A Systematic Review of Youth-Focused Technical Curricula for Solar-Powered Irrigation Maintenance in the Sahel: Uptime Implications for Mali

B, o, u, b, a, c, a, r, D, i, a, k, i, t, é, ,, M, a, m, a, d, o, u, K, e, i, t, a, ,, A, m, i, n, a, t, a, T, r, a, o, r, é

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Abstract

Solar-powered irrigation is a critical technology for enhancing agricultural resilience in the Sahel. System sustainability is frequently compromised by a lack of local maintenance capacity, leading to significant pump downtime and creating a need for effective, locally-embedded technical training. This systematic review aimed to identify and synthesise evidence on youth-focused technical curricula for maintaining solar-powered irrigation pumps in the Sahel. Its primary objective was to assess how such educational interventions impact system uptime compared to traditional maintenance models, with a specific focus on implications for Mali. A systematic search of peer-reviewed and grey literature was conducted across multiple academic databases and development organisation repositories. Predefined inclusion and exclusion criteria were applied to select studies describing technical training programmes, curricula, or field interventions. Data were extracted and analysed using a narrative synthesis approach. The review found a significant scarcity of peer-reviewed studies containing empirical uptime data. A consistent theme from project reports was that programmes integrating hands-on, practical modules with foundational theory led to improved trainee competency. One identified case study suggested a potential reduction in downtime for pumps serviced by trained local youth, though robust comparative data were lacking. While indicative evidence supports the value of practical, youth-focused training

for improving maintenance capacity, the field suffers from a pronounced lack of rigorous, published evaluations measuring direct uptime outcomes. The potential for such curricula to enhance sustainability is recognised but not yet conclusively quantified. Future initiatives should incorporate robust monitoring and evaluation frameworks with standardised uptime metrics from the outset. Curriculum development must prioritise contextual relevance, using local case studies and components. Further primary research is needed to establish a stronger evidence base linking specific training elements to long-term technical performance. technical and vocational education and training, solar irrigation, maintenance, curriculum development, Sahel, youth, agriculture, sustainability This review consolidates the limited available evidence on a key aspect of educational technology integration in Africa, clearly identifying a critical gap in empirical research linking vocational training to tangible engineering outcomes and providing direction for future programme design and evaluation.