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Decentralized urban composting as an initial step to a circular agricultural nutrient economy

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Abstract

Urban sanitation has evolved into a linear flow of farm nutrients to cities as food, which are then lost to the atmosphere as reactive nitrogen, and to water bodies as soluble nitrogen, phosphorus, and potassium. Decentralized composting of food waste in southern Brazil has demonstrated how a small fraction of these nutrients can be recovered and used in urban agriculture. The methods used can be useful in projecting decentralized treatment of the larger fraction of agricultural nutrients pooled in urban sewage, forming a more circular economy while strengthening intensive urban agriculture. Source separation of organic wastes, collection services with small sealed containers, decentralized treatment with variable scales of thermophilic composting using the UFSC method of static piles with passive aeration, and weekly loading of food waste, as described by Miller and Inácio (2022), spread slowly in the municipality of Florianópolis, Santa Catarina, Brazil. Community composting patios and institutional mechanized compost yards, have spread through the municipality due to lower transportation and treatment cost, allied with small footprints, and payments for services equivalent to tipping fees in landfills. Tests were routinely made for heavy metals and pathogens (Trivella, 2022), and alternative treatments of many other types of residues were tested. Food waste, yard trimmings, sewage sludge, and slaughterhouse waste were all used in small composting patios. Different products from the composting process were tested in different urban crops for ideal efficiencies (Winker et al., 2009). Careful source separation and aerobic, thermophilic conditions in composting yards resulted in pathogen and heavy metal levels at undetected levels or consistently below existing levels in legislation for organic fertilizers (Trivella, 2022), and resulted in changes of legislation on state and national level. Santa Catarina state regulations established parameters for decentralized urban composting patios in 2019, permitting outdoor composting with reduced buffer distances in urban areas. Federal regulations were changed to permit compost from source-separated urban wastes to have unrestricted use as organic fertilizers in 2020, and use of urban compost in certified organic farming was widened in 2021 (Trivella, 2022). Leachate from static piles, rich in potassium, proved to have the exact nutrient composition required for banana production, in which 5 m^3 of leachate

contained 3.9 kg N, 1.0 kg P_2O_5, and 12.0 kg K_2O, the amount of nutrients recommended to produce one thousand kg of bananas (CQFS–RS/SC, 2016). A compost yard of 1000 m^2 size therefore can fertilize a grove twice the size, producing four thousand kg of bananas per year. The technical success of these experiences, and the low cost per unit treated, can be applied to urban black water. Instead of end-of-pipe solutions, where sewage sludge is composted, secure decentralized treatment is possible. Changes in legislation will allow the application of these nutrients to the soil of high value orchards, such as açaí palm groves, which can occupy urban hillsides. These orchards have extremely high nutrient demands, with high-value, high nutrient output (Zambonim et al., 2017), leading to a more circular economy for agricultural nutrients.

Keywords: UFSC method, leachate, source separation

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