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COMPOSTING AS A SUSTAINABLE METHOD FOR AGRICULTURAL WASTE MANAGEMENT AND REDUCING ENVIRONMENTAL IMPACT

Eliza MECHEREȘ, Deniss BOHORODIȚĂ, Simona DRAGOMIR, Daiana GRECER-STOIA **Tutor: Narcis BĂGHINĂ**

University of Life Sciences “King Mihai I” from Timisoara

Abstract:This paper examines composting as a sustainable approach to managing agricultural waste and reducing its environmental impact. Agricultural activities generate substantial quantities of crop residues, livestock manure, and other biodegradable materials, while inadequate disposal practices may contribute to pollution ,resource loss, and greenhouse gas emissions. Current research increasingly identifies depends on how the process to examine composting principles, suitable agricultural feedstocks, operational conditions, and environmental outcomes. Particular attention is given to aeration, moisture content, temperature, and the carbon-to-nitrogen ration, which influence compost quality and gaseous emissions. The paper’s originality lies in linking agricultural waste treatment, nutrient recovery, and climate-related effects within one analytical framework. The reviewed evidence suggests that properly managed composting can stabilize organic residues, produce a valuable soil amendment, support nutrient recycling, and reduce reliance on certain external soil inputs. However, poorly controlled systems can generate methane, nitrous oxide, and ammonia, potentially reducing their environmental benefits. As a review-based study, this work includes neither field experiments nor a quantitative life-cycle assessment, and outcomes may differ across regions and waste types. The findings emphasize the importance of appropriate process management and context-specific evaluation. Overall, the paper highlights composting as a relevant strategy for more resource-efficient agriculture and identifies priorities for further research and practical implementation.

• Introduction

Agricultural activities generate significant quantities of organic residues, including crop remains, livestock manure and biodegradable by-products that require sustainable management. Improper disposal may cause nutrient losses, environmental pollution and greenhouse gass emissions. Composting uses aerobic microorganisms to transform organic residues into stabilized materials suitable for agricultural use.

Objective: To evaluate the tehnical requirements and environmental benefits of composting as a sustainable agricultural waste management method.

• Material and methods

- Research approach: Literature-based technical assessment using scientific publications, institutional reports and International Compost Seminar 2026 materials.
- Materials analyzed: Crop residues, livestock manure and biodegradable agricultural processing by-products.
- Assessment criteria: Feedstock characteristics, moisture, C/N ratio, aeration, temperature, organic matter degradation, gaseous emissions and compost maturity.
- Methodological limitation: The study is based on published data and technical references, without experimental investigations or a quantitative life-cycle assessment.

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• Results and discussions

The reviewed evidence indicates that composting efficiency depends on feedstock characteristics and the management of biological decomposition.

MAIN FINDINGS:

- Mixture preparation: Indicative initial conditions include a C/N ratio of 25 35:1 and moisture of 40-60% depending on the materials.
- Process control: Aeration, temerature and moisture influence microbial activity, decomposition and compost stabilization.
- Environmental emissions: Oxygen deficiency may promote methane (CH4) formation, whilw nitrogen transformations may release nitrous oxide (N2O) and ammonia (NH4).
- Mass balance: Wet-mass reduction reflects both organic matter degradation and water losses; it cannot be interpreted directly as CO2 emissions.
- Soil benefits: Mature compost can improve soil organic matter, nutrient availability, structure and water retantion.

• Conclusions

Composting is an effective option for manageing and valorizing biodegradable agicultural residues. Appropriate feedstock blending, aeration, moisture management and maturation are essential for process efficincy. Well-managed composting supports nutrient recovery, soil improvement and circular economy objectives, although emissions and nutrient losses remain possible. Further experimental research is necessary to quantify environmental benefits under speciic agricultural conditions.