



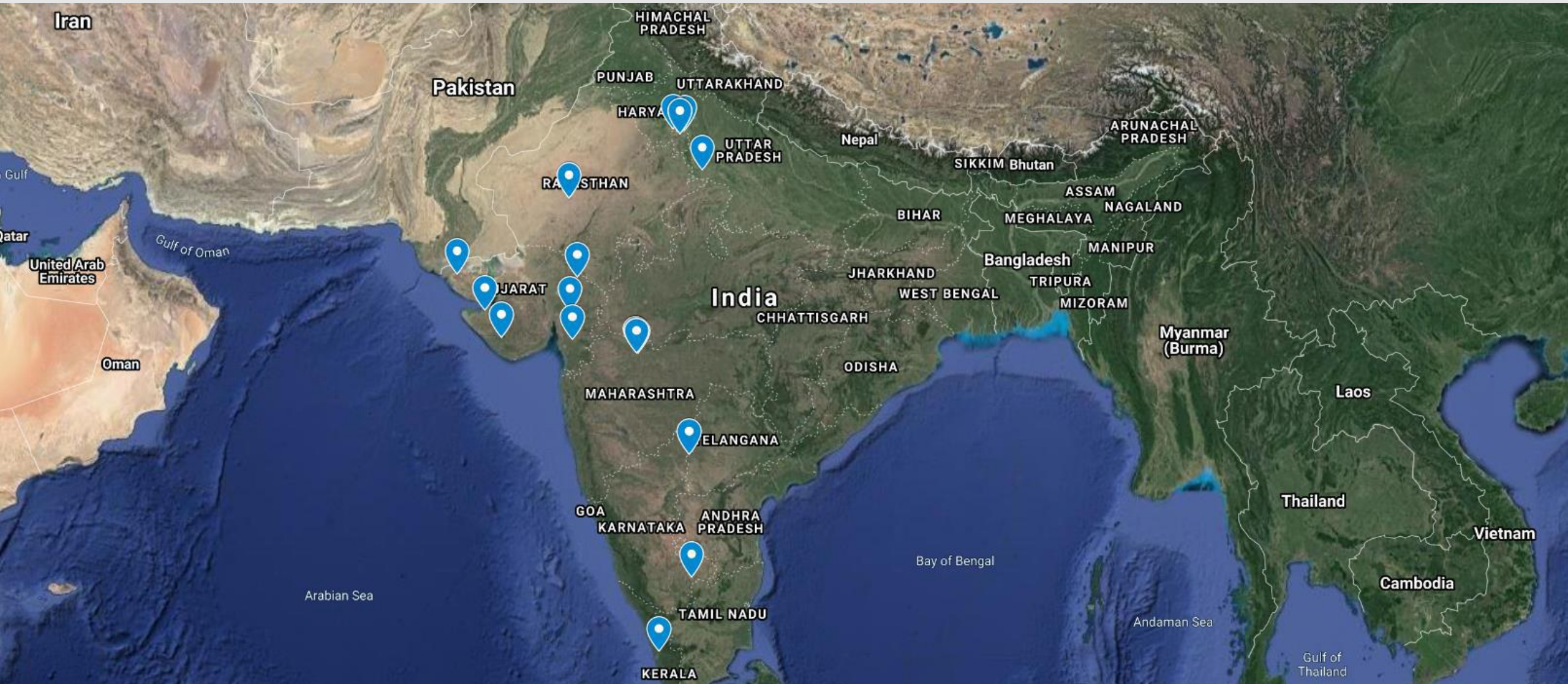
# Agri-PV in India

## Landscape, Opportunities and Potential

Subrahmanyam Pulipaka  
Chief Executive Officer  
National Solar Energy Federation of India

# 16 Agrivoltaic plants in operation in India

<https://buff.ly/3tNHxsc>



# Overview of operational projects in India

<https://buff.ly/3tNHxsc>



## Some Findings

- Very little awareness and experience with co-location of solar panels and commercial crops in India
- Current policy framework does not provide sufficient regulatory clarity
- Farmer was usually not involved before the construction of the plant
- Cleaning a challenge

# APV LEGAL STUDY



**NSEFI**  
MAKING SOLAR ENERGY AFFORDABLE



Indo-German  
Energy Forum



**KHAITAN  
& CO** ADVOCATES  
SINCE 1911



Auroville Consulting



**ATLAS LAW  
PARTNERS**



# Working Group Agriculture and RE

*Under IRENA Coalition for Action 2021*



With NSEFI being main supporter focusing on APV



# Joint Statement : IRENA Coalition for Action 2021

*Under IRENA Coalition for Action 2021*



Joint Statement  
Prepared by the  
Coalition and  
Endorsed by around  
50 International  
Entities in Renewable  
Energy Sector.



