



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?

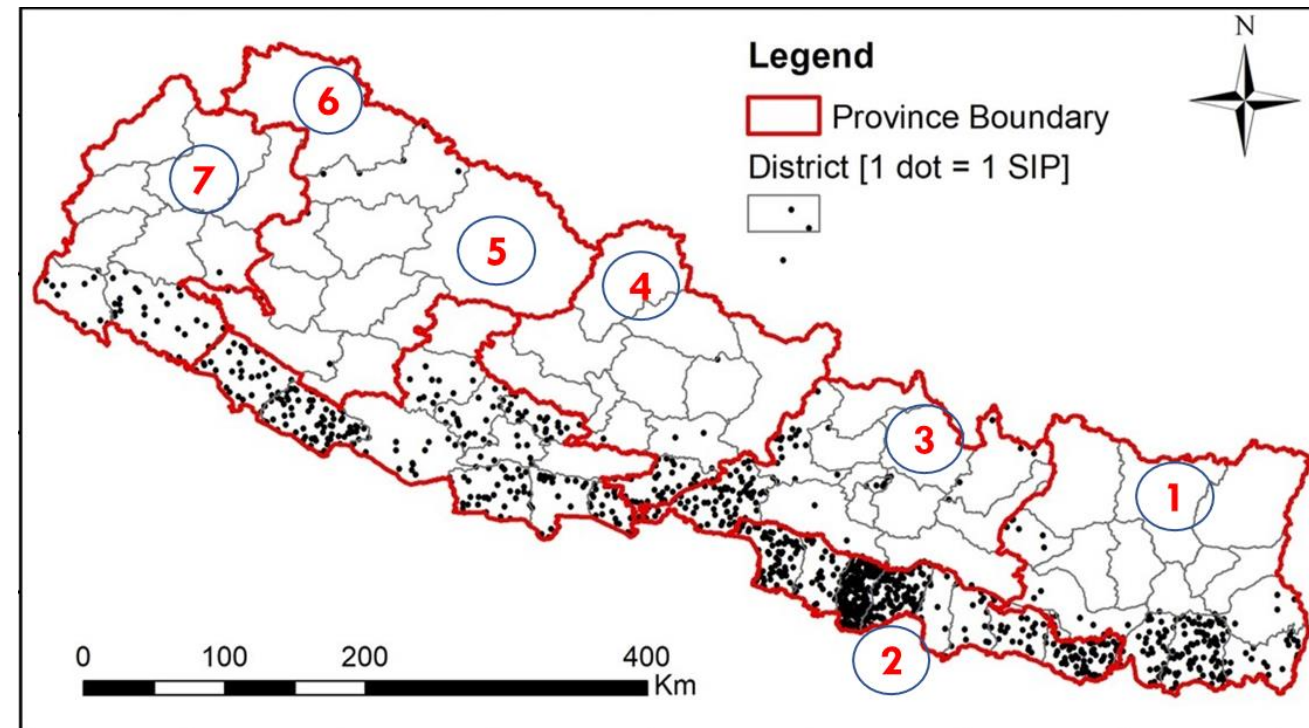


- Scenario of SIPs in Nepal
- Significance of Grid-connected SIPs
- Typologies of grid-connected solar
- Key attributes - institutional modalities for grid-connected SIPs
- Potential institutional models for Terai (Nepal) – **DISCUSSION Question!**

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
- *Tarai* 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

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

- 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



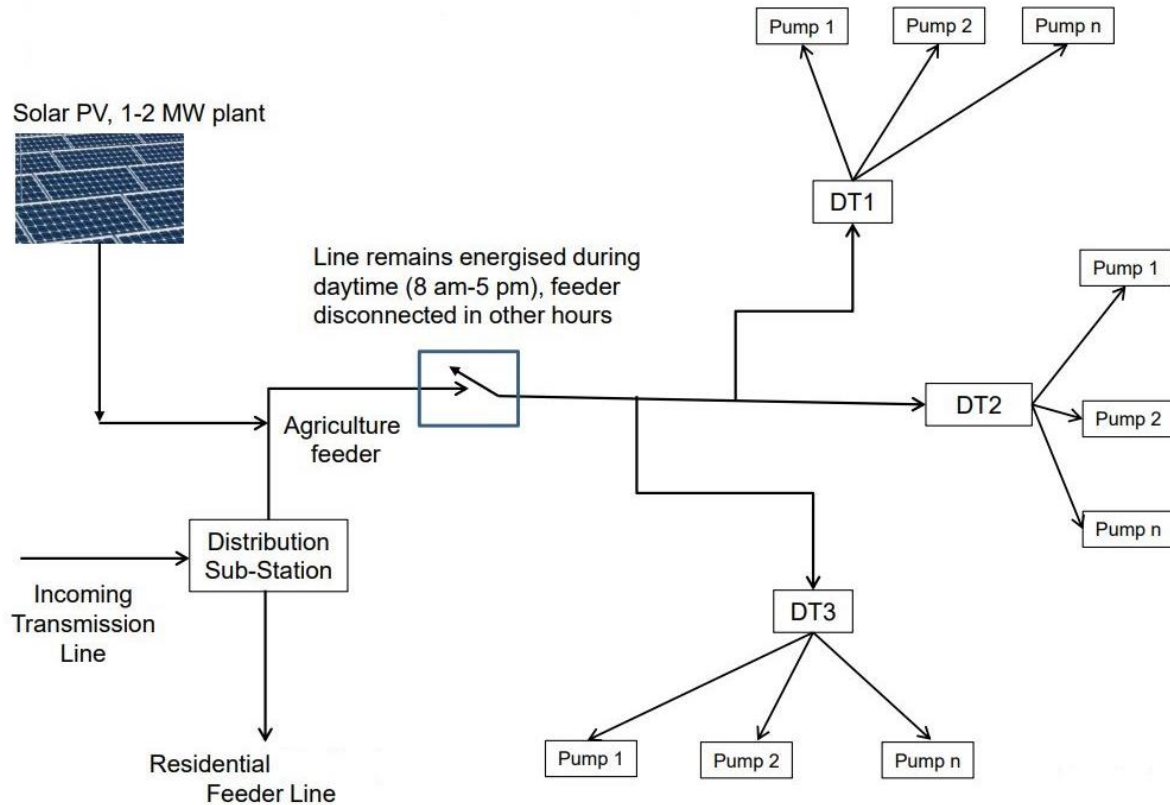
- ~ 1,800 SIPs are already installed, mostly in Tarai Plains, Nepal
 - For pumping Groundwater for irrigation purpose
- This kind of **water-energy connection** has implications in
 - Groundwater over-extraction and associated impacts on the environment.
- Therefore, it is necessary, to incentivize **evacuating 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



