



नवीन एवं
नवीकरणीय ऊर्जा मंत्रालय
MINISTRY OF
**NEW AND
RENEWABLE ENERGY**



Solar PV Potential of India

GROUND MOUNTED

SEPTEMBER 2025

Solar PV Potential of India

Ground Mounted

September 2025

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“Solar energy is sure, pure and secure”

— Shri Narendra Modi, Prime Minister of India

MESSAGE

प्रल्हाद जोशी
PRALHAD JOSHI
ಪ್ರಲ್ಹಾದ ಜೋಶಿ



उपभोक्ता मामले, खाद्य और सार्वजनिक वितरण तथा
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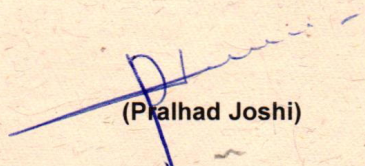


Message

I extend my heartfelt congratulations to the National Institute of Solar Energy on the release of the Report on Solar Photovoltaic Potential of India (Ground-Mounted). Today, solar power accounts for nearly half of India's renewable energy capacity, and I am confident that we will achieve much more in the days ahead.

This report provides a scientific mapping of ground-mounted solar photovoltaic potential across India and demonstrates India's commitment to internationally recognised standards in energy planning. I am confident it will serve as a vital tool in boosting domestic production capacity and in achieving our non-fossil energy target of 500 GW by 2030.

I commend the dedicated efforts of the scientists and experts at NISE and am confident this report will be a valuable resource for project developers, investors, and all stakeholders working towards an energy-secure India.


(Pralhad Joshi)



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MESSAGE

श्रीपाद नाईक
राज्य मंत्री
विद्युत एवं नवीन और नवीकरणीय ऊर्जा
भारत सरकार



SHRIPAD NAIK
Minister of State for Power and
New and Renewable Energy
Government of India



MESSAGE

India's clean energy journey has been guided by the vision of building an energy-secure, self-reliant, and sustainable future for all. Solar energy has emerged as a cornerstone of our renewable energy strategy, enabling rapid capacity addition, reducing dependence on fossil fuels, and creating new opportunities for innovation, investment, and employment.

The updated assessment of India's ground-mounted solar photovoltaic potential represents a significant step forward in strengthening our policy and planning. By combining advanced geospatial technologies, high-resolution datasets, and scientific methodologies, this study provides a realistic picture of the land resources available for Solar deployment across the country.

I would like to place on record my appreciation for National Institute of Solar Energy (NISE) for its leadership in coordinating this complex and large-scale exercise, as well as the Ministry of New and Renewable Energy (MNRE), the Ministry of Power (MoP), the Indian Space Research Organisation (ISRO) and its National Remote Sensing Centre (NRSC), and the State Nodal Agencies (SNAs) for their valuable contributions. Their collective expertise and inputs have ensured that this assessment is not only scientifically robust but also practically implementable.

As India moves steadily towards achieving its Panchamrit commitments and its long-term vision of a net-zero economy, this report will serve as a guiding document for accelerating solar energy deployment. It will help identify the most promising regions for investment, reduce uncertainties for project developers, and provide state governments with actionable insights for integrating solar power into their development priorities.

(SHRIPAD NAIK)

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MESSAGE



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भारत सरकार
नवीन और नवीकरणीय ऊर्जा मंत्रालय
Government of India
Ministry of New and Renewable Energy



Message

The rapid expansion of solar energy in India over the past decade has positioned the country among the global leaders in renewable energy deployment. Ground-mounted solar projects form the foundation of India's utility-scale RE capacity. Utility-scale capacity of India accounts for approximately 91 GW out of the total installed solar capacity of over 119 GW. This growth underlines the need for detailed, spatially resolved assessments of solar potential to support evidence-based planning, optimal resource allocation, and risk-informed decision-making.

The present report, prepared by National Institute of Solar Energy (NISE), provides a comprehensive evaluation of India's ground-mounted solar potential, integrating data from multiple sources, including satellite imagery, meteorological records, and land-use databases.

The methodology employed emphasizes transparency, reproducibility, and alignment with internationally recognized standards for solar resource assessment. The report details the assumptions, classification criteria, and estimation techniques used, ensuring that the assessments are robust, verifiable, and comparable with similar studies, globally.

By providing quantitative insights of land availability and suitability for ground-mounted solar installations, this report intends to serve as a credible, reference-quality document for planners, researchers, investors, and other stakeholders involved in the solar energy sector. It also establishes a benchmark for future assessments, supporting periodic updates and facilitating continuous refinement of India's solar energy planning framework.

The efforts of the NISE' team in analysing, compiling, and validating the data are commendable. This report exemplifies the role of rigorous scientific analysis in underpinning national energy planning and demonstrates India's commitment to building a resilient and sustainable solar energy infrastructure.

(Santosh Sarangi)

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MESSAGE



सत्यमेव जयते

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संयुक्त सचिव
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नवीन और नवीकरणीय ऊर्जा मंत्रालय
JOINT SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF NEW AND RENEWABLE ENERGY




Message

The accelerated deployment of solar energy in India necessitates precise, evidence-based understanding of the country's solar resource potential. Accurate assessments of feasible land for solar PV deployments are critical for informed planning, efficient allocation of resources, and effective implementation of government schemes for utility-scale solar PV projects.

This report provides a comprehensive evaluation of India's ground-mounted solar photovoltaic potential with detailed spatial analysis, land suitability classifications, and state-wise potential estimates that are essential for policymakers, planners, and developers. By quantifying the available land, categorizing it according to usability, and mapping its distribution across states, this report facilitates strategic decision-making for large-scale solar deployment while ensuring environmental and regulatory compliance.

The report highlights region-wise potential for ground-mounted installations, identifying areas that can support large-scale deployment with optimal efficiency. By systematically presenting technical feasibility, land constraints, and resource quality, the findings serve as a practical guide for central and state agencies, investors, project developers, and research institutions.

Collaboration among NISE, central and state agencies, and technical experts has been pivotal to the preparation of this report. Their collective efforts have ensured that the assessment is scientifically rigorous, methodologically robust, and realistic in terms of implementation. The documentation of India's solar potential in this report provides not only a snapshot of current capabilities but also benchmark for future studies and planning exercises, supporting continued leadership of the country in renewable energy deployment.


(J. V. N. Subramanyam)

FOREWORD



डॉ. मोहम्मद रिहान / Dr. Mohammad Rihan
महानिदेशक / Director General

राष्ट्रीय सौर ऊर्जा संस्थान

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Foreword

It gives me immense pleasure to present the National Solar PV Potential Assessment (Ground Mounted) Report, a comprehensive and methodologically robust evaluation of India's solar energy potential. This report marks a significant step forward in our collective efforts to realize the nation's vision of a sustainable and self-reliant energy future.

The current study estimates that India has over 27,500 square kilometres of technically feasible land for ground-mounted solar PV installations, corresponding to an aggregate deployable capacity of approximately 3343 GW. This marks a substantial increase in potential area and in estimated capacity compared to the 2014 assessment (706.15 GW, ground-mounted), reflecting improvements in data resolution, land-use mapping, and advances in solar technology efficiencies. The assessment methodology integrates high-resolution geospatial datasets, satellite-derived solar irradiance maps, land-use and land-cover (LULC) information, slope and topography constraints, and proximity to transmission infrastructure.

This report provides granular insights for state-level planning highlighting regions where concentrated policy and investment interventions can yield maximal returns. The assessment report shall be useful in effective planning of associated power system infrastructure. The report is not only a technical document it is a strategic tool designed to support stakeholders including policymakers, developers, investors, and researchers in making informed decisions.

NISE emphasizes transparency and reproducibility in its methodology. All datasets, analytical processes, and assumptions are documented to allow stakeholders policymakers, developers, and researchers to interpret and apply the findings reliably. While the focus of this edition is on ground-mounted solar PV, the framework establishes a foundation for future assessments of other solar applications, ensuring continuity and comparability over time.

This report embodies NISE's commitment to provide accurate, data-driven, and actionable insights, supporting India's ambitious renewable energy targets, and enabling informed planning for utility-scale solar deployment across the country.

Dr. Mohammad Rihan

Director General

National Institute of Solar Energy

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The updated assessment of India's ground-mounted solar photovoltaic potential was undertaken with significant institutional and technical support from multiple organizations. Comprehensive guidance, coordination and oversight were provided by the National Institute of Solar Energy (NISE), which enabled the integration of advanced geospatial methodologies, high-resolution datasets and refined analytical approaches essential for achieving the objectives of this study.

The Ministry of New and Renewable Energy (MNRE) extended consistent support throughout the assessment process and facilitated stakeholder consultations with relevant agencies and experts. This engagement ensured that diverse perspectives and technical inputs were incorporated effectively into the study.

The Ministry of Power (MoP) also provided valuable support and comments, which helped strengthen the analytical framework and align the findings with the country's broader energy planning priorities.

Access to high-quality geospatial datasets and associated technical inputs was made possible through the National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO). Elevation data, land use and land cover classifications, and other spatial layers supplied by NRSC formed the foundation for terrain, slope and wasteland analysis undertaken as part of this exercise.

Valuable support was also received from the State Nodal Agencies (SNAs) for renewable energy across the country. Their inputs on regional land-use patterns, infrastructure availability, and development constraints provided essential ground-level insights that have improved the practical applicability and accuracy of the findings across diverse geographic and administrative contexts.

These collaborative efforts have resulted in an internally validated and scientifically robust assessment that supports India's vision for an energy-secure and sustainable future.

EXECUTIVE SUMMARY

India possesses one of the world's richest solar resources, making it a critical player in the global transition to clean energy. With average solar irradiance ranging between 3.5–5.5 kWh/m²/day across the country, nearly every state offers significant potential for solar energy generation. Recognizing this opportunity, the Government of India has implemented transformative policies such as the National Solar Mission (2010) and the ambitious 175 GW renewable energy target for 2022, with a revised target of 500 GW from non-fossil-fuels based energy sources, positioning solar power as a pillar of India's energy security and climate commitments. With favorable RE policies, and government push toward green energy adoption, in January 2025, India's installed solar capacity had surpassed 100 GW_p, up from just 2.82 GW_p in 2014.

To sustain this momentum and align with long-term goals including energy independence by 2047 and net-zero emissions by 2070, accurate, actionable assessment of solar potential is essential. This report provides a comprehensive and updated analysis of India's ground-mounted solar PV potential, building on the earlier estimate of 748.98 GW_p in 2014. The updated study integrates advanced geospatial datasets and refined methodologies, accounting for key development constraints such as terrain (slope and aspect), sustainable land use, solar irradiance, and proximity to roads and electrical substations.

Key methodological enhancements include:

- Use of high-resolution GIS and satellite-derived data to identify feasible solar PV sites.
- Dynamic land-use modeling with a state-wise cap of 10% wasteland utilization to balance energy development and environmental sustainability.
- Integration of infrastructure and technical design factors such as inter-row spacing and shading analysis to ensure realistic deployment estimates.

Major findings include:

- The updated assessment identifies a total feasible ground-mounted solar potential of ~3,343 GW_p across India, derived from ~27,571 km² of suitable wasteland.
- The report shows that apart from well-known desert regions in Rajasthan and Gujarat a large number of states have very high potential for ground mounted solar PV.
- The potential is very well spread all over the country. Apart from the well-known regions of Rajasthan, Maharashtra, and Gujarat due to availability of vast wastelands, and high irradiance, a large number of other states also show significant capacity owing to favorable solar geometry and land-use efficiency.
- Northeastern and Himalayan states have limited potential due to rugged terrain, forest cover, and/or lower irradiance; however, even small states and union territories exhibit high potential density suitable for compact projects.

Beyond quantifying technical potential, this study provides a policy-linked, spatially resolved framework that can guide investment, project siting, and infrastructure planning for solar PV deployment in the country. The results are inline with India's Panchamrit commitments announced at COP26 and provide a scientific foundation for achieving the 2030 renewable energy targets, Vision 2047 for energy independence and net zero targets of 2070.

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NOMENCLATURE

Roman

A_{1MW}	Area Required per MW_p
A_{pitch}	Effective Land Area per Module
\bar{A}_{1MW}^{state}	Average Land Requirement per MW_p Statewise
B	Base of the Module at Tilt Angle
bp	Width of the Module in the Row Direction
D	Latitude of District in the State
H	Height of the Module at Tilt Angle
L	Length of the Module
P	Total Pitch
P_m	Module Wattage
S	Minimum Inter-row Clearance

Greek

α	Solar Altitude Angle
α_p	Profile Angle
β	Tilt Angle
γ_s	Solar Azimuth Angle
δ	Declination Angle
θ	Slope Angle
ρ_{DC}	DC Density (per m^2)
τ	Aspect Orientation
ϕ	Latitude Angle
ω	Hour Angle

Abbreviation

AHP	Analytical Hierarchical Process
COP	Conference of Parties
CUF	Capacity Utilization Factors
DEM	Digital Elevation Model
DNHDD	Dadra and Nagar Haveli and Daman and Diu
GHI	Global Horizontal Irradiance
GIS	Geographical Information System
GW_p	Gigawatt Peak
ISRO	Indian Space Research Organisation
kWh	Kilowatt Hour
LULC	Land Use and Land Cover
MNRE	Ministry Of New and Renewable Energy
MW_p	Megawatt Peak

NAPCC	National Action Plan on Climate Change
NISE	National Institute of Solar Energy
NRSC	National Remote Sensing Centre
NSM	National Solar Mission
OSM	Open Street Map
SE	Southeast
SNAs	State Nodal Agencies
SPV	Solar Photovoltaic
SW	Southwest

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INTRODUCTION

INTRODUCTION

India is one of the world's most promising regions for solar energy development considering its vast solar energy resource availability throughout the year. The country's geographic location, spanning from the Himalayan foothills to the coastal plains, provides an extensive range of solar irradiance, averaging between 3.5-5.5 kWh/m²/day¹. This wide range of solar insolation ensures that nearly every part of the country is suitable for solar energy generation, from the sun-drenched deserts of Rajasthan to the sunny coasts of Tamil Nadu. Such diversity and abundance in solar radiation position India as a significant player in the global solar energy landscape.

Recognizing this immense potential, the Government of India has undertaken a series of ambitious policy initiatives over the last decade and a half. The turning point came in 2010 with the launch of the Jawaharlal Nehru National Solar Mission (NSM) under the National Action Plan on Climate Change (NAPCC) with a target of 20 GW by 2020. Building on this momentum, in 2015 India announced an even more ambitious goal of installing 175 GW of renewable energy capacity by 2022, which included 100 GW of solar, 60 GW of wind, 10 GW of biomass, and 5 GW of small hydro. This target became one of the most far-reaching renewable energy programs in the world, intended to diversify India's energy mix, strengthen energy security, and reduce dependence on fossil fuels.

The results of these policy efforts have been remarkable. In 2014, India's installed solar capacity was just 2.82 GW. By January 2025, the country had crossed the milestone of 100 GW of solar installations². This transformation is illustrated in **Figure 1**, which shows the year-to-year growth of Solar PV capacity. The sharp upward curve reflects the impact of enabling measures such as large-scale solar parks, viability gap funding, rooftop solar programs, and development of solar ecosystem in the country. Today, solar accounts for nearly a quarter of India's total installed power capacity, making it the single largest contributor to renewable energy growth. This growth trajectory has also been closely aligned with India's international commitments. At the 26th Conference of Parties (COP26) in Glasgow in November 2021, Prime Minister Narendra Modi unveiled the Panamrit commitments, which have since become the foundation of India's climate and energy roadmap³. These commitments (summarized in **Figure 2**) elevated solar energy from being a sectoral development focus to becoming a strategic pillar of India's climate diplomacy and global positioning as a responsible energy leader.

Looking ahead, India has articulated a vision of achieving energy independence by 2047, coinciding with the centenary of its independence. This vision implies transition towards a self-sufficient, clean, and resilient energy system, with solar power as its backbone. Given its modular scalability, falling costs, and immense domestic resource base, solar energy will remain the cornerstone of this transition, supporting both rapid economic growth and deep decarbonization.

Building on this international commitment, India has also strengthened the technical underpinnings of its solar roadmap through systematic potential assessments. The first national-level exercise, conducted by National Institute of Solar Energy (NISE) in 2014, estimated that India had a technical deployable solar potential of 748.98 GW_p. While groundbreaking at the time, the analysis was constrained by data availability, resolution, and methodological assumptions.

1 World Bank Group (2019). Global Solar Atlas. <https://globalsolaratlas.info>.

2 Press Information Bureau (2025). "India Achieves Historic Milestone of 100 GW Solar Power Capacity," Press Release ID 2100603, Government of India, posted February 7, 2025. <https://www.pib.gov.in/>

3 Ministry of External Affairs (2021). National Statement by Prime Minister Shri Narendra Modi at COP26 Summit in Glasgow. Government of India. <https://www.mea.gov.in/>

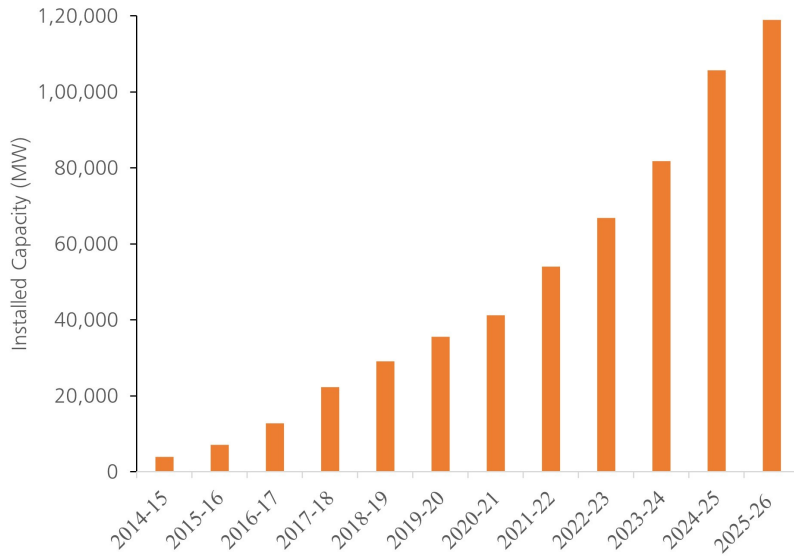


Figure 1: Year wise installed Solar PV potential (till July 2025) capacity in India⁴



Figure 2: India’s Panchamrit Commitments announced at COP26, Glasgow (2021)

4 Ministry of New and Renewable Energy (2025). “Year-Wise Achievements: Installed Renewable Energy Capacity (MW),” Government of India. <https://mnre.gov.in/en/year-wise-achievement/>

Recognizing these gaps, NISE has developed an updated methodology that integrates advanced satellite-derived datasets and high-resolution Geographical Information System (GIS) modeling. This refined approach provides a more accurate mapping of feasible solar sites, by incorporating environmental and infrastructure constraints, and directly aligns with the renewable energy of the country.

Unlike the earlier estimate, the updated assessment does not merely quantify theoretical potential, it establishes a scientific, spatially resolved, and policy-linked framework for solar deployment. By identifying priority zones, optimizing land use, and ensuring sustainability, it provides actionable insights that can guide project developers, policymakers, and investors alike.

While the 2014 assessment of 748.98 GW_p served as a baseline for India's early solar ambitions, the updated assessment marks a decisive step forward. It reflects the convergence of better data, advanced technology, and India's sharpened climate goals. This updated solar potential is not just a number it is the foundation upon which India can achieve its 2030 renewable energy targets, move towards energy independence and ultimately realize the vision of net-zero emissions.

Importance of Assessing Solar Potential

A clear understanding and reliable assessments of solar potential is fundamental for designing an effective renewable energy strategy in India. It allows decision-makers to quantify the scale of the resource, identify priority areas for deployment, and integrate solar energy into national and regional energy planning frameworks. A robust assessment will help India plan strategically, capture economic opportunities, reduce environmental impacts, and strengthen energy security as summarized in **Figure 3**.

From a planning perspective, solar potential assessments reduce uncertainty and enable more efficient allocation of resources. Identifying locations with high irradiance, suitable land, and adequate grid access ensures that solar projects can be developed where they are most viable. This minimizes project risks, helps direct investments to the most productive areas, supports balanced regional deployment, and helps align renewable energy growth with national targets.

The economic implications are equally significant. Solar energy is a domestic, inexhaustible resource that can lower energy costs over time, reduce dependence on imported fuels, and generate employment across the value chain.

Solar energy also plays a critical role in meeting environmental and climate objectives. By displacing fossil-fuel generation, it reduces greenhouse gas emissions and contributes directly to India's commitments under the Paris Agreement and the Panchamrit targets. Solar potential assessment makes it possible to estimate these contributions more precisely and link deployment with measurable environmental outcomes.

Finally, robust assessments underpin energy security. With electricity demand projected to grow steadily, India requires a diversified and resilient supply base. Solar power, being abundant and widely distributed across the country, enhances energy independence and mitigates exposure to international fuel price volatility. Mapping and quantifying solar resources ensure that this potential can be mobilized in a systematic and sustainable manner.

In sum, assessing accurate and reliable solar potential is a prerequisite for informed policy, sound investment, and sustainable growth. It ensures that India's solar expansion is grounded in scientific evidence and aligned with the country's economic, environmental and security priorities.

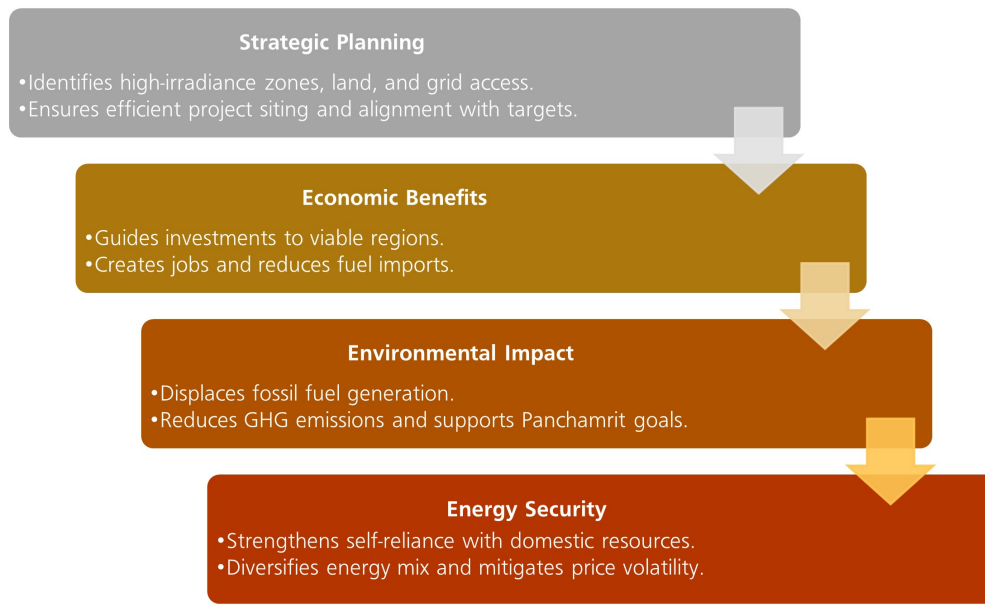


Figure 3: Importance of Assessing Solar Potential

Solar Potential Assessment 2014

The first solar potential map of India was developed by NISE in 2014, marking a significant milestone in India's renewable energy journey. This comprehensive estimation included identifying suitable areas on wasteland for solar energy generation, assessing rooftop solar potential in urban areas, and aggregating the total solar potential for each state. The assessment revealed a staggering total potential of 748.98 GW_p across the nation. However, to estimate the solar potential of the country in 2014, certain assumptions and approximations has been considered. The details are as follows:

- **Identifying Potential Areas for Solar Power Plants on Wasteland**

NISE used the wasteland data published in the Wasteland Atlas of India 2010⁵, which was provided by the Department of Land Resources, Ministry of Rural Development, and the National Remote Sensing Centre (NRSC), ISRO. The assumption was made that 3% of the wasteland could be used for solar power projects. The area of solar power plants on wasteland was calculated based on this assumption.

- **Estimating Solar Potential Based on Wasteland**

The solar potential based on wasteland was determined by considering a standard SPV module efficiency of 15%. It was assumed that one (1) km² of wasteland could accommodate a 50 MW_p SPV power plant.

- **Calculating Rooftop Solar Potential**

The potential of putting up solar power plants on rooftops was calculated using the urban data from the Census of India 2011⁶, provided by the Ministry of Home Affairs. **Table 1** provided below specifies the percentage (X) of different categories of buildings that can be installed with a certain capacity (Y) of

5 Department of Land Resources. (2010). Wasteland Atlas of India 2010. Ministry of Rural Development, Government of India. <https://dolr.gov.in/wasteland-atlas-of-india-2010/>

6 Registrar General & Census Commissioner, India. (n.d.). Census tables. Census of India. Ministry of Home Affairs, Government of India. <https://censusindia.gov.in/>

SPV power. Multiplying the total number of buildings in each category by the percentage and capacity values gave the rooftop solar potential for each category.

Table 1: Assumption for estimation of solar rooftop potential (2014)

Category	X (%)	Y (kW _p)
Factory, Workshop, Workshed, etc.	20	50
Hospital, Dispensary, etc.	2	100
Hotel, Lodge, Guest house etc.	20	10
Place of worship	2	50
School, College	10	50
Shop, Office	25	1
Other non-residential (power plant, cinema hall, etc.)	10	10
Residential	20	1

Updated Ground Mounted Solar Potential Assessment

Recognizing the need for continuous improvement and adaptation to evolving technologies and conditions, NISE has significantly upgraded its assessment methodology for evaluating India's solar potential. This updated approach, detailed in the methodology section, leverages advanced tools and refined parameters to provide a more accurate and comprehensive analysis. By integrating multiple parameters, the new assessment goes beyond broad theoretical estimates and provides actionable insights that directly support strategic planning for solar power development.

A wide range of factors are considered to ensure a realistic and robust evaluation:

- **Land Use and Land Cover (LULC):** Examines agricultural, industrial, and residential land categories to identify areas suitable for solar deployment without disrupting existing uses.
- **Slope:** Considers terrain suitability, recognizing that flat or gently sloping land is optimal for large-scale solar farms, while steep slopes pose technical challenges.
- **Aspect:** Evaluates slope orientation, which influences daily and seasonal solar exposure, ensuring site selection that maximizes irradiance.
- **Road Network:** Assesses proximity to roads to enable transport of equipment, ease of construction, and long-term site accessibility.
- **Transmission Substations:** Maps the distance to substations, a critical factor for power evacuation with minimum transmission losses and integrating new capacity into the grid.
- **Solar Irradiance Data:** Incorporates global horizontal irradiance (GHI) datasets from Global Solar Atlas to quantify potential energy output with site-level precision.

These datasets, summarized in **Table 2**, demonstrate the shift toward a data-backed, geospatially precise methodology.

Table 2: Data sets considered for the solar potential assessment

Parameter	Source
Land Use and Land Cover	NRSC ⁷
Slope	Digital elevation Model (DEM) ⁸
Aspect	DEM ⁸
Road network	Open Street Map (OSM)
Transmission substation network	OSM
Solar Irradiance data	Global Solar Atlas ⁹

The updated framework marks a significant improvement over the 2014 methodology. At that time, India's technical solar potential was estimated at around **748.98 GW_p**, based on static land-use assumptions and limited datasets. By contrast, the updated potential employs high-resolution GIS layers, integrates terrain and infrastructure constraints, and accounts for dynamic factors such as shading, latitude-specific performance, and grid connectivity. The comparative analysis of the methodologies is shown in **Table 3**.

Table 3: Comparison of the solar potential assessment methodologies

Parameter	2014 Approach	Updated Approach
Land Assumptions	3% wasteland (static)	Dynamic land-use
Technology Factor	15% SPV module efficiency	20% SPV module efficiency
Area Requirement	1 km ² = 50 MW _p (fixed)	Calculated (for each site) based on latitude & shading losses
GHI	Not included	Included
Road Proximity	Not included	Included
GIS Detail	Not included	High-resolution, multi-layered (terrain filters)
Grid Consideration	Not included	Grid connectivity integrated

By integrating these diverse datasets and methodological improvements, the updated assessment provides a far more precise picture of India's solar potential.

7 National Remote Sensing Centre (NRSC). (2024). Land Use Land Cover (LULC) data. Indian Space Research Organisation (ISRO), Department of Space, Government of India. <https://bhuvan.nrsc.gov.in>

8 National Remote Sensing Centre (NRSC). (2024). Digital Elevation Model (DEM) data. Indian Space Research Organisation (ISRO), Department of Space, Government of India. <https://bhuvan.nrsc.gov.in>

9 World Bank Group (2019). Global Solar Atlas. <https://globalsolaratlas.info>.



METHODOLOGY

METHODOLOGY

Assessing the ground-mounted solar photovoltaic potential of a country as large and diverse as India requires a systematic and multi-layered methodology. It is critical to consider factors such as land availability, terrain conditions, accessibility, and grid infrastructure for realistic determination of potential sites. Therefore, this study follows a multi-criteria geospatial approach that progressively filters unsuitable land and retains only those regions that satisfy a set of technical, environmental, and logistical conditions.

The methodology has been designed to ensure three objectives:



This approach mirrors international studies published in reputed peer-reviewed journals. For example, in Spain, solar site planning framework emphasizes the exclusion of agricultural basins and proximity to grid nodes¹⁰. In Morocco, GIS-AHP analysis gives priority to barren land while penalizing steep slopes and remote areas¹¹. In Arizona, USA, studies have applied strict slope thresholds and road buffers to ensure constructability¹². Likewise, in Israel and Iran, national-level assessments integrate slope, irradiance, and infrastructure filters^{13,14}. By adopting a similar, internationally benchmarked framework, this study ensures that India's solar potential estimates are not just aspirational but also grounded in realistic development criteria. A few similar aspects were also considered by GIZ for assessment of agrivoltaics potential in India¹⁵.

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- 10 Marques-Perez, I., Guaita-Pradas, I., Gallego, A., & Segura, B. (2020). Territorial planning for photovoltaic power plants using an outranking approach and GIS. *Journal of Cleaner Production*, 257, 120602.
 - 11 Merrouni, A. A., Elalaoui, F. E., Mezrhab, A., Mezrhab, A., & Ghennioui, A. (2018). Large scale PV sites selection by combining GIS and Analytical Hierarchy Process. Case study: Eastern Morocco. *Renewable energy*, 119, 863-873.
 - 12 Majumdar, D., & Pasqualetti, M. J. (2019). Analysis of land availability for utility-scale power plants and assessment of solar photovoltaic development in the state of Arizona, USA. *Renewable energy*, 134, 1213-1231.
 - 13 Hafeznia, H., Yousefi, H., & Astaraei, F. R. (2017). A novel framework for the potential assessment of utility-scale photovoltaic solar energy, application to eastern Iran. *Energy Conversion and Management*, 151, 240-258.
 - 14 Shriki, N., Rabinovici, R., Yahav, K., & Rubin, O. D. (2022). Methodology for estimating the potential of ground-mounted solar photovoltaic as part of the national electricity grid: The case of Israel. *Energy for Sustainable Development*, 68, 332-349.
 - 15 GIZ (2024). Agrivoltaics in India.

The analysis relies on high-quality geospatial datasets, including digital elevation data from NRSC, LULC maps from NRSC, road and substation networks from OSM, solar irradiance data from the Global Solar Atlas, and validated administrative boundaries from the Survey of India¹⁶. Each dataset was harmonized within a GIS and resampled to a common grid to allow integration.

The process is structured as a series of exclusionary and suitability filters (**Figure 4**). Terrain suitability is assessed first (slope and aspect), followed by land-use constraints (wasteland prioritization), solar resource screening (GHI thresholds), and infrastructure access (roads and substations). At each stage, unsuitable regions are removed. The final feasible land is then translated into solar potential using updated capacity density assumptions that reflect modern module efficiencies and shading considerations.

By combining these filters, the methodology ensures that India's solar PV potential estimate is scientifically robust, internationally comparable, and aligned with national priorities. It also represents an evolution from earlier assessments (NISE's 2014 estimate), incorporating advances in satellite-derived datasets, GIS techniques, and global best practices in energy system planning.

Geographical Evaluation

The first stage in assessing SPV potential involves evaluating the terrain characteristics of India. Topography determines both the technical feasibility of construction and the long-term operational efficiency of ground-mounted solar power plants. Among terrain features, slope and aspect are the two most influential parameters.

Slope refers to the steepness or incline of the land surface. From an engineering perspective, steeper slopes increase site preparation costs because they require grading, terracing, or specialized mounting structures. Excessive slope also raises the risk of soil erosion, especially during monsoon rainfall, which can compromise both the foundations of SPV structures and the surrounding ecology.

From an operational standpoint, high slopes reduce the usable surface area for panel rows and may lead to uneven irradiance distribution across modules, causing efficiency losses. Many international studies use slope threshold as a primary criterion for site selection^{17,18,19,20}.

For India, a threshold of slope $\leq 10^\circ$ has been adopted. This reflects a balance between international benchmarks and India's vast and varied geography. While flatter terrain ($< 5^\circ$) is ideal, restricting to such values would exclude large wasteland tracts that are otherwise developable. Thus, the 10° cutoff ensures both feasibility and realistic land availability.

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- 16 Survey of India. (n.d.). Digital products portal. Department of Science & Technology, Government of India. https://onlinemaps.surveyofindia.gov.in/Digital_Product_Show.aspx
- 17 Hafeznia, H., Yousefi, H., & Astaraei, F. R. (2017). A novel framework for the potential assessment of utility-scale photovoltaic solar energy, application to eastern Iran. *Energy Conversion and Management*, 151, 240-258.
- 18 Shriki, N., Rabinovici, R., Yahav, K., & Rubin, O. D. (2022). Methodology for estimating the potential of ground-mounted solar photovoltaic as part of the national electricity grid: The case of Israel. *Energy for Sustainable Development*, 68, 332-349.
- 19 Majumdar, D., & Pasqualetti, M. J. (2019). Analysis of land availability for utility-scale power plants and assessment of solar photovoltaic development in the state of Arizona, USA. *Renewable energy*, 134, 1213-1231.
- 20 Doljak, D., & Stanojevic, G. (2017). Evaluation of natural conditions for site selection of ground-mounted photovoltaic power plants in Serbia. *Energy*, 127, 291-300.

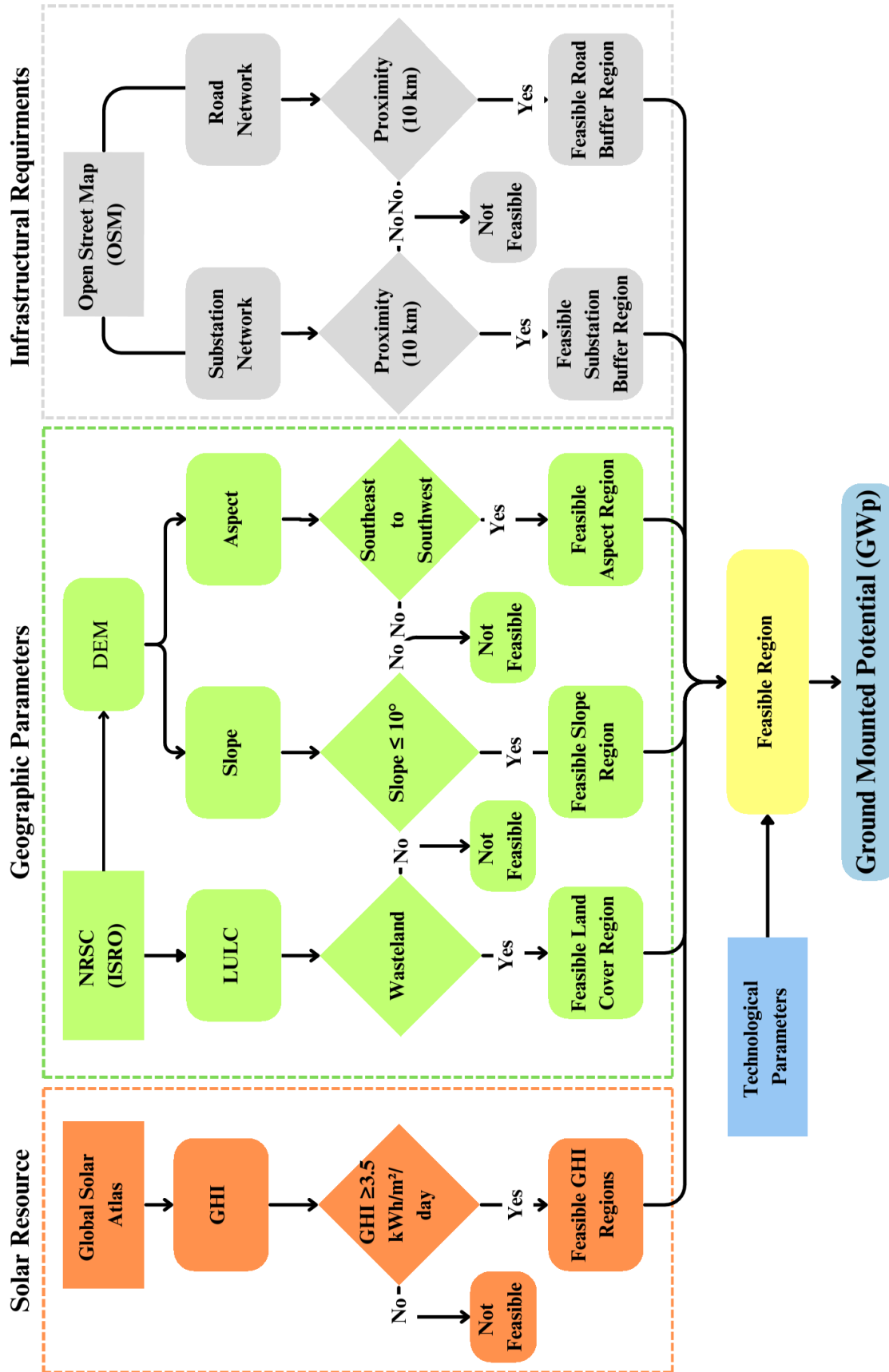


Figure 4: Flowchart of the methodology used for the ground mounted solar potential assessment

Slope was calculated from the Digital Elevation Model provided by the NRSC. The slope angle (θ) for each grid cell was computed using elevation (z) gradients in the east–west (x) and north–south (y) directions:

$$\theta = \arctan \left(\sqrt{\left(\frac{\delta z}{\delta x}\right)^2 + \left(\frac{\delta z}{\delta y}\right)^2} \right)$$

A nationwide slope map generated through this process is presented in **Figure 5**.

Second factor in terrain analysis is the compass direction that a slope faces. It influences the amount and quality of solar radiation received by the land surface throughout the day. At India’s latitudes, slopes facing between southeast and southwest receive maximum exposure during productive solar hours, especially in fixed-tilt systems where panels are typically oriented southward.

Global studies highlight the importance of aspect orientation:

- In Spain, aspect filters were used in territorial planning to prioritize south-facing slopes, which were shown to improve annual energy yield²¹.
- In Chile, where terrain variability is high, orientation was factored into multi-criteria analyses to identify slopes with maximum exposure²².

For India, aspects from 135° (SE) to 225° (SW) were retained as feasible. This range ensures that identified land parcels are aligned with the sun’s path, thereby maximizing yield potential without requiring excessive panel tilt adjustments.

Aspect was also derived from the NRSC DEM, calculated as the azimuth of the steepest slope for each cell:

$$\tau = \arctan \left(\frac{\frac{\delta z}{\delta y}}{\frac{\delta z}{\delta x}} \right)$$

where τ represents the orientation in degrees (0° = North, 90° = East, 180° = South, 270° = West). The resulting national aspect map is shown in **Figure 6**.

By combining slope and aspect layers in a GIS framework, the analysis isolates land parcels that are both physically buildable and solar-favorable. This dual filtering is crucial in a country like India, where landforms range from the flat Indo-Gangetic plains to the hilly plateaus of central India and the Himalayan foothills. The geographical evaluation thus provides the first critical filter, removing land that would be prohibitively inefficient for solar deployment.

21 Marques-Perez, I., Guaita-Pradas, I., Gallego, A., & Segura, B. (2020). Territorial planning for photovoltaic power plants using an outranking approach and GIS. *Journal of Cleaner Production*, 257, 120602.

22 Suuronen, A., Lensu, A., Kuitunen, M., Andrade-Alvear, R., Celis, N. G., Miranda, M., ... & Kukkonen, J. V. (2017). Optimization of photovoltaic solar power plant locations in northern Chile. *Environmental Earth Sciences*, 76, 1-14.

