Global Best Practices and Policy Supports for Solar Irrigation Systems: Implications for South Asia

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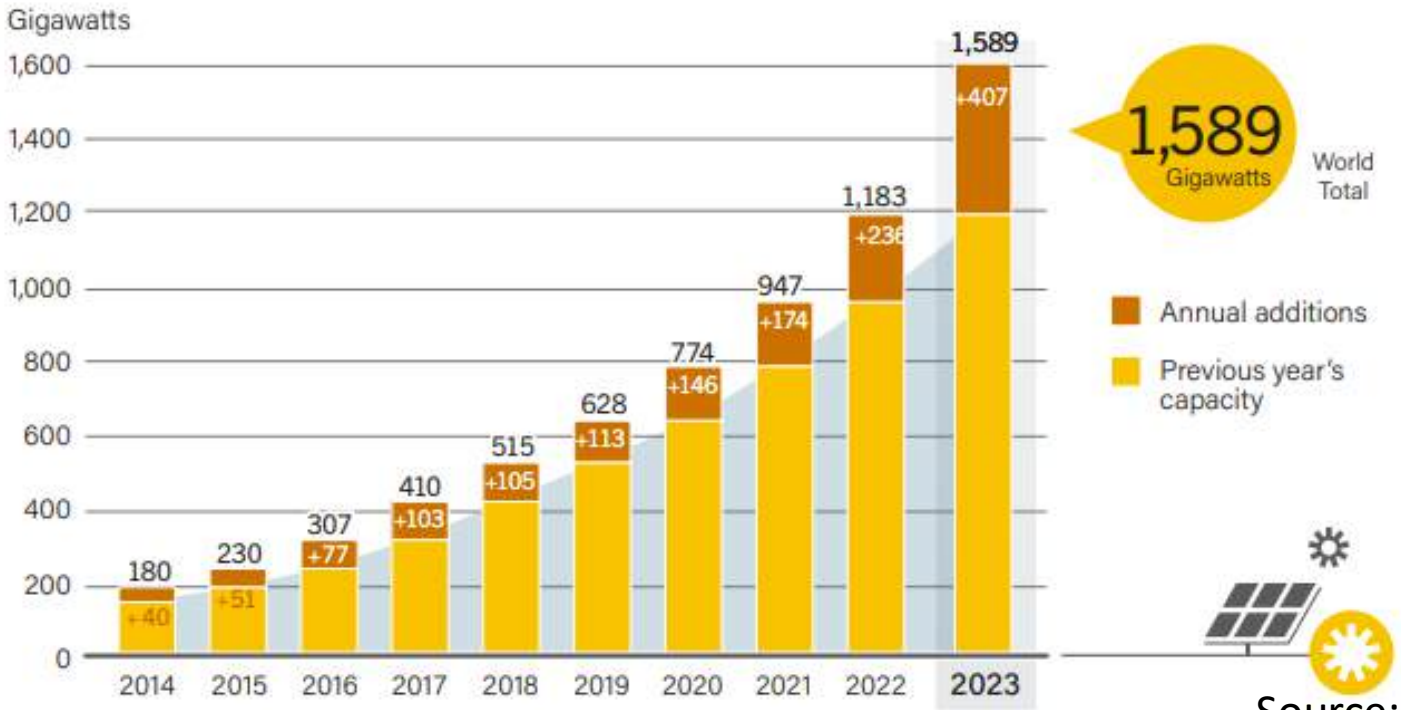
Solar PV Annual Capacity Worldwide

