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# Design, construction and testing of a solar-biomass flatbed dryer for maize cobs drying in Rwanda

Janvier Ntwali, Joévin Wiomou Bonzi, Sebastian Romuli, Joachim Müller

*University of Hohenheim, Inst. of Agricultural Engineering, Tropics and Subtropics Group, Germany*

**Abstract**

Maize is one of the most relevant cereal crops for human diet worldwide and specifically in sub-Saharan Africa due to its wide adaptability and nutritional value. The high-altitude regions in the tropics above 1500 m a.s.l. are characterised by low temperatures and abundant rainfall, making drying of maize cobs difficult. In this study, a solar-biomass hybrid flatbed dryer for drying maize cobs was designed, constructed and tested in the high-altitude maize producing volcanic regions of Rwanda. The dryer capacity is two tons of fresh maize cobs per drying batch. A low-cost biomass combustion unit was designed and constructed using locally available materials. The dryer was equipped with two fans, which are powered by a photovoltaic (PV) system. One fan was installed behind the heat exchanger to bring heated air into the plenum of the dryer. The other fan was installed at the air inlet of the combustion unit, in order to regulate the supply of combustion air. Airflow and temperature distribution in the combustion unit and the drying chamber were optimised by simulation with computational fluid dynamics (CFD) software. Size of solar arrays and batteries of the PV system was determined with MATLAB/Simulink model integrated with climate data for the target region. The technical performance will be on-site assessed, in terms of drying rate and dryer efficiency. Preliminary results show that the maize cobs bulk produced a static pressure of 120 Pa for a volumetric airflow of 1 $m^3$ $s^{-1}$. Simulation of the PV system shows that the battery state of charge (SOC) remained above the threshold of 40 % for more than 25 days in a row during a typical harvesting period. The solar-biomass hybrid flatbed dryer can be used as a sustainable solution to smallholder farmers for handling maize cobs.

**Keywords:** Biomass energy, CFD, Matlab/Simulink, renewable energy, solar panels, ventilator test rig

**Contact Address:** Janvier Ntwali, University of Hohenheim, Inst. of Agricultural Engineering, Tropics and Subtropics Group, Garbenstr. 9, 70599 Stuttgart, Germany, e-mail: janvier.ntwali@uni-hohenheim.de