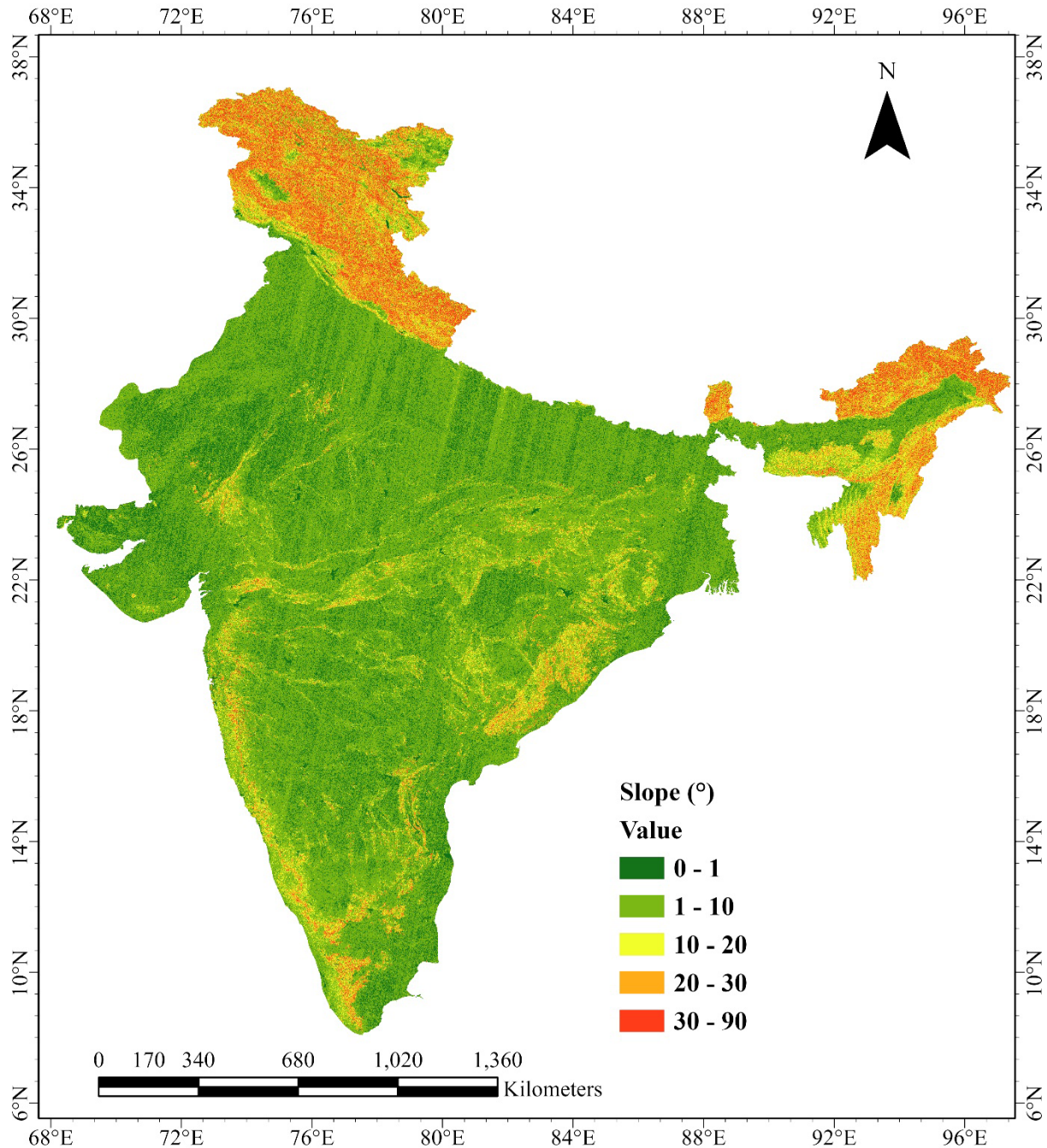


Figure 5: The map of the slope developed from the DEM of NRSC

Land Use and Land Cover (LULC) Evaluation

Land availability is often the most critical constraint in scaling solar power. Unlike fossil-fuel plants, which can be sited close to demand centers with relatively small land footprints, utility-scale solar PV requires large, contiguous tracts of land. This inevitably creates competition with other land uses such as agriculture,

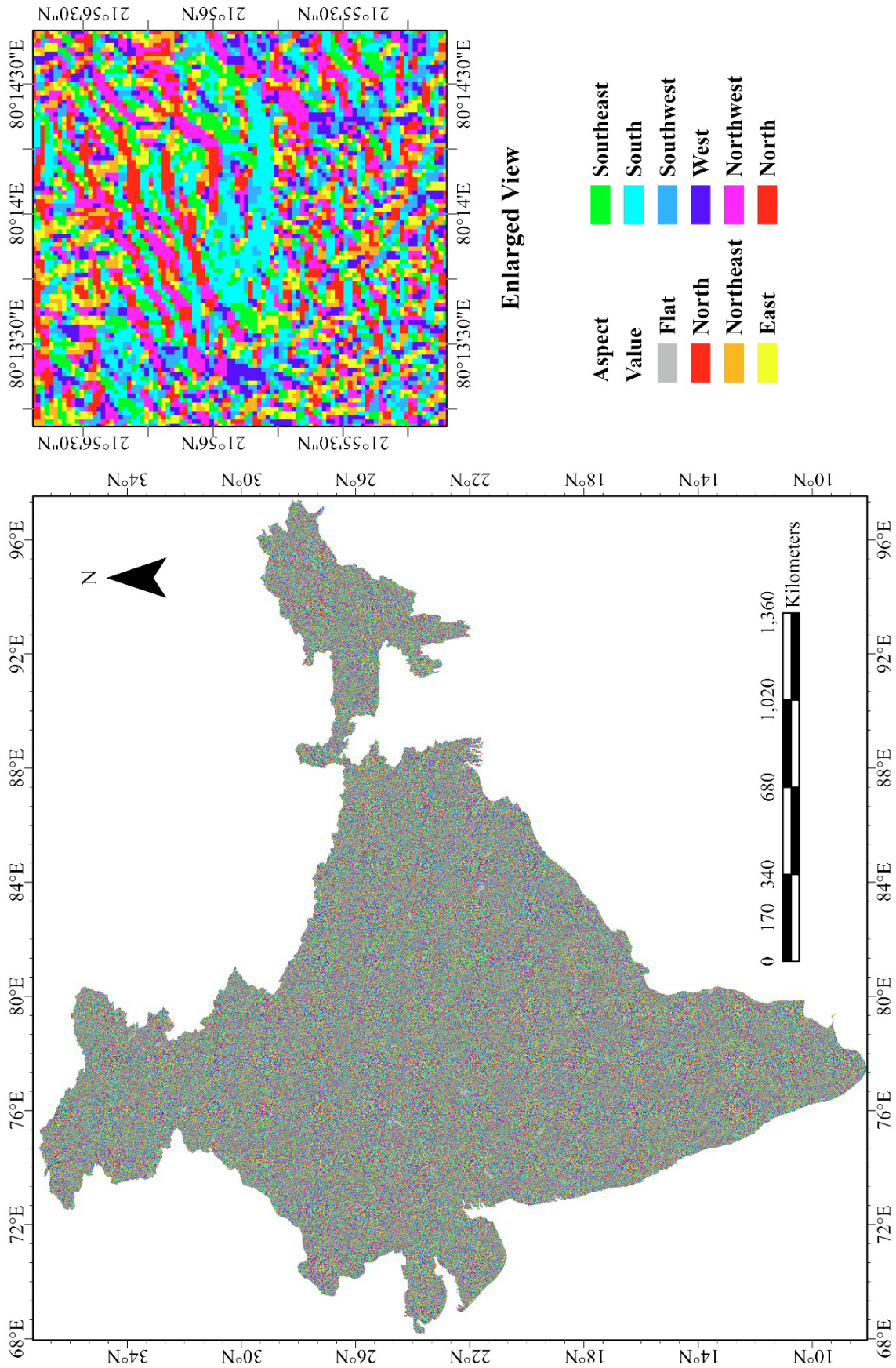


Figure 6: The map of the aspect developed from the DEM of NRSC

forestry, urban expansion, or conservation. Globally, poorly planned solar siting has sometimes led to conflicts over food security, displacement of communities, or ecological damage. Hence, a robust land-use screening process is essential to ensure that solar deployment in India remains both socially acceptable and environmentally sustainable.

The evaluation of land-use suitability in this study relies on the LULC datasets provided by the NRSC. These datasets classify India's land surface into categories such as agriculture land, forest, urban areas, built up area, water bodies, and wasteland. The focus of this study is on wastelands areas that are barren, degraded, or otherwise unproductive. Wasteland represents the best compromise between land availability and minimal opportunity cost. By using these lands, solar expansion can be achieved without undermining agricultural productivity or ecological integrity. By aligning with these international best practices, the present study ensures that India's solar roadmap avoids the pitfalls of land-use conflict seen elsewhere.

To further safeguard ecological balance and other priority uses of land, a state-wise land allocation cap was applied. Only 10% of the total wasteland area in each state is considered available for SPV deployment. This constraint is important because even wasteland categories often provide ecosystem services such as grazing for livestock, biodiversity niches, or groundwater recharge. Limiting solar deployment to 10% ensures that energy goals are balanced with environmental sustainability and the livelihood needs of local communities.

While India's gross wasteland area is large, the 10% cap ensures that only strategically selected parcels are considered in this assessment. This approach produces realistic and implementable potential estimates, as opposed to purely technical potentials that disregard land-use constraints. The distribution of wasteland areas identified for solar are shown in **Figure 7**.

Solar Irradiance Evaluation

Among all parameters considered in solar site assessment, solar irradiance is the most fundamental. While land, slope, and infrastructure determine whether a site is buildable, it is the level of irradiance that dictates whether it is profitable. Irradiance directly influences the energy yield per unit of installed capacity, thereby affecting the Levelized Cost of Electricity (LCOE), payback period, and long-term financial viability of solar plants. High irradiance zones improve energy yield, capacity utilization factors (CUF) of the solar PV plant, and ensure investor confidence. Conversely, developing projects in low-irradiance regions can result in underperformance (low energy yield), grid underutilization (low CUF), and stranded assets.

The metric adopted in this study is GHI, expressed in kilowatt-hours per square meter per day (kWh/m²/day). GHI represents the total radiation received by a horizontal surface and includes both direct and diffuse components. It is the most widely used metric in solar resource assessment because it provides a standard baseline independent of plant design.

GHI data for this assessment was obtained from the Global Solar Atlas²³, developed by the World Bank in association with SolarGIS. The dataset integrates satellite-derived solar radiation estimates with ground-based pyranometer measurements, ensuring high accuracy. The Atlas is used extensively in international planning exercises, which makes it an appropriate benchmark for India's assessment as well. For this assessment a threshold of 3.5 kWh/m²/day was considered. Any site receiving less than this value was excluded from further consideration. This value represents a conservative lower limit that ensures energy yields remain commercially viable.

23 World Bank Group (2019). Global Solar Atlas. <https://globalsolaratlas.info>.

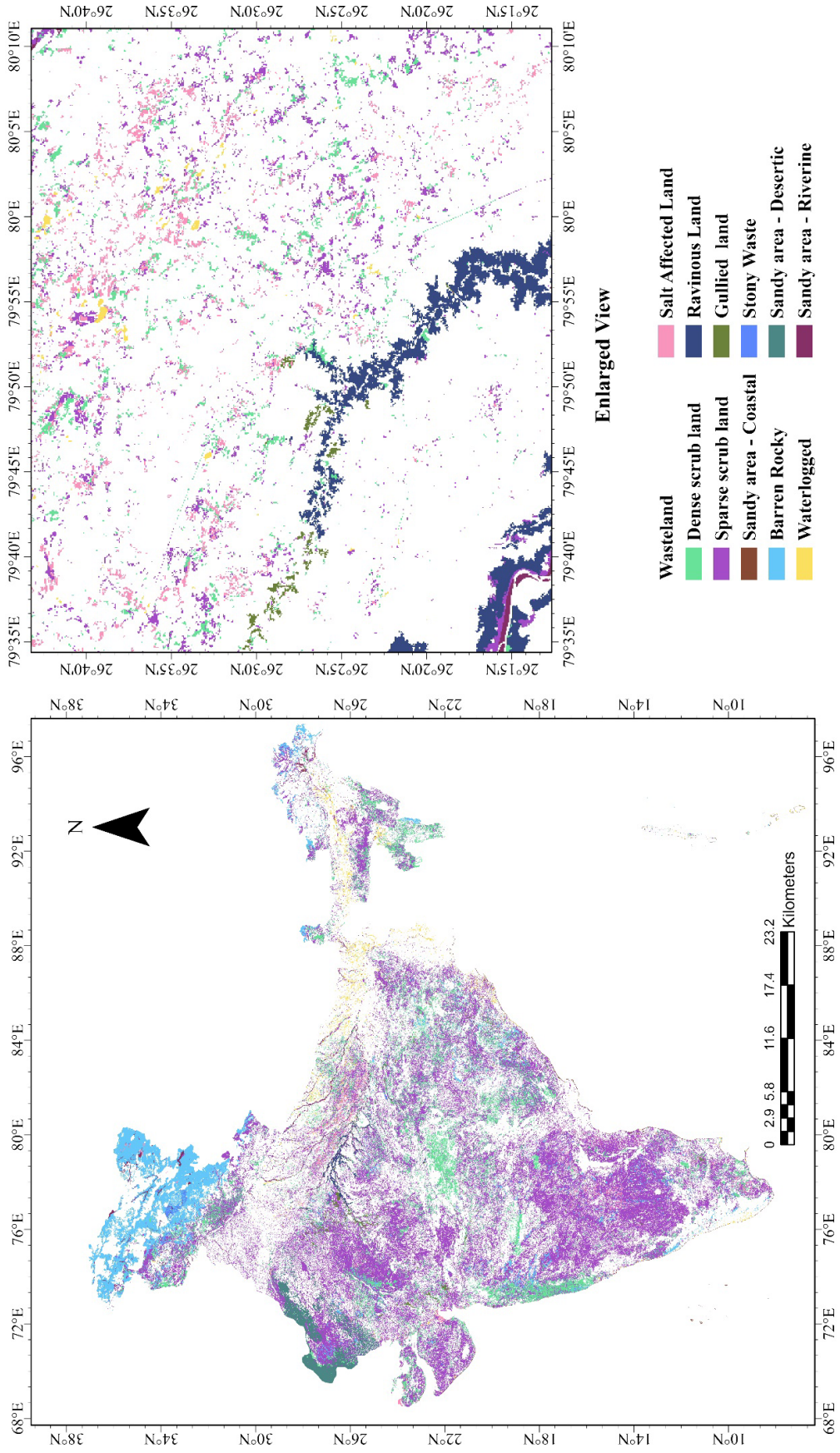


Figure 7: Wasteland map of India based on data shared by NRSC

India's average GHI ranges from 3.5 to 5.5 kWh/m²/day depending on the region. The Thar Desert in Rajasthan, and the Deccan Plateau in states like Telangana and Karnataka record the highest values, comparable to global solar hotspots. In contrast, the Himalayan foothills and parts of the northeastern states receive lower irradiance.

Applying the 3.5 kWh/m²/day filter therefore excludes persistently cloudy or mountainous regions but retains most of India's central and western landmass as suitable.

The nationwide irradiance distribution is shown in **Figure 8**.

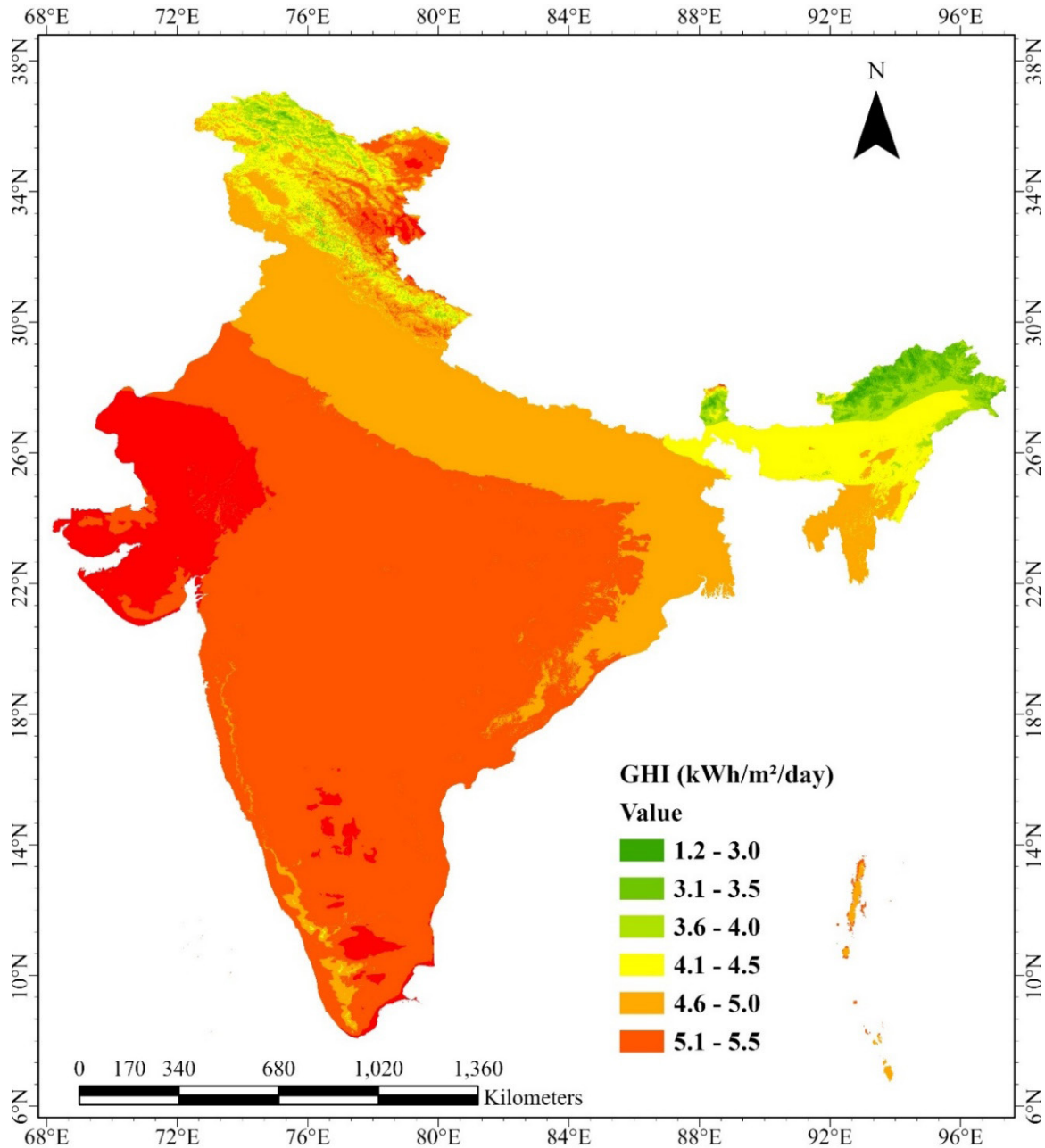


Figure 8: Solar irradiance map (GHI) of India²⁴

24 World Bank Group (2019). Global Solar Atlas. <https://globalsolaratlas.info>.

This map highlights clear high-potential corridors, including Rajasthan, Gujarat, Maharashtra, and parts of Andhra Pradesh, as well as scattered zones in other states. By applying a standardized irradiance threshold, the study ensures that only locations with adequate long-term solar yield are included in the feasible potential.

Infrastructural Evaluation

Even in regions with abundant land and high solar irradiance, solar development is not viable without supporting infrastructure. Two types of infrastructure are critical for large-scale PV deployment:

- Transportation access (primarily roads), which ensures the movement of solar system, transformers, and other heavy equipment during construction and operation.
- Electrical substations, which provide the interface between solar plants and the transmission grid, enabling efficient evacuation of power.

Globally, inadequate infrastructure has been one of the most common reasons why technically promising sites remain undeveloped. For example, several solar projects in sub-Saharan Africa and parts of Latin America faced delays or cost escalations due to the need to build new transmission lines spanning hundreds of kilometers. Similar risks exist in India: even if land and irradiance are favorable, remote locations without nearby substations or all-weather road access can lead to prohibitive project costs.

For this assessment both road networks and electrical substations were mapped using OpenStreetMap (OSM), an open-source platform that provides detailed geospatial data at national scale. The OSM data was cleaned and validated against available state and central utility datasets to ensure reliability. Proximity analysis was conducted using Euclidean distance buffers, measuring the straight-line distance between each grid cell and the nearest road or substation.

Road Proximity Criteria

For this study, sites within 10 km of the nearest road were considered feasible, provided they are not within 2 km of the road corridor. This exclusion buffer accounts for possible future road expansion and prevents direct land-use conflicts with transportation infrastructure.

- International Benchmarks:
 - In Arizona, USA, buffers of 0.5–1 mile (approximately 0.8–1.6 km) were used to maintain logistic feasibility²⁵.
 - In Morocco, site selection considered the buffer of 5 km from existing roads²⁶.
- Justification for India

India's geographic diversity and the dispersed nature of its rural road network necessitate a broader threshold. A 10 km cutoff strikes a balance: it ensures practical accessibility for moving heavy solar equipment, while not excessively restricting land availability. Given that many wastelands suitable for solar are in semi-arid rural zones, this range is both conservative and realistic.

The nationwide road proximity map, including the 10 km band and the 2 km exclusion buffer, is shown in **Figure 9**.

25 Majumdar, D., & Pasqualetti, M. J. (2019). Analysis of land availability for utility-scale power plants and assessment of solar photovoltaic development in the state of Arizona, USA. *Renewable energy*, 134, 1213-1231.

26 Merrouni, A. A., Elalaoui, F. E., Mezrhab, A., Mezrhab, A., & Ghennioui, A. (2018). Large scale PV sites selection by combining GIS and Analytical Hierarchy Process. Case study: Eastern Morocco. *Renewable energy*, 119, 863-873.

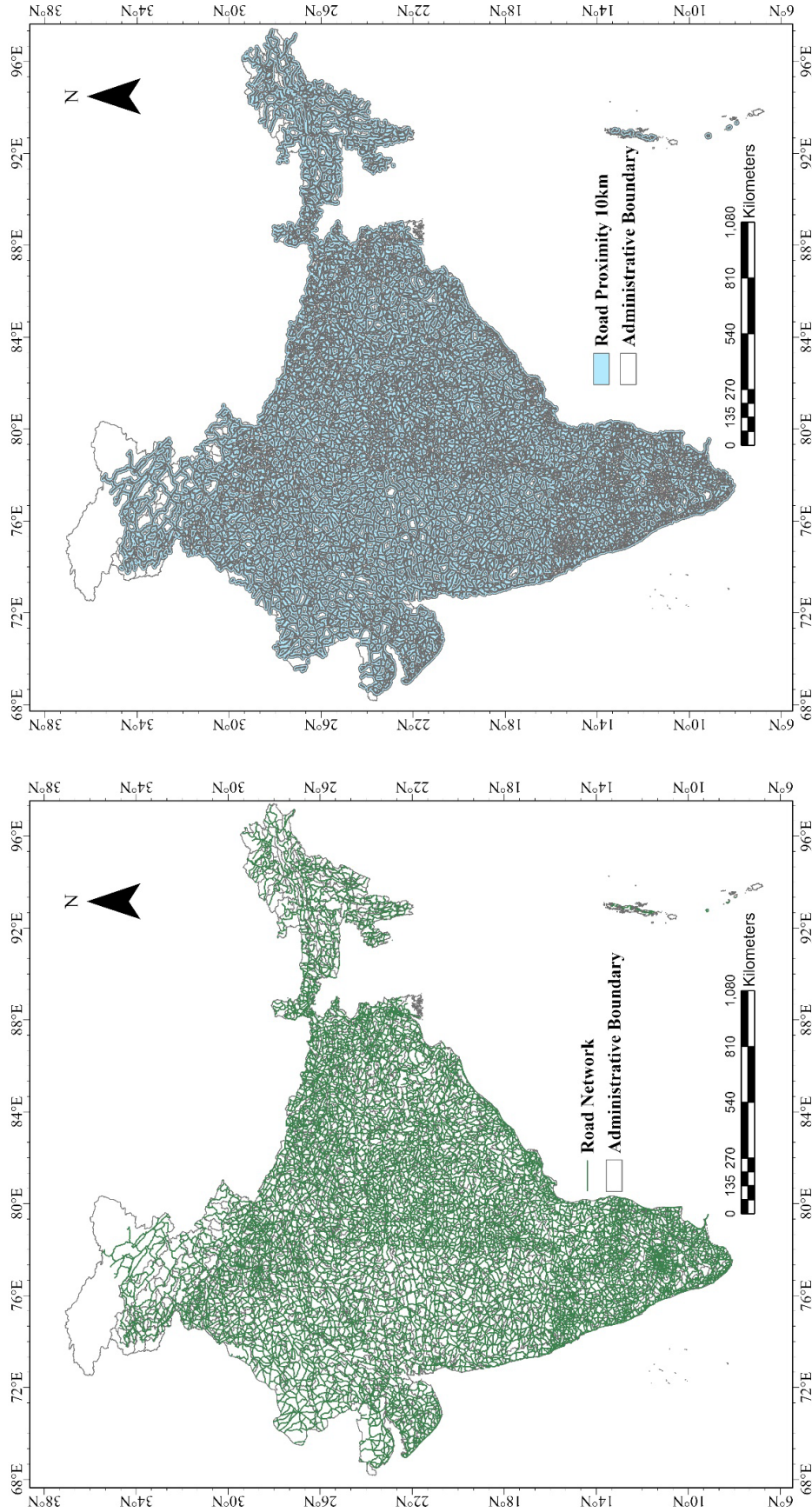


Figure 9: Indian road network and its proximity of 10 km excluding the 2 km for future scope of expansion

Substation Proximity Criteria

Proximity to electrical substations is equally crucial. Transmission infrastructure ensures that generated solar electricity can be integrated into the national grid without excessive line losses or costly new line extensions. For this assessment, sites within 10 km of a substation were considered feasible.

- International Benchmarks:
 - In North Macedonia, a GIS–AHP framework similarly constrained feasible solar zones to substation-adjacent areas²⁷.
 - In Chile, studies showed that projects located more than 10–15 km from transmission nodes faced delays and higher LCOE, reinforcing the need for strict proximity criteria²⁸.
- Justification for India:
 - Given India’s rapid solar expansion and the fact that substations are not evenly distributed, the 10 km threshold ensures a realistic assessment of land that can be cost-effectively grid-connected. Longer distances would require substantial investment in transmission infrastructure, significantly delaying project commissioning.

The national substation proximity map is shown in **Figure 10**.

By applying both road and substation filters, this study ensures that only sites with logistical accessibility and grid integration potential are retained. This dual consideration reflects lessons from global renewable expansion: projects developed in isolation from infrastructure are often delayed, underperforming, or economically unviable.

Feasibility Assessment of Ground Mounted Solar

While each parameter slope, aspect, land use, irradiance, and infrastructure play a distinct role in solar site selection, it is the integration of all filters that ultimately defines whether a site is truly feasible. A location with high solar irradiance but steep slopes may be technically unfeasible; similarly, a flat wasteland site with good irradiance but no road or grid connectivity may be economically prohibitive. Therefore, this stage performs a logical intersection of all suitability layers, ensuring that only areas meeting the full suite of conditions are retained.

This integrated approach reflects the best international practices. For instance, in Spain, outranking-based GIS frameworks combined environmental exclusions, terrain criteria, and infrastructure access before identifying viable solar corridors²⁹. In Morocco, an AHP-driven model required simultaneous satisfaction of irradiance, slope, and infrastructure constraints to minimize stranded capacity³⁰. Similarly, studies in Chile and the USA emphasized the necessity of multi-layer screening, noting that ignoring a single criterion particularly infrastructure led to overestimation of national solar potential^{31, 32}.

27 Adjiski, V., & Serafimovski, D. (2024). GIS-and AHP-based Decision Systems for Evaluating Optimal Locations of Photovoltaic Power Plants: Case Study of Republic of North Macedonia. *Geomatics and environmental engineering*, 18(1).

28 Suuronen, A., Lensu, A., Kuitunen, M., Andrade-Alvear, R., Celis, N. G., Miranda, M., ... & Kukkonen, J. V. (2017). Optimization of photovoltaic solar power plant locations in northern Chile. *Environmental Earth Sciences*, 76, 1-14.

29 Marques-Perez, I., Guaita-Pradas, I., Gallego, A., & Segura, B. (2020). Territorial planning for photovoltaic power plants using an outranking approach and GIS. *Journal of Cleaner Production*, 257, 120602.

30 Merrouni, A. A., Elalaoui, F. E., Mezrhab, A., Mezrhab, A., & Ghennioui, A. (2018). Large scale PV sites selection by combining GIS and Analytical Hierarchy Process. Case study: Eastern Morocco. *Renewable energy*, 119, 863-873.

31 Suuronen, A., Lensu, A., Kuitunen, M., Andrade-Alvear, R., Celis, N. G., Miranda, M., ... & Kukkonen, J. V. (2017). Optimization of photovoltaic solar power plant locations in northern Chile. *Environmental Earth Sciences*, 76, 1-14.

32 Majumdar, D., & Pasqualetti, M. J. (2019). Analysis of land availability for utility-scale power plants and assessment of solar photovoltaic development in the state of Arizona, USA. *Renewable energy*, 134, 1213-1231.

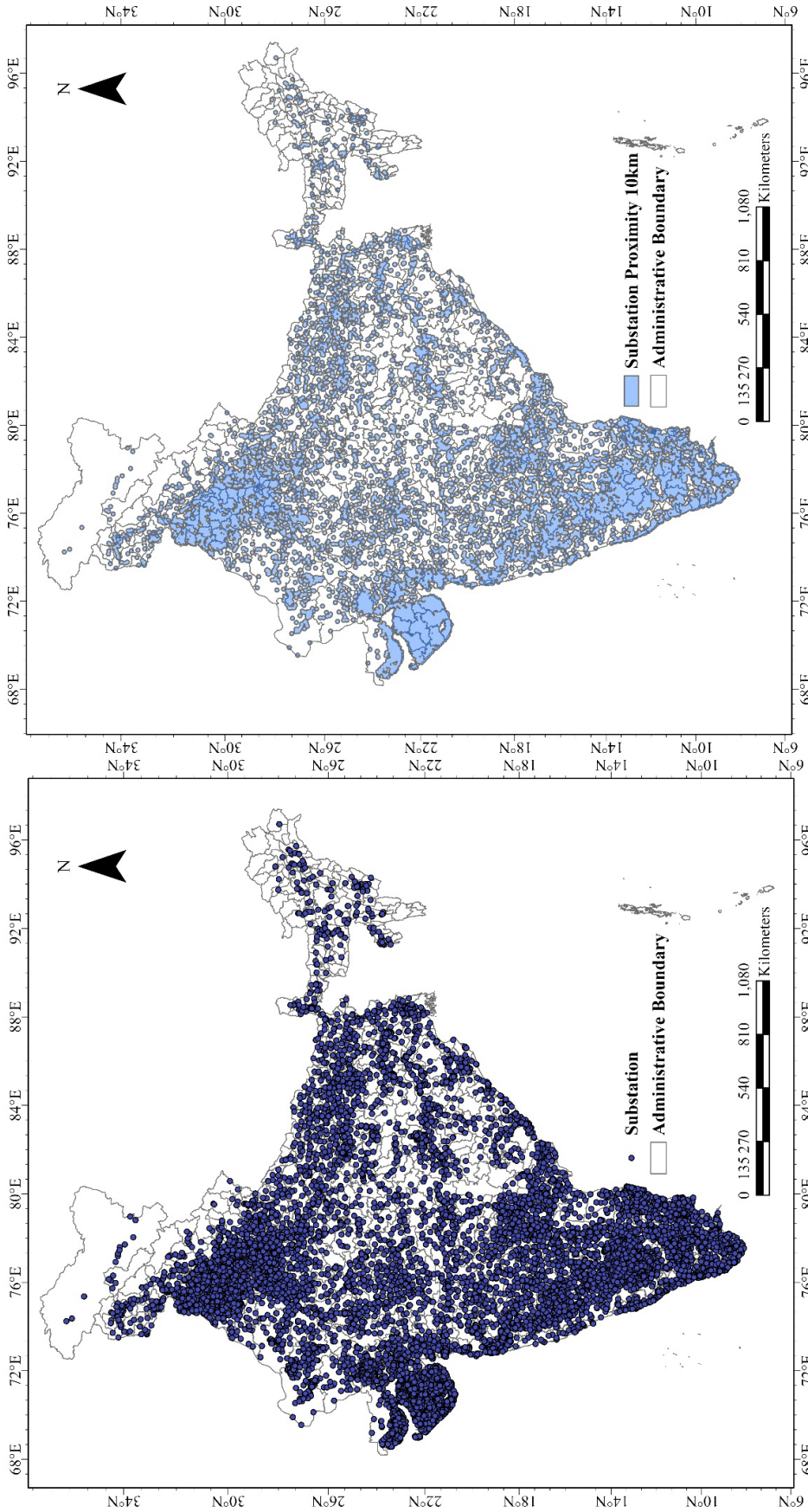


Figure 10: Indian substation network and its proximity of 10 km

The feasibility was determined through a Boolean overlay operation in a GIS. Only grid cells which satisfy all conditions were classified as feasible solar zones. The parameters and their thresholds are summarized in **Table 4**.

Table 4: Summary of the threshold parameters

Parameter	Assessment Criteria
Slope	Identify regions with slopes less than or equal to 10°
Aspect	Determine regions with the desired Southeast to Southwest orientation
Land Cover	Identify suitable land use areas, particularly wastelands
GHI	Assess regions that meet the minimum GHI threshold of 3.5 kWh/m ² /day
Road	Find regions within the 10 km proximity to road networks, excluding the buffer of 2 km for future scope of expansion
Substation	Find regions with proximity upto 10 km substations

The integration of all filters produced the combined feasibility map of India (**Figure 11**). This map represents the intersection of technical, socio-environmental, and infrastructural considerations, offering a realistic depiction of where solar PV plants can be developed.

By incorporating high-resolution datasets and realistic constraints, it reduces the risk of overestimation and ensures that the identified zones can form the backbone of India's solar expansion.

This integrated feasibility assessment directly supports:

- National planning, by guiding the siting of solar parks and ultra-mega projects.
- State-level energy roadmaps, by identifying priority zones for investment.
- Infrastructure planning, by highlighting where transmission upgrades or new road development can unlock additional solar capacity.
- International comparability, since the thresholds and datasets used are aligned with practices in other solar-rich countries.

Inter-Row Spacing and Total Pitch

In this assessment, the feasible area identified through GIS analysis is translated into potential solar capacity by applying geometric and technological parameters. To ensure that SPV modules do not shade with one another under critical winter conditions, the inter-row spacing is calculated for 21 December at an hour angle (ω) of $\pm 45^\circ$.

This design case represents the low-sun period when shading risks and curtailment penalties are greatest. This methodology establishes the inter-row clearance, total pitch, and per-MW_p land requirement, which are then combined with GIS-based feasible areas to estimate the solar potential across Indian states.

To maintain consistency across diverse regions of India, a fixed set of technological and geometric assumptions has been adopted. These reflect commercially dominant PV module configurations and standard solar park practices. By holding these parameters constant, the methodology highlights the impact of solar geometry and land-use availability rather than technology variability. The key assumptions used in the assessment are shown in **Figure 12**.

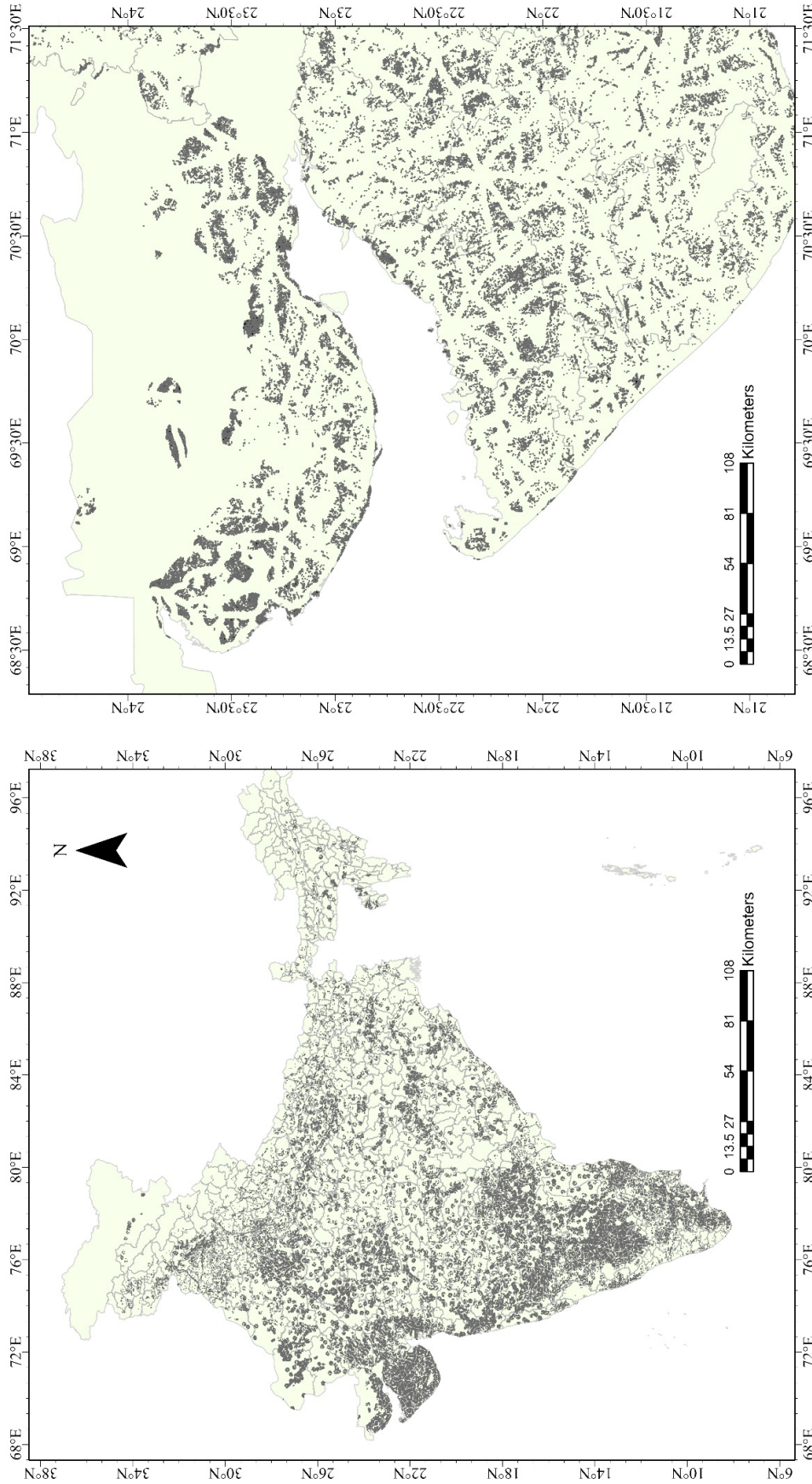


Figure 11: Potential SPV region identification based on feasibility analysis of the considered parameters such as Slope, Aspect, GHI, Road proximity, Substation proximity and wasteland

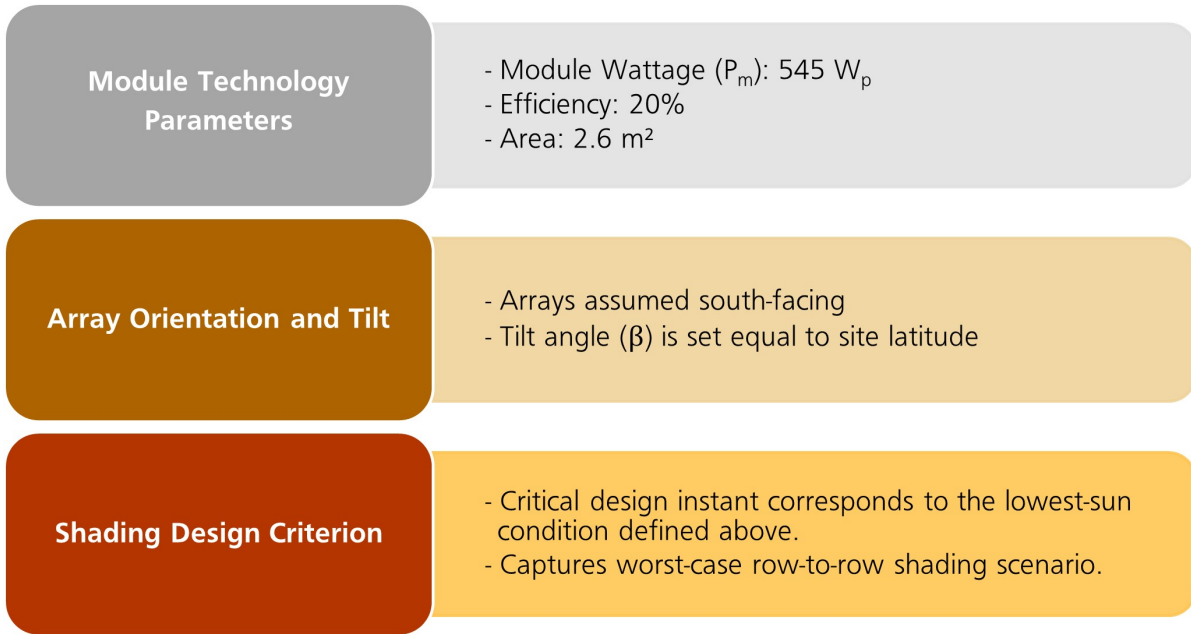


Figure 12: Assumption used in the inter row spacing and pitch calculations

To translate these assumptions into state-level land requirement estimates, the methodology follows a sequential calculation framework. The schematic representation of the inter array spacing is shown in **Figure 13**.