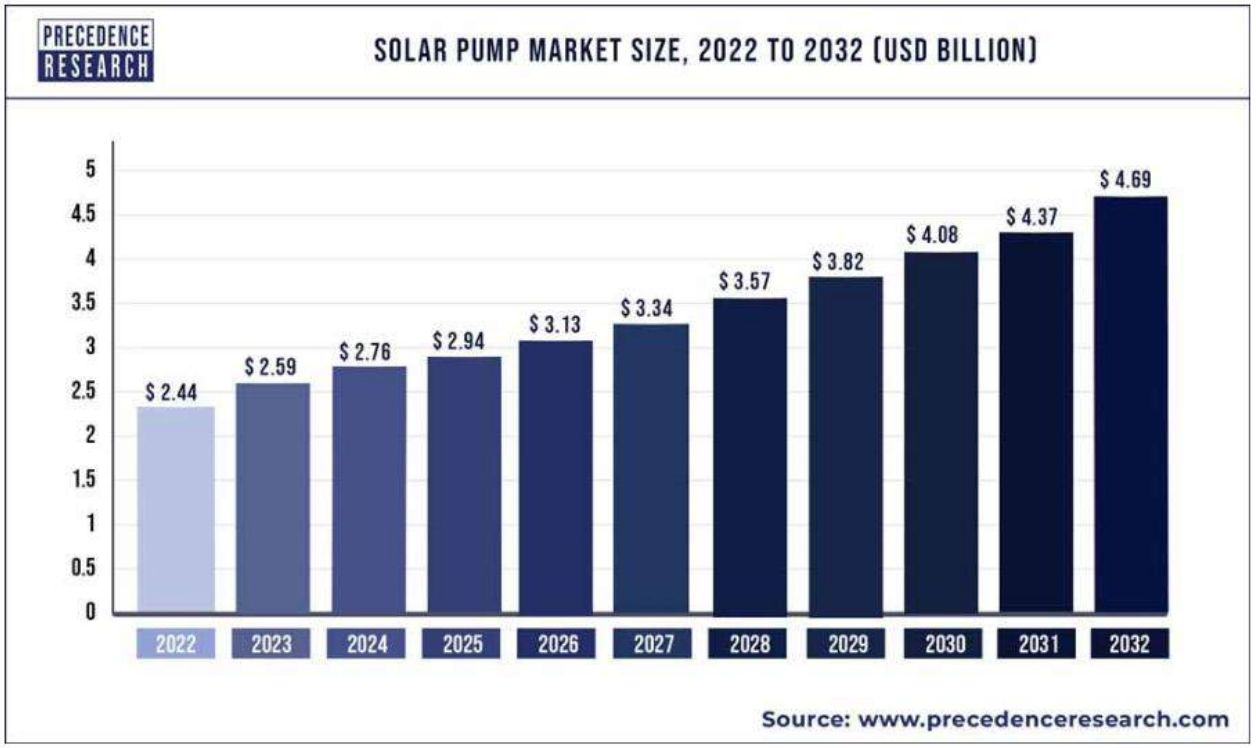
- Global solar PV capacity totaled 1589 GW by 2023
- Highest growth among all RE over decade, more than 8 times growth
- 407 GW of solar PV capacity was added worldwide in 2023
- 117GW of wind capacity was added worldwide in 2023 totaling 1021GW
- 7.2GW of hydropower in 2023 totaling 1237GW



