen et al. do not provide a whole carbon budget for oyster farming. Key processes likely to cause significant CO₂ emissions are spat production, harvest, transport, depuration, consumption of oyster flesh, and the disposal of shells which are frequently incinerated (4, 5). All these stages need to be covered in a comprehensive life cycle analysis (LCA) that is specific to their aquaculture system. The two LCA studies cited in the paper are of limited relevance, since they relate to clams and mussels, and their findings are not supported by other work (2, 6).

Third, shallow, short-term sedimentation of organic carbon was considered a carbon sink despite its extreme susceptibility to remineralization over longer periods. Given that climate-mitigation strategies require carbon sequestration on multidecadal, preferably geological, timescales (7), realistic remineralization needs to be incorporated into the carbon budget.

There are key differences between the closed mesocosms and open field conditions for oyster farming that limit the generalization of the study. In particular, oyster stocking

densities were very low [0.5 to 4 ind m⁻² compared to 80 to 300 ind m⁻² in typical oyster aquaculture (8)] and the highest stocking density used did not show any enhancement of primary production relative to the control without oysters. Furthermore, nutrients were added to stimulate phytoplankton growth but nutrient concentrations compared to natural levels were not reported. Finally, oxygen exchange was likely limited in these closed mesocosms held in a closed pond, likely to favor carbon storage due to low oxygen concentration in the sediment.

The field data do not support the claim that aquaculture enhances photosynthesis and, thus, carbon uptake. Instead, the chlorophyll and oxygen measurements seem to indicate the opposite effect. Furthermore, the data and chosen analyses were inadequate to support any assertion that waters surrounding the farms display enhanced primary production from regenerated nutrients relative to the adjacent sea (1).

Finally, the authors claim that oyster farming is a scalable mCDR option, but they provide no evidence to support this. This is particularly important given that they advocate low-density aquaculture in areas that are often spatially restricted and heavily used.

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The authors declare no competing interest.

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1. X.-W.-J. Chen *et al.*, Oyster farming acts as a marine carbon dioxide removal (mCDR) hotspot for climate change mitigation. *Proc. Natl. Acad. Sci. U.S.A.* **122**, e2504004122 (2025).
2. F. Pernet, S. Dupont, J.-P. Gattuso, M. Metian, F. Gazeau, Cracking the myth: Bivalve farming is not a CO₂ sink. *Rev. Aquac.* **17**, e12954 (2025).
3. F. Pernet, S. Dupont, J.-P. Gattuso, M. Metian, F. Gazeau, Bivalve farming is not a CO₂ sink: From myth to legend, where is science? *Rev. Aquac.* **17**, e70067 (2025).
4. A. A. Alonso, X. A. Álvarez-Salgado, L. T. Antelo, Assessing the impact of bivalve aquaculture on the carbon circular economy. *J. Clean. Prod.* **279**, 123873 (2021).
5. A. C. Dias *et al.*, Environmental assessment of oyster farming from a life cycle perspective. *Sustain. Prod. Consum.* **54**, 102–114 (2025).
6. M. Mistri, C. Munari, Clam farming generates CO₂: A study case in the Marinetta lagoon (Italy). *Mar. Pollut. Bull.* **64**, 2261–2264 (2012).
7. NASEM, *A Research Strategy for Ocean-Based Carbon Dioxide Removal and Sequestration* (The National Academies Press, Washington, DC, 2022), p. 360.
8. M. Mercer, L. Gennari, A. Lovatelli, *Pacific Oyster Farming: A Practical Manual* (Food & Agriculture Org, 2024).