Each step builds logically on the previous, connecting solar geometry to array spacing, and then to land-use density³³.

Step 1. Solar Geometry

The first step is to determine the **position of the sun** at the chosen design instant. Using the site latitude (ϕ), the solar altitude angle (α) and solar azimuth (γ_s) are computed. These two angles define how high the sun appears above the horizon and its orientation relative to due south.

- **Solar altitude (α):**

$$\sin \alpha = \sin \phi \sin \delta + \cos \phi \cos \delta \cos \omega$$

- **Solar azimuth (γ_s):**

$$\sin \gamma_s = \frac{\cos \delta \sin \omega}{\sin \alpha}$$

where δ is the declination angle calculated for the day of the year (n) as mentioned in assumption:

$$\delta = 23.45 \sin \left(\frac{360}{365} (284 + n) \right)$$

33 Duffie, J. A., Beckman, W. A., & Blair, N. (2020). Solar engineering of thermal processes, photovoltaics and wind. John Wiley & Sons.

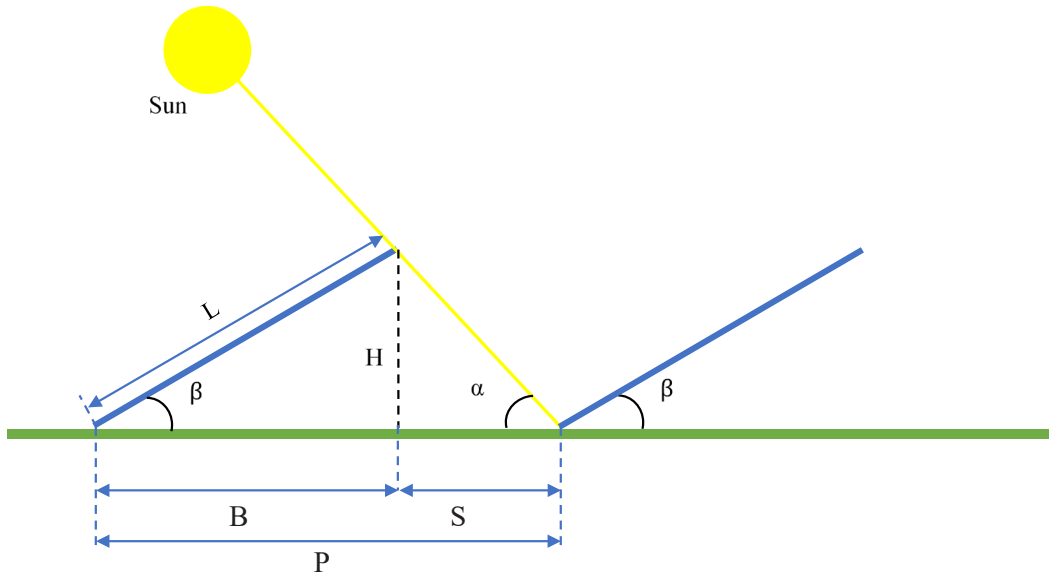


Figure 13: Schematic representation of inter array spacing

Step 2. Module and Row Geometry

Next, the geometric shape of a tilted PV row is defined. A module tilted at angle β creates a triangular rise (H) and base (B), which determines how much shadow is cast. The width of the module in the row direction (b_p) defines how much land is occupied per row.

$$H = L \sin \beta$$

$$B = L \cos \beta$$

where L is the module side lifted off the ground.

Step 3. Profile-Angle Spacing

The profile angle (α_p) links the sun's path with the tilt geometry, dictating the shadow cast by one row onto the next. For south-facing arrays:

$$\tan \alpha_p = \frac{\tan \alpha}{\cos(\gamma_s)}$$

The minimum inter-row clearance (S) required to avoid shading is then:

$$S = \frac{H}{\tan \alpha_p}$$

The total pitch (P) is the sum of the module base and this clearance:

$$P = S+B$$

Step 4. Effective Land Area per Module

Each module occupies not just its own area but also the spacing dictated by pitch. The effective land footprint per module is therefore:

$$A_{pitch} = b_p \times P$$

Step 5. Capacity Density

The land-use efficiency is expressed as:

- **DC density (per m²):**

$$\rho_{DC} = \frac{P_m}{A_{pitch}}$$

- **Area (m²) required per MW_p:**

$$A_{1MW} = \left(\frac{10^6}{P_m} \right) \times A_{pitch}$$

This can be converted to hectares ($\div 10,000$) or km² ($\div 1,000,000$).

Step 6. State-Level Aggregation

Finally, these calculations are repeated across representative latitudes for each district in state. The land requirement per MW_p is averaged as:

$$\bar{A}_{1MW}^{state} = \frac{1}{N} \sum_{i=1}^D A_{1MW}(\varphi_i)$$

Where D is the representation district latitudes in the state.

These state-level values are then integrated with GIS-estimated feasible land areas to compute the solar potential for each state. This approach ensures that both spatial availability and technical spacing requirements are consistently integrated into the solar potential assessment.



RESULTS AND DISCUSSION

RESULTS & DISCUSSION

After identifying all feasible regions suitable for ground mounted solar installations, the calculation of SPV capacity takes into account the shadow-free area available for deployment. This assessment considers technological parameters such as module wattage ($545 W_p$), module efficiency (20%), and module area ($2.6 m^2$). Additionally, the analysis incorporates a shadow assessment conducted on December 21st to optimize the utilization of available space for solar panel installation. Based on analysis the statewise ground mounted solar potential of India is shown in **Table 5**.

Table 5: Statewise ground mounted solar potential*

Sr. No	States	Total Wasteland (km ²)	Feasible Wasteland (km ²)	Potential (GW _p)
1	Andaman & Nicobar Islands	165.90	3.94	0.59
2	Andhra Pradesh	21814.27	2181.43	299.31
3	Arunachal Pradesh	7810.66	4.53	0.47
4	Assam	3556.68	176.18	19.17
5	Bihar	2995.76	299.58	32.99
6	Chandigarh	2.37	0.24	0.02
7	Chhattisgarh	11765.16	1032.67	126.48
8	DNHDD	38.36	3.84	0.50
9	Delhi	55.15	5.51	0.55
10	Goa	483.78	48.38	6.75
11	Gujarat	20324.34	2032.43	243.22
12	Haryana	643.31	64.33	6.47
13	Himachal Pradesh	18510.10	235.79	21.50
14	Jammu and Kashmir	15525.87	101.12	8.59
15	Jharkhand	4472.70	447.27	51.83
16	Karnataka	15604.19	1560.42	223.28
17	Kerala	816.17	81.62	12.40
18	Ladakh	72860.36	100.73	8.56
19	Madhya Pradesh	28040.69	2730.10	318.97
20	Maharashtra	37870.67	3787.07	486.68
21	Manipur	3091.48	20.04	2.29
22	Meghalaya	3079.51	131.21	14.67
23	Mizoram	1259.34	5.15	0.61
24	Nagaland	835.24	1.74	0.19

* Note: Solar PV potential for Lakshadweep is not covered due to limited data availability.

25	Odisha	16442.52	1108.22	139.47
26	Puducherry	19.38	1.38	0.20
27	Punjab	960.68	96.07	9.21
28	Rajasthan	77207.01	7692.79	828.78
29	Sikkim	2597.73	2.40	0.25
30	Tamil Nadu	13577.11	1357.71	204.77
31	Telangana	10235.84	1023.58	140.45
32	Tripura	1447.62	77.72	9.11
33	Uttar Pradesh	9153.25	915.33	97.84
34	Uttarakhand	7139.07	45.28	4.44
35	West Bengal	2056.10	195.59	22.74
Total		4,12,458.37	27,571.39	3343.37

The feasibility analysis yielded a total ground-mounted solar PV potential (DC capacity) of **3343.37 GW_p** across India, derived from a **feasible wasteland area of 27,571.39 km²**, which represents **approximately 6.69%** of the total identified wasteland (4,12,458.37 km²). This is in line with the imposed constraint that no more than 10% of wasteland of the state to be utilized for solar deployment.

National Landscape and Regional Trends

India's solar potential demonstrates significant spatial variability, shaped by regional solar resource availability, terrain conditions, and infrastructure access:

- Western India, led by Rajasthan (828.78 GW_p), Maharashtra (486.68 GW_p), and Gujarat (243.22 GW_p), contributes over 45% of the national potential. These states benefit from vast, contiguous wasteland and high solar irradiance.
- Southern states including Andhra Pradesh (299.31 GW_p), Karnataka (223.28 GW_p), Tamil Nadu (204.77 GW_p), and Telangana (140.45 GW_p) show significant contributions despite moderate wasteland area. This is attributed to favorable solar geometry, dense irradiance levels, and high land-use efficiency.
- Northeastern and Himalayan states such as Nagaland, Mizoram, Arunachal Pradesh, and Uttarakhand present low ground-mounted potential due to lower solar irradiance, rugged terrain and high forest cover, and scattered, less-accessible wastelands.

This comprehensive assessment highlights the vast and regionally diverse potential for ground-mounted SPV deployment across India. By integrating land suitability criteria, solar resource availability, and infrastructure proximity while adhering to sustainable land-use constraints the study provides a robust baseline for strategic solar planning at the national and state levels. The findings can serve as a critical input for guiding future investments, policy interventions, and implementation strategies aimed at accelerating India's transition to a low-carbon energy future.



**STATE/UT WISE
POTENTIAL**

Andaman & Nicobar Islands

SPV Installed Capacity (July 2025)

- 25.05 MW

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 92% of the union territory's land.
- Wastelands cover about 2% (165.90 km²) of the state's area.
- Scrub Land alone makes up over 48% of the wasteland area highly suitable for solar power plants.

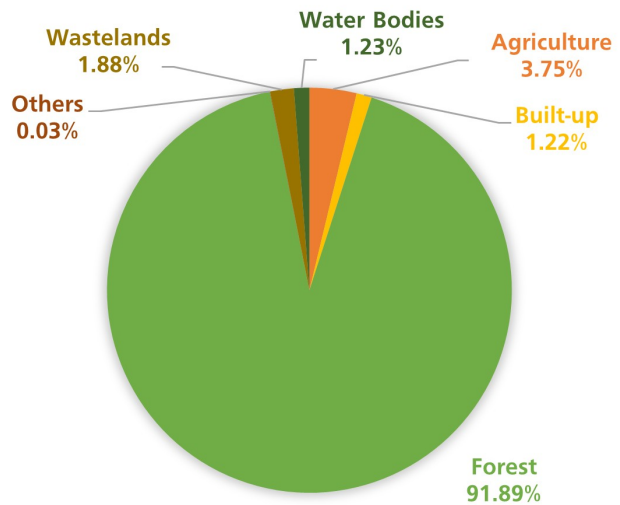


Figure 14: Land use and land cover of Andaman & Nicobar Islands

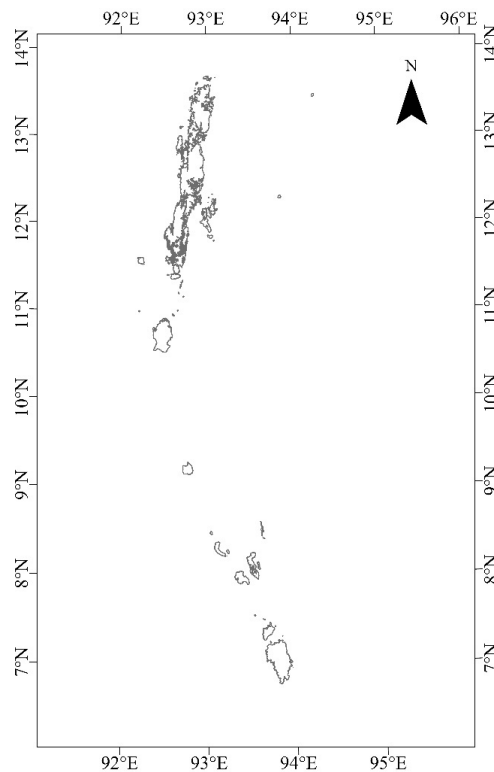
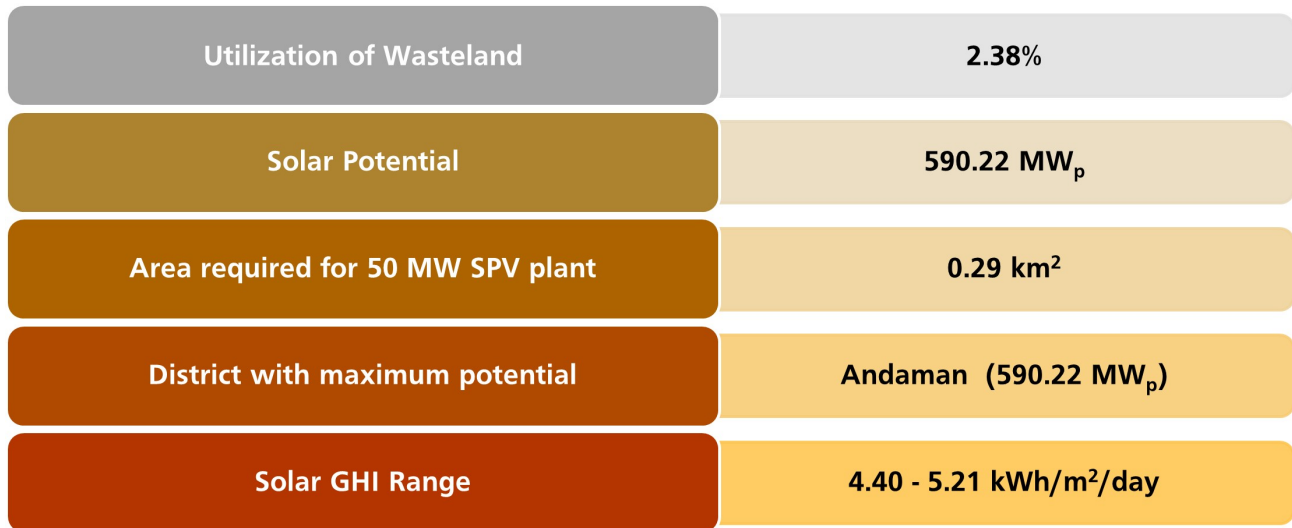


Figure 15: Feasible wasteland parcel of Andaman & Nicobar Islands for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Andaman & Nicobar Islands solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 6: District wise solar potential of Andaman & Nicobar Islands

Sr. No	District	Solar Potential (MW _p)
1	Andaman	590.22
Total Solar Potential (MW_p)		590.22

Andhra Pradesh

SPV Installed Capacity (July 2025)

- 5006.34 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 56% of the state's land.
- Wastelands cover about 13% (21814 km²) of the state's area.
- Scrub Land alone makes up over 89% of the wasteland area highly suitable for solar power plants.

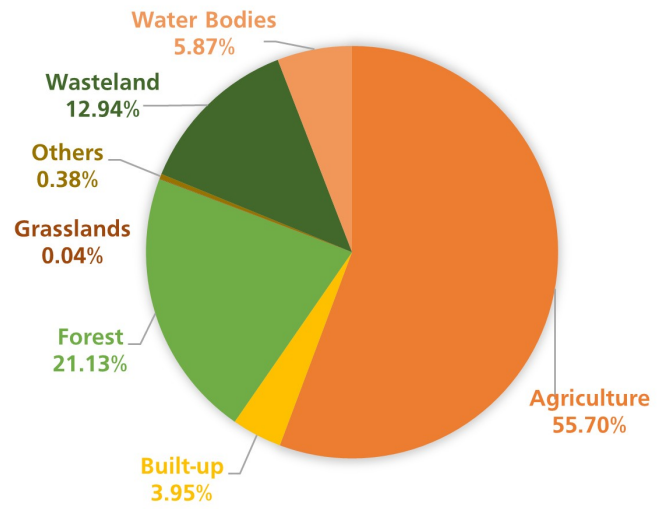


Figure 16: Land use and land cover of Andhra Pradesh

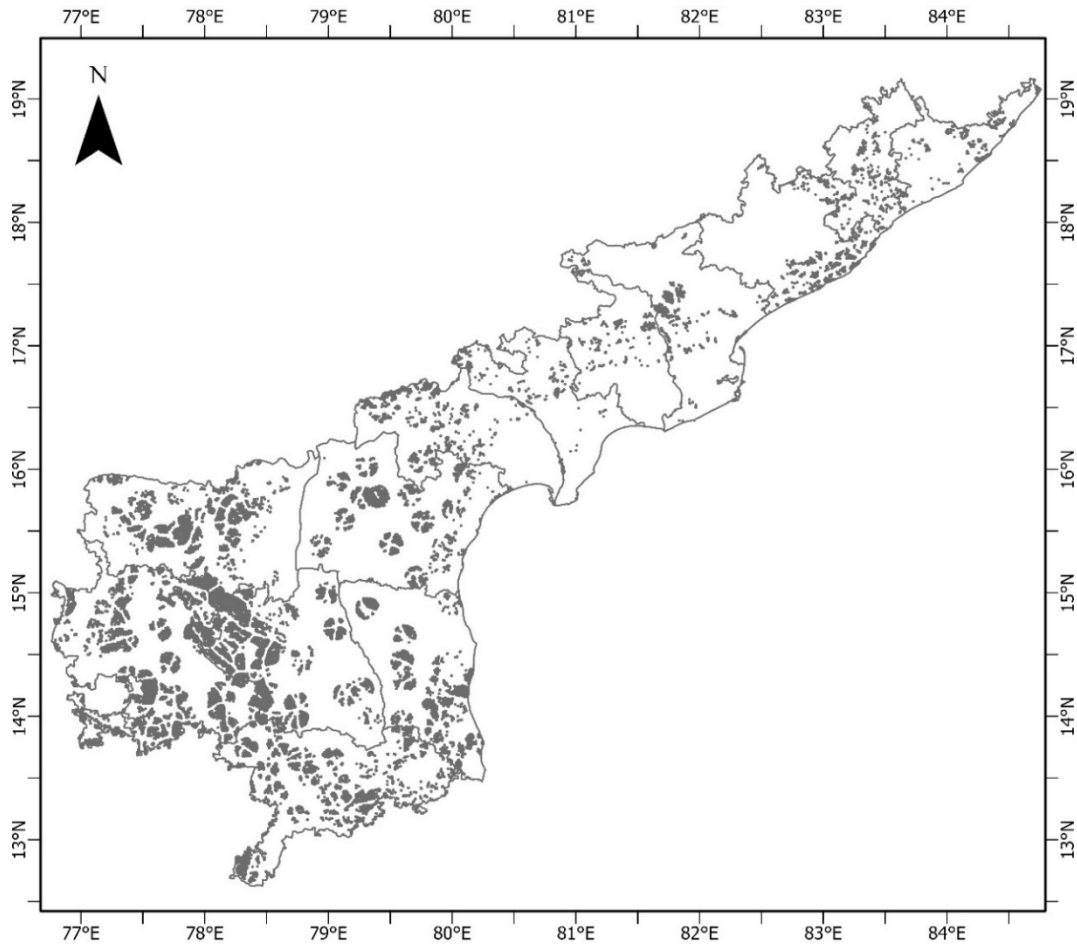
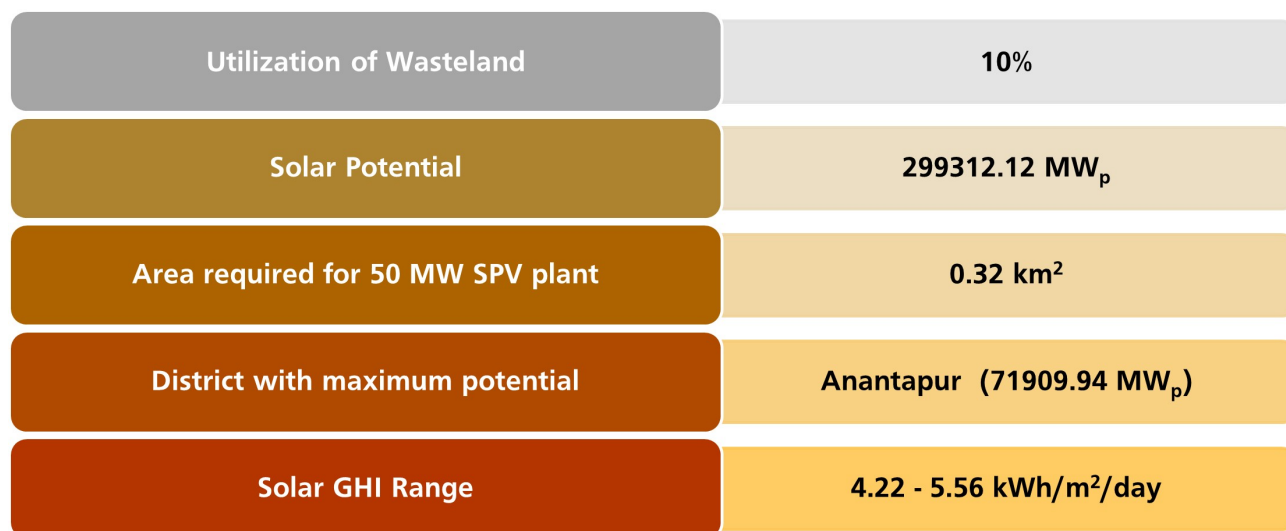


Figure 17: Feasible wasteland parcel of Andhra Pradesh for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Andhra Pradesh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 7: District wise solar potential of Andhra Pradesh

Sr. No	District	Solar Potential (MW _p)
1	Anantapur	71909.94
2	Chittoor	33021.71
3	East Godavari	6535.91
4	Guntur	12410.45
5	Krishna	3546.34
6	Kurnool	40224.31
7	Potti Sriramulu Nellore	25849.15
8	Prakasam	23724.14
9	Srikakulam	3441.68
10	Vishakhapatnam	8283.98
11	Vizianagaram	3505.12
12	West Godavari	2862.12
13	Y S R Kadapa	63997.25
Total Solar Potential (MW_p)		299312.12

Arunachal Pradesh

SPV Installed Capacity (July 2025)

- 1.27 MW

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 76% of the state's land.
- Wastelands cover about 10% (7811 km²) of the state's area.
- Scrub Land alone makes up over 43% of the wasteland area highly suitable for solar power plants.

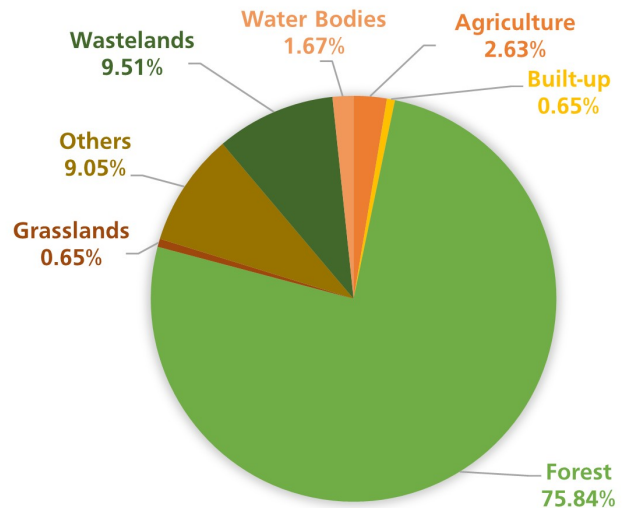


Figure 18: Land use and land cover of Arunachal Pradesh

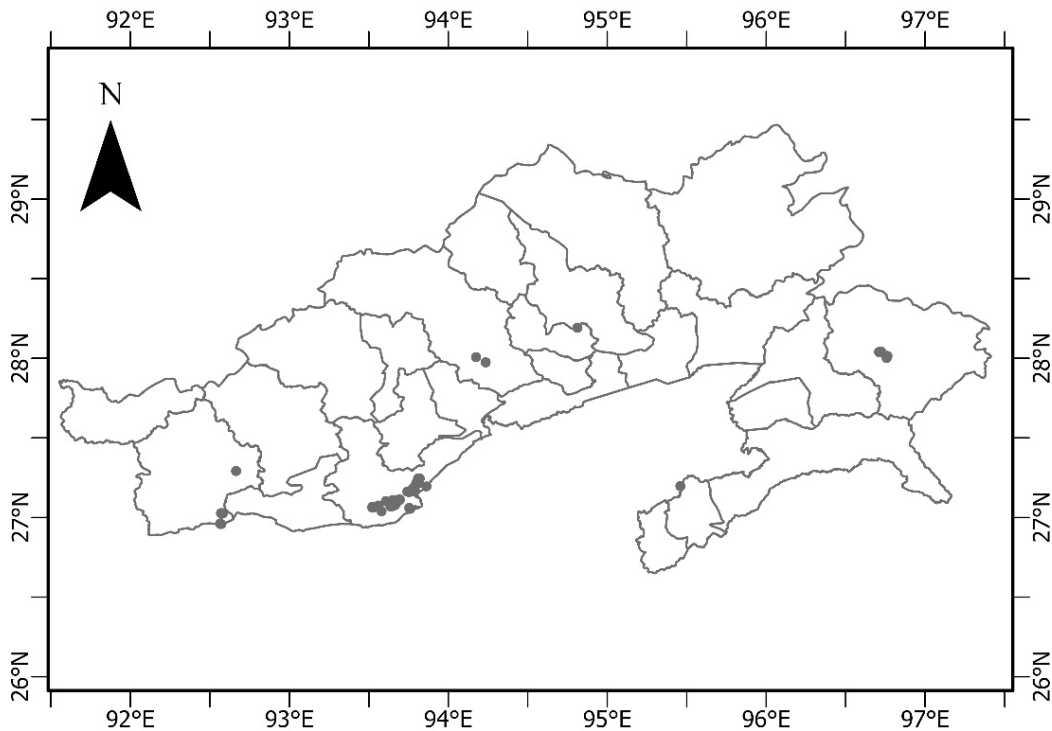


Figure 19: Feasible wasteland parcel of Arunachal Pradesh for solar installation

Solar Potential Insights

Utilization of Wasteland	0.06%
Solar Potential	467.52 MW _p
Area required for 50 MW SPV plant	0.42 km ²
District with maximum potential	Papumpare (354.50 MW _p)
Solar GHI Range	1.35 - 5.17 kWh/m ² /day

Solar Potential

The following table presents a district-wise breakdown of Arunachal Pradesh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 8: District wise solar potential of Arunachal Pradesh

Sr. No	District	Solar Potential (MW _p)
1	Anjaw	35.17
2	Papumpare	354.50
3	Tirap	7.09
4	Upper Subansiri	14.07
5	West Kameng	49.67
6	West Siang	7.02
Total Solar Potential (MW_p)		467.52

Assam

SPV Installed Capacity (July 2025)

- 126 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 40% of the state's land.
- Wastelands cover about 5% (3557 km²) of the state's area.
- Scrub Land alone makes up over 74% of the wasteland area highly suitable for solar power plants.

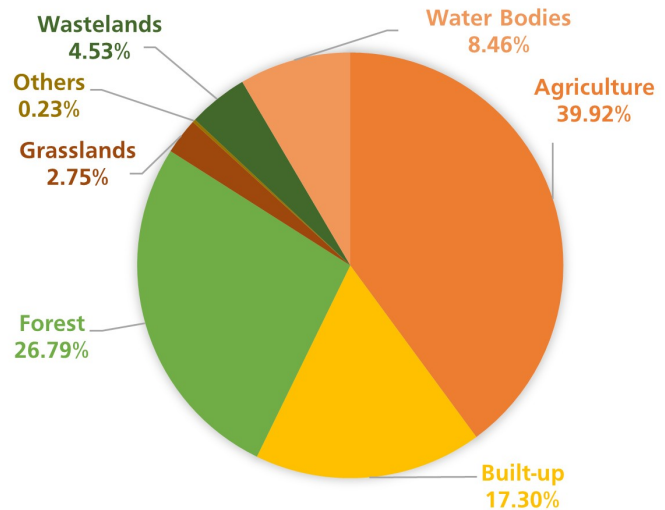


Figure 20: Land use and land cover of Assam

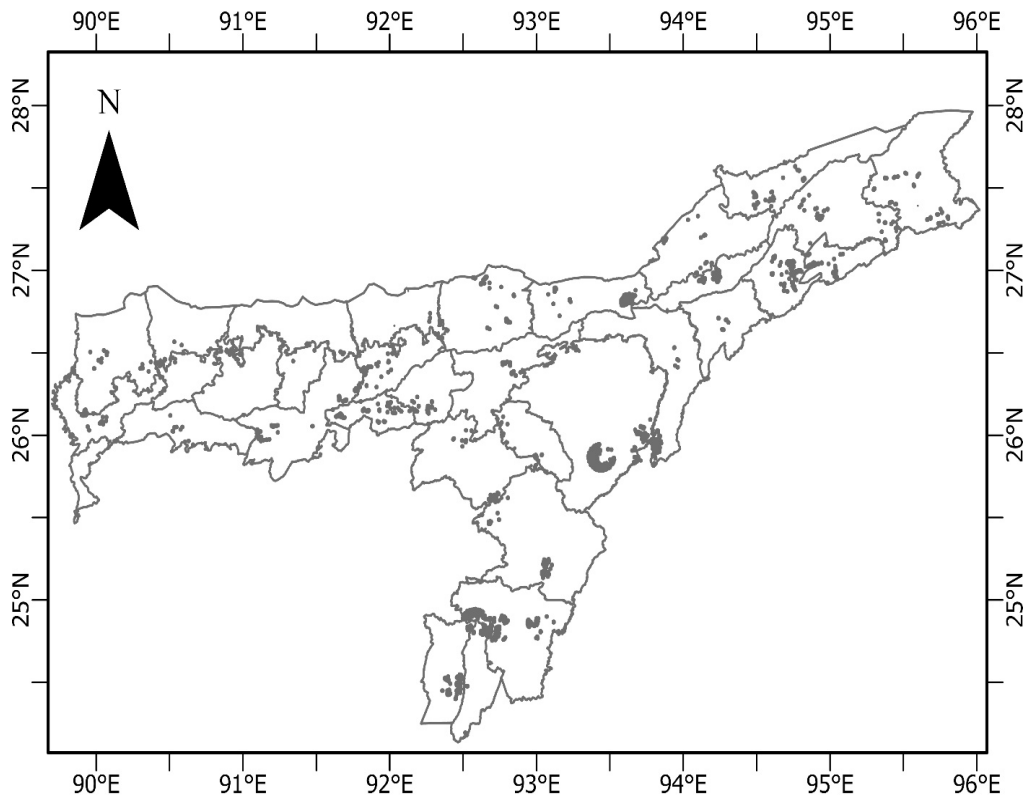


Figure 21: Feasible wasteland parcel of Assam for solar installation

Solar Potential Insights

Utilization of Wasteland	4.95%
Solar Potential	19173.13 MW _p
Area required for 50 MW SPV plant	0.40 km ²
District with maximum potential	Karbi Anaglong (4123.23 MW _p)
Solar GHI Range	1.35 - 5.17 kWh/m ² /day

Solar Potential

The following table presents a district-wise breakdown of Assam's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 9: District wise solar potential of Assam

Sr. No	District	Solar Potential (MW _p)
1	Baksa	67.61
2	Barpeta	142.74
3	Biswanath	2404.76
4	Bongaigaon	52.60
5	Cachar	2953.88
6	Charaideo	575.85
7	Chirang	22.53
8	Darrang	255.64
9	Dhemaji	394.77
10	Dhubri	105.54
11	Dibrugarh	432.61
12	Dima Hasao	515.96
13	Goalpara	82.97
14	Golaghat	490.38
15	Hailakandi	327.64
16	Hojai	113.23
17	Jorhat	105.02
18	Kamrup Metro	678.22

19	Kamrup Rural	632.91
20	Karbi Anaglong	4123.23
21	Karimganj	1022.93
22	Kokrajhar	308.61
23	Lakhimpur	231.61
24	Majuli	688.42
25	Marigaon	218.48
26	Nagaon	195.54
27	Nalbari	15.03
28	Sibsagar	949.92
29	Sonitpur	337.05
30	Tinsukia	394.93
31	Udalguri	30.00
32	West Karbi Anaglong	302.50
Total Solar Potential (MW_p)		19173.13

Bihar

SPV Installed Capacity (July 2025)

- 196.06 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 80% of the state's land.
- Wastelands cover about 3% (2996 km²) of the state's area.
- Scrub Land alone makes up over 68% of the wasteland area highly suitable for solar power plants.

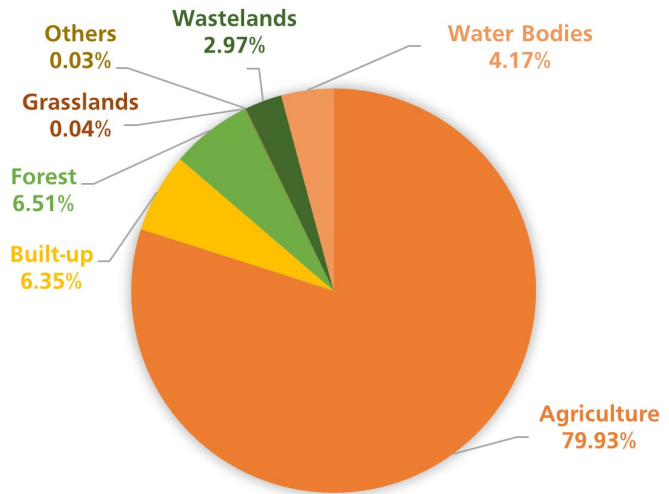


Figure 22: Land use and land cover of Bihar

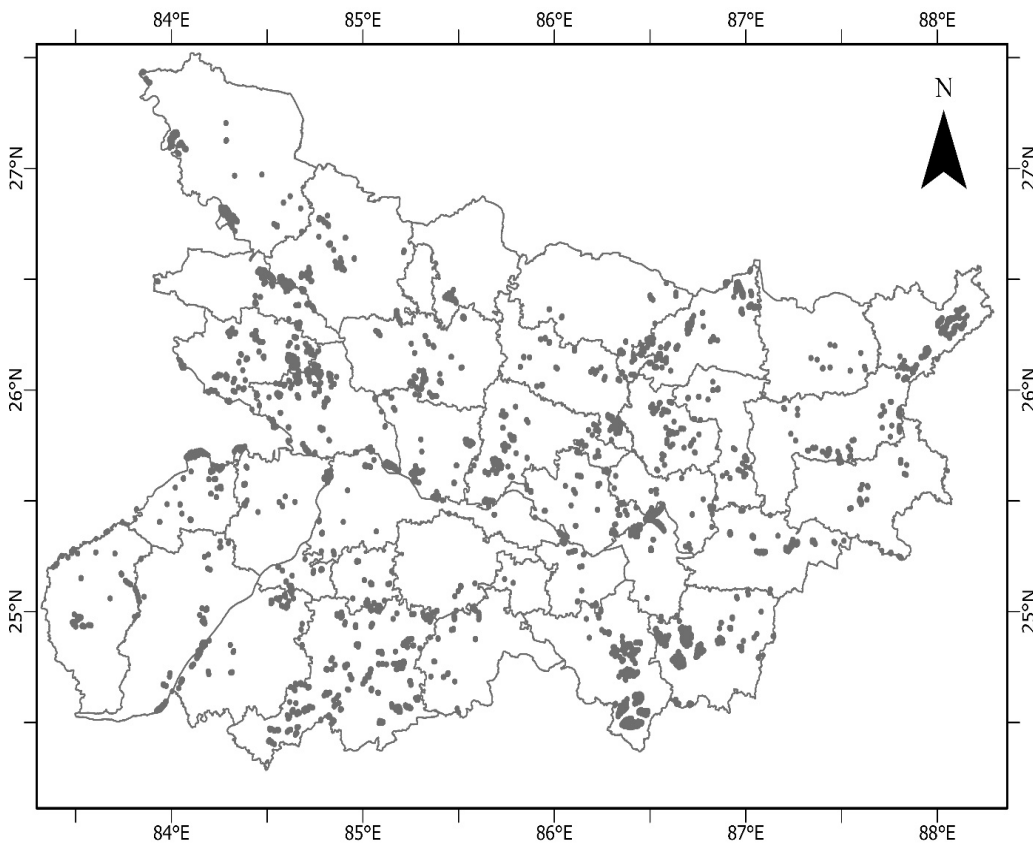
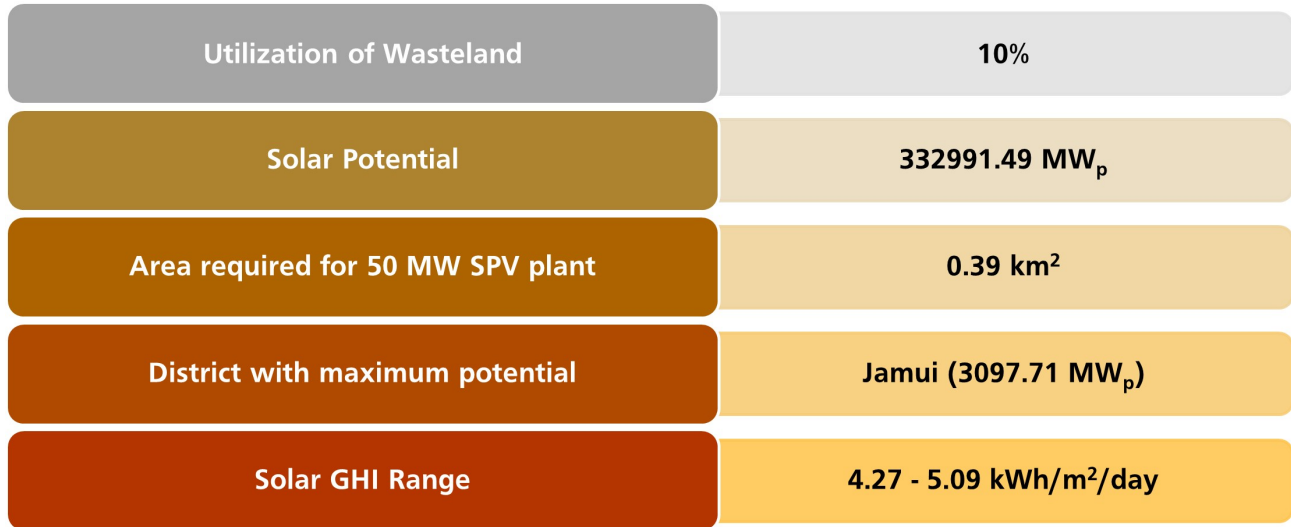


Figure 23: Feasible wasteland parcel of Bihar for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Bihar's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 10: District wise solar potential of Bihar

Sr. No	District	Solar Potential (MW _p)
1	Araria	81.53
2	Arwal	164.34
3	Aurangabad	525.91
4	Banka	2864.25
5	Begusarai	750.34
6	Bhagalpur	833.37
7	Bhojpur	264.59
8	Buxar	1309.23
9	Darbhangha	615.47
10	Gaya	2632.90
11	Gopalganj	1319.26
12	Jahanabad	354.21
13	Jamui	3097.71
14	Kaimur	417.57
15	Katihar	214.32
16	Khagaria	227.03

17	Kishanganj	1165.08
18	Lakhisarai	246.37
19	Madhepura	257.90
20	Madhubani	463.69
21	Munger	1110.45
22	Muzaffarpur	539.38
23	Nalanda	113.86
24	Nawada	253.36
25	Purbi Champaran	1731.58
26	Purnia	565.77
27	Pashchimi Champaran	1507.25
28	Patna	548.30
29	Rohtas	747.84
30	Sitamarhi	644.31
31	Saran	2154.91
32	Saharsa	477.74
33	Samastipur	1120.35
34	Sheikhpura	12.64
35	Siwan	1391.97
36	Supaul	1285.05
37	Vaishali	981.65
Total Solar Potential (MW_p)		332991.49

Chandigarh

SPV Installed Capacity (July 2025)

- 6.34 MW

Land Use and Land Cover (LULC)

- Built-up areas dominate nearly 80% of the union territory's land.
- Wastelands cover about 2% (2 km²) of the state's area.
- Scrub Land alone makes up over 100% of the wasteland area highly suitable for solar power plants.

