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Initial perspectives for resource recovery and integrative water approach in the WWTPs of the São Paulo Metropolitan Region

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Highlights:

- Limited data: Only 1.34% of data corresponds to Total Phosphorus, and 2.51% to ammonia.
- Resource recovery: Daily input of 1.84 to 47.76 tons of ammonia in WWTPs with potential for recovery.
- GHG reduction: Resource recovery reduces emissions like nitrous oxide, aligning with climate action plans.

Keywords: Monitoring data; Resource recovery; Climate action

INTRODUCTION

We live in an era of climate change that implies measures for mitigation and adaptation to climate risks, such as variations in the hydrological regime and water availability for regions (IPCC, 2023). This implies the need to employ new approaches and adopt climate actions.

Within this context, integrative water approaches emerge to urban water management, as well as the recovery of generated resources (Daigger et al., 2019). Such approaches are embedded in a theoretical and institutional framework that depends on laws and plans - such as cities' climate adaptation plans - and the characteristics of the region in which it is being implemented.

In Brazil, the Paraná River Basin is home to over 30% of the Brazilian population but accounts for only 5% of the total surface water availability (Gesulado et al., 2021). Within this region, the Upper Tietê River Basin stands out, the most densely populated basin in the country, which coincides with the boundaries of the São Paulo Metropolitan Region (SPMR), with more than 21 million inhabitants.

Beyond its physical characteristics, the Metropolitan Region has five major Wastewater Treatment Plants (WWTPs), including some of the largest WWTP in Brazil (flowrate). It is important to consider these WWTPs within the context of climate change and the mitigation of greenhouse gas emissions (Souza; Souza; Nolasco, 2023) and resource recovery (Chrispim et al., 2020).

Thus, the research aimed to verify the available monitoring data of WWTPs in the SPMR and align it with the directives stated in the Climate Plan of the city of São Paulo regarding reuse and emission mitigation.

METHODOLOGY

Monitoring data from 2019-2022 of the WWTPs in the Metropolitan Region of São Paulo were obtained and analyzed through descriptive statistics. A focus was given to the concentrations and compounds of nitrogen and phosphorus, which could be recovered in the form of ammonia and struvite.

Additionally, a documentary analysis of the São Paulo Climate Action Plan (São Paulo, 2021) was conducted considering mentions and keywords related to "water", "sewage", "wastewater", "GHG" (greenhouse gases) and "sanitation".

RESULTS AND CONCLUSIONS

From the four years of WWTPs monitoring data, which total approximately 93 thousand rows of data, only 1.34% of the data corresponds to Total Phosphorus and 2.51% to ammonia. These relationships also vary differently among each WWTP, which have more or less available information (Figure 1).

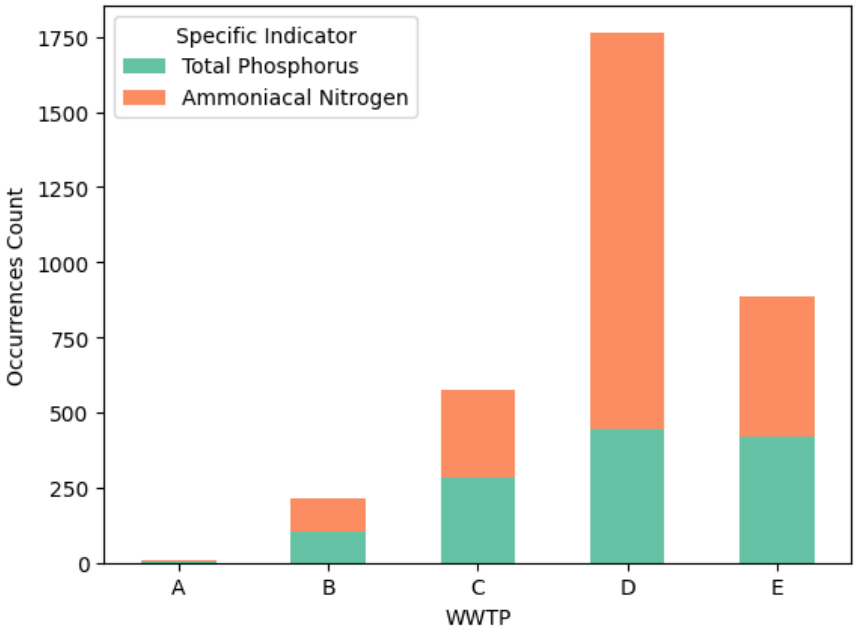

Figure 1. Occurrences Count of Total Phosphorus and Ammonia by WWTP

Daily, the WWTPs receive an input of 1.84 to 47.76 tons of ammonia in the aeration tanks, which raises the possibility of recovering these resources as nutrients. Alternatives such as ammonia recovery are being studied, including physical-chemical adsorption (Cruz et al., 2019) and biological assimilation through bacteria (Tang et al., 2023).

Furthermore, Total Phosphorus, after dewatering and thickening stages, reached concentrations from 0.02 to 146 mg/L with possibilities of recovery in the form of struvite (Sena et al., 2021).

Such recoveries consequently reduce GHG emissions, such as nitrous oxide. When considering the São Paulo Climate Action Plan, actions are foreseen, such as greenhouse gas data reporting as well as the reduction of emission factors in the municipality's WWTPs by 2030.

The Plan also includes a comprehensive overview of environmental changes, vulnerability factors, threats, and impacts on water adaptation and supply. This opens a window of opportunity for the inclusion of integrative approaches.

In this way, the importance of monitoring and data as an important tool for decision-making is highlighted, considering both the diagnosis of potentials and the reporting and support for recovery measures and integration of water and nutrient resources.

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