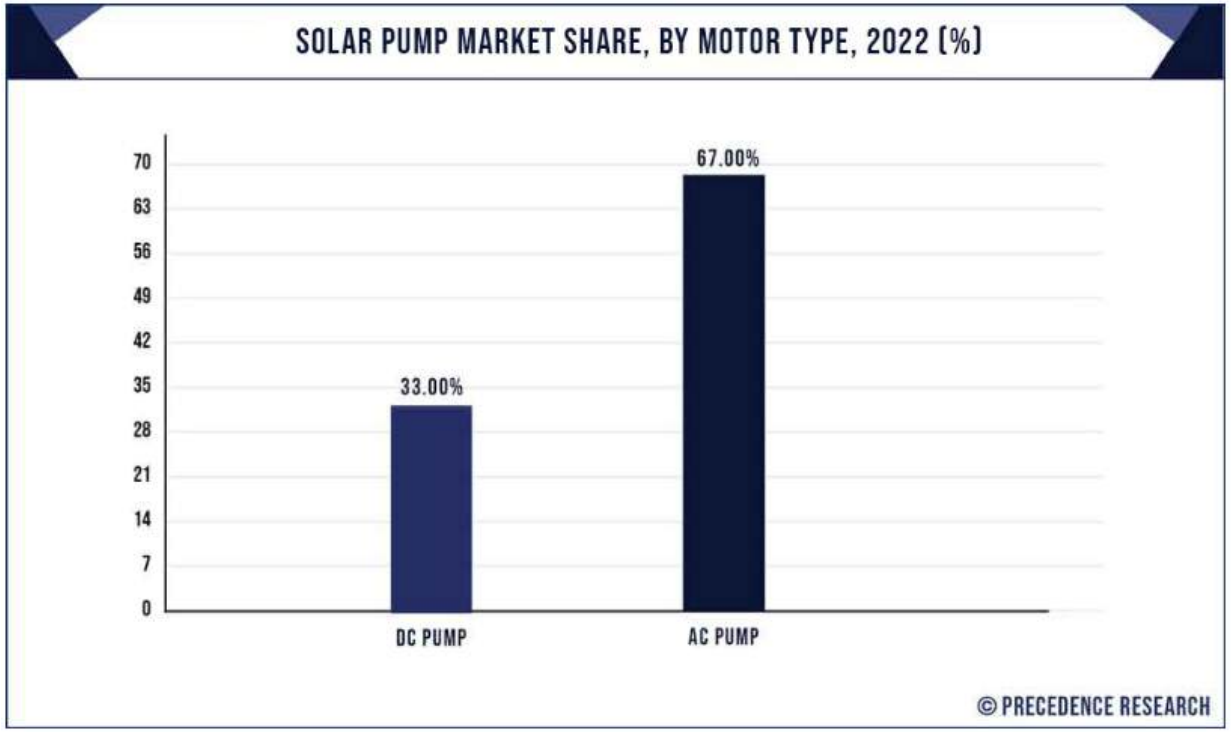
Source: GSR 2024, REN21

Solar Pumps global market

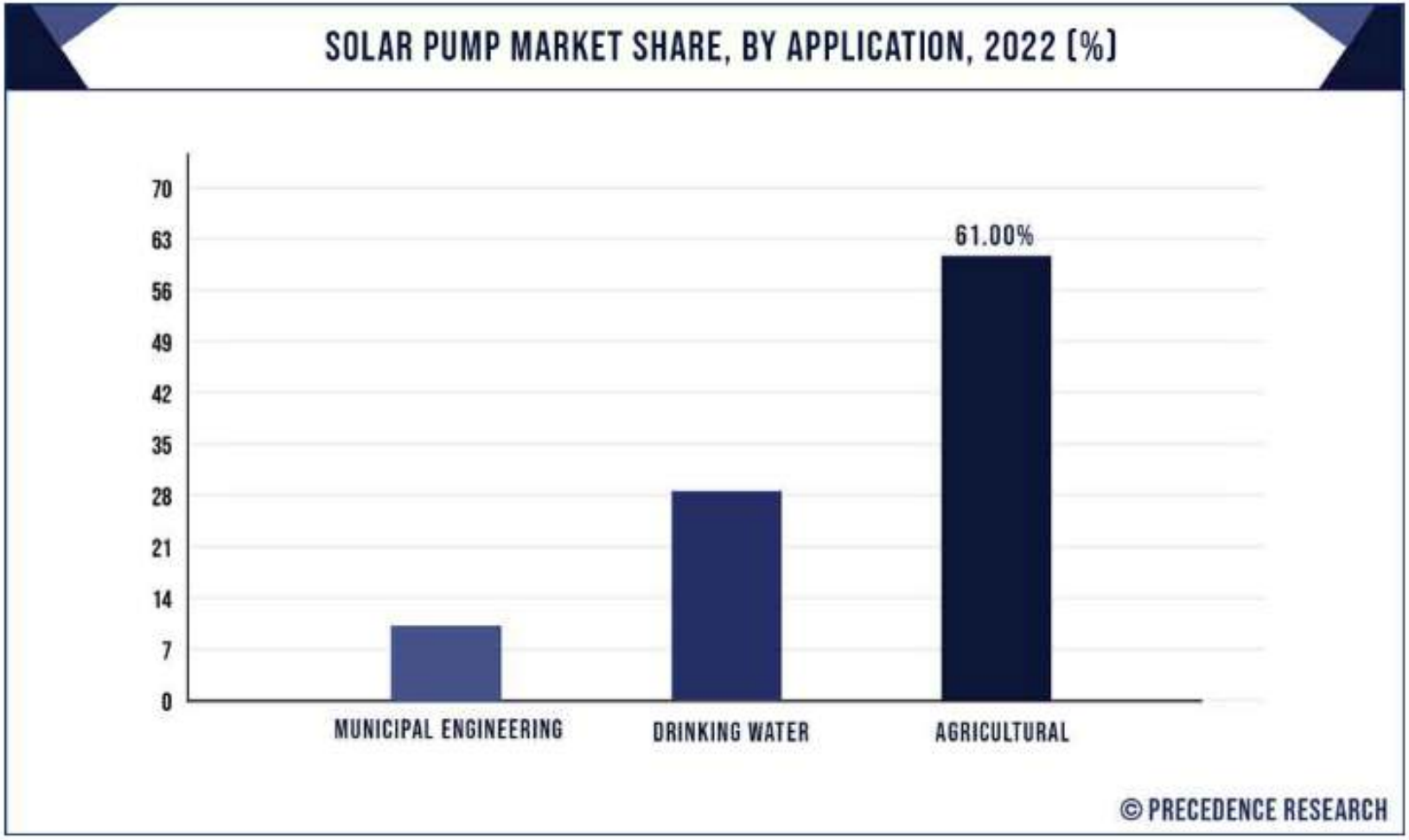
- The solar pump market, including irrigation pumps, is projected to reach USD 4 billion by 2030
- CAGR 6.8% and
- Asia-Pacific region accounting for 44%



