Institutional Modalities for Grid-Connected Solar Irrigation Pumps (SIPs): A Review

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3-Key Questions for Today’s Discussion

• Are grid-connected SIPs good solution to increase capacity utilization of SIPs?

• How feasible the idea is given smaller size of SIPs in Nepal?

• What could be an appropriate institutional modality for governance of grid-connected SIPs in Nepal?
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• Significance of Grid-connected SIPs

• Typologies of grid-connected solar

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• Potential institutional models for Terai (Nepal) – DISCUSSION Question!
Scenario of SIPs in Nepal – SIP distribution is primarily in Terai

• About 1,800 SIPs installed in Nepal; > 1,380 are with AEPC’s subsidy

• *Terai* provinces (P 1, 2, & 5) accounted for
  – 75% of applications & 85% of the granted SIPs. The pattern was true for districts & Palikas too.

• Furthermore,
  – About 22% of SIP subsidy are granted to women applicants
  – A large number of pumps are between 1-2 HP size
Scenario of SIPS in Nepal – Cost of SIPS are high in all Provinces

- Even with 60% subsidy, farmers still had to pay 263,793 rupees (2,180 USD) for a SIP, though it varied with pump size.

**Table.** Average cost (in NRs lakhs) of SIP by province (P) and pump capacity

<table>
<thead>
<tr>
<th>Pump capacity (hp)</th>
<th>P1</th>
<th>P2</th>
<th>Bagmati</th>
<th>Gandaki</th>
<th>Lumbini</th>
<th>Sudur-paschim</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>3.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4.5</td>
<td>4.9</td>
<td>4.6</td>
<td>4.7</td>
<td>4.7</td>
<td>5.0</td>
</tr>
<tr>
<td>2</td>
<td>6.7</td>
<td>8.4</td>
<td>4.9</td>
<td>4.9</td>
<td></td>
<td>6.9</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>11.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>29.9</td>
<td>15.9</td>
<td></td>
<td></td>
<td>23.4</td>
</tr>
<tr>
<td>&gt;5</td>
<td></td>
<td>14.4</td>
<td>16.4</td>
<td>16.9</td>
<td>12.8</td>
<td>24.4</td>
</tr>
<tr>
<td>Total pumps</td>
<td>146</td>
<td>658</td>
<td>105</td>
<td>12</td>
<td>122</td>
<td>12</td>
</tr>
</tbody>
</table>

- One of the **Challenge** is – Enhancing Return on Subsidy (or **Maximizing Return**)
  - Maximizing use of Energy by **Connecting SIPS to Grid** could be one of the Strategies for Maximizing Return.
Significance of Grid-connected SIPs

• ~ 1,800 SIPs are already installed, mostly in Tarai Plains, Nepal
  – For pumping Groundwater for irrigation purpose

• This kind of water-energy connection has implications in
  – Groundwater over-extraction and associated impacts on the environment.

• Therefore, it is necessary, to incentivize evacuating surplus energy to grids to generate extra income, as it helps
  – mitigate the risk of groundwater over-extraction,
  – stabilize the grid system and provide quality power in nearby area, &
  – contribute to proliferating the income generation opportunity for individuals.
Typologies of grid-connected solar system

• Based on scale of solar PV system
  – Stand-alone solar PV system - For individual houses, solar home system (SHS)
  – Mini/Micro-grid system - Community or village scale solar system
    ▪  Mini grid (10 kW – few MW); Micro-grid (1-10 kW); Nano/Pico (< 1 kW)
  – Grid-connected/Grid-extension (on-grid) system
    ▪  Connection of community to new areas using national power transmission system

• Based on method of connection to grid
  – Direction connection to Grid; & Connection through mini-micro grids

• Based on ownership of business model
  – Privately-owned;
  – Community-owned (community-managed & co-operative managed); &
  – Government-owned/Franchisee
Typologies of grid-connected solar system: grid-connection options?

1. Direct net-metering of solar pump system – water pump can get electricity input from both solar grid inverter & power grid network

2. Solar micro-grid (MG) system

3. Solar-powered agricultural feeder - to create a tail-end grid-connected solar PV plants (1-2 MW) dedicated to agricultural loads

Key attributes - institutional models for grid-connected SIPs

• Ownership – Private (38%), community (25%), government (13%).
  – Which one could be more suitable in Nepal-Terai context?

• Beneficiaries – types (e.g. HH, private, public, farmer) & other characteristics (e.g. land holding, cast, ethnicity, income level, etc.)
  – How to ensure different sections of societies are benefited?

• Benefit/energy sharing/access mechanisms
  – Estimation of benefits? Mechanism for ensuring equitable access of energy and distribution of benefits? Sharing of losses in distribution system? Accounting for total energy use?

• Linkage with the government stakeholders –
  – Roles of government and other stakeholders? Regulatory approach?

• Business models – for investment & revenue generation?
  – Arrangement of capital investment – % of grant, loan & equity?
  – Revenue generation – basis for charging (e.g. flat, progressive)?
## Key attributes - institutional models for grid-connected SIPs

<table>
<thead>
<tr>
<th>Model name</th>
<th>Privately-owned</th>
<th>Community-Owned</th>
<th>Government-Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Beneficiaries</em></td>
<td>HHs/Private /Public Sector</td>
<td>Large-holder (Farmers)</td>
<td>smallholder (Farmers)</td>
</tr>
<tr>
<td>Benefit/Energy/ Equity sharing mechanism (BSM)</td>
<td>Based on extent of use (e.g., farm size, number/size of rooms, infrastructure, etc.)</td>
<td>Ensuring benefit to marginal users (e.g., in the form of more or all subsidy, waiver in tariff, etc.)</td>
<td>Incentivising women (e.g., in the form of extra subsidy, etc.)</td>
</tr>
<tr>
<td>Capital Investment (CI)</td>
<td>Subsidy from GOV &amp; equity from individuals</td>
<td>Subsidy from GOV, loan from suppliers/ manufacturers &amp; equity from developers</td>
<td>Subsidy from GOV &amp; donors &amp; equity from developers</td>
</tr>
<tr>
<td>Regulatory Approach (RA)</td>
<td>Fully Regulated by GOV</td>
<td>Jointly regulated by GOV &amp; community</td>
<td>Based on provision of license</td>
</tr>
<tr>
<td>Business Model (BM)</td>
<td>Grant Model</td>
<td>Grant Loan Model</td>
<td>Pay As You Go (PAYGO) Model</td>
</tr>
</tbody>
</table>

**Question:** What attributes will be appropriate for Nepal-Terai?
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