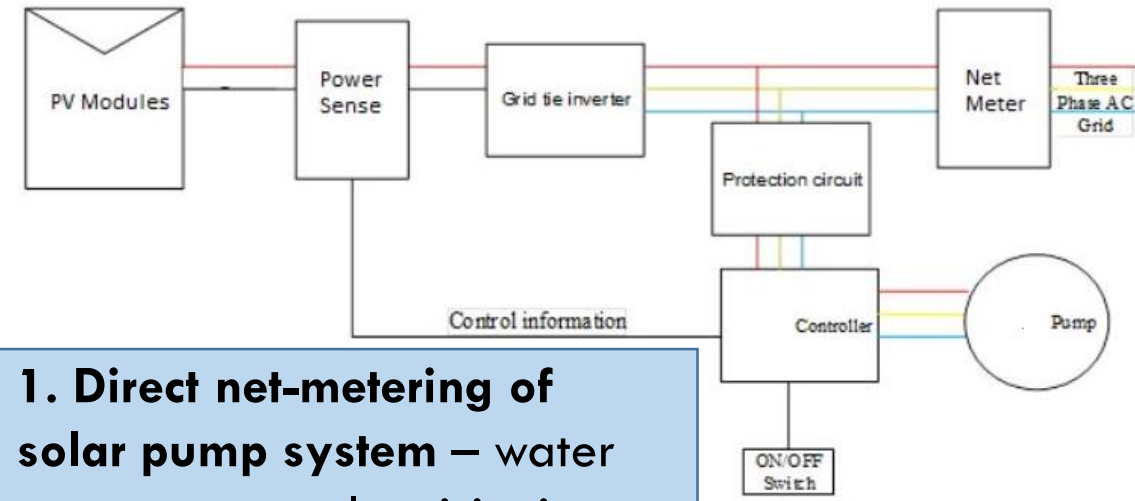
- Based on scale of solar PV system
 - Stand-alone solar PV system - For individual houses, solar home system (SHS)
 - Mini/Micro-grid system - Community or village scale solar system
 - Mini grid (10 kW – few MW); Micro-grid (1-10 kW); Nano/Pico (< 1 kW)
 - Grid-connected/Grid-extension (on-grid) system
 - 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?

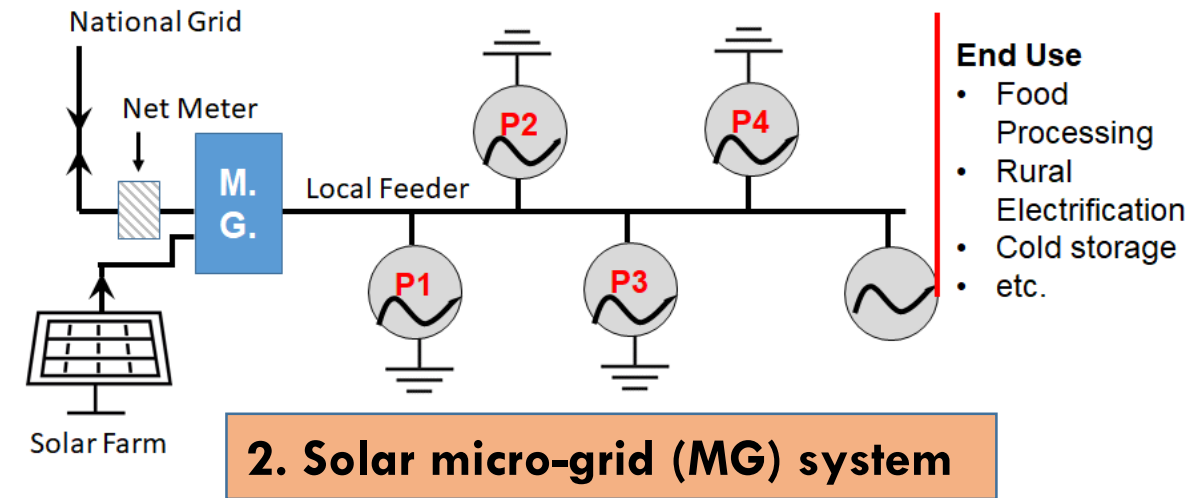


3. Solar-powered agricultural feeder - to create a tail-end grid-connected solar PV plants (1-2 MW) dedicated to agricultural loads

4. On-Grid Solar Pump Inverter – advanced net-metering system



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



- 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



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

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

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