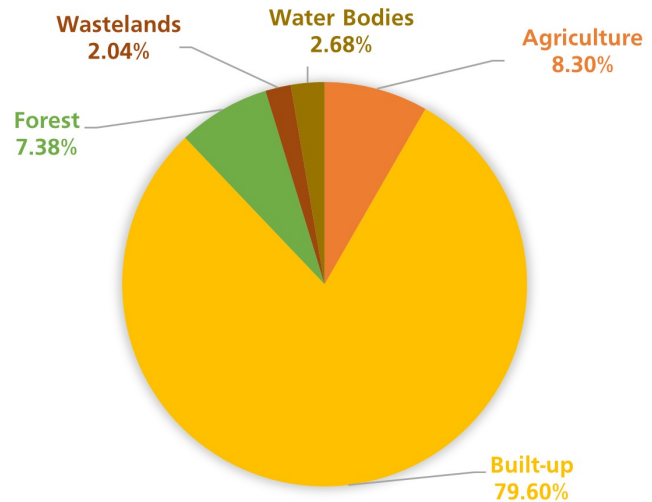


Figure 24: Land use and land cover of Chandigarh

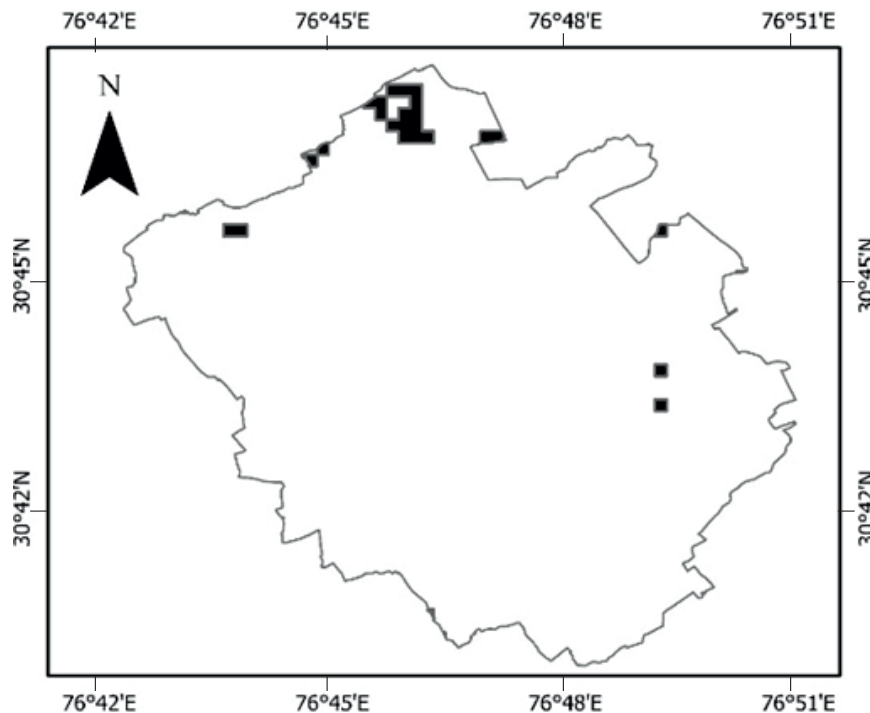
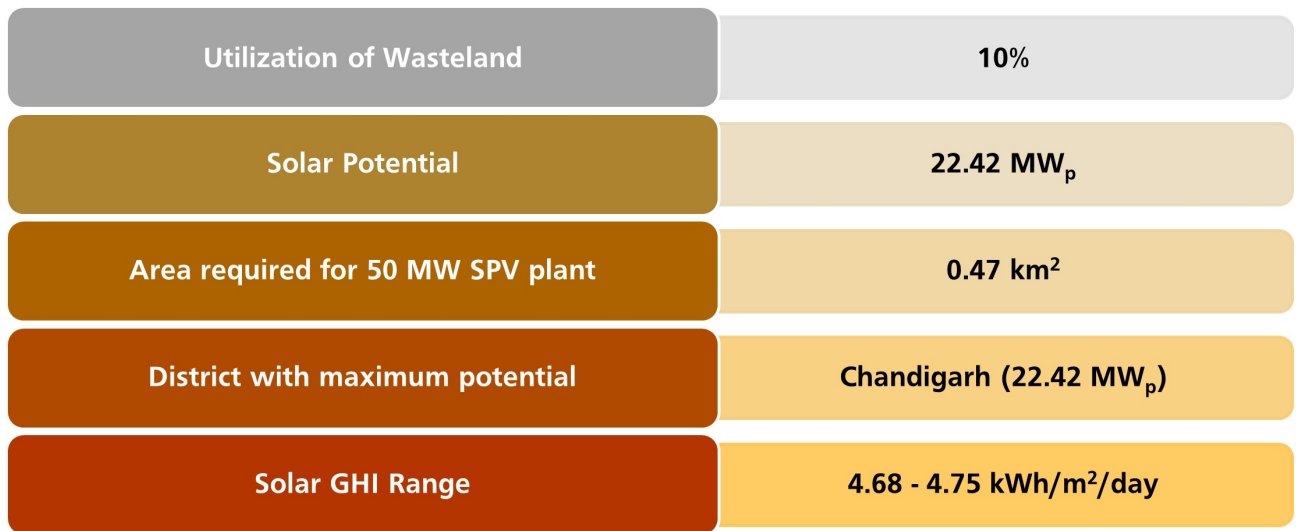


Figure 25: Feasible wasteland parcel of Chandigarh for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Chandigarh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 11: District wise solar potential of Chandigarh

Sr. No	District	Solar Potential (MW _p)
1	Chandigarh	22.42
Total Solar Potential (MW_p)		22.42

Chhattisgarh

SPV Installed Capacity (July 2025)

- 998.91 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 44% of the state's land.
- Wastelands cover about 9% (11765 km²) of the state's area.
- Scrub Land alone makes up over 95% of the wasteland area highly suitable for solar power plants.

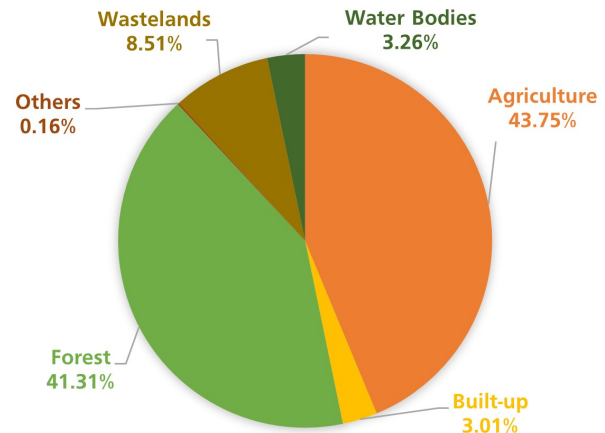


Figure 26: Land use and land cover of Chhattisgarh

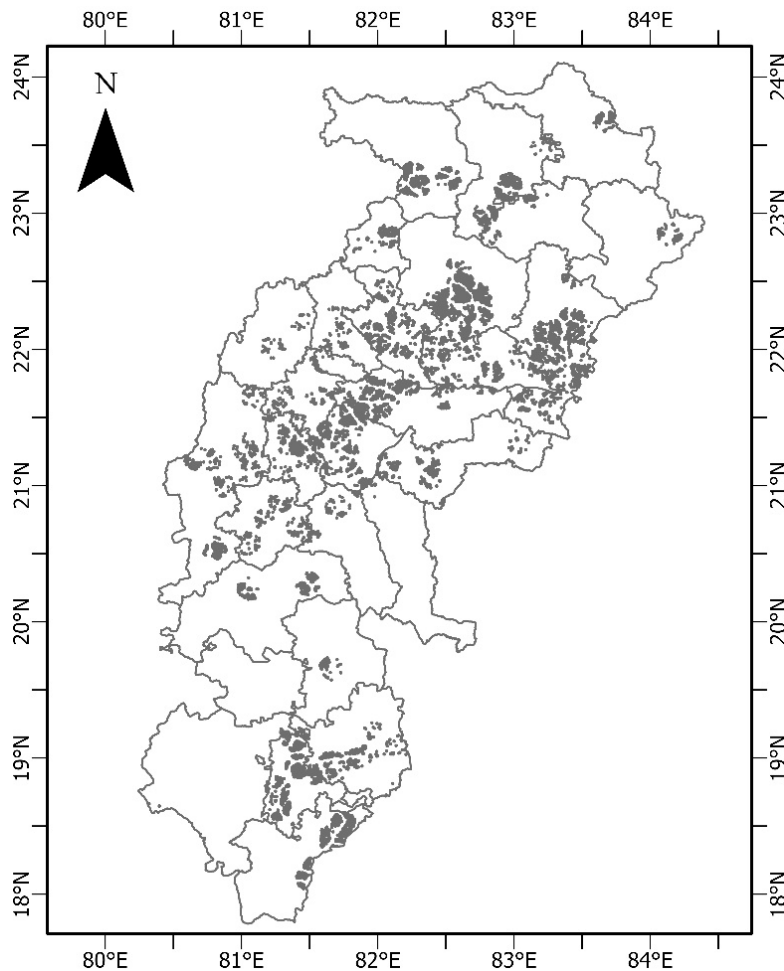
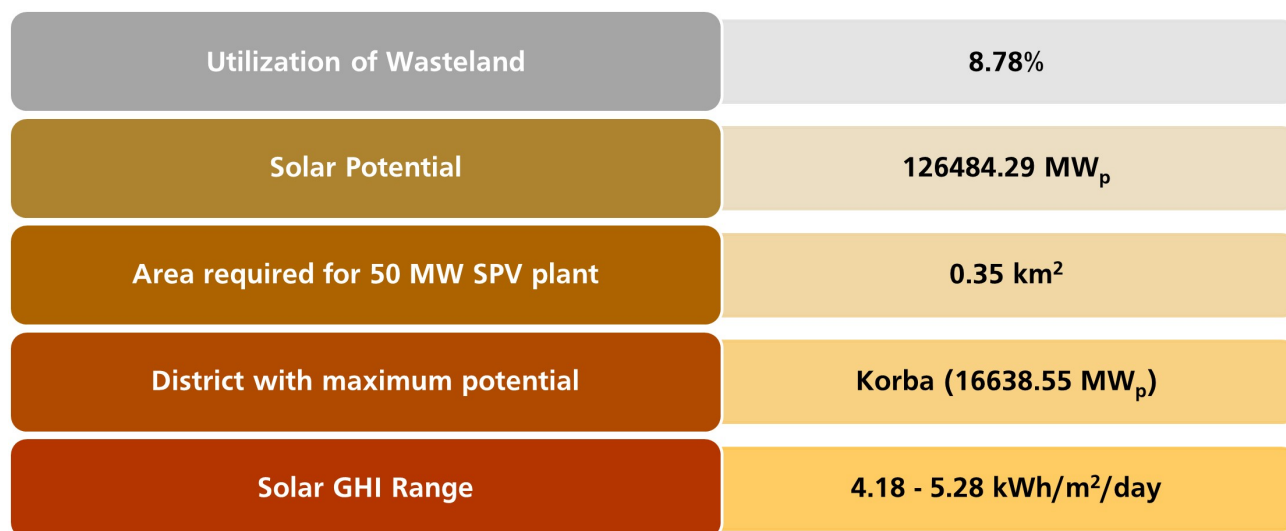


Figure 27: Feasible wasteland parcel of Chhattisgarh for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Chhattisgarh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 12: District wise solar potential of Chhattisgarh

Sr. No	District	Solar Potential (MW _p)
1	Bijapur	829.16
2	Balod	2586.44
3	Baloda Bazar	9027.22
4	Balrampur	1236.60
5	Bastar	4130.77
6	Bemetara	2308.50
7	Bilapur	6453.91
8	Dakshin Bastar Dantewada	9848.03
9	Dhamtari	970.74
10	Durg	4168.65
11	Gariyaband	237.92
12	Gaurela-Pendra-Marwahi	1557.60
13	Janjgir - Champa	6479.92
14	Jashpur	861.39
15	Kabirdham	621.09
16	Kondagaon	497.59
17	Korba	16638.55

18	Korea	6133.49
19	Mahasamund	3213.19
20	Mungeli	769.74
21	Raj Nandgaon	5647.66
22	Raigarh	15669.60
23	Raipur	8403.61
24	Surajpur	5894.78
25	Sukma	7233.75
26	Surguja	1894.70
27	Uttar Bastar Kanker	3169.69
Total Solar Potential (MW_p)		126484.29

Dadra and Nagar Haveli and Daman and Diu (DNHDD)

SPV Installed Capacity (July 2025)

- 14.3 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 43% of the union territory's land.
- Wastelands cover about 6% (38 km²) of the state's area.
- Scrub Land alone makes up over 96% of the wasteland area highly suitable for solar power plants.

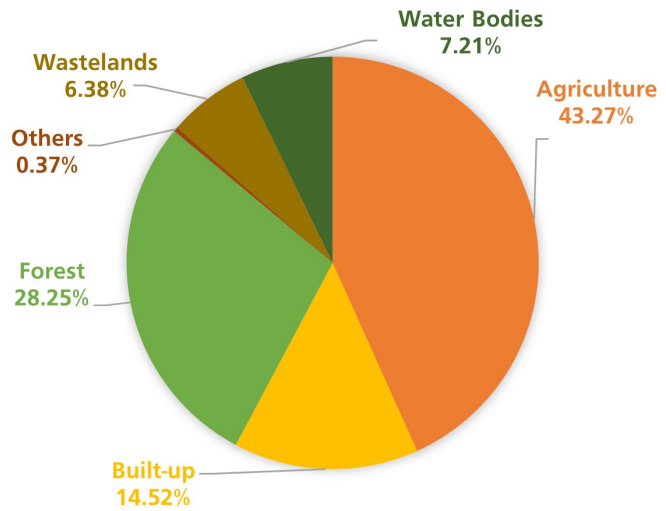


Figure 28: Land use and land cover of DNHDD

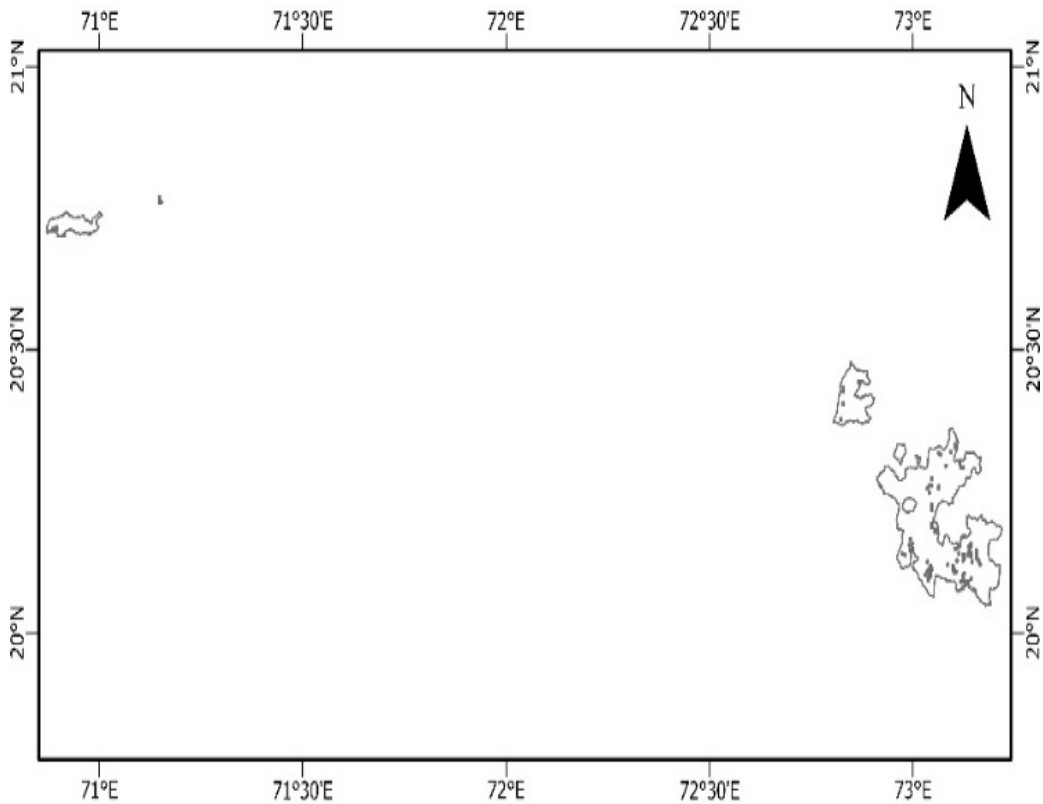
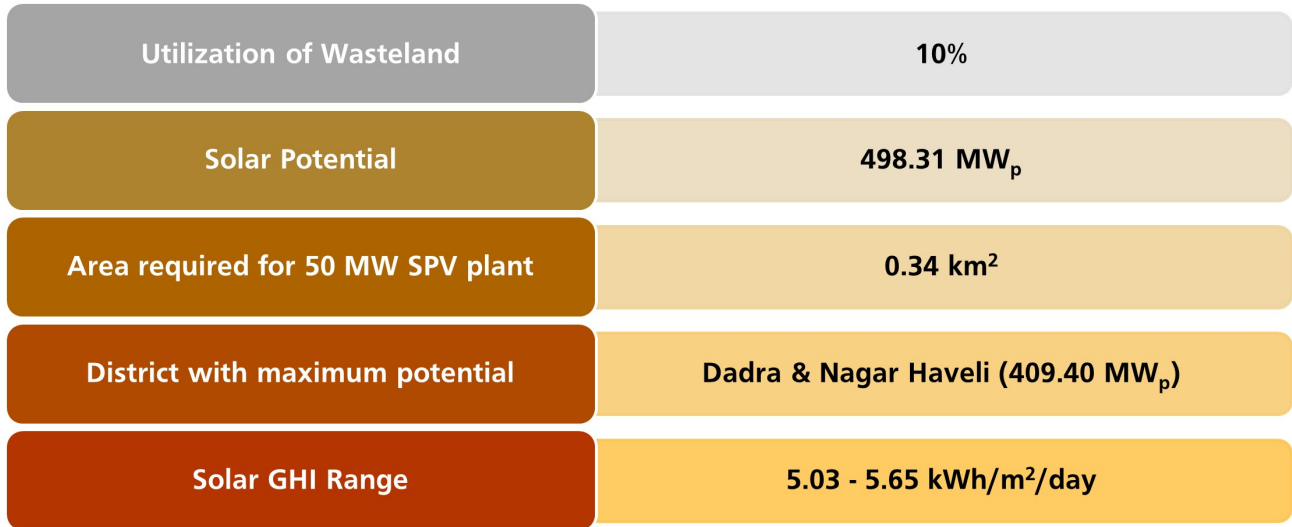


Figure 29: Feasible wasteland parcel of DNHDD for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of DNHDD's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 13: District wise solar potential of DNHDD

Sr. No	District	Solar Potential (MW _p)
1	Dadra & Nagar Haveli	409.40
2	Daman	40.87
3	Diu	48.04
Total Solar Potential (MW_p)		498.31

Delhi

SPV Installed Capacity (July 2025)

- 9.34 MW

Land Use and Land Cover (LULC)

- Built-up areas dominate nearly 61% of the union territory's land.
- Wastelands cover about 4% (55 km²) of the state's area.
- Scrub Land alone makes up over 78% of the wasteland area highly suitable for solar power plants.

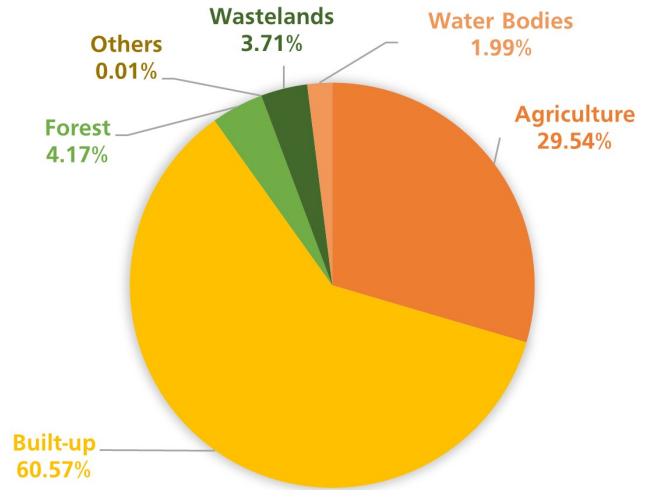


Figure 30: Land use and land cover of Delhi

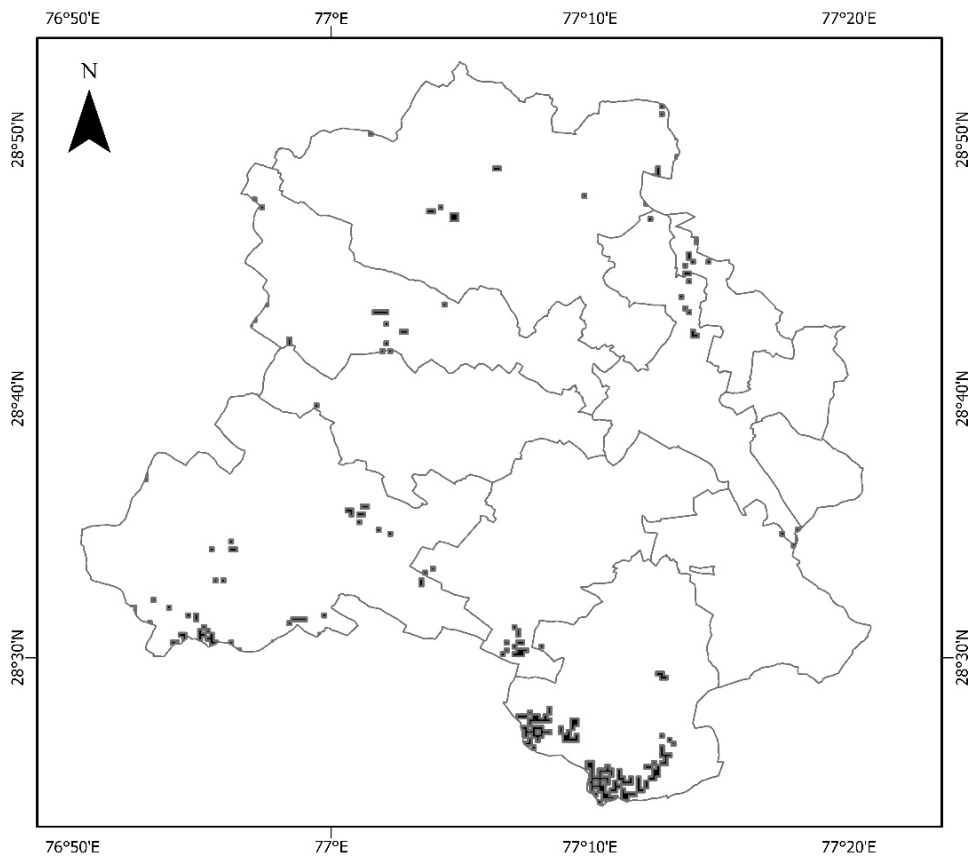
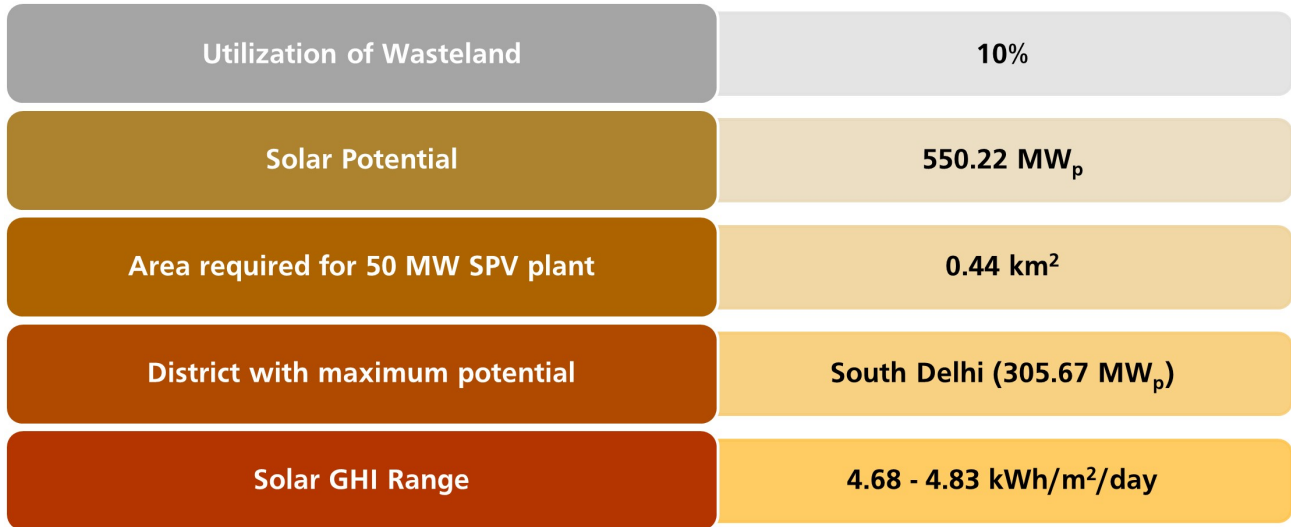


Figure 31: Feasible wasteland parcel of Delhi for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Delhi's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 14: District wise solar potential of Delhi

Sr. No	District	Solar Potential (MW _p)
1	Central Delhi	25.95
2	New Delhi	36.83
3	North Delhi	28.09
4	Northeast Delhi	15.13
5	Northwest Delhi	30.27
6	South Delhi	305.67
7	Southeast Delhi	2.17
8	Southwest Delhi	101.79
9	West Delhi	4.33
Total Solar Potential (MW_p)		550.22

Goa

SPV Installed Capacity (July 2025)

- 1.95 MW

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 51% of the state's land.
- Wastelands cover about 13% (484 km²) of the state's area.
- Scrub Land alone makes up over 88% of the wasteland area highly suitable for

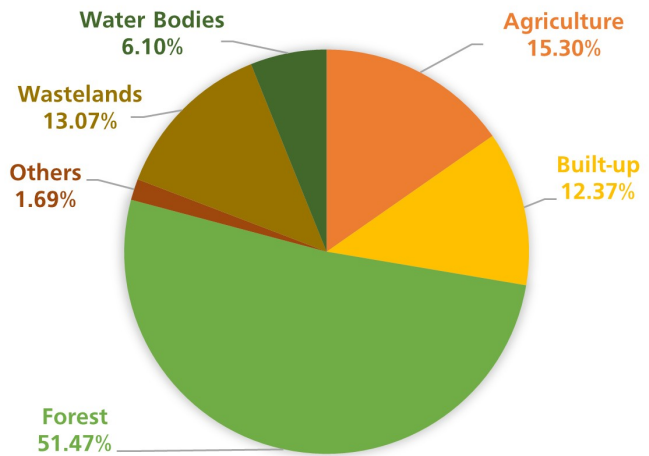


Figure 32: Land use and land cover of Goa

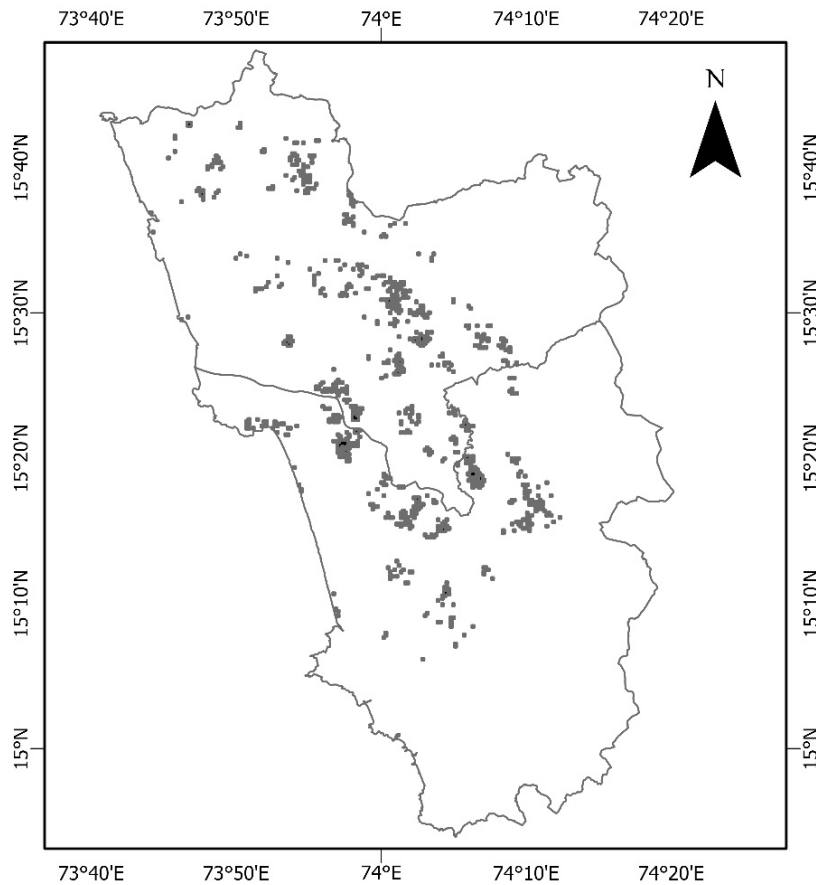
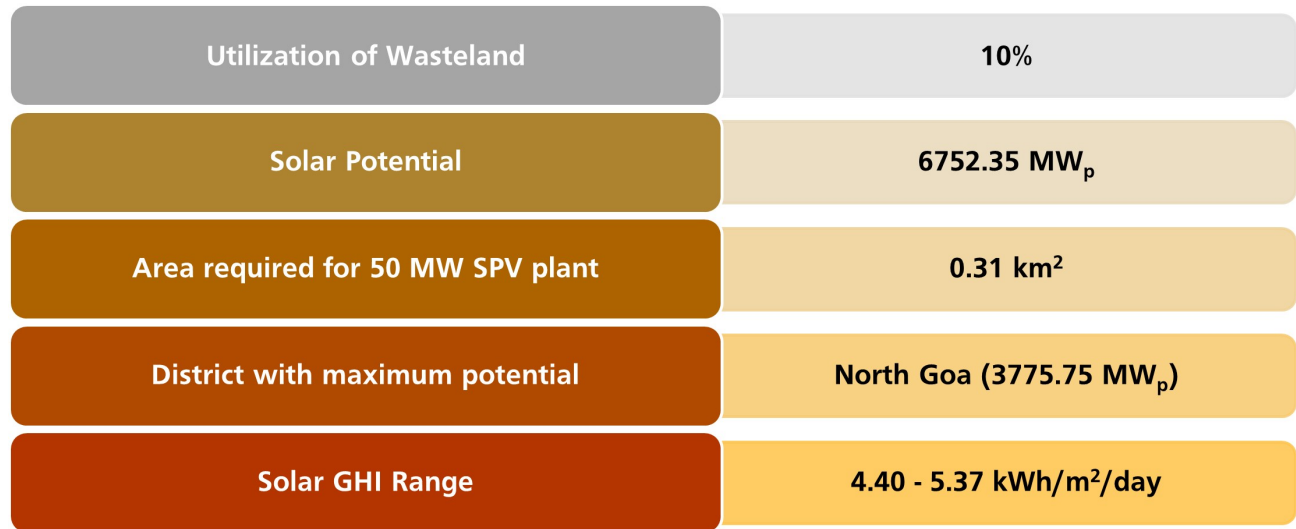


Figure 33: Feasible wasteland parcel of Goa for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Goa's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 15: District wise solar potential of Goa

Sr. No	District	Solar Potential (MW _p)
1	North Goa	3775.75
2	South Goa	2976.60
Total Solar Potential (MW_p)		6752.35

Gujarat

SPV Installed Capacity (July 2025)

- 15025.13 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 59% of the state's land.
- Wastelands cover about 11% (20324 km²) of the state's area.
- Scrub Land alone makes up over 86% of the wasteland area highly suitable for solar power plants.

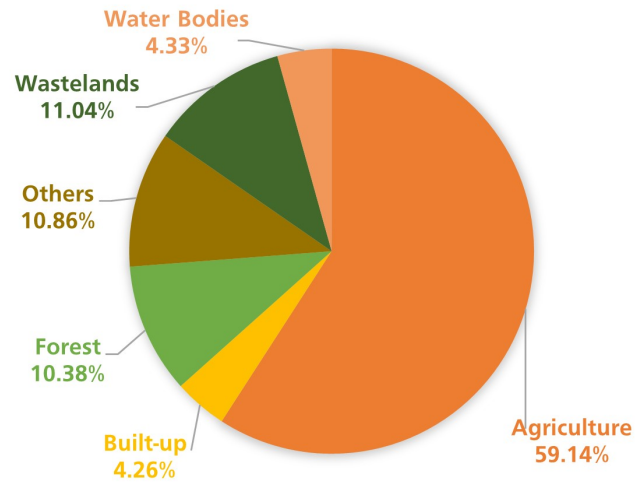


Figure 34: Land use and land cover of Gujarat

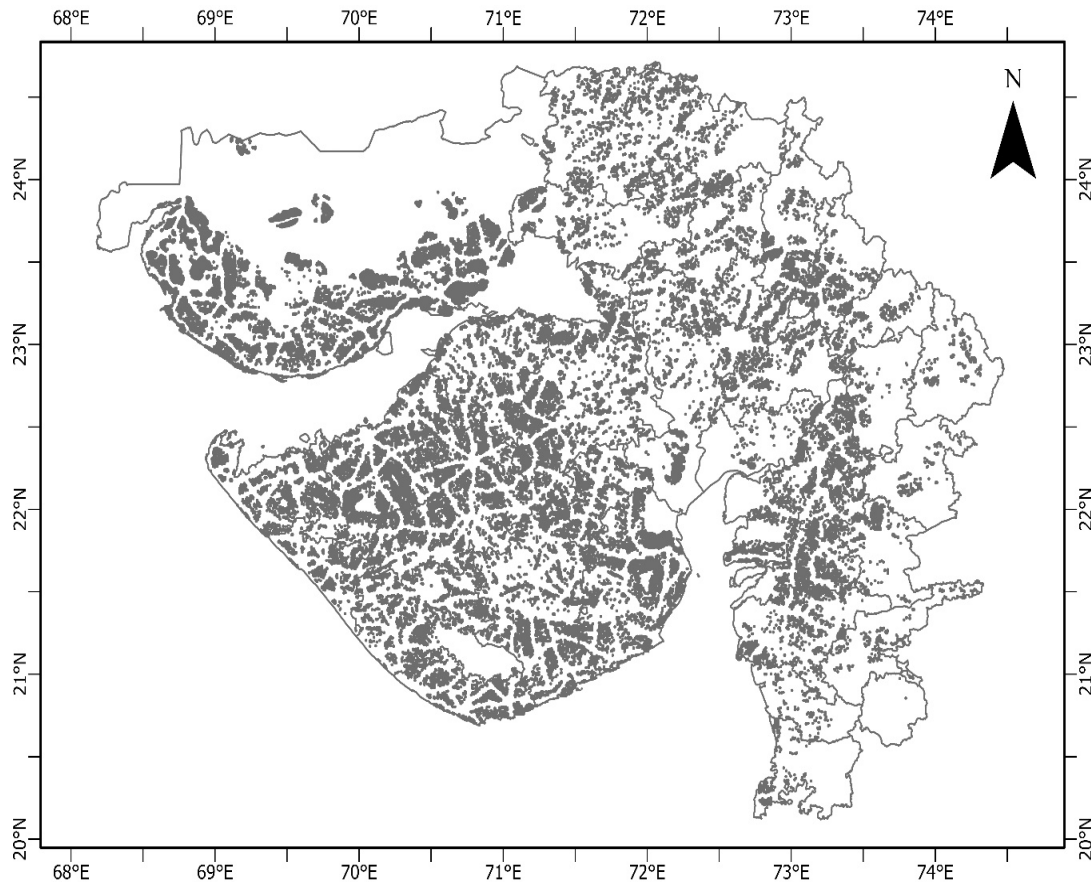
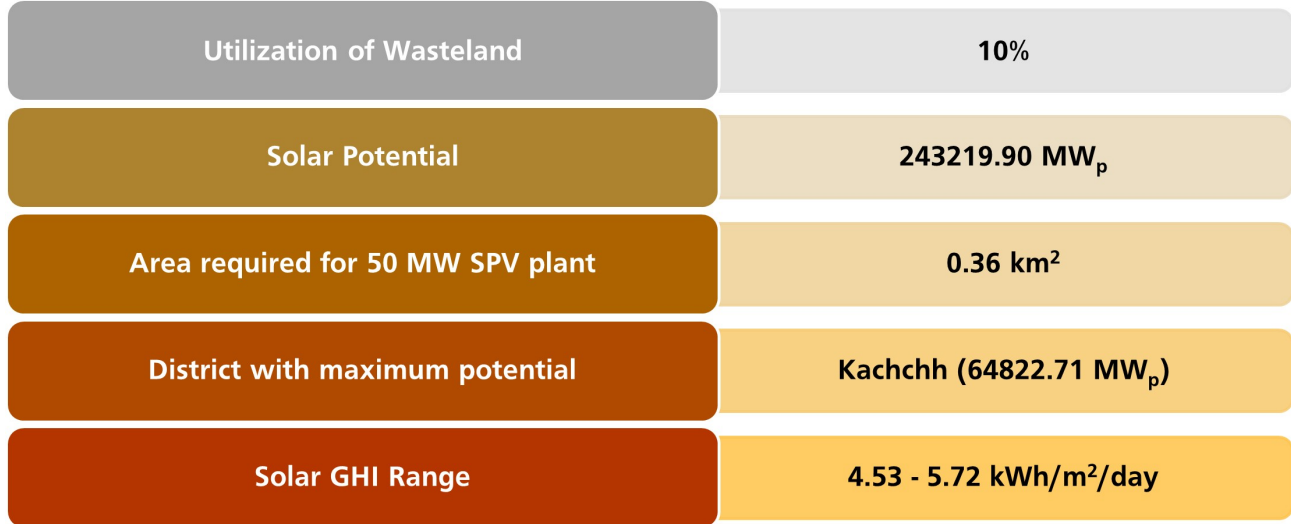


Figure 35: Feasible wasteland parcel of Gujarat for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Gujarat's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 16: District wise solar potential of Gujarat

Sr. No	District	Solar Potential (MW _p)
1	Anand	1569.20
2	Ahmadabad	6345.41
3	Amreli	11480.81
4	Aravalli	2442.31
5	Banas Kantha	8625.31
6	Bhavnagar	17165.14
7	Bharuch	7856.44
8	Botad	4728.18
9	Chhota Udepur	726.34
10	Dahod	938.28
11	Dangs	6.16
12	Devbhumi Dwarka	8075.01
13	Gir Somnath	4549.81
14	Gandhinagar	2363.71
15	Junagadh	7611.73
16	Jamnagar	16929.63
17	Kachchh	64822.71

18	Kheda	2435.91
19	Mahesana	3929.88
20	Mahisagar	1585.59
21	Morbi	7952.85
22	Narmada	2082.87
23	Navsari	665.22
24	Panch Mahals	1153.19
25	Patan	4831.64
26	Porbandar	4308.63
27	Rajkot	14790.08
28	Surat	4349.57
29	Sabar Kantha	3516.77
30	Surendranagar	16835.56
31	Tapi	866.37
32	Vadodara	6759.76
33	Valsad	919.85
Total Solar Potential (MW_p)		243219.90

Haryana

SPV Installed Capacity (July 2025)

- 267.76 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 84% of the state's land.
- Wastelands cover about 1% (643 km²) of the state's area.
- Scrub Land alone makes up over 70% of the wasteland area highly suitable for solar power plants.