DC and AC Pumps

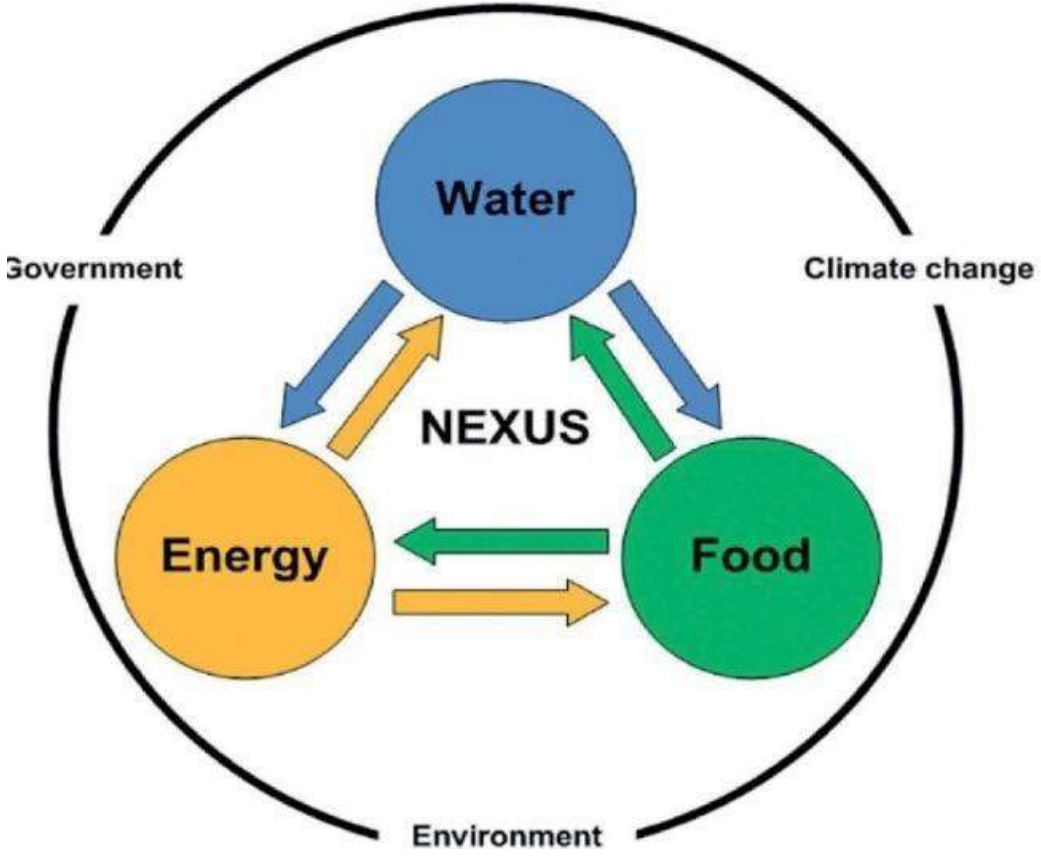


Market share by application



Water-Energy-Food Nexus

- Access to solar powered irrigation
- Reliable power supply
- Water and energy security



Solar PV pumping for sustainable irrigation

Advantage

- No fuel cost
- Low O&M
- Can operate anywhere in the sunshine
- Reliable-it can work partially even is overcast sky
- More productivity of solar pump in summer (longer day) during which more water is required
- Powered by clean energy

Disadvantages

- High capital cost
- Space required

Photo courtesy: sakti pump

Benefits of Solar Pumping

Farmers

- Supply of energy and improved access to water for irrigation
- Improved crop yields and increased incomes
- Reduced manual work and improved expenditure of time
- More income generating opportunities

Government

- Reduction in electricity and fuel use
- Reduced fuel imports
- Creation of small businesses/employment across the value chain
- Improved reliability of power systems
- Increased agricultural economic output
- Emissions reductions

Challenges of Irrigation in South Asia

Primary Canal, Secondary Canal but no tertiary canals

Very limited electricity distribution lines in the agriculture farm

Low voltage due to long T&D lines

draw higher current

chances of burning out of motor winding

Making subsidies on efficient water usages

Habit of flood irrigation

Very limited knowledge on sprinkler or drip irrigation

Pumping without water recharge system

https://www.paanifoundation.in/ india

Raising awareness for sustainable water usage amongst farmers, civil society, public institutions, and solar pump installers.

Limited local capacity

Capacity building to farmers, NGOs, service providers on repair and maintaincce

Solar Panel Theft in Rural Farms

- Solar panel theft in rural farming areas
  - Use of portable solar systems
  - Anti thread nuts and bolts.

