

# STUDY THE EFFICIENCY OF COMPOSTING METHODS FOR SMALL-SCALE COMPOSTING : A META-ANALYSIS



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Project Report  
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Chenkalady  
2024

## ABSTRACT

The recent economic downturn and rapid population growth have driven the need for a self-sufficient economy, particularly in rural areas where people rely on growing their own fruits and vegetables. However, the high cost and scarcity of fertilizers have posed significant challenges to increasing agricultural productivity. Small-scale composting emerges as a viable solution to enhance soil fertility, reduce greenhouse gas emissions, and recycle organic waste into nutrient-rich compost, thereby advancing the circular economy. This study aims to evaluate the effectiveness of various small-scale composting methods (bin composting, vermicomposting, pile composting, bokashi composting, and trench composting) in terms of their efficiency with different types of organic waste, including food waste, animal waste, and plant waste. A comprehensive literature review was conducted, integrating data from 80 research publications. A meta-analysis was performed using JMP (version 18) to assess the impact of factors such as moisture content, temperature, and pH on composting efficiency, with nitrogen (N), phosphorus (P), and potassium (K) percentages as key performance indicators. The analysis revealed that maintaining moisture content between 50–60%, temperatures of 30–40°C, and a slightly acidic pH of 6–7 is optimal for small-scale composting. Animal waste demonstrated significant variability in nutrient content, with some samples achieving high levels, while food and organic waste exhibited more consistent but generally lower nutrient levels. Vermicomposting was identified as a particularly effective method, consistently producing nitrogen content exceeding 10%, phosphorus retention over 3%, and potassium content over 5%. The study concludes that animal waste is the most suitable waste type for all small-scale composting methods, and the optimum nutrient levels can be achieved through vermicomposting.

**Keywords:** Animal waste, Composting Methods, Nutrient Retention, Small-scale composting, Vermicomposting

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