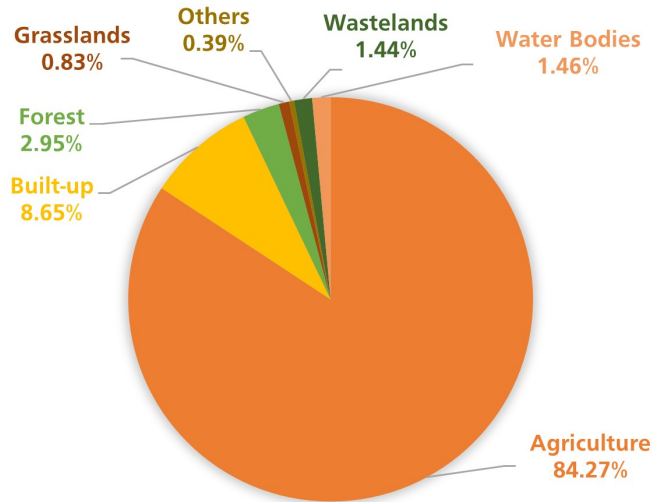


Figure 36: Land use and land cover of Haryana

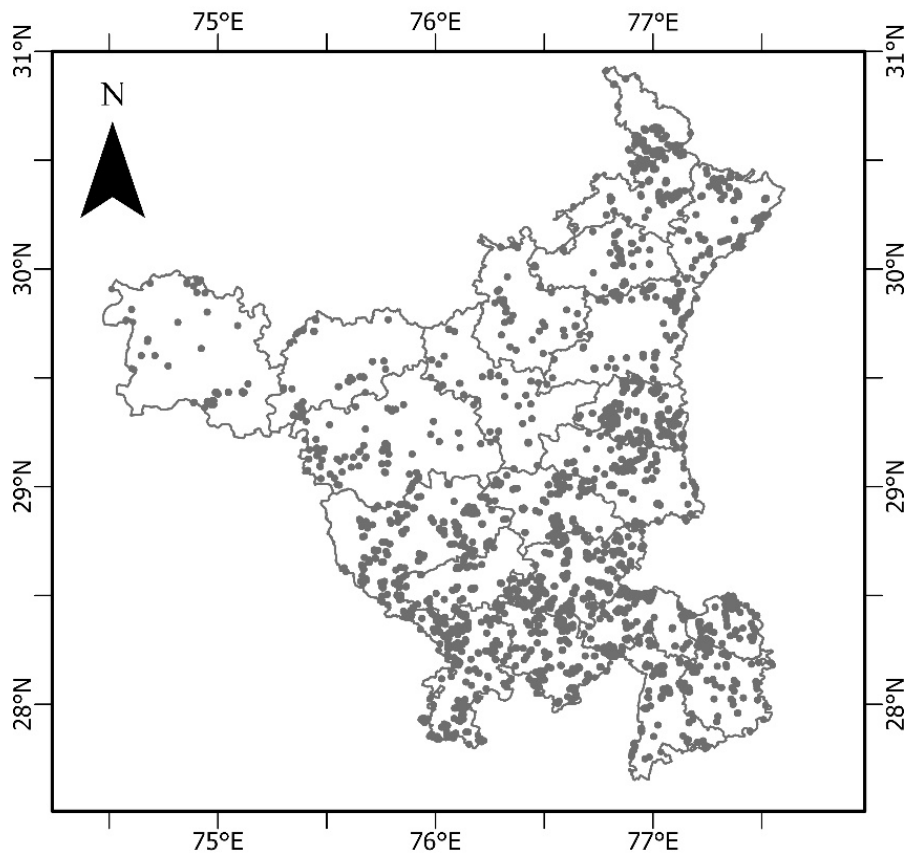
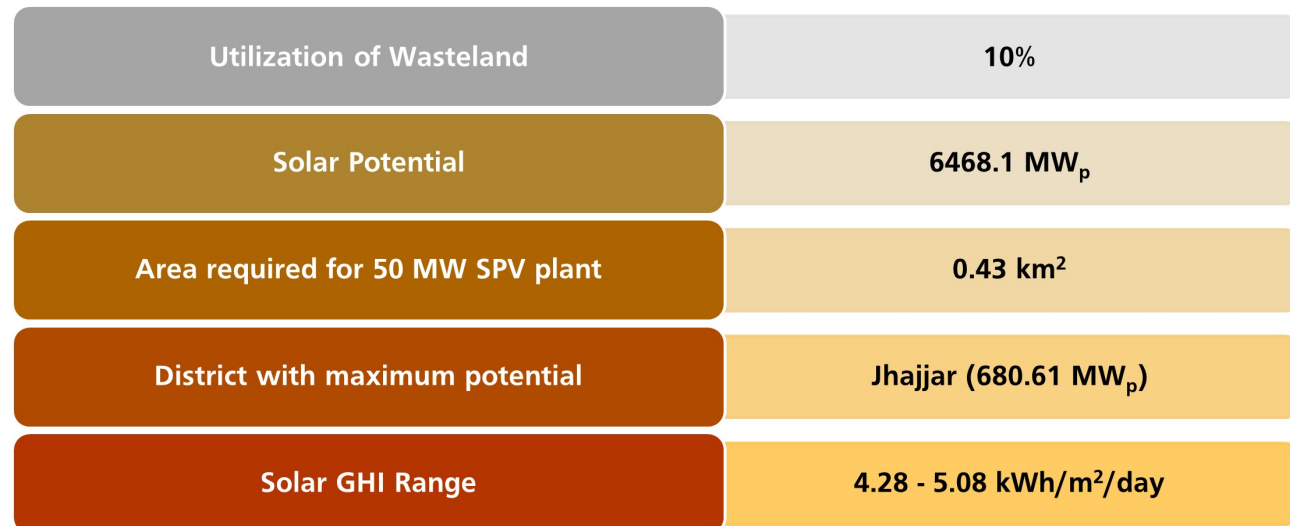


Figure 37: Feasible wasteland parcel of Haryana for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Haryana's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 17: District wise solar potential of Haryana

Sr. No	District	Solar Potential (MW _p)
1	Ambala	224.38
2	Bhiwani	464.85
3	Charkhi Dadri	147.16
4	Faridabad	532.25
5	Fatehabad	104.54
6	Gurugram	468.52
7	Hisar	240.25
8	Jind	91.51
9	Jhajjar	680.61
10	Kaithal	101.99
11	Karnal	258.39
12	Kurukshetra	101.77
13	Mahendragarh	557.64
14	Mewat	346.32
15	Panipat	444.82
16	Palwal	187.46

17	Panchkula	245.53
18	Rewari	359.12
19	Rohtak	238.65
20	Sirsa	128.41
21	Sonipat	319.22
22	Yamunanagar	224.72
Total Solar Potential (MW_p)		6468.11

Himachal Pradesh

SPV Installed Capacity (July 2025)

- 203 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 84% of the state's land.
- Wastelands cover about 33% (18510 km²) of the state's area.
- Scrub Land alone makes up over 30% of the wasteland area highly suitable for solar power plants.

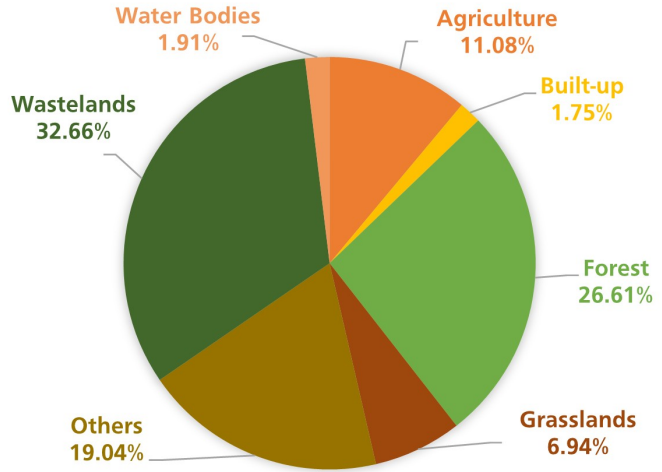


Figure 38: Land use and land cover of Himachal Pradesh

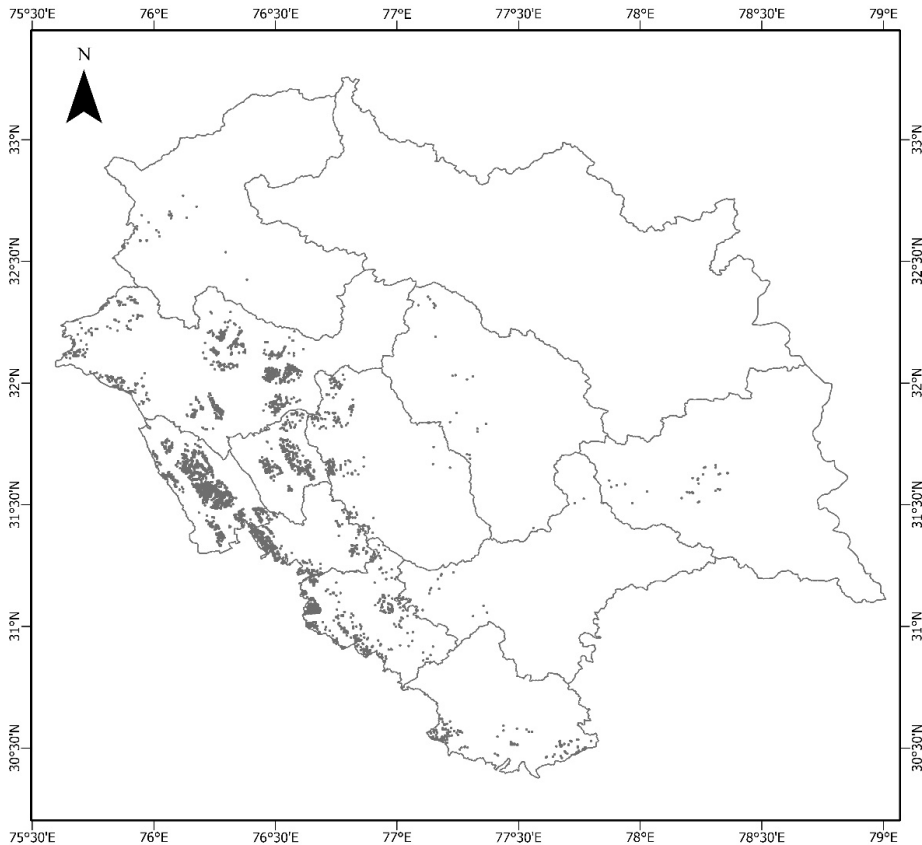
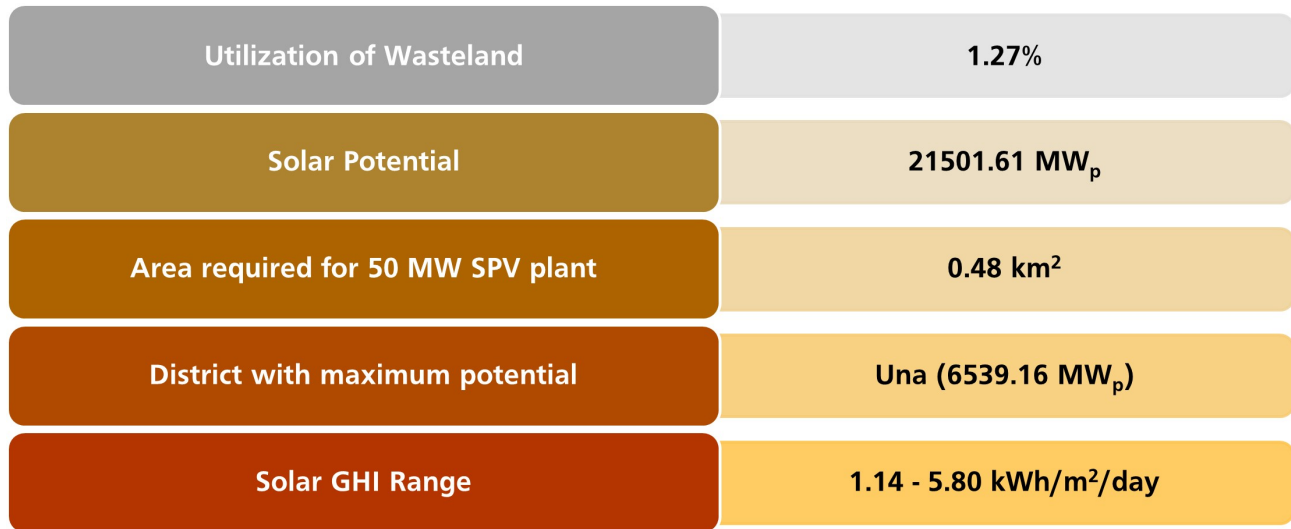


Figure 39: Feasible wasteland parcel of Himachal Pradesh for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Himachal Pradesh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 18: District wise solar potential of Himachal Pradesh

Sr. No	District	Solar Potential (MW _p)
1	Bilaspur	2200.94
2	Chamba	177.94
3	Hamirpur	1851.22
4	Kangra	5323.20
5	Kinnaur	179.93
6	Kullu	125.38
7	Mandi	1185.24
8	Shimla	132.50
9	Sirmaur	860.92
10	Solan	2925.19
11	Una	6539.16
Total Solar Potential (MW_p)		21501.61

Jammu and Kashmir

SPV Installed Capacity (July 2025)

- 2.49 MW

Land Use and Land Cover (LULC)

- Snow covered areas dominate nearly 31% of the union territory's land.
- Wastelands cover about 23% (15526 km²) of the state's area.
- Scrub Land alone makes up over 61% of the wasteland area highly suitable for solar power plants.

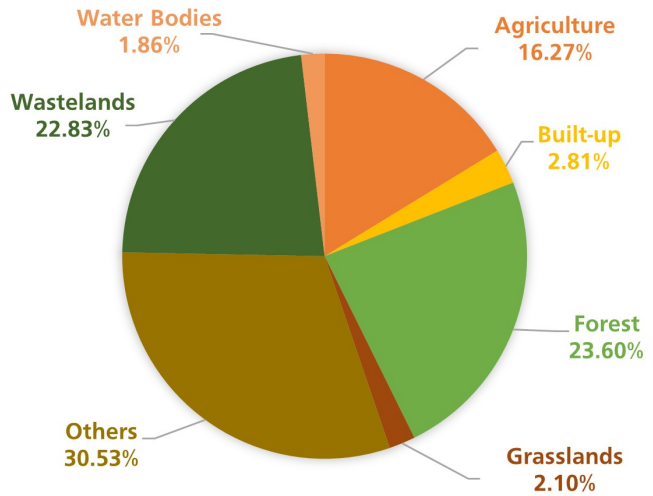


Figure 40: Land use and land cover of Jammu and Kashmir

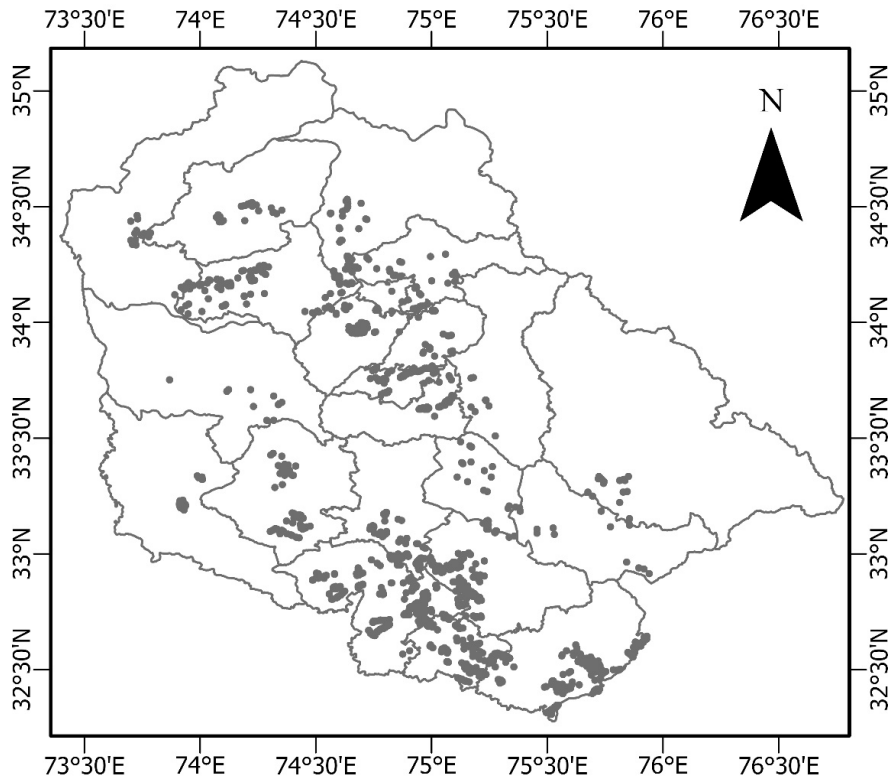
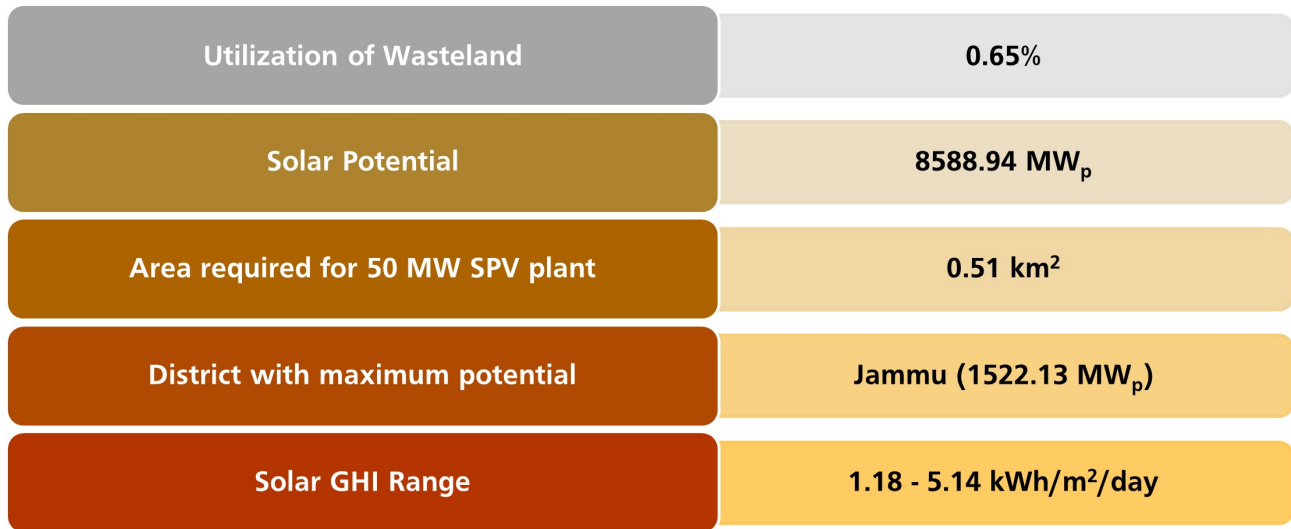


Figure 41: Feasible wasteland parcel of Jammu and Kashmir for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Jammu and Kashmir's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 19: District wise solar potential of Jammu and Kashmir

Sr. No	District	Solar Potential (MW _p)
1	Anantnag	49.15
2	Baramula	477.83
3	Badgam	386.30
4	Bandipura	466.28
5	Doda	76.95
6	Ganderbal	222.50
7	Jammu	1522.13
8	Kathua	1378.12
9	Kishtwar	82.26
10	Kulgam	349.55
11	Kupwara	162.32
12	Mirpur	197.57
13	Muzaffarabad	113.85
14	Punch	60.07
15	Pulwama	141.59
16	Rajauri	318.38
17	Ramban	164.62

18	Riasi	357.48
19	Samba	784.92
20	Shupiyan	376.39
21	Srinagar	201.11
22	Udhampur	699.55
Total Solar Potential (MW_p)		8588.94

Jharkhand

SPV Installed Capacity (July 2025)

- 21 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 53% of the state's land.
- Wastelands cover about 6% (4473 km²) of the state's area.
- Scrub Land alone makes up over 90% of the wasteland area highly suitable for solar power plants.

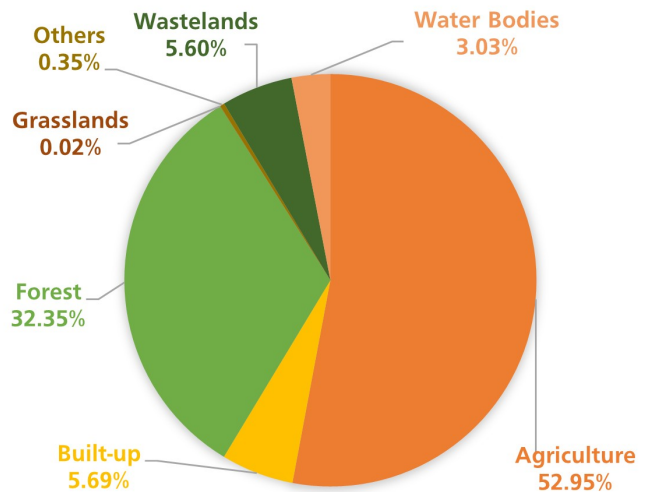


Figure 42: Land use and land cover of Jharkhand

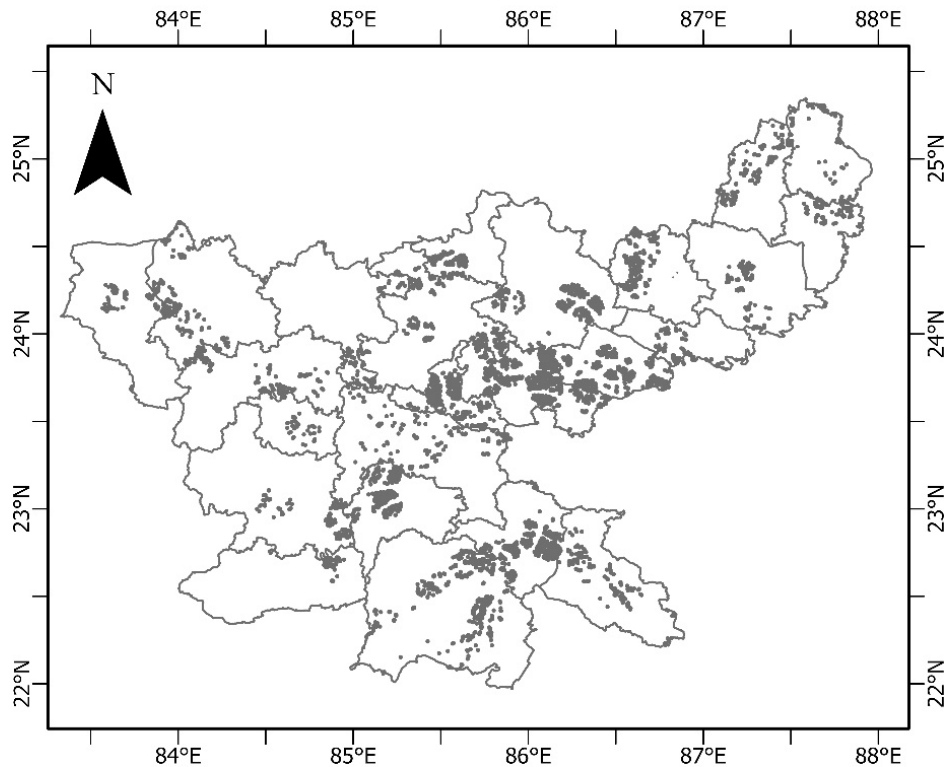
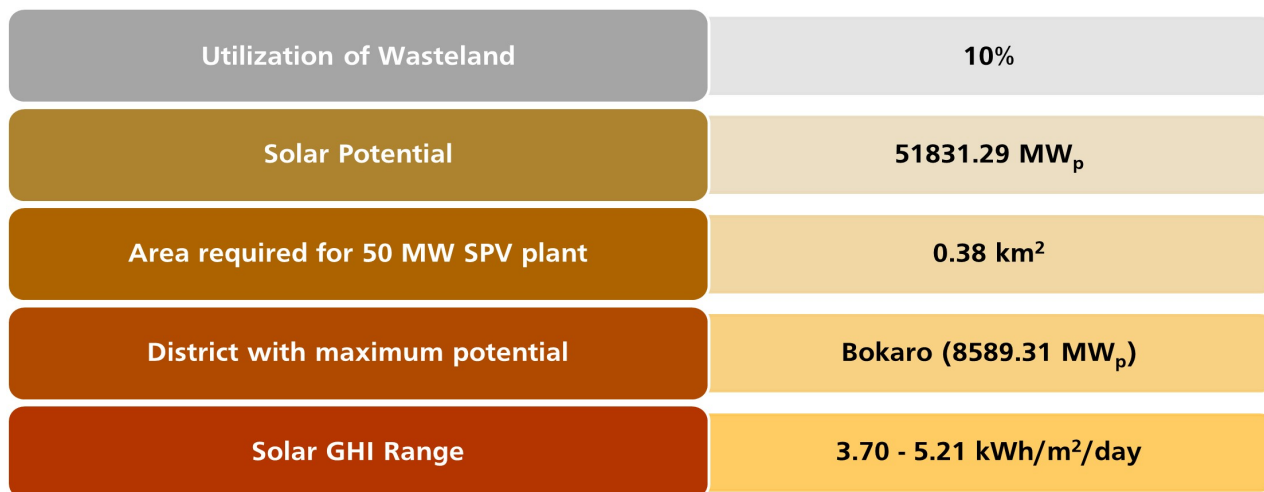


Figure 43: Feasible wasteland parcel of Jharkhand for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Jharkhand's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 20: District wise solar potential of Jharkhand

Sr. No	District	Solar Potential (MW _p)
1	Bokaro	8589.31
2	Chatra	765.25
3	Deoghar	2237.26
4	Dhanbad	4097.96
5	Dumka	1087.00
6	East Singhbhum	1516.18
7	Garhwa	1080.36
8	Giridih	2983.45
9	Godda	1249.16
10	Gumla	1001.08
11	Hazaribagh	3111.33
12	Jamtara	868.74
13	Khunti	2763.46
14	Kodarma	1334.91
15	Latehar	1201.45
16	Lohardaga	317.59
17	Pakur	790.36
18	Palamu	1792.92

19	Ramgarh	3925.17
20	Ranchi	1515.58
21	Sahibganj	751.48
22	Saraikela-Kharsawan	4417.54
23	Simdega	408.64
24	West Singhbhum	4025.12
Total Solar Potential (MW_p)		51831.29

Karnataka

SPV Installed Capacity (July 2025)

- 9054.03 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 64% of the state's land.
- Wastelands cover about 9% (15604 km²) of the state's area.
- Scrub Land alone makes up over 90% of the wasteland area highly suitable for solar power plants.

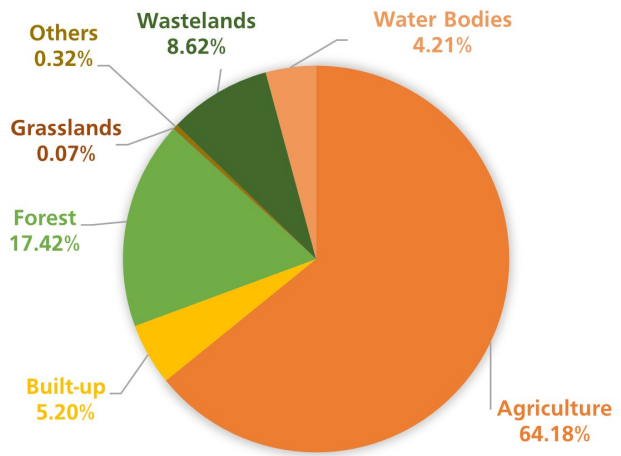


Figure 44: Land use and land cover of Karnataka

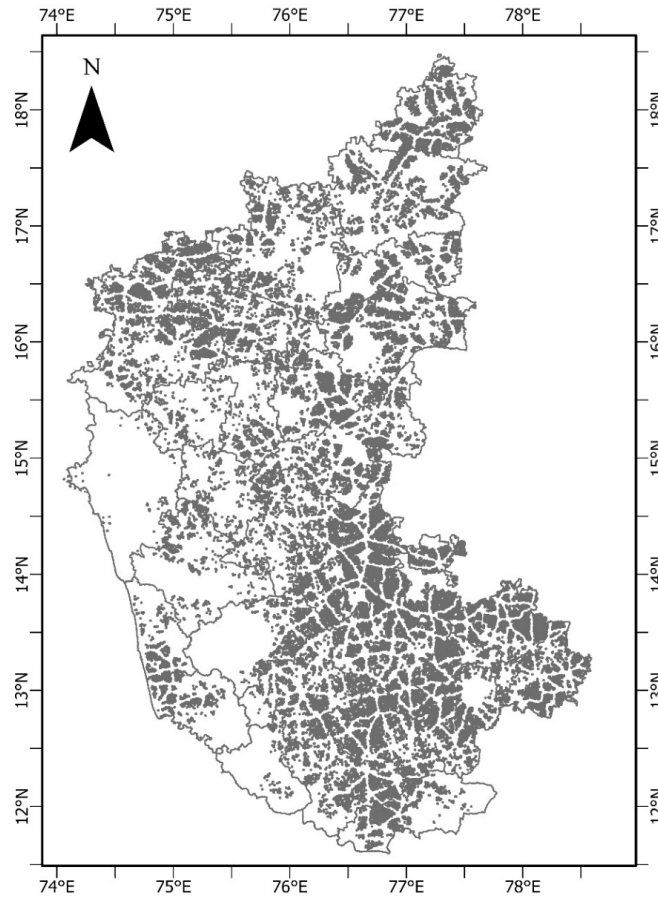
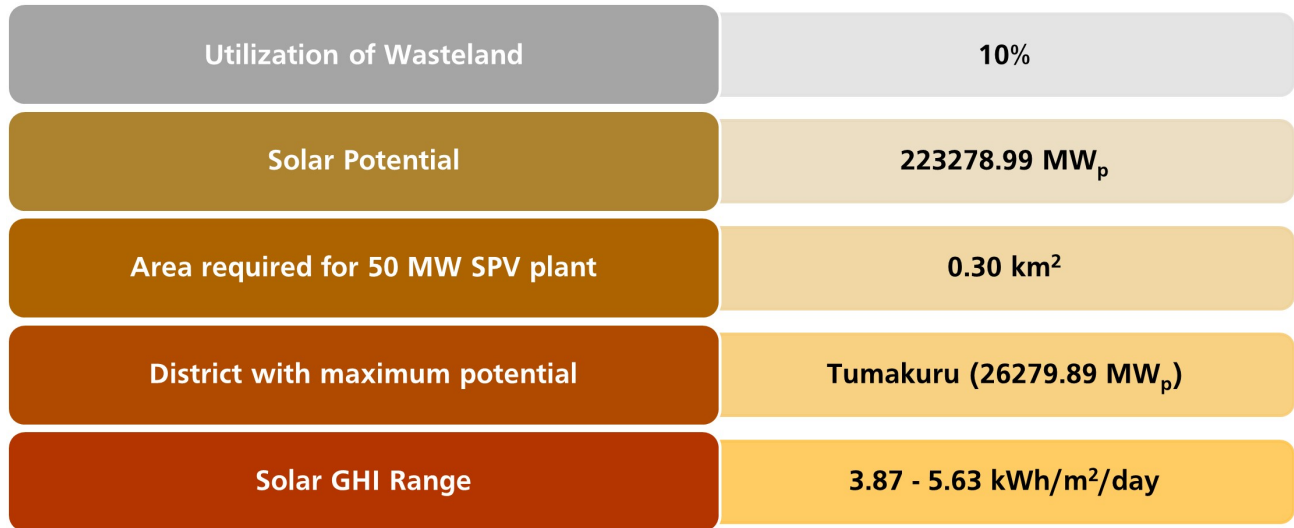


Figure 45: Feasible wasteland parcel of Karnataka for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Karnataka's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 21: District wise solar potential of Karnataka

Sr. No	District	Solar Potential (MW _p)
1	Bidar	8511.93
2	Bagalkot	6881.44
3	Ballari	10393.03
4	Belagavi	19456.30
5	Bengaluru Rural	3413.70
6	Bengaluru Urban	2707.60
7	Chamarajanagar	4785.39
8	Chik Ballapur	12149.68
9	Chikkamagaluru	3896.56
10	Chitradurga	22984.20
11	Davangere	4109.55
12	Dakshina Kannada	2893.53
13	Dharwad	1143.16
14	Gadag	2804.88
15	Haveri	1757.23
16	Hassan	7330.05

Sr. No	District	Solar Potential (MW_p)
17	Kalaburagi	8178.63
18	Kodagu	505.13
19	Kolar	6902.17
20	Koppal	8646.87
21	Mandya	10280.79
22	Mysuru	6957.77
23	Raichur	12046.78
24	Ramanagaram	6431.44
25	Shivamogga	3072.03
26	Tumakuru	26279.89
27	Udupi	2457.18
28	Uttara Kannada	502.12
29	Vijayapura	9204.28
30	Yadgir	6595.66
Total Solar Potential (MW_p)		223278.99

Kerala

SPV Installed Capacity (July 2025)

- 323.21 MW_p

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 33% of the state's land.
- Wastelands cover about 2% (816 km²) of the state's area.
- Scrub Land alone makes up over 28% of the wasteland area highly suitable for solar power plants.

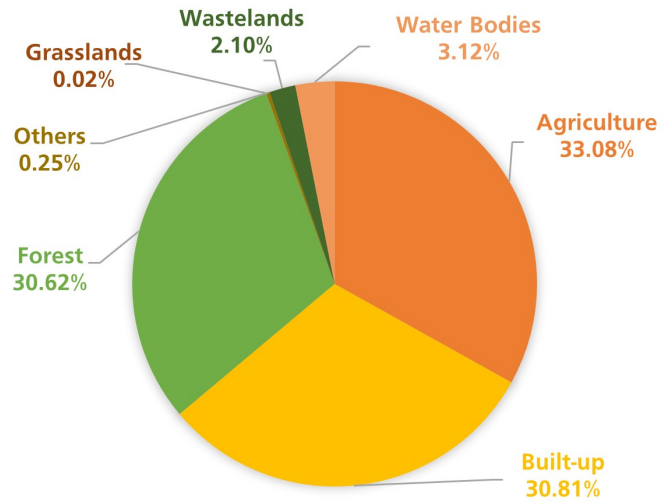


Figure 46: Land use and land cover of Kerala

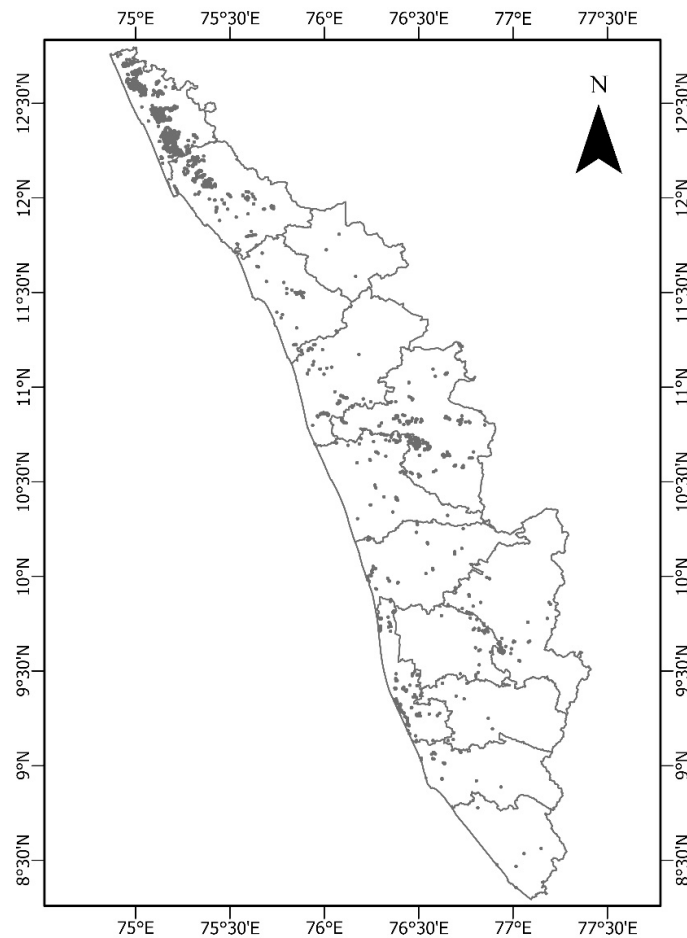
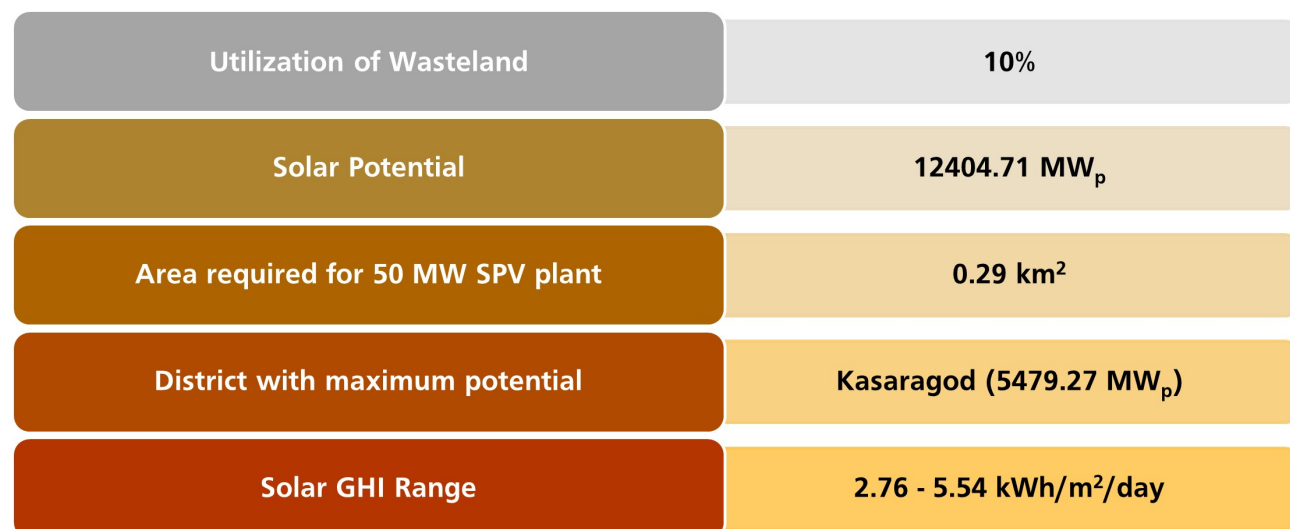


Figure 47: Feasible wasteland parcel of Kerala for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Kerala's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 22: District wise solar potential of Kerala

Sr. No	District	Solar Potential (MW _p)
1	Alappuzha	1090.56
2	Ernakulam	330.02
3	Idukki	353.43
4	Kasaragod	5479.27
5	Kannur	1643.88
6	Kollam	191.80
7	Kottayam	228.26
8	Kozhikode	219.66
9	Malappuram	520.39
10	Palakkad	1673.27
11	Pattanamthitta	73.71
12	Thiruvananthapuram	42.54
13	Trissur	535.97
14	Wayanad	21.95
Total Solar Potential (MW_p)		12404.71

Ladakh

SPV Installed Capacity (July 2025)

- 6 MW

Land Use and Land Cover (LULC)

- Snow covered areas dominate nearly 53% of the union territory's land.
- Wastelands cover about 43% (72860 km²) of the state's area.
- Scrub Land alone makes up over 5% of the wasteland area highly suitable for solar power plants.