Drying-up of water sources

- Deforestation
- Chaotic development work
- Sand and Aggregate Extraction
- Drying of rivers and shrinking of pond- no water recharge
- Water sources are disappearing
- Failure of water pumps
- Excessive extraction in low-land

Inter-governmental cooperation to manage shared water resources effectively

Holistic development for SIPs

Community-Based Large Irrigation Pumps

- Encourages community ownership and involvement in management

Grid Connected

- additional income for farmers through sale of surplus energy sales.

Water Recharge Systems

- Prevents groundwater depletion
- Boulder packing around boreholes, check dams in water streams, excavation of pits in upstream, pondage, bio-engineering etc

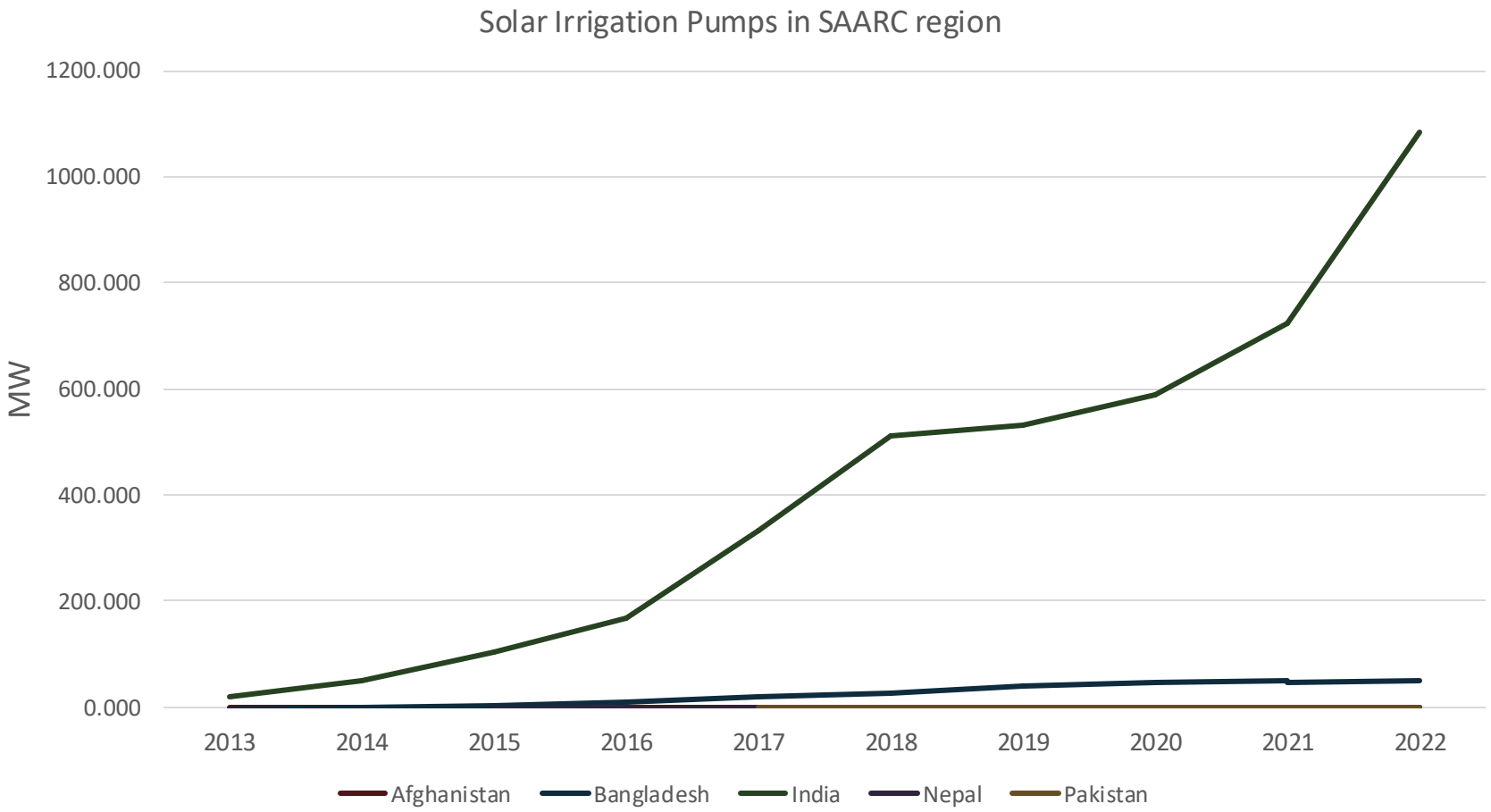
Integration of drinking water

- Sense of ownership

Agrovoltaic system

- Harvest the sun for both agriculture and energy uses

Solar Irrigation Pumps in SAARC countries

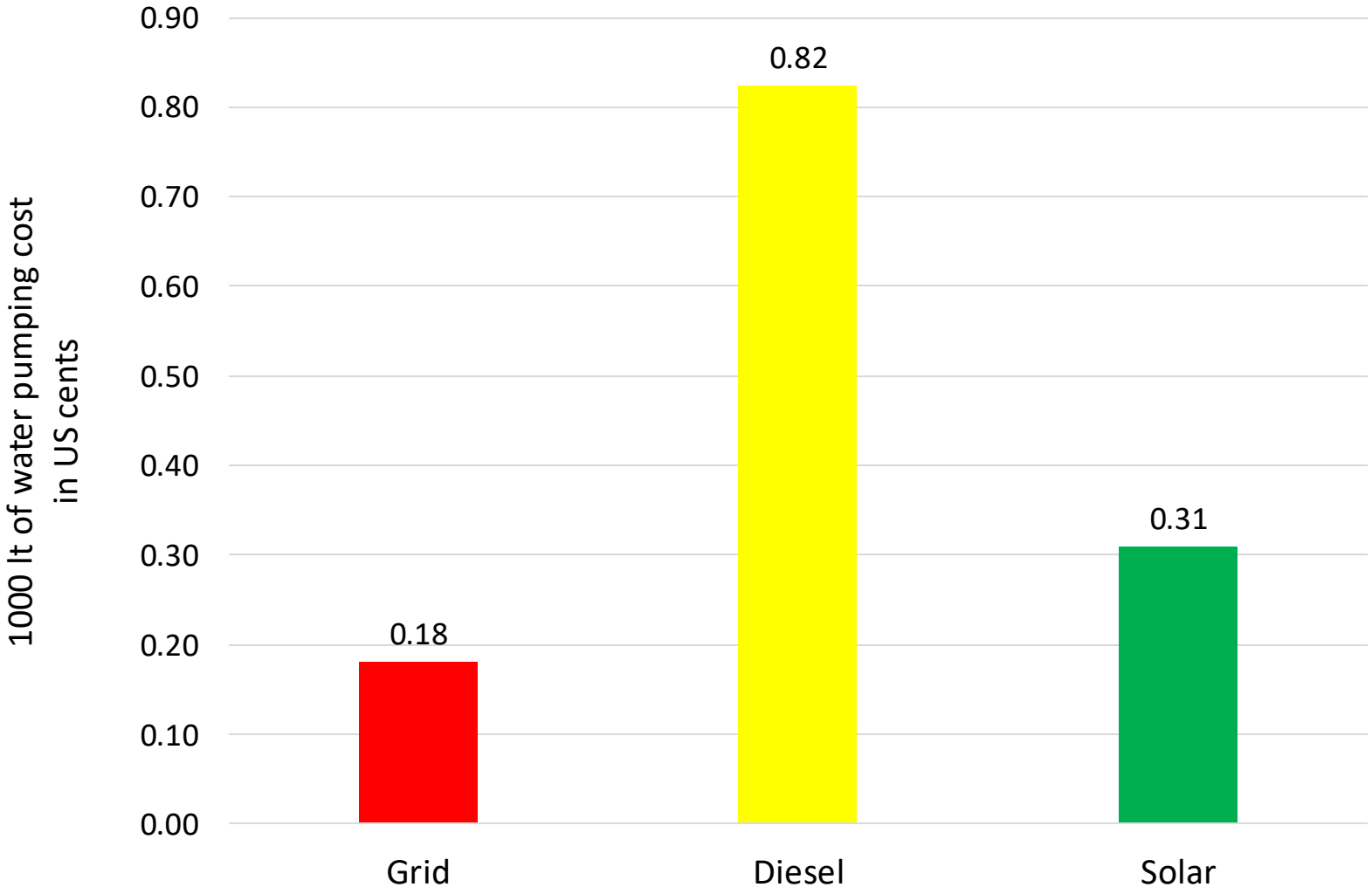


IRENA Off-grid Report 2023

SIPs Policies in SAARC countries

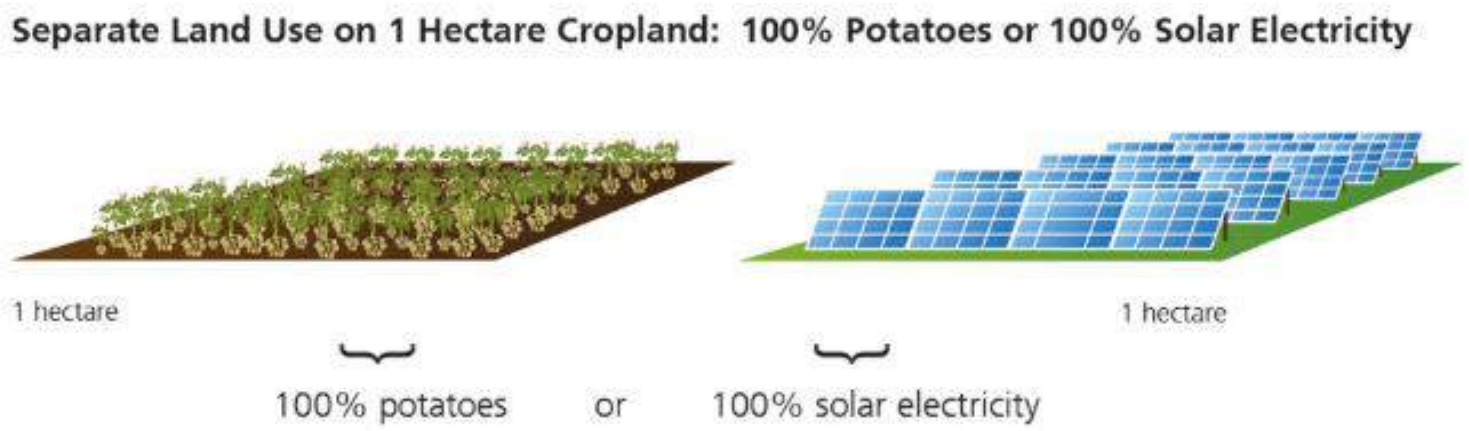
- **PM KUSUM-India (MNRE)**
  - Ambitious program of 34.8GW solar systems in agriculture sector by 2026 with financial support of $4.13billion from central government
  - The central government provides a subsidy of up to 30% or 50% of the total cost of installing a standalone solar pump or solarizing an existing grid-connected agricultural pump.
