



MAGNITUDE AND SPATIAL DISTRIBUTION OF METHANE FLUX IN FISH FARMING SYSTEMS IN THE STATE OF MINAS GERAIS

Vitor Luis da C. Duque¹; Pedro Amarilho A. Macedo¹; Laís C. Soranço¹; Anderson M. de Melo Júnior²; Arthur C. Martins¹; Caique R. Soares¹; Jonas Nasário¹; Marta E. Ummus³; Giovanni R. de Oliveira⁴; Nathan Barros¹

¹ *Department of Biology, Laboratory of Aquatic Ecology, Federal University of Juiz de Fora, Juiz de Fora 36036-900, Brazil*

² *Aquaculture Center, São Paulo State University, Jaboticabal, Brazil.*

³ *Embrapa Fisheries and Aquaculture, Palmas, Tocantins, 77008-900, Brazil*

⁴ *Agricultural Research Company of Minas Gerais, Experimental Field of Leopoldina, Leopoldina 36700 000, Brazil*

E-mail: vitor.duque@estudante.ufjf.br

While aquaculture is pivotal to meeting the UN Sustainable Development Goals (SDGs) for sustainable protein production, the rapid expansion of the sector makes it essential to quantify its environmental impacts, particularly Greenhouse Gas (GHG) emissions. Despite its importance, methane dynamics and overall climate footprint of pond-based systems remains poorly quantified. This study investigated methane emissions from earthen fishponds in Minas Gerais, Brazil's, the third largest fish-producing state, represents a strategic setting given the ongoing growth of the activity, to bridge data gaps. We assessed its relationship with water quality, regional climate gradients, and farmed species in order to understand the real climate impact of fish production. Data were quantified to the entire state using geospatial mapping derived from direct visual interpretation. Results indicate a total emission for the state of 0,11 Gg CO₂-eq. When extrapolated to the 4,276 hectares (ha) of water surface in Minas Gerais, this corresponds to an annual flux ranging from 42.54 to 59.93 Gg CO₂-eq. year⁻¹. Emissions showed significant spatial heterogeneity, with the ebullitive pathway accounting for the majority of total emissions, although at magnitudes lower than the global averages reported in the literature. GHG fluxes were mainly driven by eutrophication indicators, production management practices, and system characteristics. By addressing data gaps in an important aquaculture-producing region, these findings support the sustainable expansion of aquaculture through improved understanding of GHG emissions and contribute to the refinement of national GHG inventories, as well as to the development of mitigation strategies aligned with global climate commitments.

Palavras-chave: *Aquaculture; Methane; Greenhouse Gases; Environmental Mitigation; Climate Change*