## Forests

- Includes all lands classed as forest under any legal enactment dealing with forests or administered as forests, whether state-owned or private, and whether wooded or maintained as potential forest land. The area of crops raised in the forest and grazing lands or areas open for grazing within the forests should remain included under the forest area

## Area under non-agricultural use

- Includes all lands occupied by buildings, roads and railways or under water, e.g. rivers and canals and other lands put to uses other than agriculture.

## Barren and uncultivable land

- Includes all barren and uncultivable land like mountains, deserts, etc. Land which cannot be brought under cultivation except at an exorbitant cost, should be classed as uncultivable whether such land is in isolated blocks or within cultivated holdings.

## Permanent pastures & other grazing land

- Includes all grazing lands whether they are permanent pastures and meadows or not. Village common grazing land is included under this head

## Land under miscellaneous tree crops

- Includes all cultivable land which is not included in 'Net area sown' but is put to some agricultural uses. Lands under Casurina trees, thatching grasses, bamboo bushes and other groves for fuel, etc. which are not included under 'Orchards' should be classed under this category.

## Culturable waste land

- Includes lands available for cultivation, whether not taken up for cultivation or taken up for cultivation once but not cultivated during the current year and the last five years or more in succession for one reason or other. Such lands may be either fallow or covered with shrubs and jungles, which are not put to any use.

## Current Fallows

- Represents cropped area, which are kept fallow during the current year. For example, if any seeding area is not cropped against the same year it may be treated as current fallow.

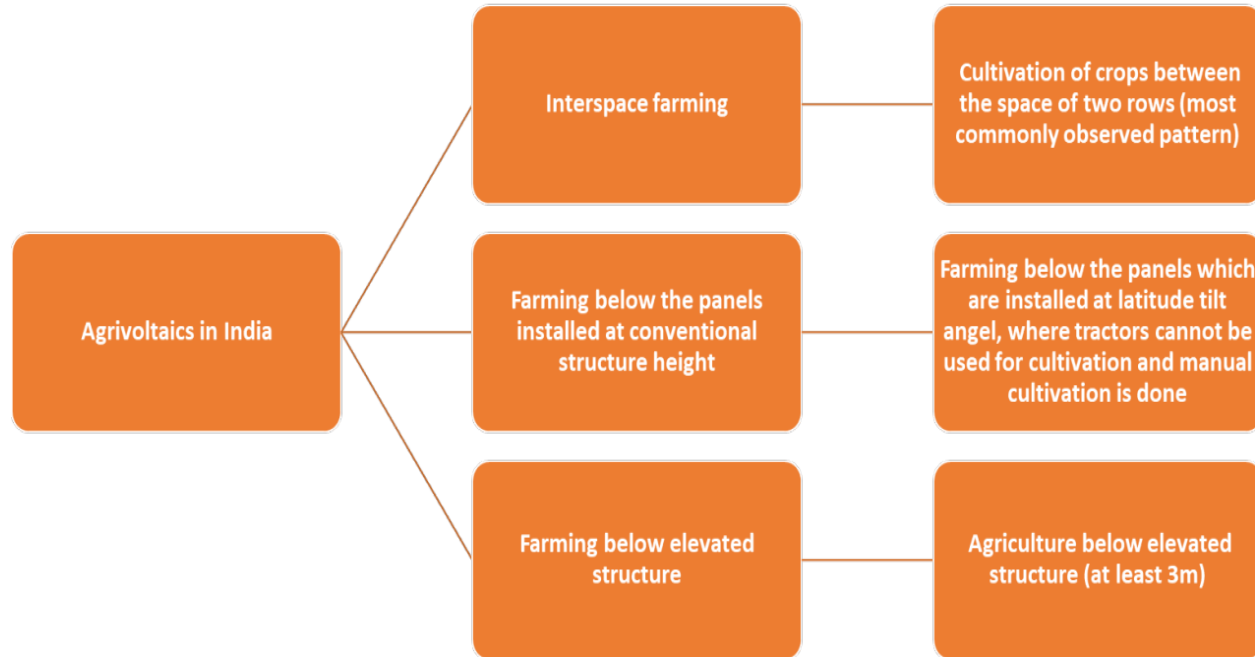
## Fallow land other than Current Fallows

- Includes all lands, which were taken up for cultivation but are temporarily out of cultivation for a period of not less than one year and not more than five years.