  - The state government provides a minimum subsidy of 30%, and the remaining amount is paid by the farmer.
- Nepal- 60% of CAPEX (GoN Subsidy Policy 2022)
- The subsidy for BREB model ranges from 62%–66%
  - IDCOL: 50%
- Pakistan: 60% of capital cost not exceeding (Rs. 720,000)

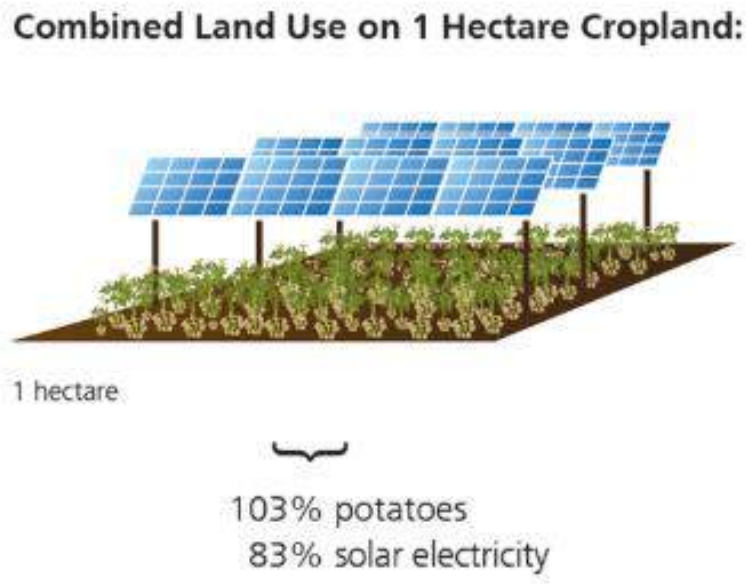
Cost comparison of pumping systems



Pump Comparison sheet

Agrophotovoltaic (agri+solar)





Doubling the harvesting

Agrophotovoltaic (APV)

- More agriculture production due to partial shedding of solar panels on crop
- Need to conduct study on suitable crops on partial shedding of solar panel in context of Terai.

