African Nanotechnology in Engineering (Environmental applications)

Solar-Powered Irrigation for Ethiopian Women Farmers in Highland Ecosystems: Performance and Economic Evaluations

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Abstract

Solar-powered irrigation systems are increasingly being promoted as a sustainable solution for smallholder farmers in arid and semi-arid regions, including Ethiopia's highland ecosystems. A mixed-methods approach combining quantitative data from pump efficiency tests and qualitative interviews with farmer participants was employed. Solar pumps demonstrated an average daily lift capacity of 20% higher than conventional diesel pumps, reducing electricity costs by approximately 65% for farmers. The economic benefits of solar irrigation systems significantly outweigh the initial investment costs, particularly for women farmers who often lack access to formal credit markets. Government subsidies and public-private partnerships should be encouraged to facilitate widespread adoption of solar-powered irrigation in Ethiopian highlands. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Ethiopia, Highlands, Solar-Powered Irrigation, Smallholder Farmers, Women Agriculture, Economic Evaluations, Performance Analysis*

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