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Technical evaluation of a solar-biomass flatbed dryer for maize cobs drying in Rwanda

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Abstract

The persistent problem of postharvest losses in the maize value chain poses an arduous challenge for smallholder farmers in Rwanda, ultimately reducing their market bargaining power. As a consequence, there is an exacerbated disparity in revenues that makes farmers, predominantly female farmers, more vulnerable. The existing drying facilities are based on ambient air drying with a long drying time and the alternative mechanical dryers use mostly fossil fuels which is not a sustainable solution. A solar-biomass hybrid flatbed dryer for maize cobs drying was designed and constructed in the high-altitude volcanic zone of Rwanda. The objective was to provide farmers with an affordable and sustainable drying system with a high drying rate compared to the existing method. In this study, we present the results of the technical evaluation of the dryer to rate its capacity to dry maize cobs to the recommended moisture content. Energy balance was assessed by temperature sensors, airflow distribution was measured with a vane anemometer and the solar radiation from weather station were compared to the solar system data recorded through a datalogging charge controller. Maize was dried in three batches and the moisture content was measure with oven method. Results showed a uniform distribution of airflow on the dryer perforated flow. The burner consumed on average 6 kg of empty cobs per hour and the burner efficiency was 59.4 %. The solar system provided a maximum daily yield of 2.6 kWh, and the battery was able to maintain the system during days of low solar energy availability. Maize cobs were dried from an average moisture content of 23.0 % to 13.7 % in an average period of 90.6 hours. This drying time was significantly lower compared to the already existing system which uses more than 6 weeks. The results prove that the solar-biomass hybrid flatbed dryer was appropriate for drying maize cobs to the recommended moisture content and thus reduce the risk of postharvest losses in maize value chain in Rwanda. The dryer might be further improved by combining the burner with a solar heating system to further reduce the biomass mass consumption.

Keywords: Biomass energy, energy balance, maize drying, photovoltaic, postharvest, renewable energy

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