Photo: APV in Germany

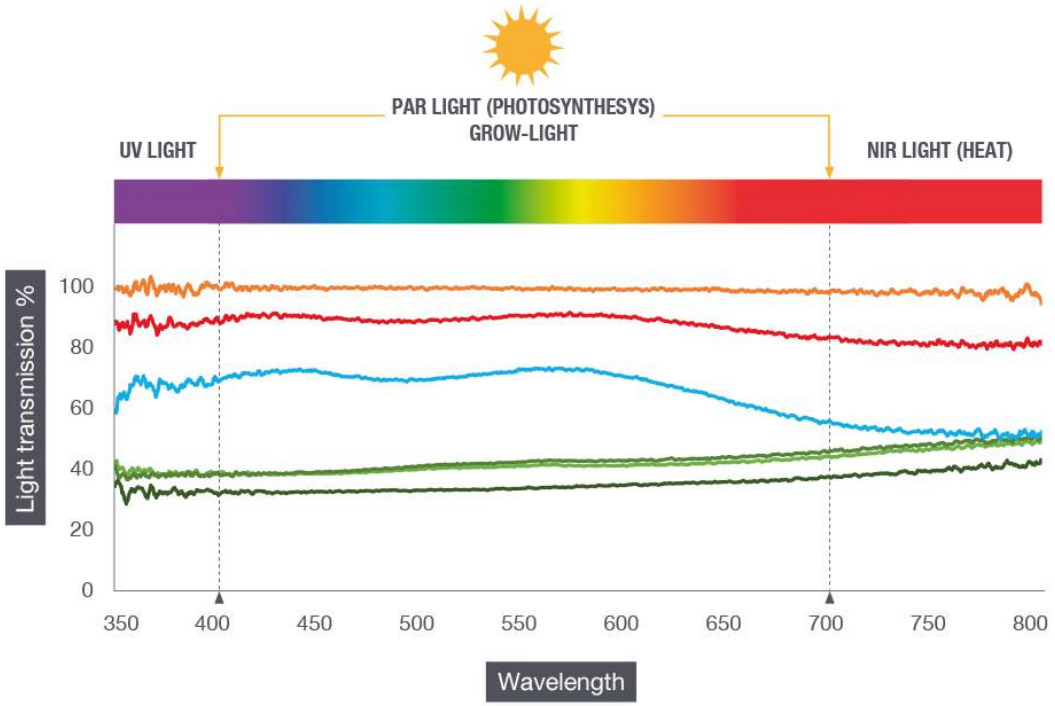
Photo: APV in India

- APV-CAZARI.mp4

Sunlight requirement for plants

Plants like lemon grass, aloe-vera, cumin seed etc requires less sunlight and perfect to grow under the PV plant

Plant type	Web-length (nano-meter)
Cabbage	660
Tomato	660
Mustered	638
Green bay leaf	638
Sweet pepper	660
Cucumber	455



Ref:horti-growlight.com

Some of our initiative

- 5HP, 4kWp of Solar Pumping in Telkuwa Bara
- Implemented in 2016

Pilot for modern agriculture farming; nursery, poly house, organic farming, floriculture etc

30kWp Integrated Drinking water and Irrigation Project-Nepal

Location:	**Belhi Village, Hanspur Municipality-5, Dhanusha Nepal**	
Intervention:	Solar Powered Drinking Water facility to 256 households of Belhi and Irrigation water for drip and sprinkler irrigation	
Water Demand	270,000 litre per day (150,000+120,000)	
Major Works:	RCC Overhead Tank	$75m^3$
	Water Supply Distribution Pipe Line	4,363.69m
	Mechanical Water Treatment Plant (Pressure Filter)	
	Solar PV Array	30kWp

Devidanda Solar Drinking Water Project
Ishworpur Municipality - 12, Guidung, Sarlahi

Solar Array	20 kWp
Household	60
Intake source	Sump well, Banke Khola
Water demand	38,000 litres per day
Head	240 m
Pump size	12 HP
Overhead tank size	20,000 lts. (2x10,000)
Cost of solar & pipleline	NRs. 5,199,149
Cost of civil works	NRs. 9,354,299
Start	November 2022
Completion	June 2023

Tinghare Solar Drinking Water Project- Nepal

Solar Array	40 kWp
Household	450
Intake source	Sump well, Jharjhare Khola
Water demand	370,000 litres per day
Head	48 m
Pump size	17 HP
Reservoir tank size	270,000 lts.
Start	January 2023
Learning:	• Civil works through community saves money upto 28% (15% contractor overhead and 13% VAT) • 6 months construction time- a record breaking time in Nepal • Work didn't stop even while there was crusher industry was shutdown

Agrovoltaic Project

(Tinghare Sarlahi Nepal)

Failed case- Atmospheric Water Generator (AWG)

- Water source was distant apart from the settlement
- Scattered settlement and difficult terrain- high cost for extension of grid electricity
- We purpose Atmospheric Water Generator (Air to Water conversion)
- Piloting of AWG shows neither optimal solution nor sustainable solution.
- AWG may be temporary solution for disaster hit area for time being.

Atmospheric water generator process

Current provision of earthpit for drinking water

Drying-up of water sources

- Very limited availability of NEA distribution feeder lines upto water source
- Low voltage and highly unbalanced voltage due to long T&D lines
  - draw higher current
  - burning of electric motors
- Drying of rivers and shrinking of pond- no water recharge
- Water sources are disappearing
- Failure of water pumps
- Queuing for water collection – routine work affected
- Limited local capacity for O&M of water pumping project

Let’s Act now- else similar picture will appear in distant future too

Capacity Building

Local farmers
Local technicians
Electric pump repair shops

Thank You

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