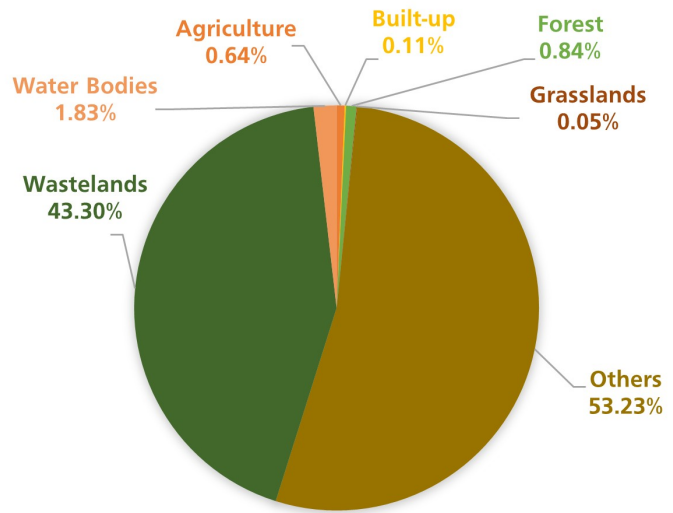


Figure 48: Land use and land cover of Ladakh

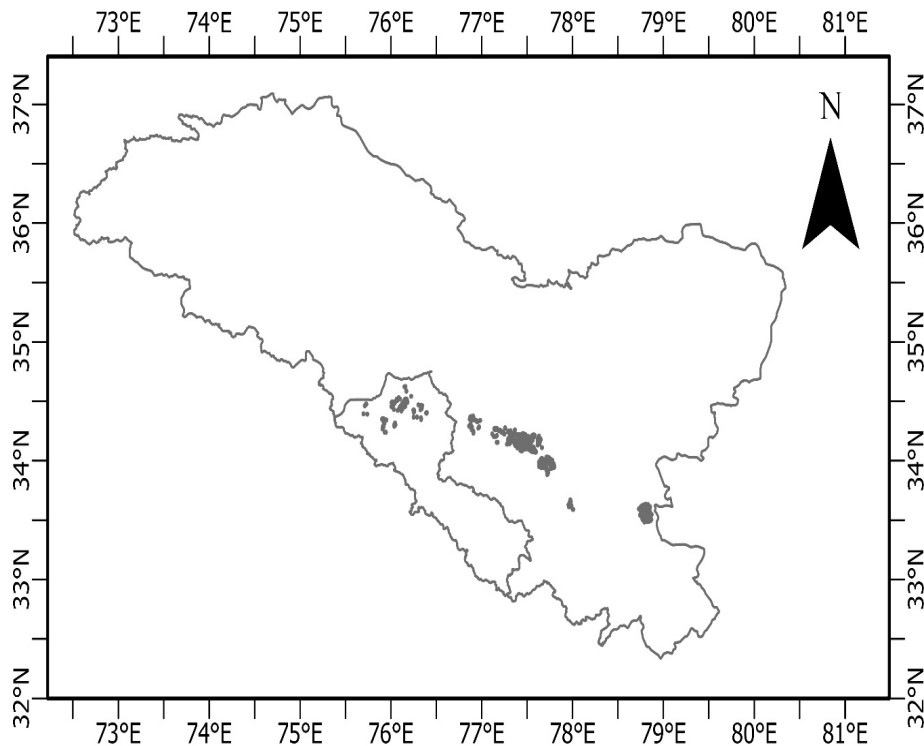
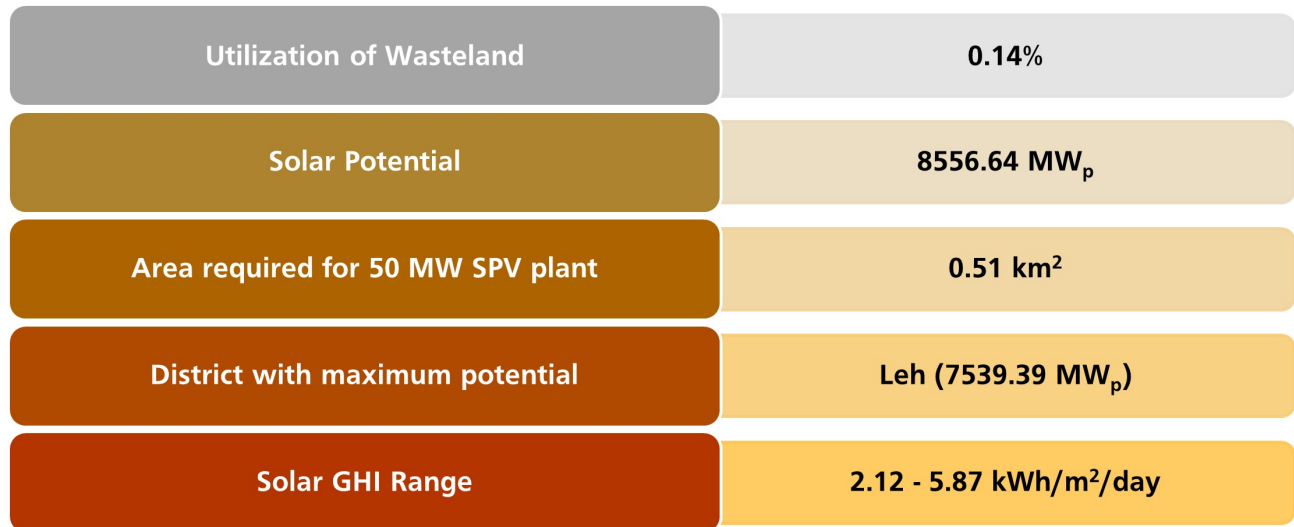


Figure 49: Feasible wasteland parcel of Ladakh for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Ladakh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 23: District wise solar potential of Ladakh

Sr. No	District	Solar Potential (MW _p)
1	Kargil	1017.25
2	Leh	7539.39
Total Solar Potential (MW_p)		8556.64

Madhya Pradesh

SPV Installed Capacity (July 2025)

- 4865.23 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 59% of the state's land.
- Wastelands cover about 9% (28041 km²) of the state's area.
- Scrub Land alone makes up over 93% of the wasteland area highly suitable for solar power plants.

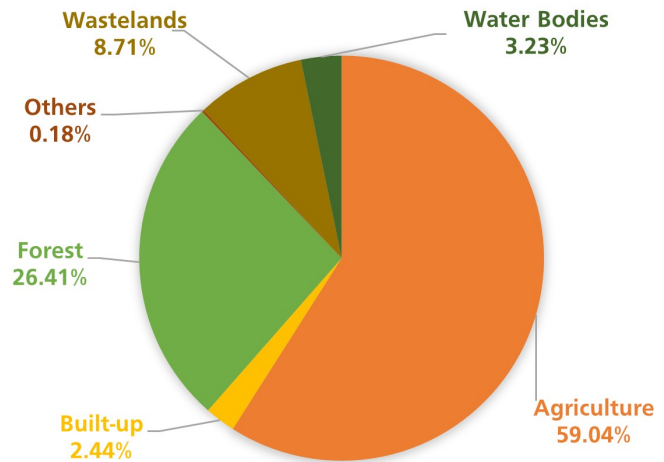


Figure 50: Land use and land cover of Madhya Pradesh

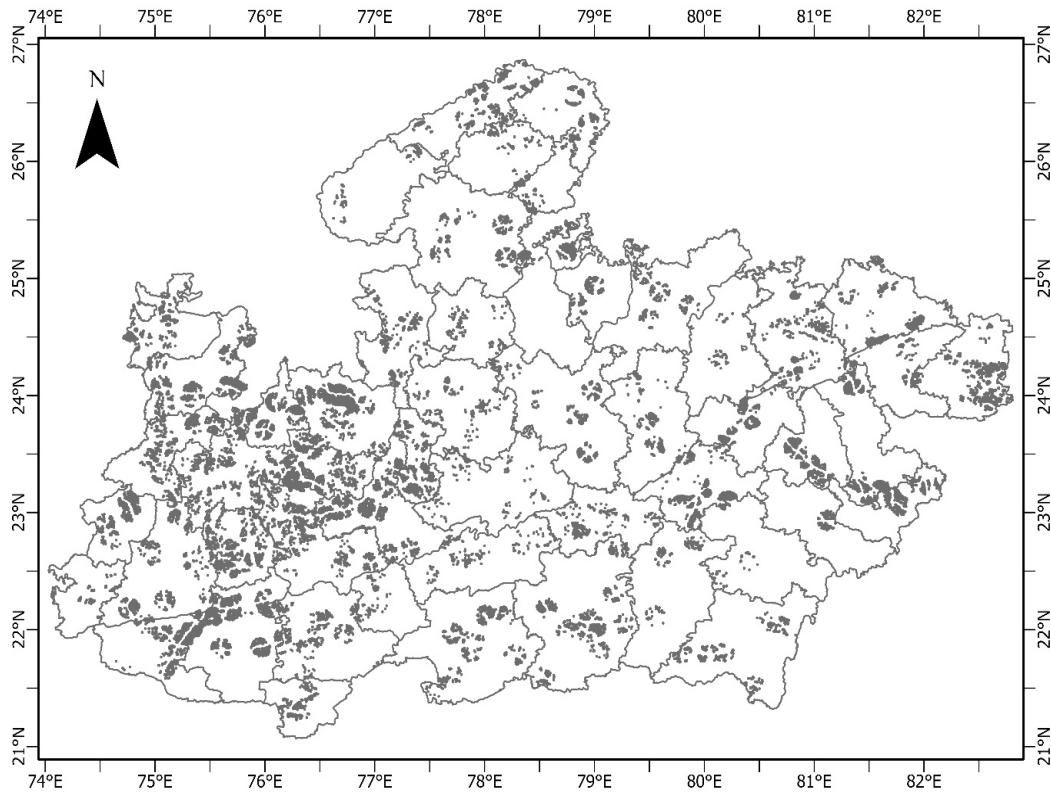
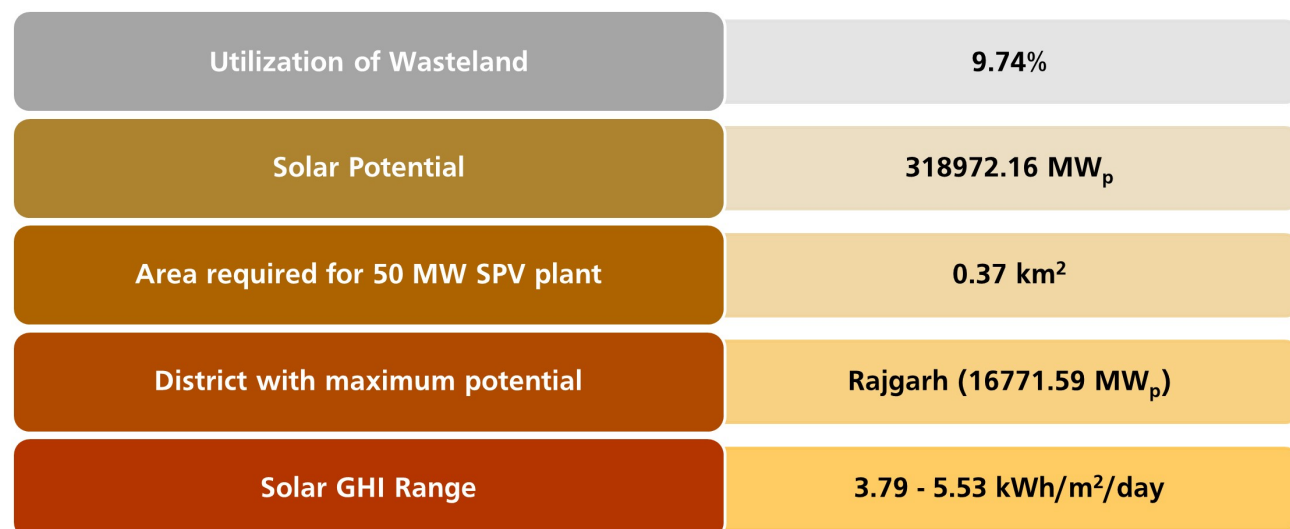


Figure 51: Feasible wasteland parcel of Madhya Pradesh for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Madhya Pradesh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 24: District wise solar potential of Madhya Pradesh

Sr. No	District	Solar Potential (MW _p)
1	Agar Malwa	10578.14
2	Alirajpur	1149.71
3	Anuppur	6765.29
4	Ashoknagar	1778.18
5	Balaghat	4715.19
6	Barwani	6933.89
7	Betul	6648.37
8	Bhind	5641.53
9	Bhopal	6854.23
10	Burhanpur	3211.49
11	Chhatarpur	3261.19
12	Chhindwara	7375.34
13	Damoh	4632.74
14	Datia	4641.15
15	Dewas	8370.80
16	Dhar	11810.54
17	Dindori	2164.81

18	East Nimar	5718.85
19	Guna	5000.94
20	Gwalior	2565.71
21	Harda	1124.91
22	Hoshangabad	2127.95
23	Indore	8352.19
24	Jabalpur	10053.70
25	Jhabua	4965.96
26	Katni	6973.80
27	Mandla	1576.35
28	Mandsaur	11401.90
29	Morena	9598.85
30	Narshimapura	4380.75
31	Nimach	5774.90
32	Nivari	2737.32
33	Panna	1083.99
34	Raisen	1787.61
35	Rajgarh	16771.59
36	Ratlam	8320.78
37	Rewa	9751.32
38	Sagar	6344.71
39	Satna	6831.20
40	Sehore	10856.99
41	Seoni	2195.48
42	Shajapur	10623.99
43	Shahdol	8337.58
44	Sheopur	1507.48
45	Shivpuri	5015.65
46	Sidhi	1256.04
47	Singrauli	10144.97
48	Tikamgarh	2623.57
49	Ujjain	9293.82
50	Umaria	7402.63
51	Vidisha	3879.82
52	West Nimar	16056.30
Total Solar Potential (MW_p)		318972.16

Maharashtra

SPV Installed Capacity (July 2025)

- 7982.71 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 65% of the state's land.
- Wastelands cover about 12% (37871 km²) of the state's area.
- Scrub Land alone makes up over 88% of the wasteland area highly suitable for solar power plants.

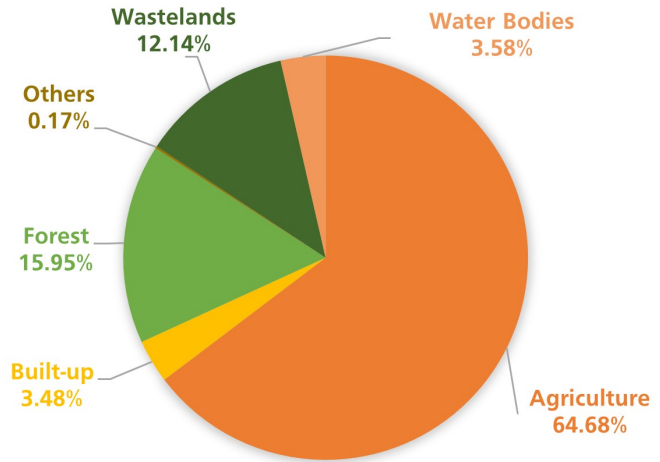


Figure 52: Land use and land cover of Maharashtra

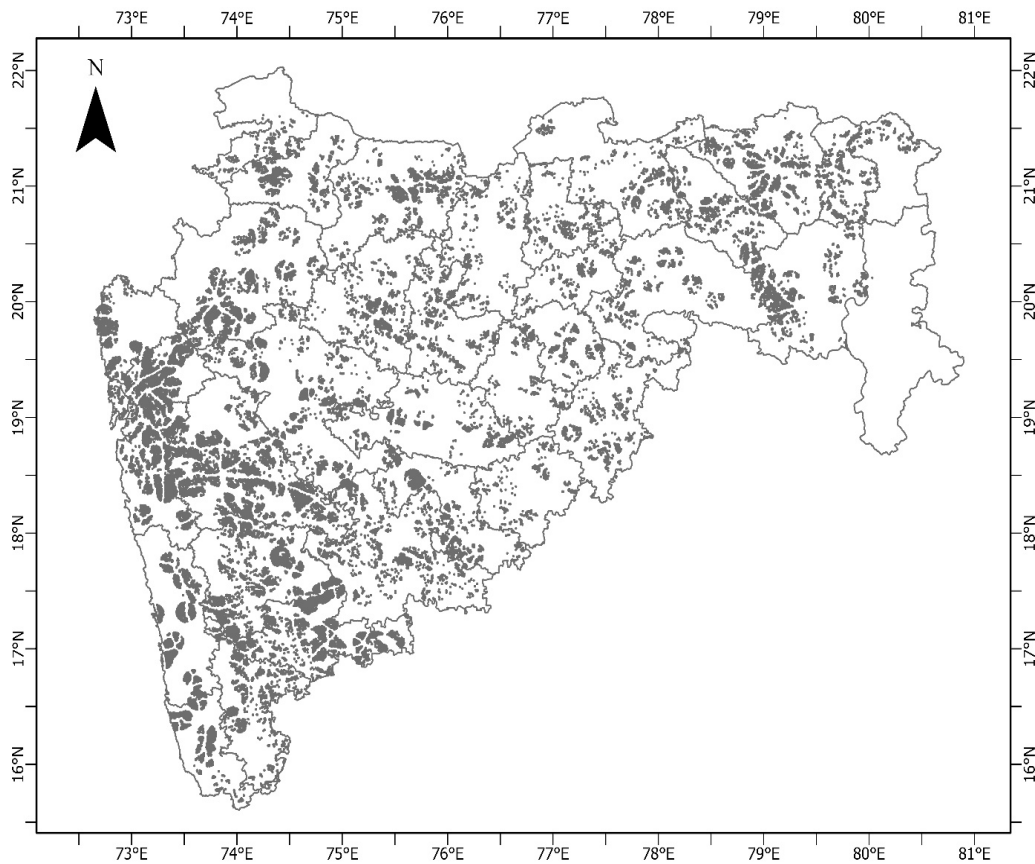
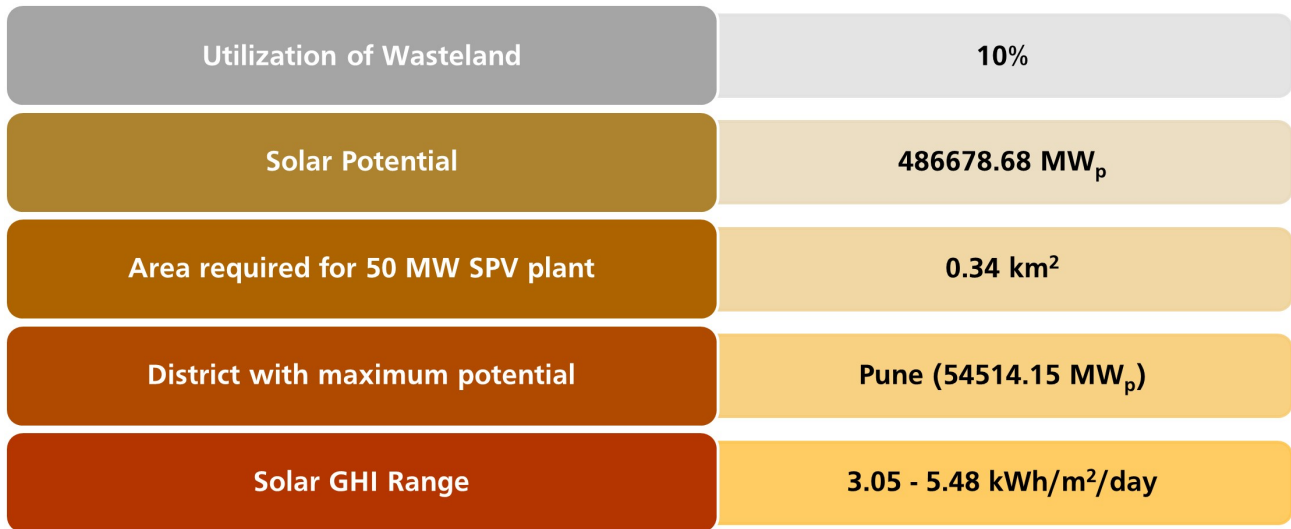


Figure 53: Feasible wasteland parcel of Maharashtra for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Maharashtra's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 25: District wise solar potential of Maharashtra

Sr. No	District	Solar Potential (MW _p)
1	Ahamadnagar	28196.41
2	Akola	4752.39
3	Amaravati	7974.94
4	Aurangabad	10058.32
5	Bid	10317.00
6	Bhandara	5807.76
7	Buldhana	5617.23
8	Chandrapur	14788.50
9	Dhule	10996.58
10	Gadchiroli	211.32
11	Gondia	2463.18
12	Hingoli	4989.72
13	Jalna	7767.68
14	Jalgaon	15690.88
15	Kolhapur	11820.66
16	Latur	3568.91
17	Mumbai City	7.60

18	Nagpur	15930.04
19	Nanded	7958.36
20	Nashik	28089.57
21	Nandurbar	3048.29
22	Palghar	13054.04
23	Parbhani	3271.09
24	Pune	54514.15
25	Raygad	30307.45
26	Ratnagiri	21173.11
27	Sangli	36783.57
28	Satara	29520.84
29	Sindhudurg	13095.84
30	Solapur	19740.05
31	Sub Urban Mumbai	1404.63
32	Thane	28036.65
33	Usmanabad	13012.10
34	Washim	3982.00
35	Wardha	8104.58
36	Yavatmal	10623.24
Total Solar Potential (MW_p)		486678.68

Manipur

SPV Installed Capacity (July 2025)

- 0.6 MW

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 70% of the state's land.
- Wastelands cover about 14% (3091 km²) of the state's area.
- Scrub Land alone makes up over 99% of the wasteland area highly suitable for solar power plants.

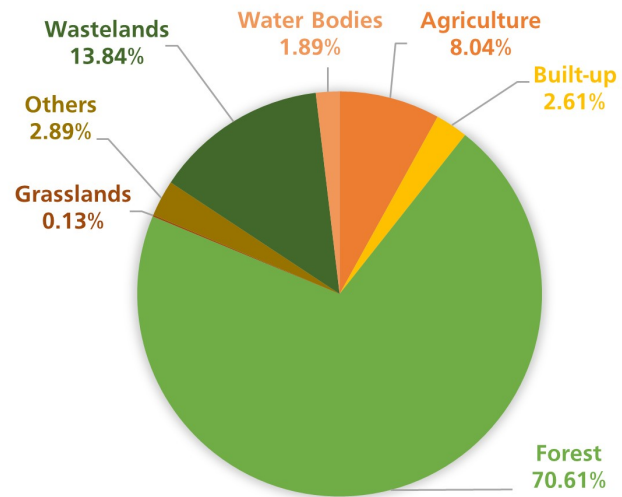


Figure 54: Land use and land cover of Manipur

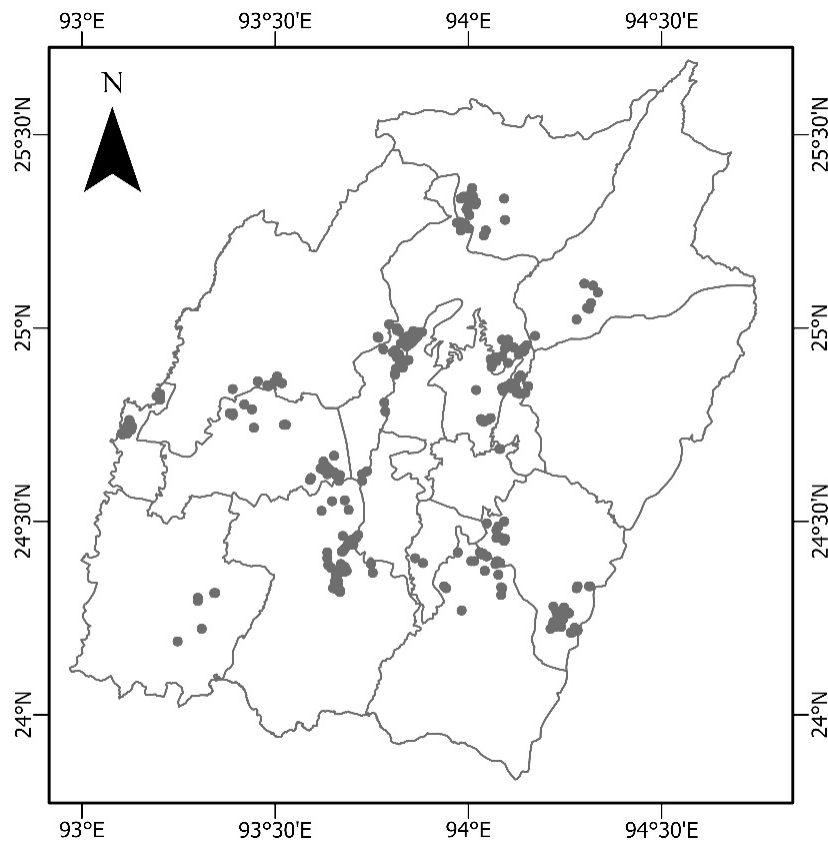


Figure 55: Feasible wasteland parcel of Manipur for solar installation

Solar Potential Insights

Utilization of Wasteland	0.65%
Solar Potential	2293.92 MW _p
Area required for 50 MW SPV plant	0.38 km ²
District with maximum potential	Kangpokpi (632.45 MW _p)
Solar GHI Range	2.55 - 4.84 kWh/m ² /day

Solar Potential

The following table presents a district-wise breakdown of Manipur's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 26: District wise solar potential of Manipur

Sr. No	District	Solar Potential (MW _p)
1	Bishnupur	8.04
2	Chandel	128.66
3	Churachandpur	377.85
4	Imphal East	80.13
5	Imphal West	56.05
6	Jiribam	136.28
7	Kamjong	8.01
8	Kangpokpi	632.45
9	Kakching	16.08
10	Nonei	192.53
11	Pherzawl	48.28
12	Senapati	135.68
13	Tamenglong	80.09
14	Tengnoupal	313.76
15	Thoubal	16.04
16	Ukhrul	63.98
Total Solar Potential (MW_p)		2293.92

Meghalaya

SPV Installed Capacity (July 2025)

-

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 67% of the state's land.
- Wastelands cover about 14% (3080 km²) of the state's area.
- Scrub Land alone makes up over 99% of the wasteland area highly suitable for solar power plants.

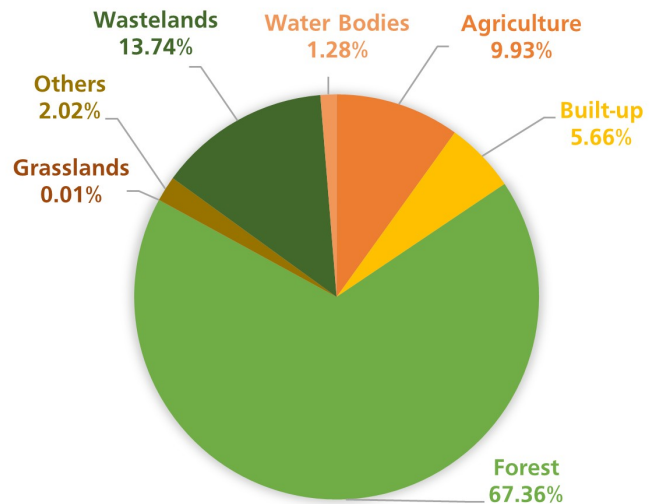


Figure 56: Land use and land cover of Meghalaya

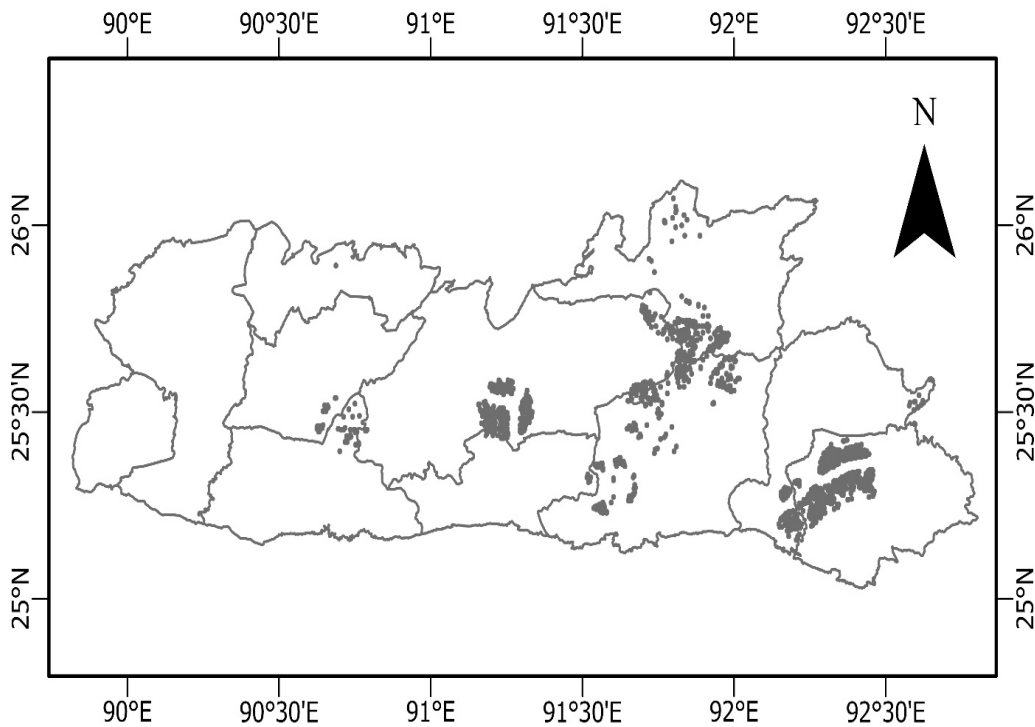
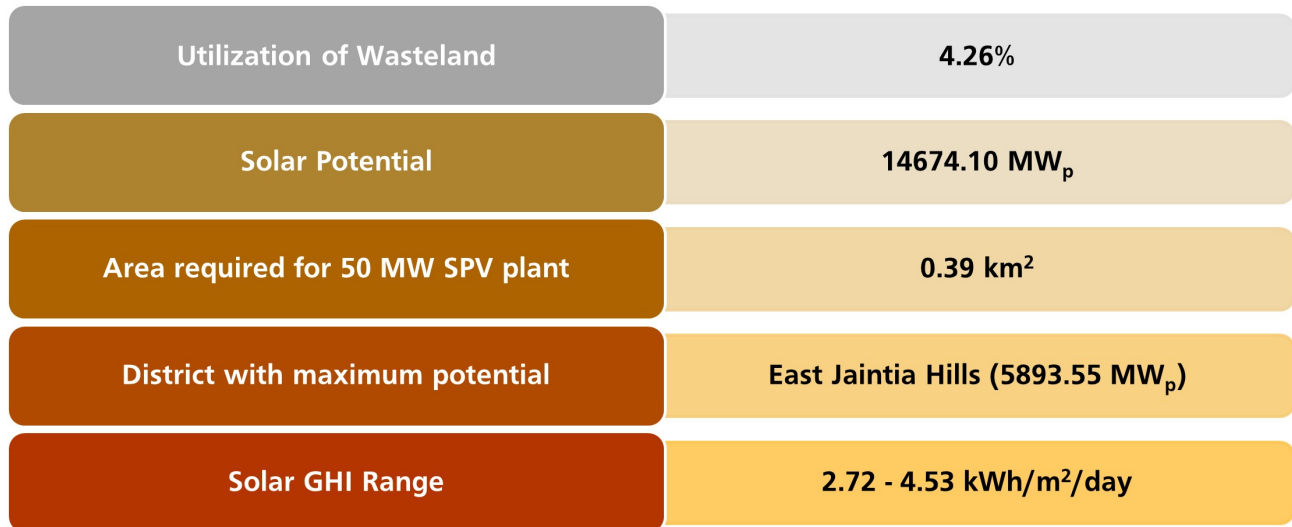


Figure 57: Feasible wasteland parcel of Meghalaya for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Meghalaya's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 27: District wise solar potential of Meghalaya

Sr. No	District	Solar Potential (MW _p)
1	East Garo Hills	210.22
2	East Jaintia Hills	5893.55
3	East Khasi Hills	2343.83
4	North Garo Hills	7.76
5	Ri-Bhoi	1553.89
6	South Garo Hills	257.00
7	Southwest Khasi Hills	101.29
8	West Jaintia Hills	1349.40
9	West Khasi Hills	2957.15
Total Solar Potential (MW_p)		14674.10

Mizoram

SPV Installed Capacity (July 2025)

- 22 MW

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 81% of the state's land.
- Wastelands cover about 6% (1259 km²) of the state's area.
- Scrub Land alone makes up over 82% of the wasteland area highly suitable for solar power plants.

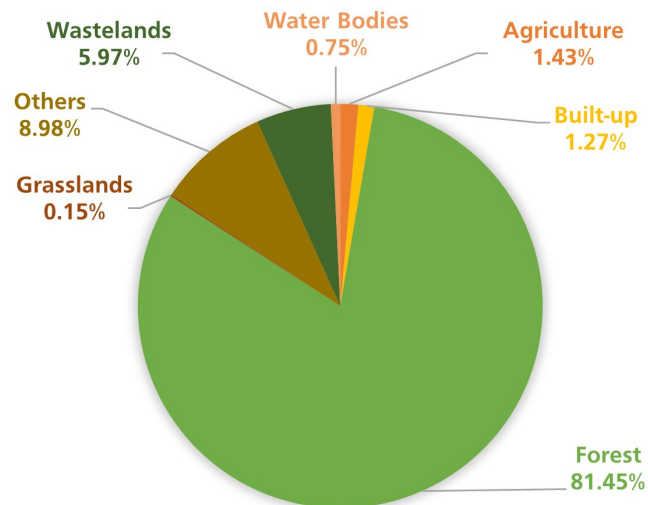


Figure 58: Land use and land cover of Mizoram

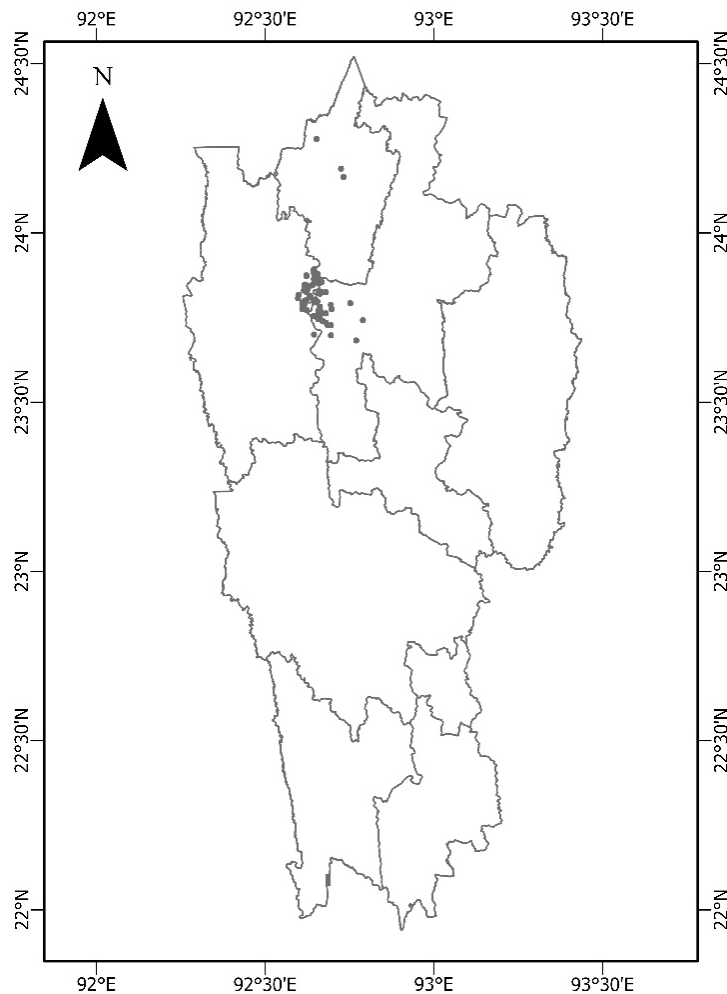
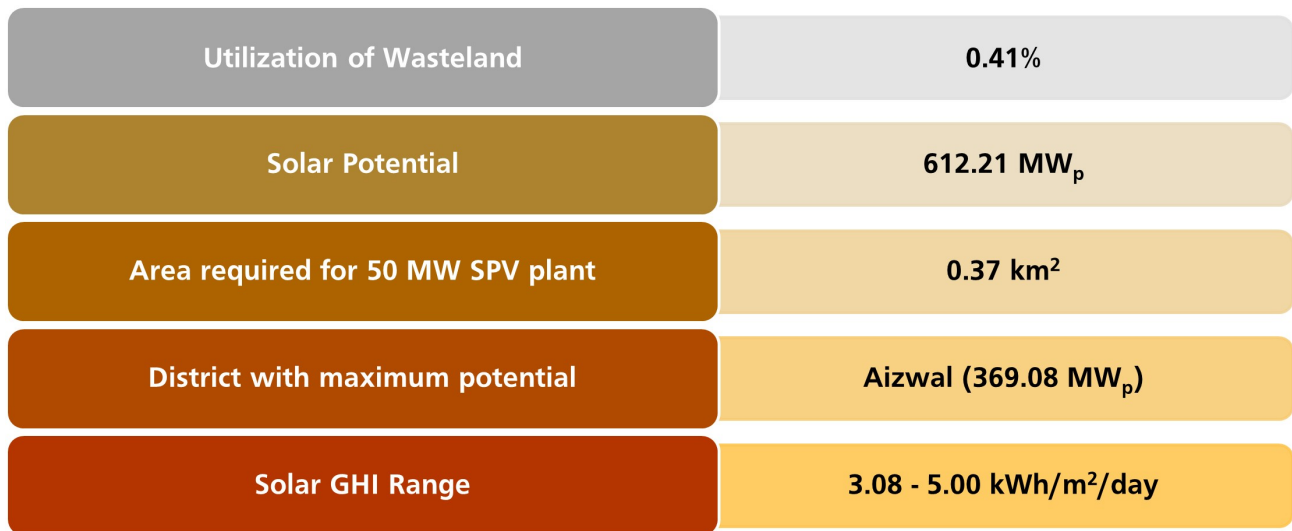


Figure 59: Feasible wasteland parcel of Mizoram for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Mizoram's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 28: District wise solar potential of Mizoram

Sr. No	District	Solar Potential (MW _p)
1	Aizwal	369.08
2	Kolasib	25.08
3	Mamit	218.04
Total Solar Potential (MW_p)		612.21

Nagaland

SPV Installed Capacity (July 2025)

-

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 78% of the state's land.
- Wastelands cover about 4% (835 km²) of the state's area.
- Scrub Land alone makes up over 75% of the wasteland area highly suitable for solar power plants.

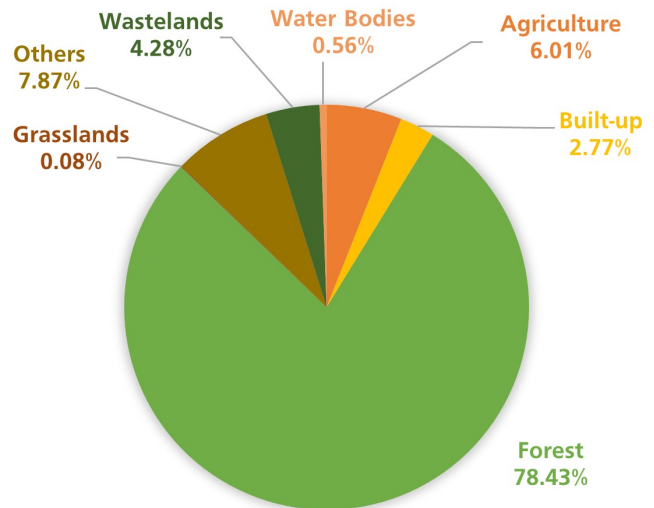


Figure 60: Land use and land cover of Nagaland

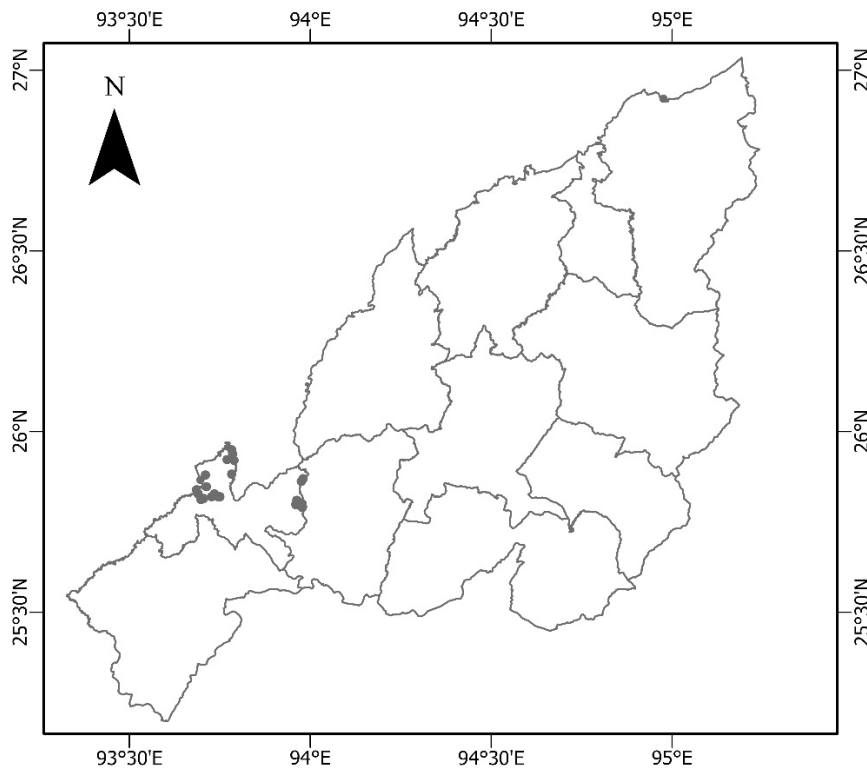
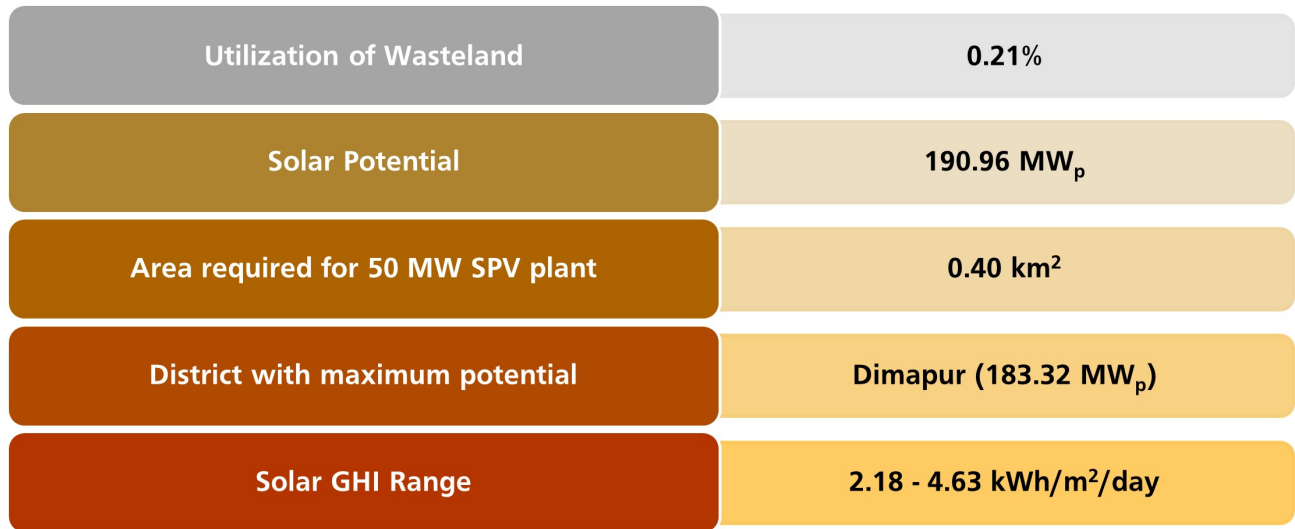


Figure 61: Feasible wasteland parcel of Nagaland for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Nagaland's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 29: District wise solar potential of Nagaland

Sr. No	District	Solar Potential (MW _p)
1	Dimapur	183.32
2	Kohima	7.64
Total Solar Potential (MW_p)		190.96

Odisha

SPV Installed Capacity (July 2025)

- 574.5 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 47% of the state's land.
- Wastelands cover about 10% (16443 km²) of the state's area.
- Scrub Land alone makes up over 91% of the wasteland area highly suitable for solar power plants.

