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Utilization of Photovoltaic Systems in Africa — Optimization of Grain Mill for a Rural Household Size

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Abstract

Africa has poor level of mechanization, infrastructure and energy supply. Specially rural areas, where 80 % of the population is living and only 4 % of them are connected to public grid, are seriously affected by these problems. As a result the young generation is migrating to cities for better living conditions, increasing uncontrolled urbanization and unemployment while reducing agricultural productivity. Due to their scattered settlement connecting rural areas to public grid is not economical, however, decentralized power supply like photovoltaic (PV) systems is the best alternative to satisfy their energy demand. Optimising agricultural machinery for lower energy consumption (100 Wp) further encourages the utilization of PV systems. Grain milling, usually done by women and children, is one of the most drudgery and time consuming rural activity that needs optimisation.

Therefore, a project has been launched at University of Hohenheim to optimise grain mill for smaller energy consumption. Easily available materials like Corundum, Magnesium oxide, Magnesium chloride and water were used to construct the appropriate millstone. The millstone has a diameter of 150 mm and a thickness of 23 mm. It was driven using a 12 V DC motor connected to PV systems. Almost all major grains grown in Africa (maize, sorghum, barley and wheat) were used for the milling test. The parameters like millstone gap and feed rate of the grain were used for the optimisation purpose.

During the optimisation process it has been observed that reducing the gap between the millstone increases energy consumption and proportion of fine particles. Increasing the feed rate has also increased the energy requirement of the milling process. The comparison between the preference of local people in Zambia, Chad and Niger showed that the flour produced using the optimised mill is in the acceptable range for their diet. Therefore, the result indicates that the optimised grain mill whose capacity is 25–50 kg/day, is more than enough for a daily requirement (2–3 kg/day) of an average family and can be powered using a Solar Home System with two PV modules.

Keywords: Energy, grain milling, photovoltaic systems

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