Tropentag, September 18-20, 2019, Kassel

"Filling gaps and removing traps
for sustainable resource management"

Development of a Decision-Making Tool for Solar Energy Implementation along the Rice Value Chain

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Abstract

Energy supply in agri-food value chains is challenging in several African countries, where the supply is weak and relies mostly on fossil fuels. Nowadays, there are different renewable energy solutions which could cover the energy demand at different levels of the agri-food chains. Solar photovoltaic (PV) systems and solar thermal devices are the leading solar technologies used for applications like solar PV pumps for irrigation systems, solar dryers, solar cooling systems, solar mills, and solar cooking, among others. Moreover, researchers are continuously working on the development of different energy sources or on the optimisation of the existing solutions to improve the efficiency of various machines on several value chains. Nevertheless, the implementation of solar energy systems throughout Africa is limited, mainly due to the lack of information on new research related to solar energy applications in agriculture, the energy demand of various machinery utilised along the value chain and lack of performance evaluation of a solar photovoltaic (PV) system. It is for this reason that farmers, producers, stakeholders, policy makers, governmental and non-government agencies require rapid analytical tools to support the decision-making process for advising proper implementation. Therefore, a decision-making tool was developed using a graphical interface designed in MATLAB®/Simulink®. Taking as a baseline example the rice value chain in Benin, it was assessed two potential scenarios. The first scenario the partial substitution of fossil fuels by simulating the energy supply of a hybrid design (PV systems plus diesel generator-system) and the second scenario is the total replacement of fossil fuel by simulating the energy supply of solar PV systems. This tool evaluates the optimum PV system taking into consideration many factors, such as local weather data, baseline information of the energy consumption of different machines operated in the rice value chain, machine capacity, and the economic data in terms of the payback period. At the same time, this tool offers information on the potential mitigation of greenhouse emissions, due to the reduction of fossil fuel consumption by the integration of solar PV systems in the value chain.

Keywords: Decision-making tool, hybrid PV, diesel systems, rice value chain, solar energy

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