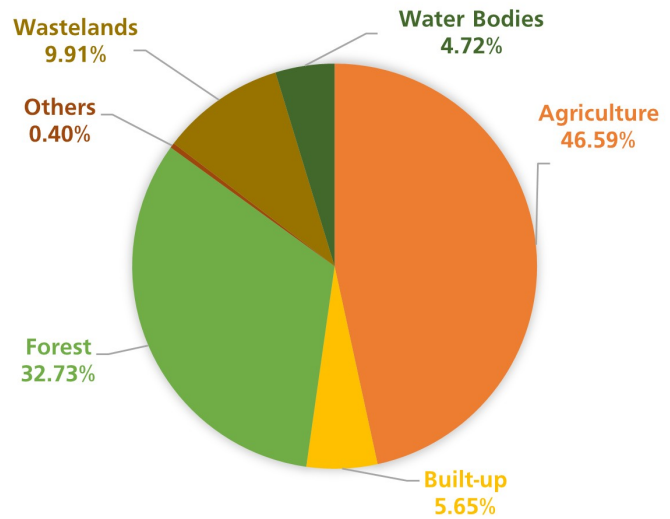


Figure 62: Land use and land cover of Odisha

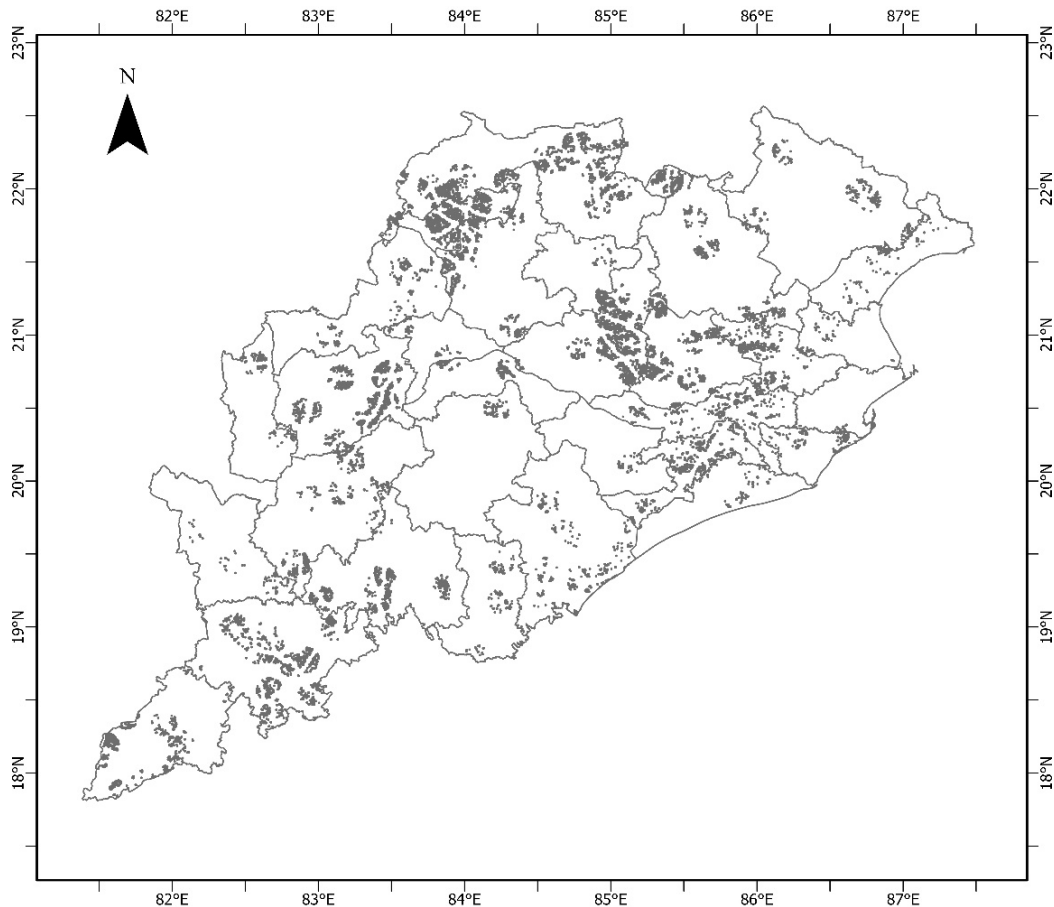
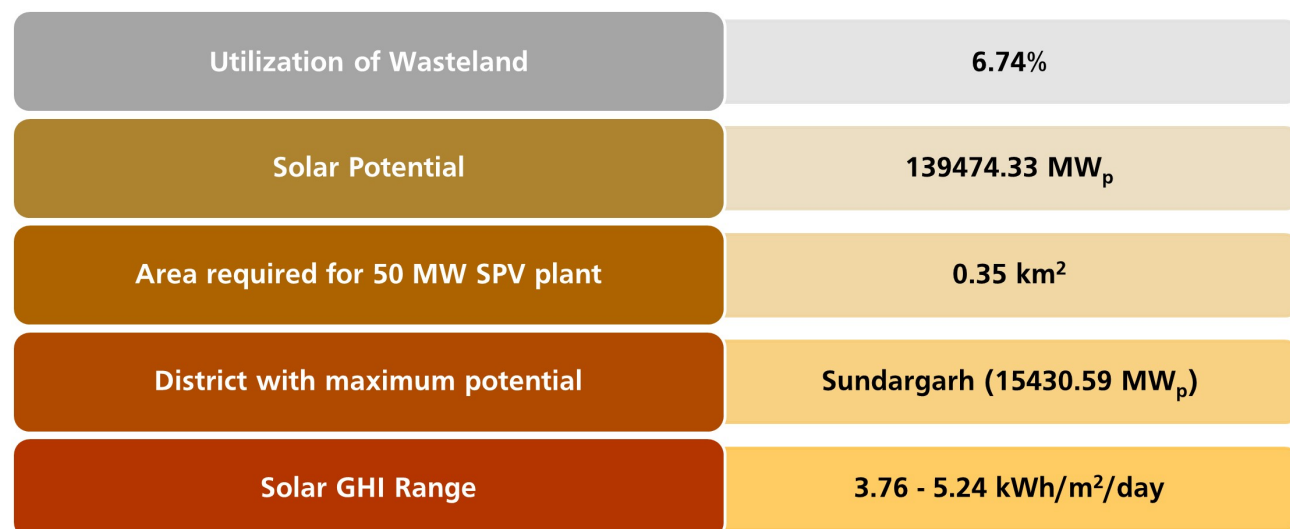


Figure 63: Feasible wasteland parcel of Odisha for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Odisha's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 30: District wise solar potential of Odisha

Sr. No	District	Solar Potential (MW _p)
1	Anugul	14240.65
2	Balasore (Baleshwar)	1227.04
3	Baragarh	2693.01
4	Baudh (Bauda)	2121.92
5	Bhadrak	688.25
6	Bolangir (Balangir)	11767.88
7	Cuttack	4269.39
8	Deogarh	839.98
9	Dhenkanal	9826.98
10	Gajapati	1199.35
11	Ganjam	3665.46
12	Jajapur	5001.66
13	Jagatsinghpur	1690.97
14	Jharsuguda	11563.78
15	Kalahandi	4479.83
16	Kandhamal	899.35

17	Kendraparha	272.76
18	Keonjhar (Kendujhar)	7892.20
19	Khordha	4370.19
20	Koraput	8711.75
21	Malkangiri	6372.94
22	Mayurbhanj	3031.26
23	Nabarangapur	786.57
24	Nayagarh	427.97
25	Nuaparha	1405.89
26	Puri	1157.33
27	Rayagarha	6515.94
28	Sambalpur	5981.45
29	Subarnapur	941.97
30	Sundargarh	15430.59
Total Solar Potential (MW_p)		139474.33

Puducherry

SPV Installed Capacity (July 2025)

- 1.03 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 55% of the union territory's land.
- Wastelands cover about 4% (19 km²) of the state's area.
- Scrub Land alone makes up over 68% of the wasteland area highly suitable for solar power plants.

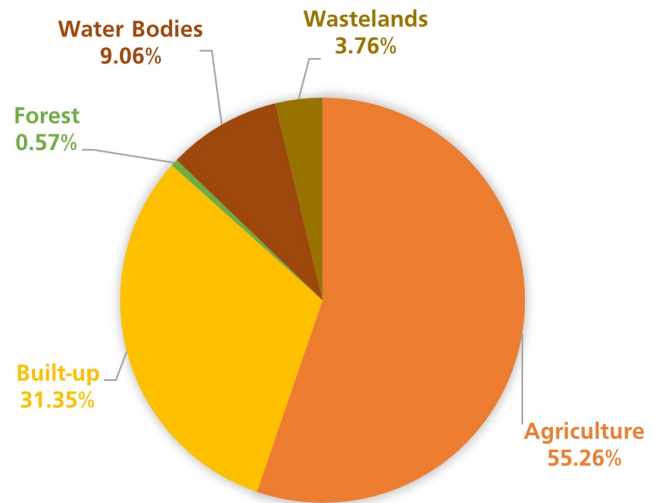


Figure 64: Land use and land cover of Puducherry

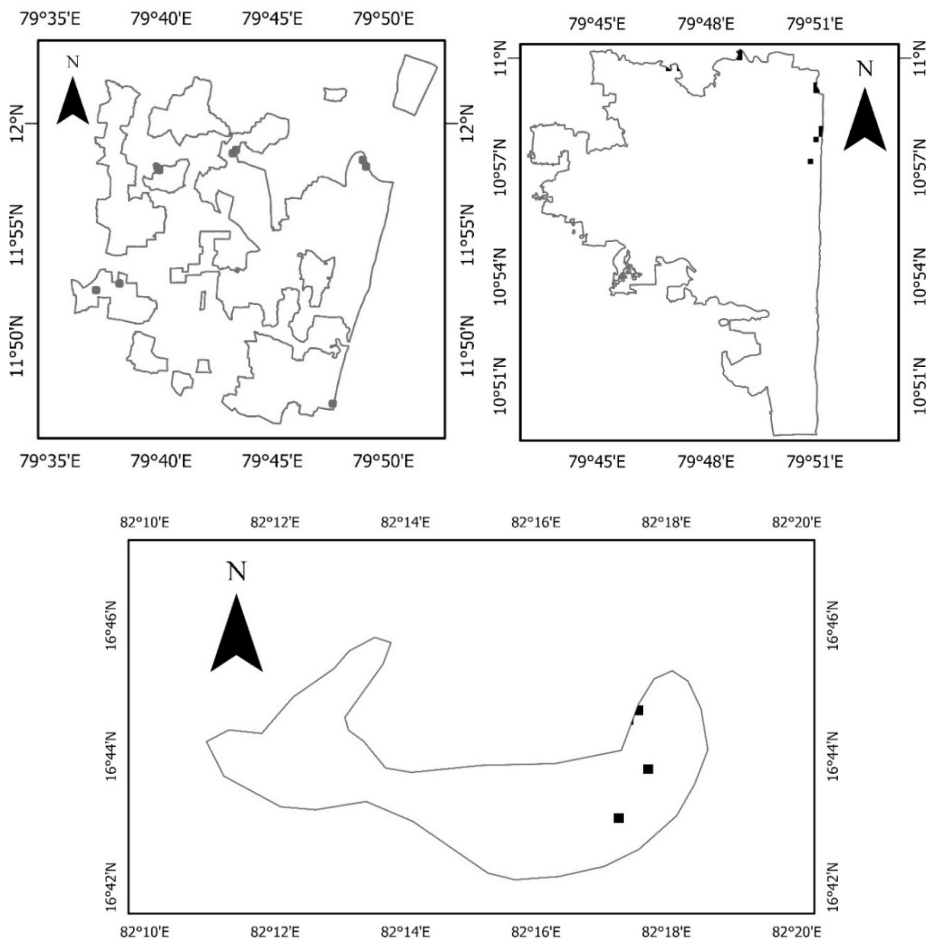
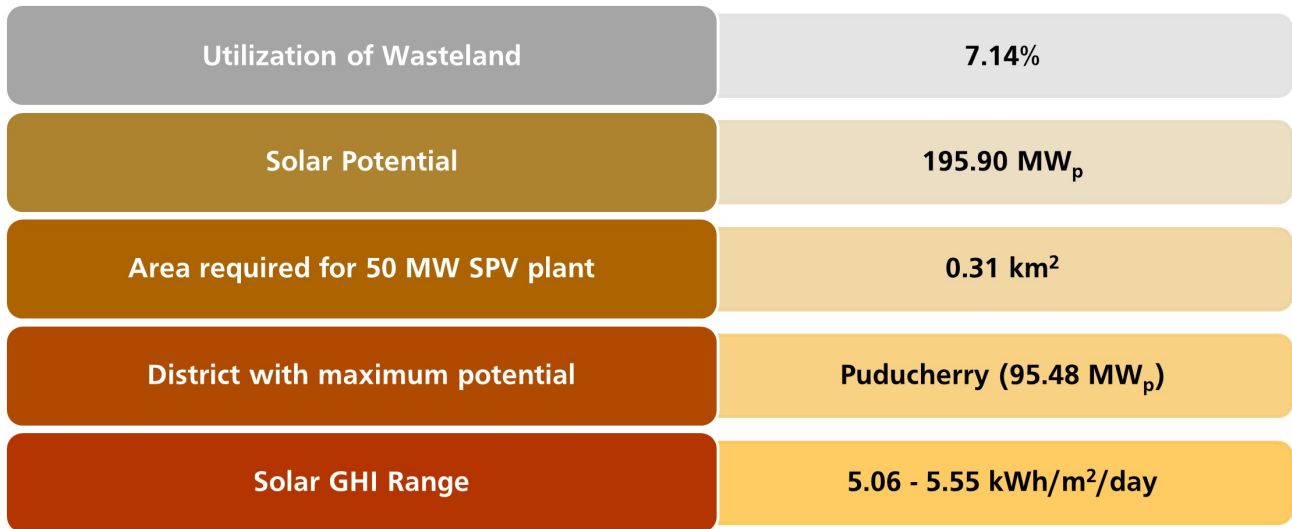


Figure 65: Feasible wasteland parcel of Puducherry for solar installation



Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Puducherry's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 31: District wise solar potential of Puducherry

Sr. No	District	Solar Potential (MW _p)
1	Karaikal	69.08
2	Puducherry	95.48
3	Yanam	31.34
Total Solar Potential (MW_p)		195.90

Punjab

SPV Installed Capacity (July 2025)

- 886.27 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 84% of the state's land.
- Wastelands cover about 2% (961 km²) of the state's area.
- Scrub Land alone makes up over 92% of the wasteland area highly suitable for solar power plants.

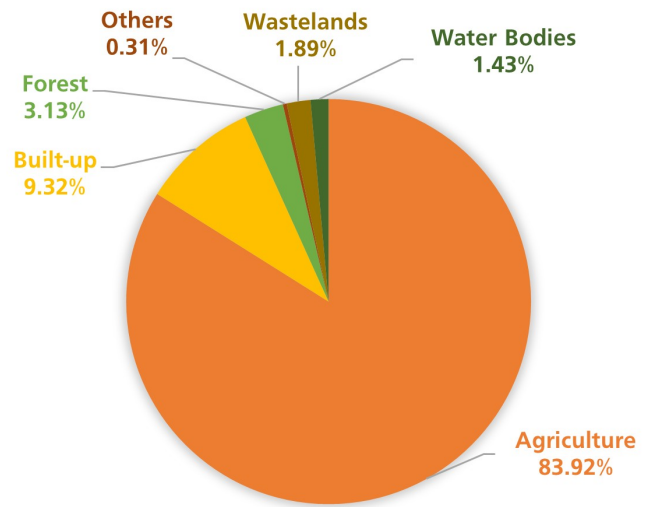


Figure 66: Land use and land cover of Punjab

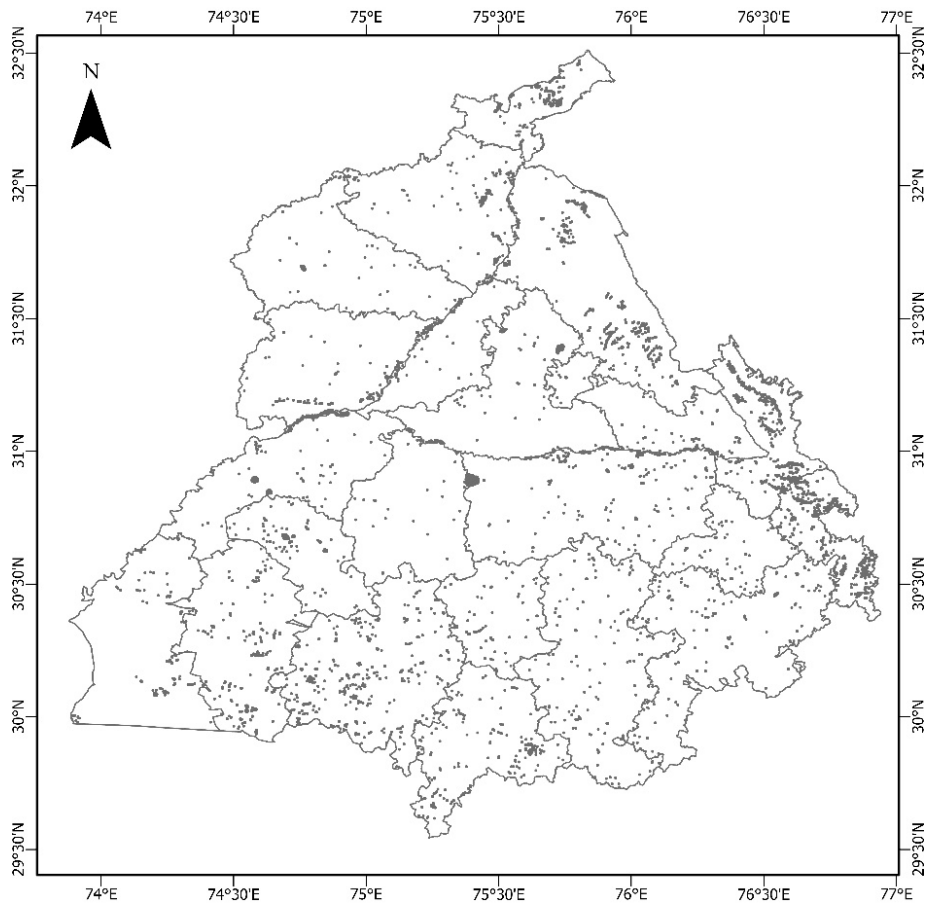
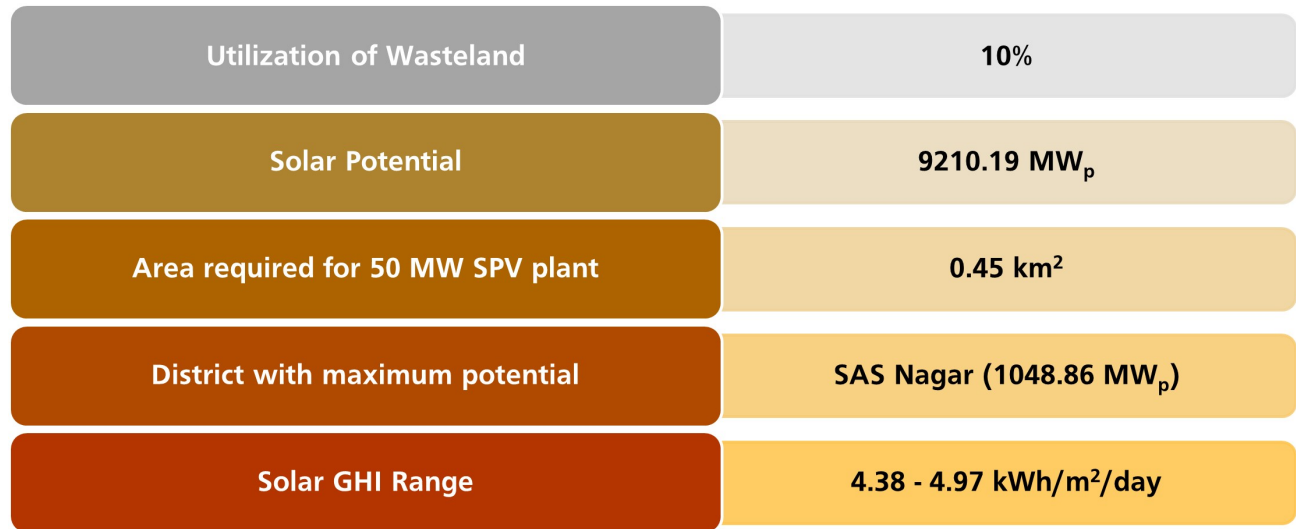


Figure 67: Feasible wasteland parcel of Punjab for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Punjab's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 32: District wise solar potential of Punjab

Sr. No	District	Solar Potential (MW _p)
1	Amritsar	163.88
2	Barnala	130.70
3	Bathinda	808.06
4	Firozpur	367.51
5	Fazilka	254.98
6	Faridkot	236.33
7	Fatehgarh Sahib	121.53
8	Gurdaspur	366.30
9	Hoshiarpur	881.32
10	Jalandhar	329.26
11	Kapurthala	162.22
12	Ludhiana	502.29
13	Mansa	420.81
14	Moga	370.18
15	Pathankot	414.59
16	Patiala	330.10
17	Rupnagar	963.24
18	Sangrur	297.27

19	SAS Nagar	1048.86
20	Shahid Bhagat Singh Nagar	182.61
21	Sri Muktsar Sahib	403.74
22	Tarn Taran	454.43
Total Solar Potential (MW_p)		9210.19

Rajasthan

SPV Installed Capacity (July 2025)

- 27821.74 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 62% of the state's land.
- Wastelands cover about 26% (77207 km²) of the state's area.
- Scrub Land alone makes up over 59% of the wasteland area highly suitable for solar power plants.

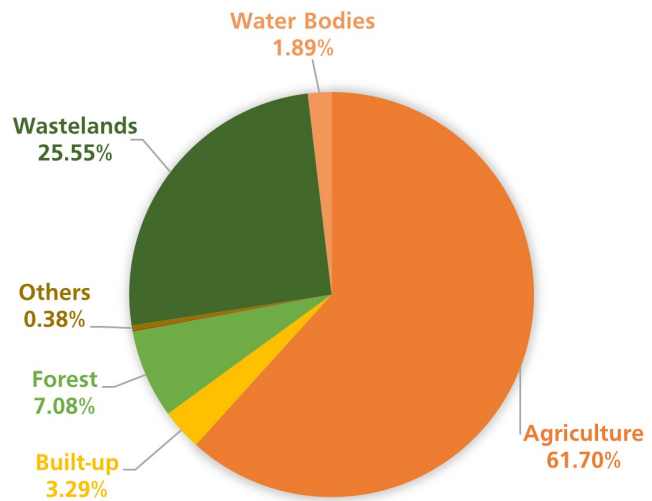


Figure 68: Land use and land cover of Rajasthan

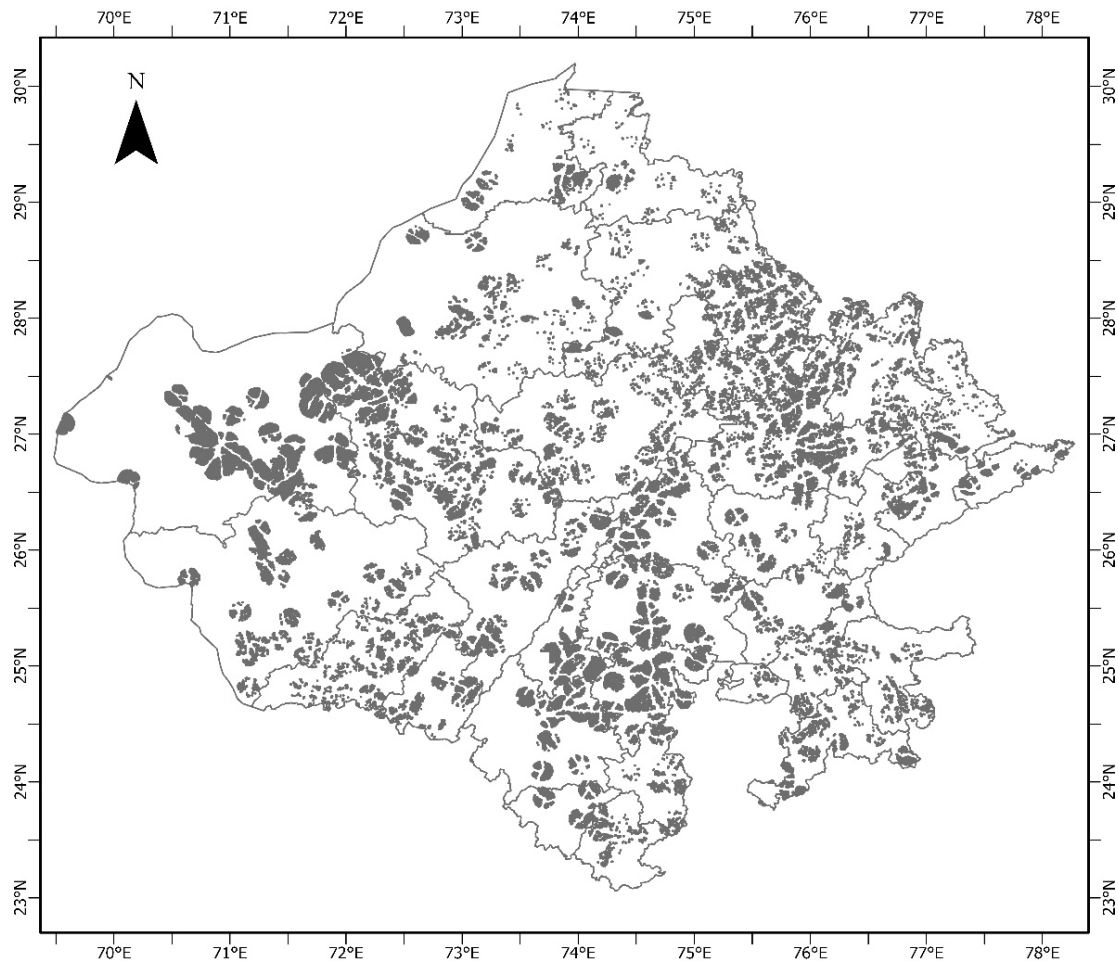
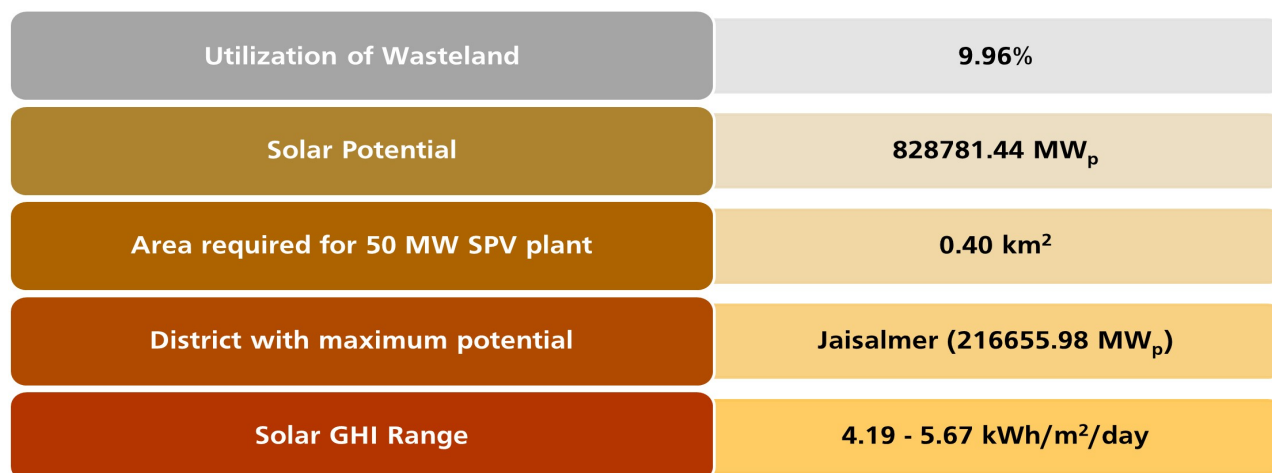


Figure 69: Feasible wasteland parcel of Rajasthan for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Rajasthan's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 33: District wise solar potential of Rajasthan

Sr. No	District	Solar Potential (MW _p)
1	Ajmer	24027.69
2	Alwar	16906.93
3	Bundi	8239.91
4	Bikaner	34022.99
5	Banswara	5504.27
6	Baran	7173.37
7	Barmer	44128.80
8	Bhilwara	33512.70
9	Bharatpur	7402.52
10	Churu	15271.63
11	Chittaurgarh	38911.51
12	Dungarpur	8601.07
13	Dausa	6949.87
14	Dhaulpur	8850.47
15	Ganganagar	13331.38
16	Hanumangarh	5217.50
17	Jalor	20858.44
18	Jaipur	38085.66

19	Jaisalmer	216655.98
20	Jhalawar	13320.49
21	Jhunjhunun	15809.64
22	Jodhpur	82887.33
23	Karauli	8592.53
24	Kota	11035.80
25	Nagaur	22244.81
26	Pali	23142.28
27	Pratapgarh	6937.87
28	Raj Samand	22537.36
29	Sikar	15338.40
30	Sawai Madhopur	5424.33
31	Sirohi	11104.48
32	Tonk	7674.34
33	Udaipur	29079.10
Total Solar Potential (MW_p)		828781.44

Sikkim

SPV Installed Capacity (July 2025)

- 0.52 MW

Land Use and Land Cover (LULC)

- Wasteland areas dominate nearly 33% of the state's land.
- Wastelands cover about 2597 km² of the state's area.
- Scrub Land alone makes up over 62% of the wasteland area highly suitable for solar power plants.

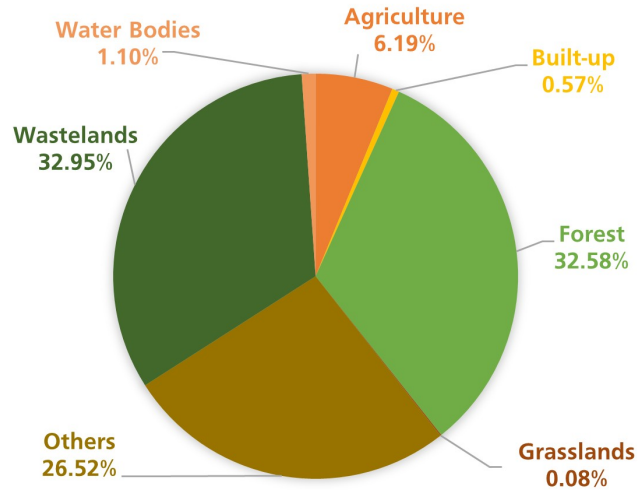


Figure 70: Land use and land cover of Sikkim

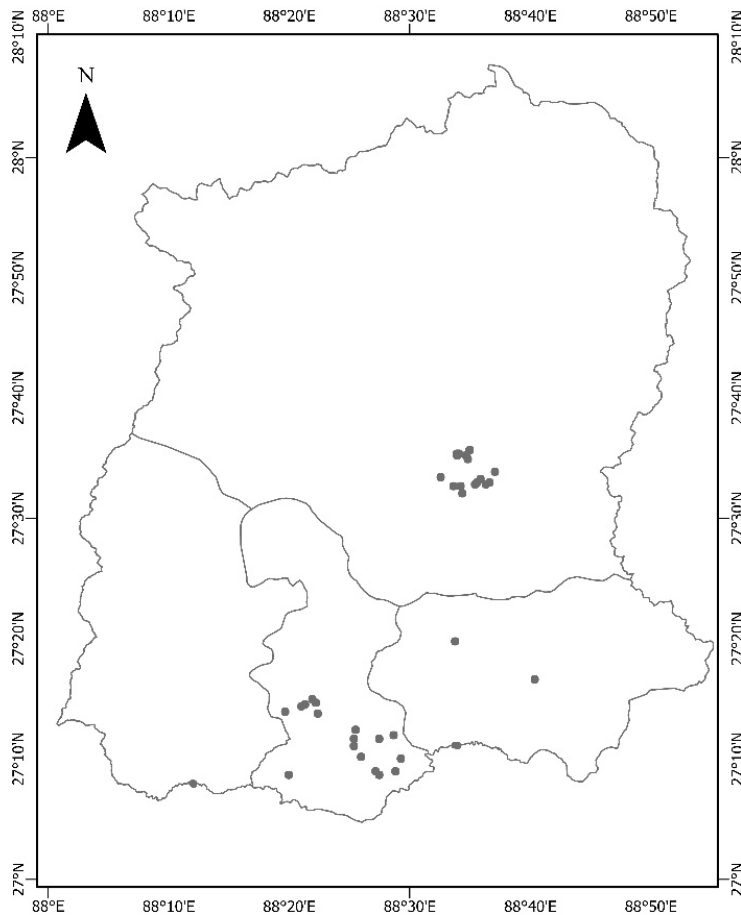
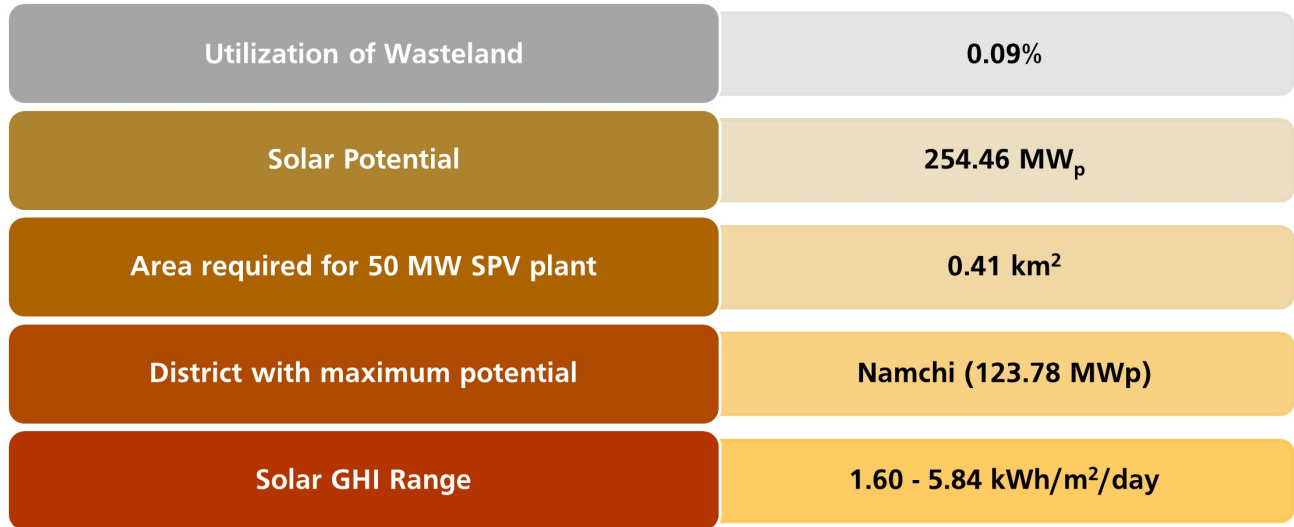


Figure 71: Feasible wasteland parcel of Sikkim for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Sikkim's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 34: District wise solar potential of Sikkim

Sr. No	District	Solar Potential (MW _p)
1	Gangtok	14.55
2	Mangan	116.12
3	Namchi	123.78
Total Solar Potential (MW_p)		254.46

Tamil Nadu

SPV Installed Capacity (July 2025)

- 9621.08 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 58% of the state's land.
- Wastelands cover about 10% (13577 km²) of the state's area.
- Scrub Land alone makes up over 85% of the wasteland area highly suitable for solar power plants.

