

Sustainable Thermal Energy Storage Technologies: Enhancing Post-Harvest Drying Efficiency in Sub-Saharan Agriculture

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Abstract : Sub-Saharan African nations depend greatly on agriculture, a sector mainly marked by low production. Most of the farmers live in rural areas and employ basic labor-intensive technologies that lead to time inefficiencies and low overall effectiveness. Even with attempts to enhance farmers' welfare through improved seeds and fertilizers, meaningful outcomes are yet to be achieved due to huge amounts of post-harvest losses. Such losses significantly endanger food security, economic stability, and result in unsustainable agricultural practices because more land, water, labor, energy, fertilizer, and other inputs must be used to produce more food. Drying, as a critical post-harvest process involving simultaneous heat and mass transfer, deserves attention. Among alternative green-energy sources, solar energy-based drying garners attention, particularly for small-scale farmers in remote communities. However, the intermittent nature of solar radiation poses challenges. To address this, energy storage solutions like rock-based thermal energy storage offer cost-effective solutions tailored to the needs of farmers. Methodologically, three solar dryers were constructed of metal, wood, and clay brick. Several tests were carried out with and without energy storage material. Notably, it has been demonstrated that soapstone stands out as a promising material due to its affordability and high specific energy capacity. By implementing these greener technologies, Sub-Saharan African countries could mitigate post-harvest losses, enhance food availability, improve nutrition, and promote sustainable resource utilization.

Keywords : energy storage, food security, post-harvest, solar dryer

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