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Mitigating Food Insecurity and Malnutrition by Promoting Carbon Farming via a Solar-Powered Enzymatic Composting Bioreactor with Arduino-Based Sensors

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Abstract : Malnutrition and food insecurity represent significant global challenges affecting millions of individuals, particularly in low-income and developing regions. The researchers created a solar-powered enzymatic composting bioreactor with an Arduino-based monitoring system for pH, humidity, and temperature. It manages mixed municipal solid wastes incorporating industrial enzymes and whey additives for accelerated composting and minimized carbon footprint. Within 15 days, the bioreactor yielded 54.54% compost compared to 44.85% from traditional methods, increasing yield by nearly 10%. Tests showed that the bioreactor compost had 4.84% NPK, passing metal analysis standards, while the traditional pit compost had 3.86% NPK; both are suitable for agriculture. Statistical analyses, including ANOVA and Tukey's HSD test, revealed significant differences in agricultural yield across different compost types based on leaf length, width, and number of leaves. The study compared the effects of different composts on Brassica rapa subsp. Chinesis (Petchay) and Brassica juncea (Mustasa) plant growth. For Pechay, significant effects of compost type on plant leaf length ($F(5,84) = 62.33$, $\eta^2 = 0.79$) and leaf width ($F(5,84) = 12.35$, $\eta^2 = 0.42$) were found. For Mustasa, significant effects of compost type on leaf length ($F(4,70) = 20.61$, $\eta^2 = 0.54$), leaf width ($F(4,70) = 19.24$, $\eta^2 = 0.52$), and number of leaves ($F(4,70) = 13.17$, $\eta^2 = 0.43$) were observed. This study explores the effectiveness of the enzymatic composting bioreactor and its viability in promoting carbon farming as a solution to food insecurity and malnutrition.

Keywords : malnutrition, food insecurity, enzymatic composting bioreactor, arduino-based monitoring system, enzymes, carbon farming, whey additive, NPK level
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