## Net area sown

- Represents the total area sown with crops and orchards. Area sown more than once in the same year is counted only once.

# Types of Agri-PV Plants in India







1 MW GIPCL plant Amrol, Gujarat



**CAZRI™**

Enhancing resilience of arid lands

105 kW CAZRI plants Jodhpur, Rajasthan



1 MW GIPCL and Anand Krishi Agricultural University, Amrol, Gujarat

# Different from PV Rooftop

1 MWp chicken farm rooftop, Kolar, Karnataka, India





1 MW GIPCL plant Amrol, Gujarat



100 kW NISE plant near Gurgaon, Haryana



**14.4 kW Jain Irrigation private research plant, Jalgaon, Maharashtra**



200 kW Dayalbagh Agriculture University plant Agra, Uttar Pradesh





7 kWp, Junagadh Agricultural University, Junagadh



7 kWp, Junagadh Agricultural University, Junagadh



12 MWp, Kochin Airport, India



**cochin**  
INTERNATIONAL AIRPORT



**BOSCH**

True need for life

12 MWp, Kochin Airport, India



**1 MW GIPCL and Anand Krishi Agricultural University, Amrol, Gujarat**



1 MW GIPCL plant Vastan, Gujarat



1 MW GSECL plant Panandharo, Gujarat





1 MW Aravalli District, Gujarat

**Abellon CleanEnergy**



400 kWp Mahindra Susten's Agro Photovoltaic Model, Tandur, Telangana



3 kW Hinren Agri-PV Rooftop (APVRT) System, Bangalore

# Challenges

## Trade-off

- In the existing installations throughout the country, the trade-off between the extra cost incurred for facilitating agriculture below the solar panels and the resulting revenue from the cultivation is yet to be thoroughly quantified. Cost involved in a higher structure and costs for effectively cleaning solar panels at greater height have been identified as the major constraints for developers.

## Stakeholder Coordination

- In most reviewed cases, operation of the solar plant and farming activities are conducted by two different parties. Miscoordination between stakeholders frequently compromises the efficiency in Agrivoltaic plants.

## Performance analysis

- There is a lack of data investigating potential influence of different solar panel technologies and solar panel spacings on crop growth. There is no bifacial panels tested so far except in solar greenhouses by Jain Irrigation. No known research has been conducted to measure the influence of the vegetation on the performance of the solar panel.

# Challenges

## Land Use Classification

- The explicit mention of agrivoltaics is necessary in any law, scheme or policy when cultivable land is used with PV and an agrivoltaic system could be designated in the land use plan as a "special area for agrivoltaics". A prerequisite shall be that a minimum of 80% of the total surface is available and used for agricultural purposes so that the farmer or landowner continues to receive the agricultural subsidy allocated to the area in which case statistically the area does not count as sealed.

## Technical Norms and Quality Standards

- As of now there are no regulations on land use with solar PV under the Indian legal framework. To ensure dual use of land through Agrivoltaics, and to avoid solar energy yield at the cost of agricultural purpose, criteria need to be set to avoid the installation of improper agrivoltaic installation that neglect agricultural purposes.

## Financial Incentives for Agrivoltaics in India

- The improvement of livelihoods of the partnering farmers must be prioritised and if possible, annual incomes doubled for farmers with less than 2 hectares. To consider Agrivoltaics in future feed-in-tariff calculations and ceiling price setting for tender, the figures stated in the recommendations chapter of this report should be considered.

# India's Agri-Solar Scheme - KUSUM

## Component A

- 10,000 MW of Decentralized ground/stilt mounted grid connected plants
- Capacity 500 kW to 2 MW (Farmers/cooperative /panchayat /Farmers producers organisation)
- GOI will provide Procurement Based Incentive (PBI) to the DISCOMs @40 paisa/kWh or Rs 6.60 lakhs/MW/year up to 5 years whichever is less

## Component B

- Installation of 2 Million Stand-alone Pumps
- Farmers can setup Standalone solar pumps up to 7.5HP replacing existing diesel pump sets
- Centre Financial assistance (CFA) and state govt to share 30 % of stand-alone solar pump cost each

## Component C

- Solarization of 1 Million Grid Connected Agriculture Pumps
- Solar PV capacity up to 2 times of pump capacity in kW terms, to enable sale of excess power to DISCOMs
- Centre and state to share 30 per cent of pump cost each

# Ongoing APV Tenders

UPNEDA Uttar Pradesh

## **APV Solar, 106 MW**

Scope: BOO

Location: Uttar Pradesh (UP)

