Meeting the water and energy needs in the rural areas of Malawi using solar PV technologies

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Meeting the water and energy needs in the rural areas of Malawi using solar PV technologies

E. Phiri, P.N. Rowley, R.E. Blanchard

1. Introduction
- Water and energy are two global challenges that need urgent solutions.
- Approximately, 15% of Malawians still do not have access to potable water and even for those who do, the quality is questionable.
- Only 10% of the country’s population have access to grid electricity and less than 1% of rural areas.

3. Methodology
The research was interdisciplinary and used mixed methods approach as illustrated in Fig. 1.

4. Results

b. Techno-economic Analysis
- A directly-coupled solar photovoltaic water pumping system was designed (Fig 5).
- Water will be distributed to a public stand-post with four taps.
- Results for water costs are shown in Table 1.

4. Results

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- Water will be distributed to a public stand-post with four taps.
- Results for water costs are shown in Table 1.

Fig 3: Queuing for water

Fig 4: Women collecting water from broken elephant pump

Fig 5: Directly-coupled SPV water pumping system

Table 1: Economic Analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Size</td>
<td>1.5 kW</td>
</tr>
<tr>
<td>Amount of Water</td>
<td>20 m³/day</td>
</tr>
<tr>
<td>Cost of System</td>
<td>US$18, 600</td>
</tr>
<tr>
<td>Cost of Water</td>
<td>US$0.34/m³</td>
</tr>
<tr>
<td>Cost of water equivalent</td>
<td>US$1.08/month</td>
</tr>
<tr>
<td>Current Payment</td>
<td>US$0.19/month</td>
</tr>
<tr>
<td>Income</td>
<td>US$15/month</td>
</tr>
<tr>
<td>Ability to pay</td>
<td>US$0.75/month</td>
</tr>
<tr>
<td>Willingness to pay</td>
<td>US$0.38/month</td>
</tr>
</tbody>
</table>

4. Results

4.4. Results
- From the qualitative study challenges were non-functionality (Fig 4), insufficient boreholes, theft and vandalism, and long time spent collecting water.
- Primary source of lighting is disposable dry cell batteries; also used for radios.
- Mobile phone charging is done at long distances of up to 20 km.

5. Conclusions
- The research concludes that with proper design and planning solar PV pumping can meet the water and basic energy needs of the rural areas.
- The system can supply to more people than a borehole.
- The system reduces manual pumping labor and time spent queuing.
- Contributes to the Sustainable Development Goals of water, energy, education, health & gender.
- Future Work: (i) subsidizing with water for irrigation (ii) Field performance studies and (iii) distribution of water to individual houses/compounds.

Selected References
- Pritchard et al., 2007. Biological, chemical and physical drinking water quality from shallow wells in Malawi. Case study of Blantyre, Chiradzulu and Mulanje. Physics and Chemistry of the Earth, 32(15-18), 1167–1177

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