

## EMISSION AND BIOGEOCHEMISTRY OF COPPER AND MERCURY FROM INTENSIVE SHRIMP CULTURE IN NORTHEASTERN BRAZIL

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Shrimp aquaculture is a recent development of the Brazilian agribusiness but has increased by about 20% per year during the last decade along the semi-arid NE coast due to optimal climate and environmental setting. The activity has been blamed to cause several environmental impacts mostly associated with the emission of large amounts of nutrients and sediments to estuaries. However, recent research worldwide suggests that intensive aquaculture may also be a significant source of some trace metals of environmental significance, in particular Cu and Hg, to estuaries. This paper reviews recent estimates, using an emission factor approach, of the annual emissions of Cu and Hg, from intensive shrimp farming and compare them with other anthropogenic sources and natural processes to the Jaguaribe River estuary, Ceará State, NE Brazil, responsible for about 15 % of the total shrimp farming area of the country. Simultaneously, the fate of Cu and Hg within the shrimp growing process and the fate of these metals released to the environment are also presented. Copper and Hg emission factor was generated by analyzing Cu and Hg concentrations in aquafeeds and other chemical additives, in shrimp biomass and in inflow and outflow water and suspended particles and in pond bottom sediments of the largest shrimp farm of Ceará State NE Brazil, located at the Jaguaribe River estuary, latitude 4023' S and longitude 37036' W. Metal concentrations were also determined in bottom sediments and biota along 4.6 km downstream the effluent releasing point along the receiving tidal creek. Shrimp farming emission factors at the Jaguaribe estuary (386 gCu.ha-1.yr-1 and 0.18 gHg.km-2.yr-1), ranked second among the other anthropogenic sources, for both Cu and Hg. Annual emissions reached 490 kgCu.yr-1 and 0.36 kgHg.yr-1. Notwithstanding concentrations of Cu and hg in farmed shrimp are low (~40 µgCu.g-1 and 17 ngHg.g-1), posing no toxicological threat to human consumption. However, accumulation of both metals in exoskeleton compared to muscle tissue, suggest that detoxifying mechanisms are taking place and can thus impact shrimp growth and the economic efficiency of the farming process. Cu and Hg distribution in surface bottom sediments from a tidal creek receiving shrimp farm effluents confirm the importance of this source at the regional level and vertical distribution of metal concentrations in sediment cores suggest a recent increase simultaneously with aquaculture develop in the region. Comparison with concentrations of Cu and Hg from similar areas at the NE coast lacking intensive shrimp culture, showed up to 5 times increase in Cu and Hg concentrations in sediments and biota.