Offtaker: UP DISCOM(s)

Benchmark tariff:

INR 3.10/ kWh

Bid size: 0.5 - 2 MW

Commissioning: 12 months

Bid submission: 15 June 2021

OREDA Odisha

## **APV Solar, 500MW**

Scope: BOO

Location: Odisha

Offtaker: Odisha DISCOM(s)

Benchmark tariff:

INR 3.08/ kWh

Bid size: 0.5 - 2 MW

Commissioning: 9 months

Bid submission: 22 June 2021

MPUVNL Madhya Pradesh

## **APV Solar, 270 MW**

Scope: BOO

Location: Madhya Pradesh (s)

Offtaker: MP DISCOM(s)

Benchmark tariff:

INR 3.07/ kWh

Bid size: 0.5 - 270 MW

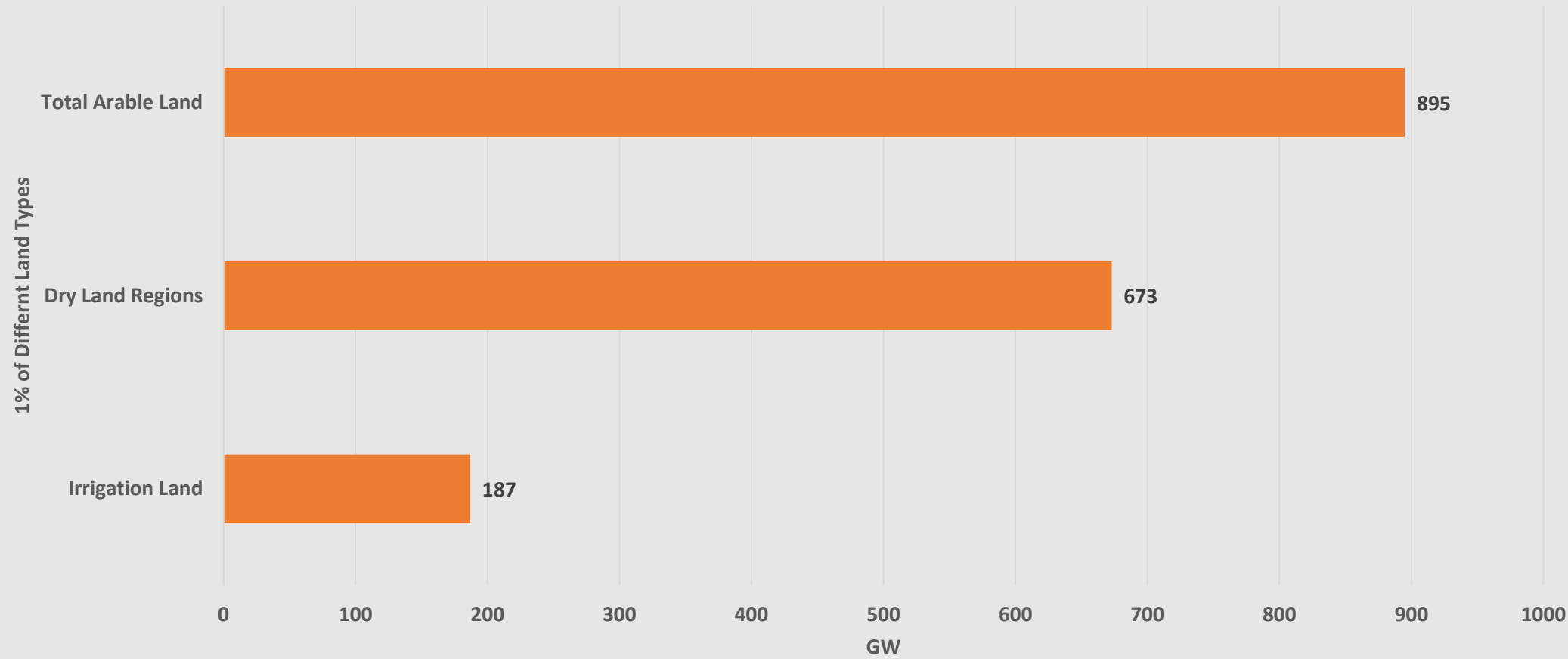
Commissioning: 9 months

Bid submission: 21 June 2021

“Cultivable land may also be used if the Solar plants are set up on stilts where crops can be grown below the stilts and sell RE power to DISCOMs.” Source: [KUSUM Scheme by MNRE](#)

# India's Agri-PV Potential

India's Agri-PV Potential(1% of the Land)



Thank You

