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Biosolids in Brazil: National Scenario, Legal Aspects and Comparison with Average Parameters Obtained in Sewage Treatment Plants: A Review

Sérgio Siqueira de Amorim Júnior*, Rocheli Carnaval Cavalcanti and Denilson de Oliveira Guilherme

Graduate Program in Environmental Sciences and Agricultural Sustainability, Dom Bosco Catholic University, Campo Grande, Brazil

*Correspondence: Sérgio Siqueira de Amorim Júnior Graduate Program in Environmental Sciences and Agricultural Sustainability, Dom Bosco Catholic University, Campo Grande, Brazil, E-mail: sergioesa17@gmail.com; DOI: <https://doi.org/10.56147/jbhs.3.2.139>

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Abstract

The production of biosolids in Brazil has increased due to the expansion of sewage treatment plants, making these materials a sustainable alternative for agricultural use. Composed of high organic matter and nutrients such as nitrogen, phosphorus, calcium and magnesium, biosolids have the potential to improve the physical, chemical and biological properties of tropical soils, contributing to greater fertility, water retention and microbial activity. National literature demonstrates that these materials can partially replace mineral fertilizers and assist in the recovery of degraded areas. On the other hand, the presence of contaminants still represents a challenge. Heavy metals such as Cd, Pb, Ni and Hg generally appear in low concentrations, while Cu and Zn tend to approach the maximum limits established by CONAMA Resolution No. 498/2020. Regarding pathogens, the efficiency of sanitization depends on the treatment method employed. Emerging organic pollutants, including pharmaceuticals and hormones, have been detected, but still lack specific regulations in Brazil. Thus, although biosolids present high agronomic potential, their safe use requires adequate monitoring, improvement in controlling the origin of sewage and advances in legislation, especially regarding emerging organic pollutants.

Keywords: Biosolids; Agricultural; Emerging organic pollutants

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Introduction

The production of biosolids in Brazil has increased significantly in recent decades as a direct consequence of the expansion of sanitary sewerage systems and the modernization of Sewage Treatment Plants (WWTPs). This trend reflects national efforts to improve sanitation coverage and reduce the environmental impacts associated with untreated wastewater discharge [1-3]. Biosolids, defined as treated sewage sludge suitable for beneficial environmental application, represent an important alternative for the sustainable management of urban waste. Their reuse is aligned with circular economy principles, as they contain high concentrations of organic matter and essential plant nutrients, such as nitrogen, phosphorus and micronutrients, which can partially

replace mineral fertilizers and reduce dependency on non-renewable resources [1-3].

National research indicates that the controlled agricultural application of biosolids can improve physical, chemical and biological soil properties, particularly in highly weathered tropical soils that typically present low organic matter content. Reported benefits include improved soil aggregation, increased water retention capacity, enhanced microbial activity and gradual nutrient release, which contribute to soil fertility restoration and sustainable crop production [4]. In addition, biosolids reuse reduces the volume of waste sent to landfills and minimizes greenhouse gas emissions associated with disposal practices, reinforcing their relevance within sustainable waste management strategies.