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Opinion Article

Annual Growth Rates and Carbon Potential of Farmed Oysters

Tilman Jauk*

Department of Aquatic Resource Management, University of Rostock, Rostock, Germany

DESCRIPTION

Oysters are recognized for their ecological and economic value, providing ecosystem services and supporting global aquaculture production. Among these services, the capacity of oysters to capture and store carbon, often referred to as blue carbon, has gained attention due to their potential contribution to climate change mitigation. Blue carbon generally refers to the carbon stored in coastal and marine ecosystems, including vegetated habitats such as mangroves, seagrasses, and salt marshes. While oysters do not store carbon in plant tissues, their ability to convert dissolved inorganic carbon into calcium carbonate shells represents a significant long-term carbon sink. Understanding the global production of oysters, their growth rates, and the associated carbon dynamics is essential for evaluating their role in carbon management strategies.

Global oyster production has expanded steadily over the past decades, driven by increasing demand for seafood and aquaculture intensification. According to recent statistics, Asia dominates the global oyster market, accounting for the majority of production, with China being the leading producer. Other regions contributing to global oyster cultivation include North America, Europe, and parts of Oceania. Production systems range from extensive intertidal farming to intensive suspended culture and hatchery-based operations. Each system has distinct growth rates, biomass yields, and environmental interactions, influencing their potential for carbon accumulation.

Quantifying the global blue carbon contribution of oysters requires integrating data on production volume, shell composition, and growth rates. The worldwide annual production of farmed oysters exceeds several million tons of live weight, with China alone contributing a substantial proportion. By converting live weight to dry shell weight and accounting for calcium carbonate content, it is possible to estimate the total carbon captured annually through shell formation. Variations in growth rate among species, farming practices, and environmental conditions necessitate careful consideration to avoid overestimation or underestimation of carbon storage potential.

Annual growth rates are also central to understanding the temporal dynamics of carbon capture. Faster-growing oysters accumulate biomass more rapidly, resulting in greater annual shell formation and associated carbon storage. Conversely, slower growth or high mortality reduces the effectiveness of oysters as a carbon sink. Seasonal variations in temperature and food supply can produce fluctuations in growth, with peak rates often occurring during warmer months when phytoplankton availability is high. Monitoring and modeling these growth patterns at farm and ecosystem scales allow for more accurate estimates of annual carbon accumulation and the potential contribution of oyster aquaculture to climate mitigation efforts.

Global oyster production is not uniform, and differences among species, farming techniques, and regions influence both biomass yields and carbon potential. Intertidal culture, often practiced in temperate regions, exposes oysters to tidal fluctuations, which can affect growth rates and shell deposition. Subtidal or suspended culture systems maintain constant immersion and can optimize feeding conditions, leading to higher growth and shell deposition. Hatchery-based spat production allows for controlled breeding and faster growth in early life stages, further contributing to annual biomass accumulation. By integrating these variations, assessments of blue carbon potential can be tailored to different production systems and management strategies.

The environmental context of oyster farming also affects carbon outcomes. Salinity, pH, and water chemistry influence calcification rates and shell composition. Acidification or changes in carbonate saturation state can reduce shell growth and alter the carbon balance. Temperature stress may affect metabolic rates and feeding efficiency, indirectly influencing annual growth and carbon capture. Sustainable management of oyster farms, including site selection, water quality monitoring, and adaptive culture practices, is essential for maximizing both production and blue carbon potential.

The economic and ecological value of oysters intersects with their carbon storage function. Oyster aquaculture provides food security, income generation, and employment opportunities,

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Correspondence to: Tilman Jauk, Department of Aquatic Resource Management, University of Rostock, Rostock, Germany, E-mail: tilman.jauk@rostock.at

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particularly in coastal communities. By producing high-value seafood while contributing to carbon retention, oysters represent a multifunctional resource. Policies and incentives that recognize these co-benefits can support sustainable aquaculture practices and encourage the integration of carbon assessment into farm management and coastal planning.

In conclusion, oysters offer measurable potential for carbon accumulation through shell formation and associated ecosystem interactions. Global production continues to expand, with Asia, Europe, and North America as major contributors, and annual growth rates vary according to species, environmental conditions, and culture techniques. By quantifying shell-based carbon storage, assessing growth dynamics, and considering indirect contributions to sedimentary carbon, it is possible to evaluate the role of oysters in blue carbon strategies. Integrating these insights into aquaculture management, reef conservation, and coastal planning supports sustainable seafood production while maintaining environmental services. Continued research on growth rates, production systems, and environmental interactions will refine estimates of carbon potential and inform policies that balance food production with climate mitigation objectives.