



UNIVERSITÄT
HOHENHEIM

INSTITUT FÜR AGRARTECHNIK

Agrartechnik Tropen und Subtropen

Prof. Dr. Joachim Müller

Master-Thesis

Agricultural Sciences in the Tropics and Subtropics

cand. M. Sc. Janna Beck

**Feasibility study of a solar powered hammer mill for Maize in rural
Mbinga district, Tanzania**

This work was financially supported by the Foundation fiat panis.

Submitted: 15.08.2022

Abstract

The use of PV energy to drive electric powered maize mills used in rural areas in Tanzania provides clean energy and long-term cost savings and can compensate for the supply volatility of the Tanzanian power grid. For optimal adjustment of the drive and energy requirements of the mill, physical characteristics of maize as well as maize flour such as its moisture content, degree of hardness, and particle sizes were studied. The average degree of hardness was 407.94 N/mm. The moisture content for the yellow fodder maize and flour was on average 15.37% and for the white food maize 12.26%. Most yellow maize grains have a long side between $6.3 < x < 8$ mm, whereas the majority of white maize grains have a long side > 8 mm. The throughput was approx. 150 kg/h. During the milling experiments it was found that feeding was an important parameter for throughput and that overloading can lead to breakdowns and disruptions in the mill. The mill visits and technical measurements in TZ showed that a drive of about 10 kW is required. The speed varied between either 1500, 3000 and 4000 rpm. Interviews with mill workers have revealed that their knowledge about the mill and the drive was low. With few exceptions, no accounting was kept of the milling business and capital expenditures. Ultimately, a hybrid drive consisting of PV and grid connection was modeled in a simulation. Two alternatives were proposed that could reduce the current grid failures from 10% to 5 and 3% with a PV share of 33 and 74%, respectively. The NPCs were slightly higher than the base case, whereas the operating costs were substantially lower. Still, the investment costs seemed to be a barrier for most people. Due to the local mentality, proper handling of the PV-powered milling system seems to be a challenge.

Keywords: Renewable energy, TANESCO, HOMER Pro, cultural feasibility, hybrid power system