ABSTRACT

The performance of a directly-coupled solar photovoltaic water pumping system was investigated under field conditions. The objectives of the study were to establish the technical performance indicators of solar photovoltaic water pumping systems, then investigate the actual performance of the system operating under field conditions. The study set-up consisted of an 18.72 kW-capacity directly coupled solar PV water pumping system installed in a 150-meter-deep borehole in a remote village in Wajir northern Kenya. The system was studied over a 60-day period under varying solar irradiance. Data was collected using an in-built data logger and remote monitoring device integrated in the Pump Inverter/Controller assembly. The results showed that solar irradiance varied from 63 W/m² to a peak of 857 W/m², corresponding to a maximum power output of 11.75 kW. PV array efficiency of 12.1%, sub-system efficiency of 91.82% and overall efficiency of 5.14%. The results obtained were compared with manufacturer’s recommendations and results reported elsewhere and it was observed that this system had a within range performance output. By obtaining an optimal load matching factor of 0.66, the results demonstrate that the system components at Abakore were averagely well matched, adequately configured and in close agreement with recommendations for load matching factor between the PV solar generator and the electro-mechanical system. The study concludes that solar PV driven systems when properly designed are more reliable and cost-effective in the long-run for water pumping applications. Since this study focused on analyzing one solar system, the findings are inadequate to make general conclusions on performance of installed solar pumping system. As such the study recommends further research to test and conduct performance evaluation of several solar pumping systems with different characteristic and at different locations over a longer period to compare influence of different characteristics and contexts.