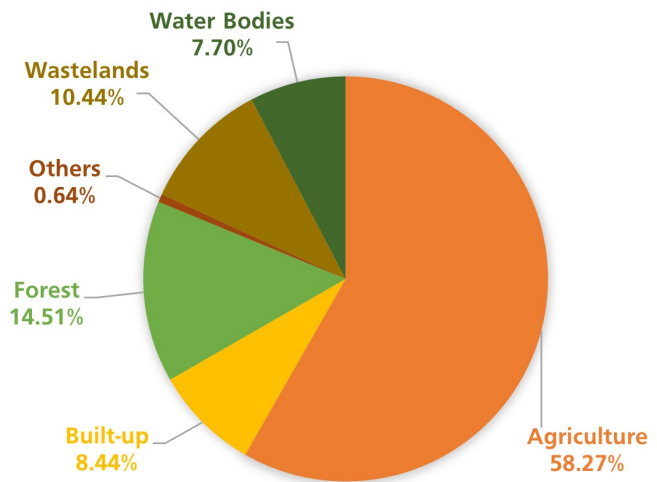


Figure 72: Land use and land cover of Tamil Nadu

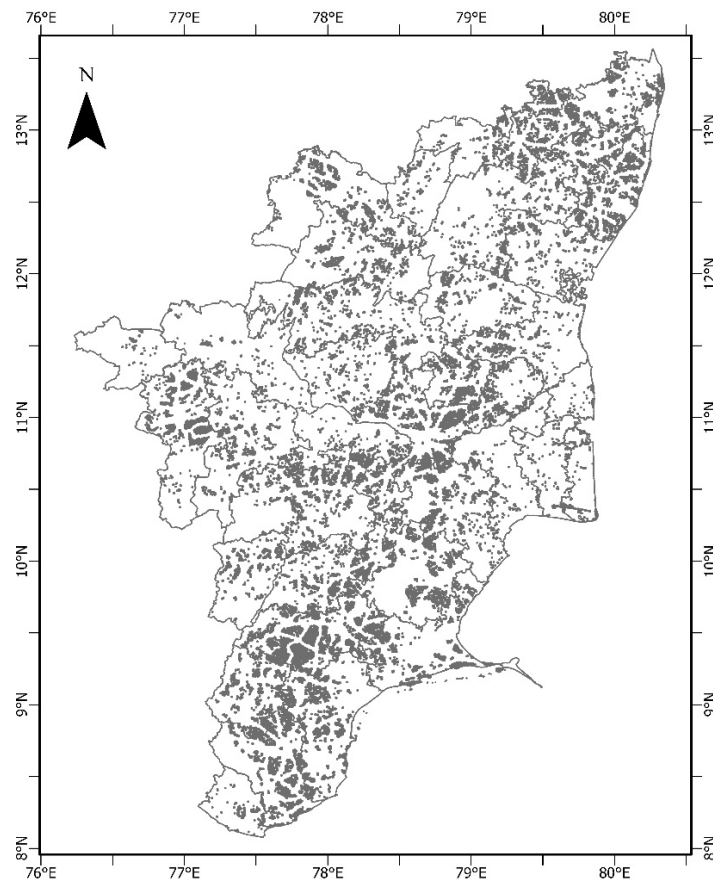
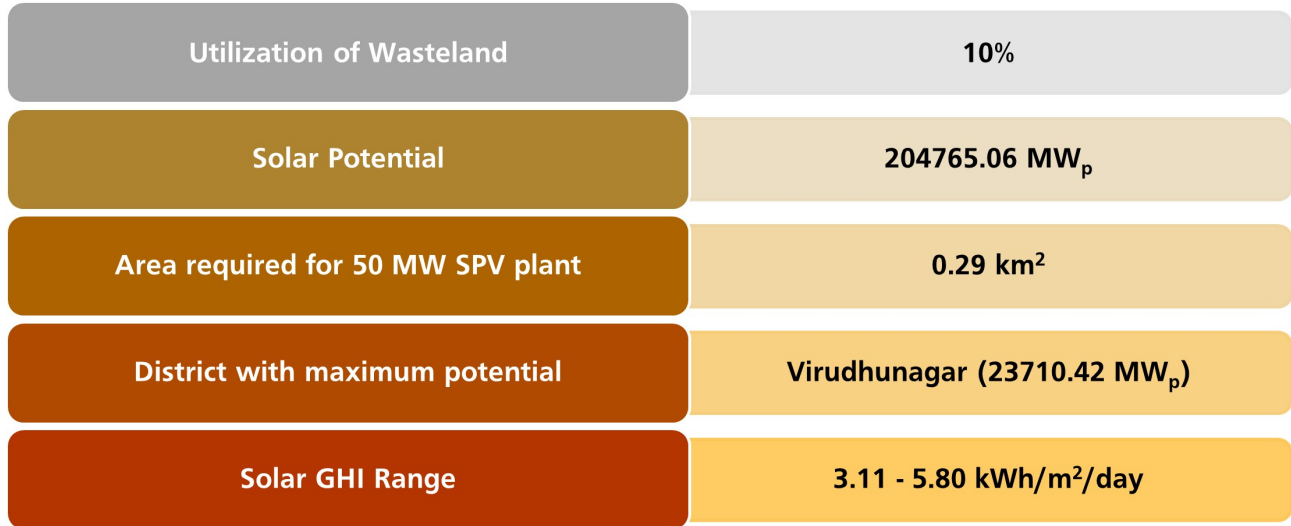


Figure 73: Feasible wasteland parcel of Tamil Nadu for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Tamil Nadu's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 35: District wise solar potential of Tamil Nadu

Sr. No	District	Solar Potential (MW _p)
1	Ariyalur	3662.55
2	Chengalpattu	8453.95
3	Chennai	408.65
4	Coimbatore	9137.05
5	Cuddalore	3758.05
6	Dharmapuri	4241.50
7	Dindigul	8648.64
8	Erode	1745.45
9	Kanchipuram	3966.15
10	Kallakurichi	3161.85
11	Kanyakumari	749.86
12	Karur	3633.67
13	Krishnagiri	5689.49
14	Madurai	8202.40
15	Nilgiris	453.04
16	Nagapattinam	1972.75

17	Namakkal	2249.67
18	Perambalur	3907.17
19	Pudukkottai	7666.76
20	Ramanathapuram	9706.80
21	Ranippettai	4322.36
22	Salem	6164.68
23	Sivaganga	7593.94
24	Teni	3355.44
25	Tenkasi	6728.56
26	Thanjavur	1710.53
27	Thiruvarur	964.75
28	Tiruchirapalli	12750.55
29	Tirunelveli	12329.36
30	Tiruppur	4792.95
31	Tiruppattur	974.74
32	Tiruvallur	7053.41
33	Tiruvannamalai	3890.30
34	Trichirapalli	50.37
35	Tuticorin	12174.72
36	Vellore	1552.01
37	Villupuram	3230.53
38	Virudhunagar	23710.42
Total Solar Potential (MW_p)		204765.06

Telangana

SPV Installed Capacity (July 2025)

- 4360.49 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 57% of the state's land.
- Wastelands cover about 9% (10236 km²) of the state's area.
- Scrub Land alone makes up over 87% of the wasteland area highly suitable for solar power plants.

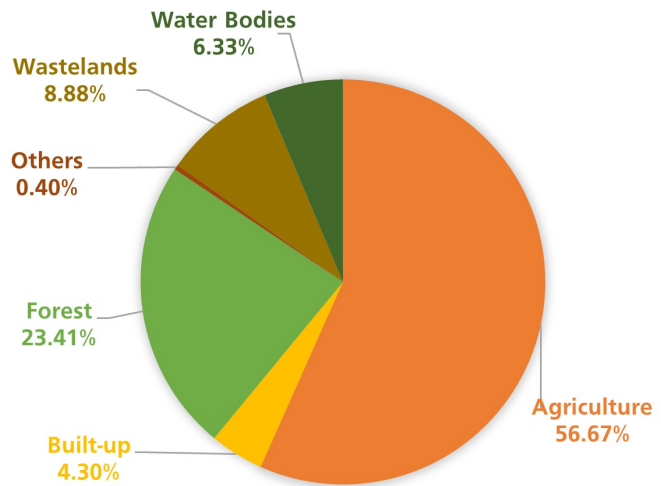


Figure 74: Land use and land cover of Telangana

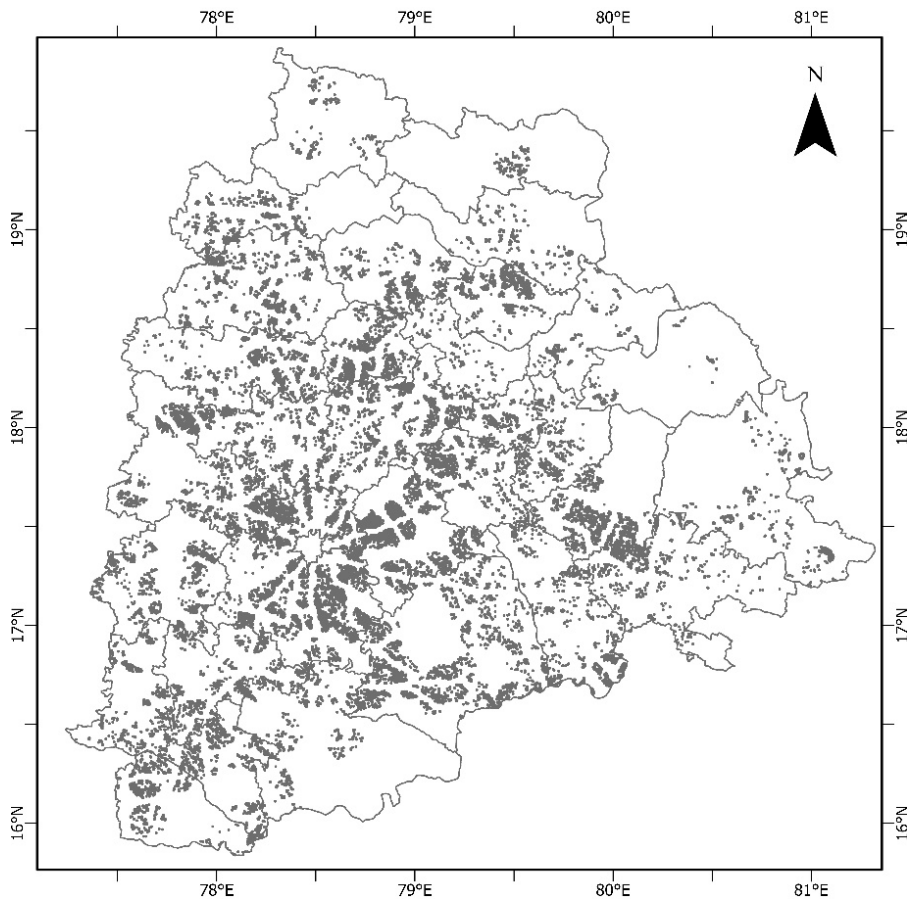
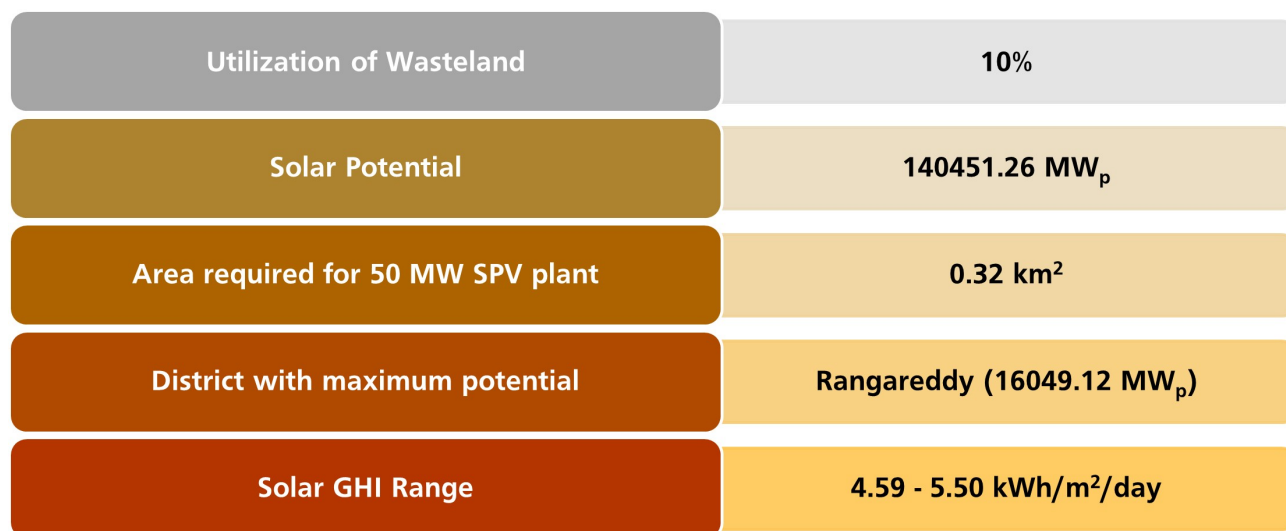


Figure 75: Feasible wasteland parcel of Telangana for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Telangana's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 36: District wise solar potential of Telangana

Sr. No	District	Solar Potential (MW _p)
1	Adilabad	1153.37
2	Bhadradi Kothagudem	2678.57
3	Hyderabad	4.95
4	Jagtial	2960.54
5	Jangaon	4138.91
6	Jayashankar Bhupalapally	1529.42
7	Jogulamba Gadwal	3311.06
8	Kamareddy	5006.35
9	Karimnagar	1170.69
10	Khammam	2871.15
11	Kumuram Bheem	826.94
12	Mahabubabad	5784.58
13	Mahabubnagar	4185.03
14	Mancherial	1559.84
15	Medak	4014.51
16	Medchal-Malkajgiri	3222.92
17	Mulugu	674.66

18	Nagarkurnool	2982.14
19	Nalgonda	11521.38
20	Narayanpet	2672.22
21	Nirmal	3308.58
22	Nizamabad	5888.16
23	Peddapalli	4994.97
24	Rangareddy	16049.12
25	Ranjanna Sircilla	5447.08
26	Sangareddy	8701.03
27	Siddipet	7265.69
28	Suryapet	4144.85
29	Vikarabad	5049.93
30	Wanaparthy	3502.20
31	Warangal (Rural)	2269.58
32	Warangal (Urban)	1986.88
33	Yadadri Bhuvanagiri	9573.97
Total Solar Potential (MW_p)		140451.26

Tripura

SPV Installed Capacity (July 2025)

- 5.57 MW

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 46% of the state's land.
- Wastelands cover about 12% (1448 km²) of the state's area.
- Scrub Land alone makes up over 98% of the wasteland area highly suitable for solar power plants.

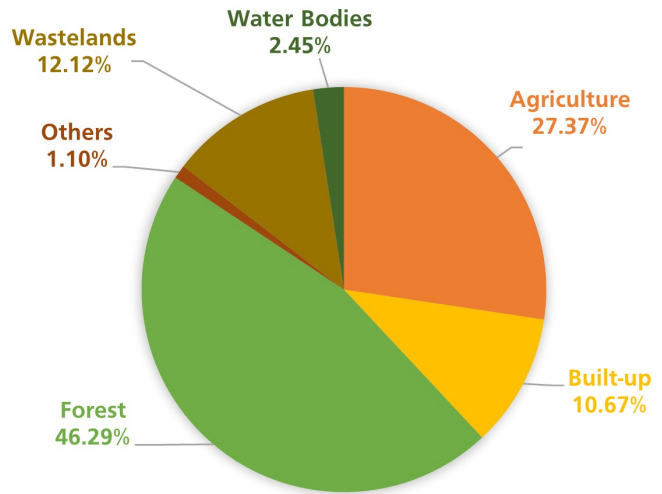


Figure 76: Land use and land cover of Tripura

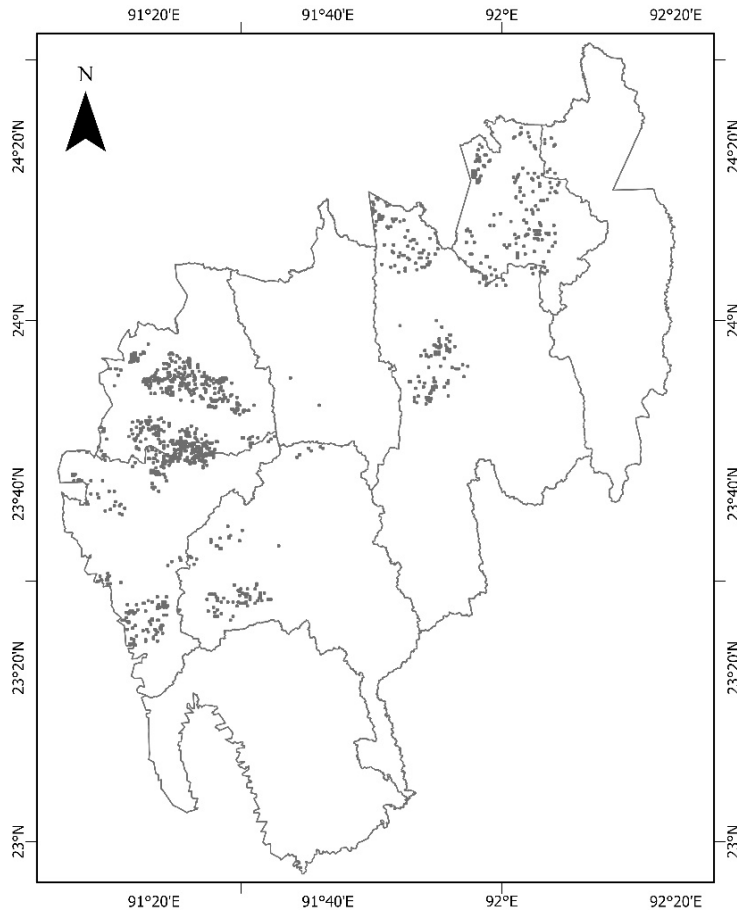
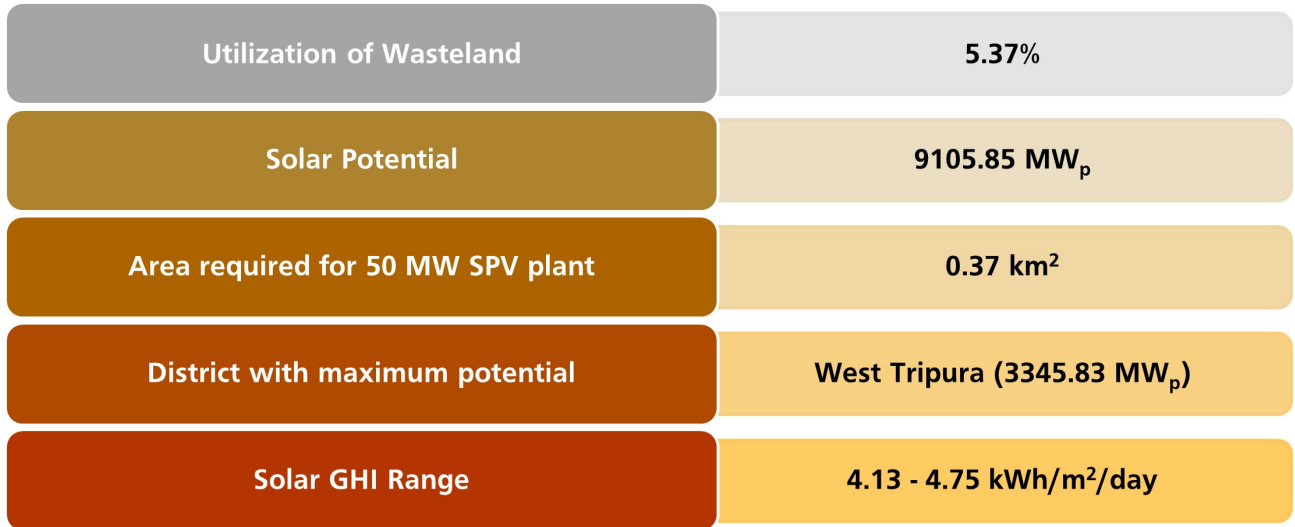


Figure 77: Feasible wasteland parcel of Tripura for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Tripura's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 37: District wise solar potential of Tripura

Sr. No	District	Solar Potential (MW _p)
1	Dhalai	1431.79
2	Gomati	679.15
3	Khowai	24.78
4	North Tripura	65.85
5	Sepahijala	2330.99
6	Unokoti	1227.46
7	West Tripura	3345.83
Total Solar Potential (MW_p)		9105.85

Uttar Pradesh

SPV Installed Capacity (July 2025)

- 2776.34 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 74% of the state's land.
- Wastelands cover about 12% (9153 km²) of the state's area.
- Scrub Land alone makes up over 58% of the wasteland area highly suitable for solar power plants.

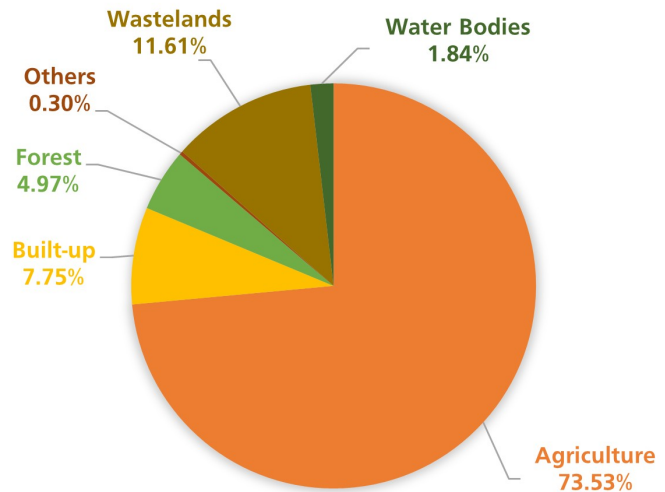


Figure 78: Land use and land cover of Uttar Pradesh

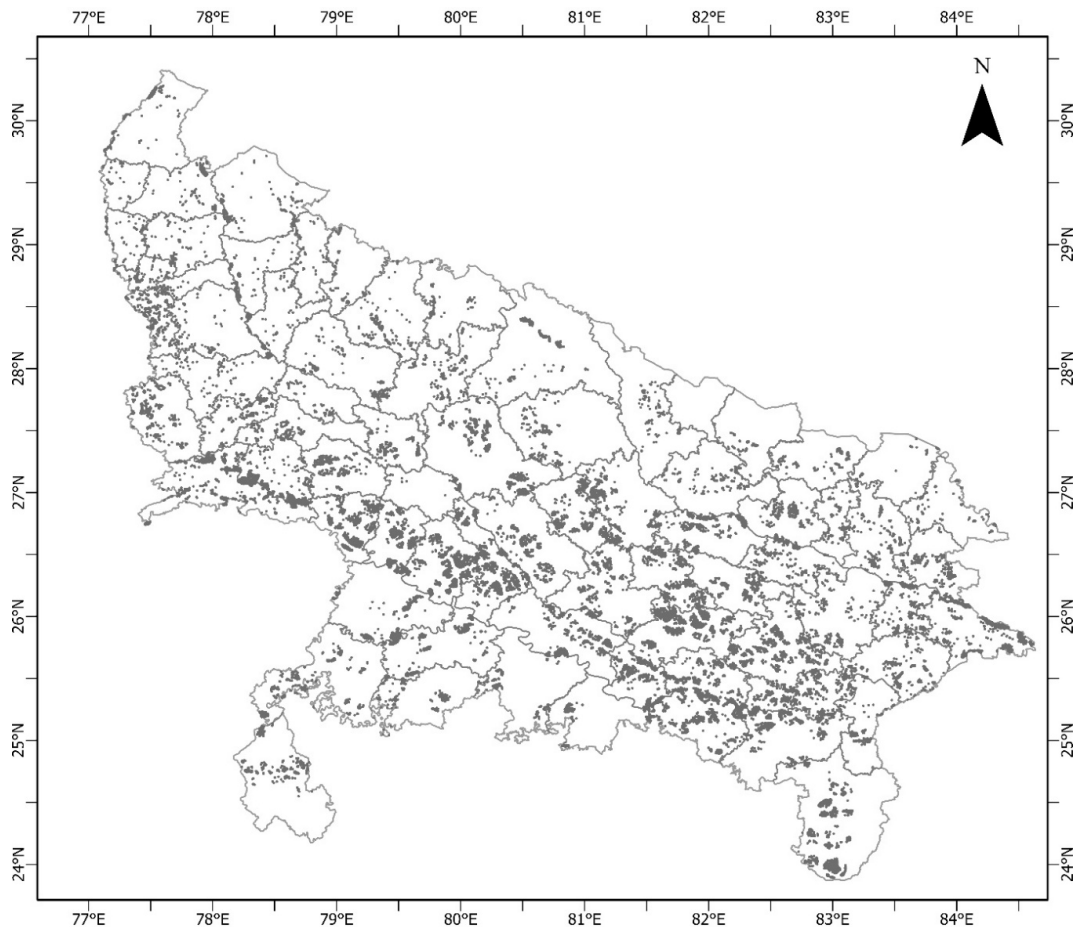


Figure 79: Feasible wasteland parcel of Uttar Pradesh for solar installation

Solar Potential Insights

Utilization of Wasteland	10%
Solar Potential	97842.99 MW _p
Area required for 50 MW SPV plant	0.41 km ²
District with maximum potential	Prayagraj (5615.85 MW _p)
Solar GHI Range	4.51 - 5.26 kWh/m ² /day

Solar Potential

The following table presents a district-wise breakdown of Uttar Pradesh's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 38: District wise solar potential of Uttar Pradesh

Sr. No	District	Solar Potential (MW _p)
1	Agra	2055.60
2	Aligarh	447.10
3	Ambedkarnagar	885.63
4	Amethi	1739.80
5	Amroha	490.04
6	Auraiya	1792.55
7	Ayodhya	1268.53
8	Azamgarh	1178.22
9	Baghpat	308.08
10	Bahraich	408.36
11	Ballia	3199.63
12	Balrampur	266.31
13	Banda	754.05
14	Barabanki	1911.85
15	Bareilly	732.51
16	Basti	1622.83
17	Bhadohi	1443.24
18	Bijnor	804.65

19	Budaun	662.10
20	Bulandshahr	874.49
21	Chandauli	773.09
22	Chitrakoot	776.25
23	Deoria	1356.97
24	Etawah	2754.98
25	Etah	325.81
26	Farrukhabad	769.01
27	Fatehpur	1976.13
28	Firozabad	3558.04
29	Gautambudhnagar	1087.92
30	Gazipur	1409.51
31	Ghaziabad	453.60
32	Gonda	961.76
33	Gorakhpur	1266.93
34	Hapur	236.87
35	Hathras	667.26
36	Hamirpur	1747.77
37	Hardoi	2404.47
38	Jalaun	2026.50
39	Jaunpur	2795.16
40	Jhansi	1339.89
41	Kannauj	90.11
42	Kanpur	3157.46
43	Kanpur Dehat	3897.80
44	Kasganj	252.10
45	Kaushambi	1535.19
46	Kheri	1298.44
47	Kushinagar	331.04
48	Lalitpur	1166.04
49	Lucknow	1538.55
50	Maharajganj	182.61
51	Mahoba	727.86
52	Mainpuri	1076.70
53	Mathura	1418.49
54	Mau	972.91
55	Meerut	383.50

56	Mirzapur	2916.85
57	Moradabad	226.41
58	Muzaffarnagar	838.95
59	Pilibhit	329.34
60	Pratapgarh	4392.02
61	Prayagraj	5615.85
62	Rampur	210.38
63	Raibareli	1876.24
64	Sitapur	725.12
65	Saharanpur	736.43
66	Sambhal	244.04
67	Santkabirnagar	364.67
68	Shahjahanpur	758.32
69	Shamli	153.34
70	Shrawasti	9.97
71	Siddharthnagar	563.03
72	Sonbhadra	4252.57
73	Sultanpur	1303.97
74	Unnao	1622.42
75	Varanasi	1140.77
Total Solar Potential (MW_p)		97842.99

Uttarakhand

SPV Installed Capacity (July 2025)

- 541.05 MW

Land Use and Land Cover (LULC)

- Forest areas dominate nearly 46% of the state's land.
- Wastelands cover about 13% (7139 km²) of the state's area.
- Scrub Land alone makes up over 73% of the wasteland area highly suitable for solar power plants.

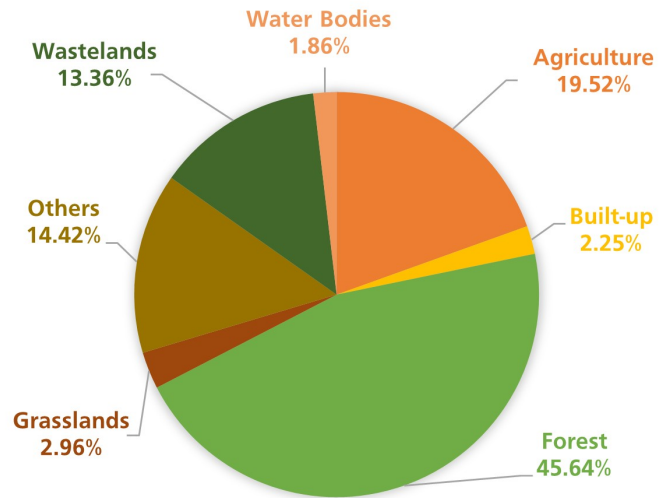


Figure 80: Land use and land cover of Uttarakhand

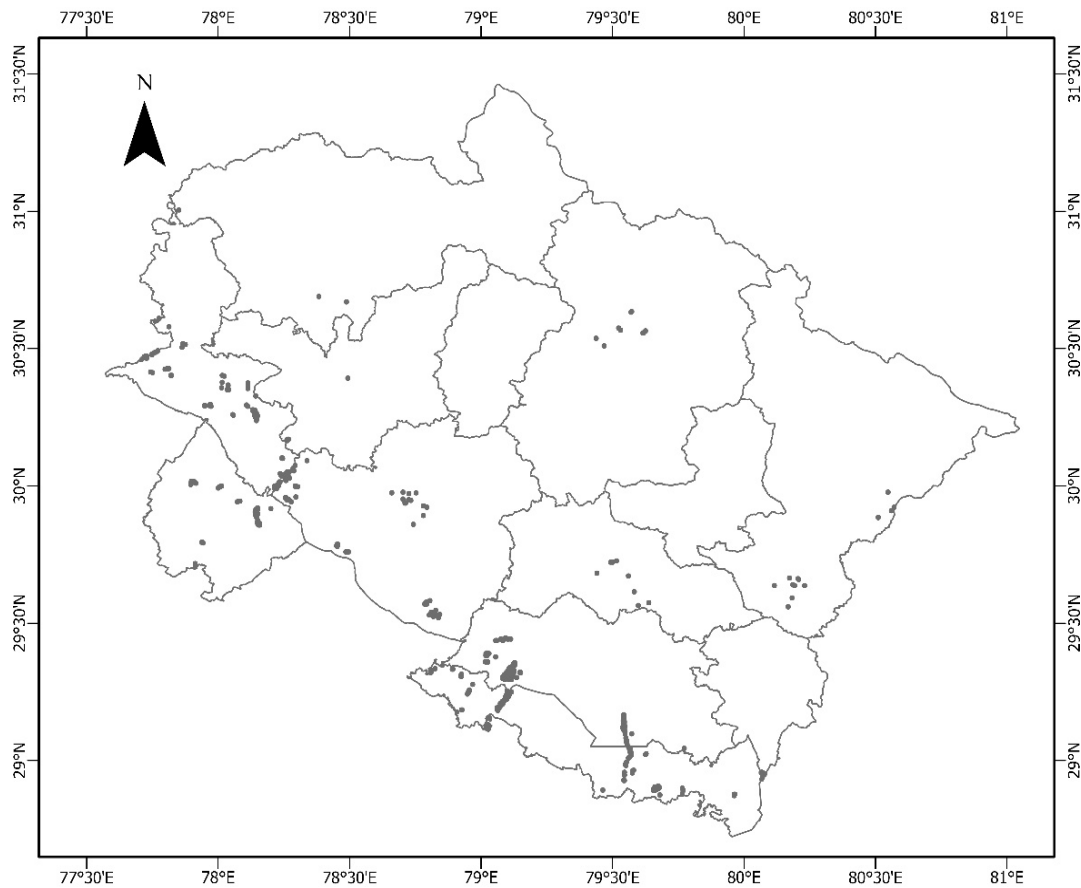
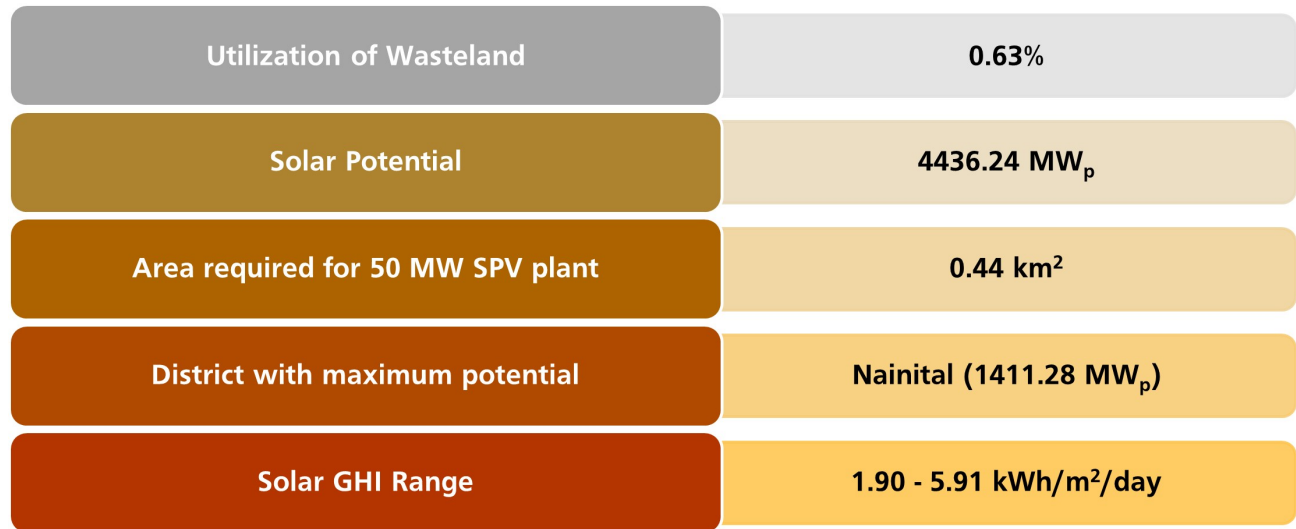


Figure 81: Feasible wasteland parcel of Uttarakhand for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of Uttarakhand's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 39: District wise solar potential of Uttarakhand

Sr. No	District	Solar Potential (MW _p)
1	Almora	52.57
2	Chamoli	58.61
3	Champawat	26.40
4	Dehradun	796.90
5	Haridwar	412.94
6	Nainital	1411.28
7	Pauri Garhwal	472.36
8	Pithoragarh	85.37
9	Tehri Garhwal	52.28
10	Udham Singh Nagar	1048.03
11	Uttarkashi	19.49
Total Solar Potential (MW_p)		4436.24

West Bengal

SPV Installed Capacity (July 2025)

- 240.35 MW

Land Use and Land Cover (LULC)

- Agricultural areas dominate nearly 60% of the state's land.
- Wastelands cover about 2% (2056 km²) of the state's area.
- Scrub Land alone makes up over 70% of the wasteland area highly suitable for solar power plants.

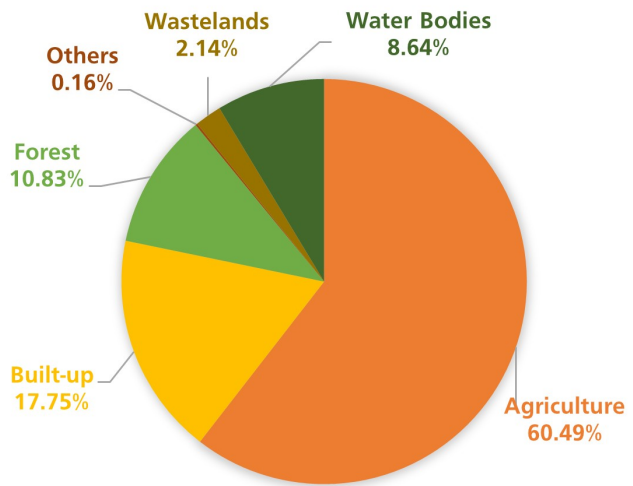


Figure 82: Land use and land cover of West Bengal

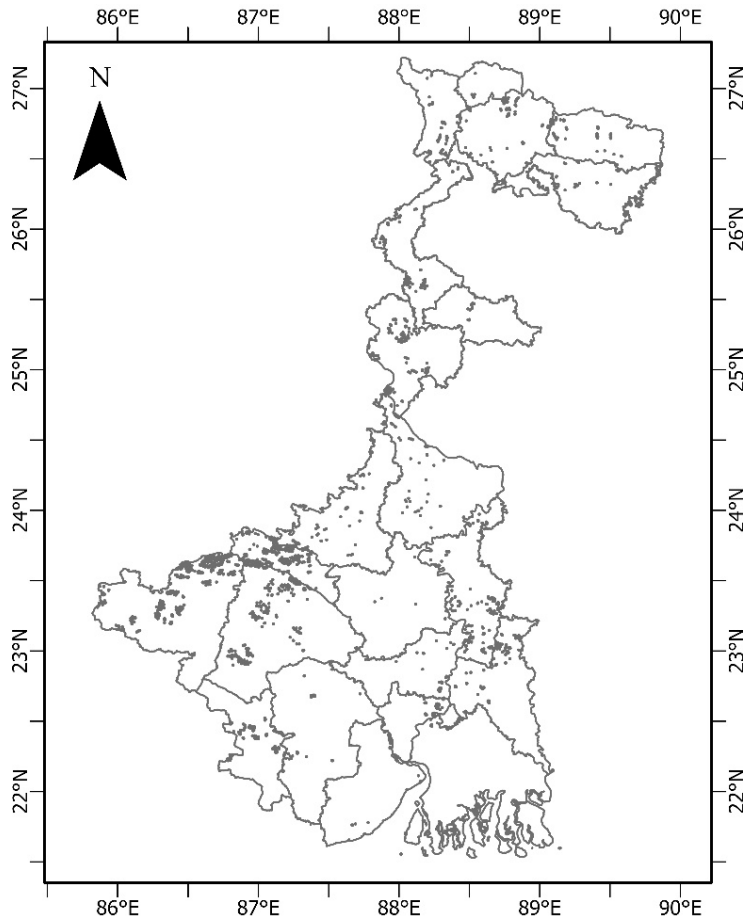
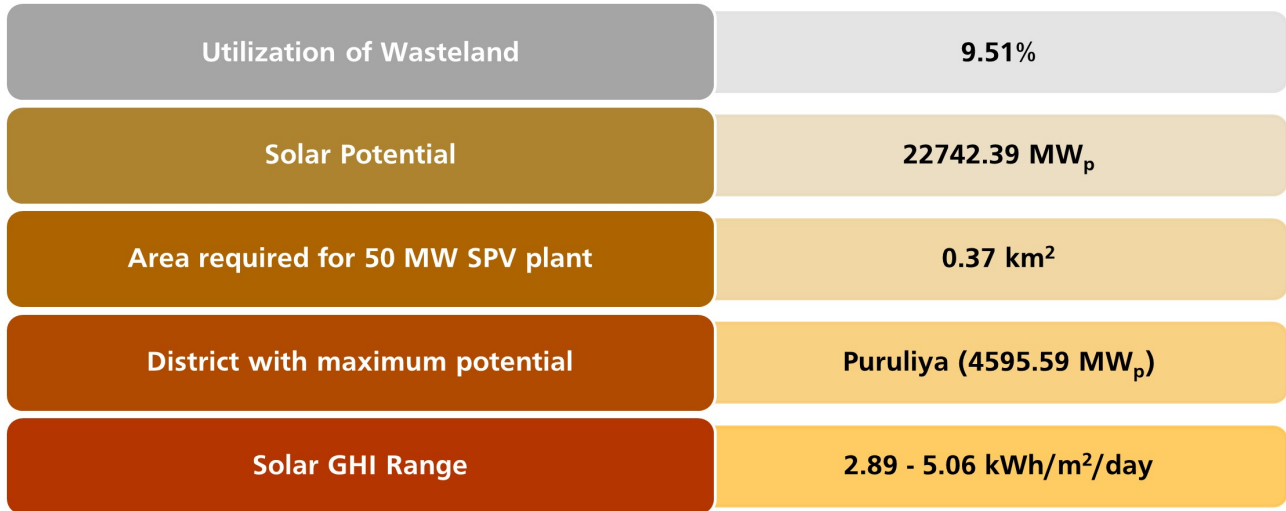


Figure 83: Feasible wasteland parcel of West Bengal for solar installation

Solar Potential Insights



Solar Potential

The following table presents a district-wise breakdown of West Bengal's solar potential, highlighting areas most suitable for large-scale solar deployment.

Table 40: District wise solar potential of West Bengal

Sr. No	District	Solar Potential (MW _p)
1	Alipur Duar	817.19
2	Birbhum	885.34
3	Bankura	3136.13
4	Darjiling	640.21
5	Dakshin Dinajpur	121.46
6	Haora	380.72
7	Hugli	478.94
8	Jalpaiguri	760.46
9	Jhargram	1044.13
10	Kalimpong	79.91
11	Koch Bihar	216.93
12	Kolkata	24.84
13	Maldah	1964.95
14	Murshidabad	506.31
15	Nadia	1522.89
16	North Twenty-Four Parganas	1048.35
17	Paschim Barddhaman	2528.32

18	Paschim Medinipur	397.46
19	Purba Barddhaman	115.10
20	Purba Medinipur	439.45
21	Puruliya	4595.59
22	South Twenty-Four Parganas	182.19
23	Uttar Dinajpur	855.50
Total Solar Potential (MW_p)		22742.39



WAY FORWARD

WAY FORWARD

Building on the robust foundation established by the updated national ground-mounted solar potential assessment, NISE envisions a structured roadmap to ensure that India's solar development remains data-driven, policy-aligned, and technologically adaptive. Key strategic directions include:

1. Periodic Upgradation of Solar Potential Assessments

Solar technology, land-use patterns, and infrastructure networks evolve rapidly. To maintain the relevance and accuracy of national estimates, NISE will undertake periodic updates of solar potential assessments, integrating:

- Advances in photovoltaic efficiency and emerging technologies.
- Latest high-resolution geospatial datasets, including updated LULC, solar irradiance, and grid infrastructure layers.
- Insights from operational solar projects to refine site feasibility and capacity density parameters.

2. Development of a Dedicated Solar Potential Portal

To enable more informed, transparent, and actionable planning, NISE is committed to developing a dedicated Solar Potential Portal. This portal will:

- Provide state- and district-level geospatial maps of feasible solar sites.
- Allow stakeholders to explore land suitability, irradiance, infrastructure proximity, and environmental constraints interactively.
- Serve as a knowledge-sharing platform linking policymakers, project developers, investors, and researchers.

3. Assessment of Specialized Solar Applications

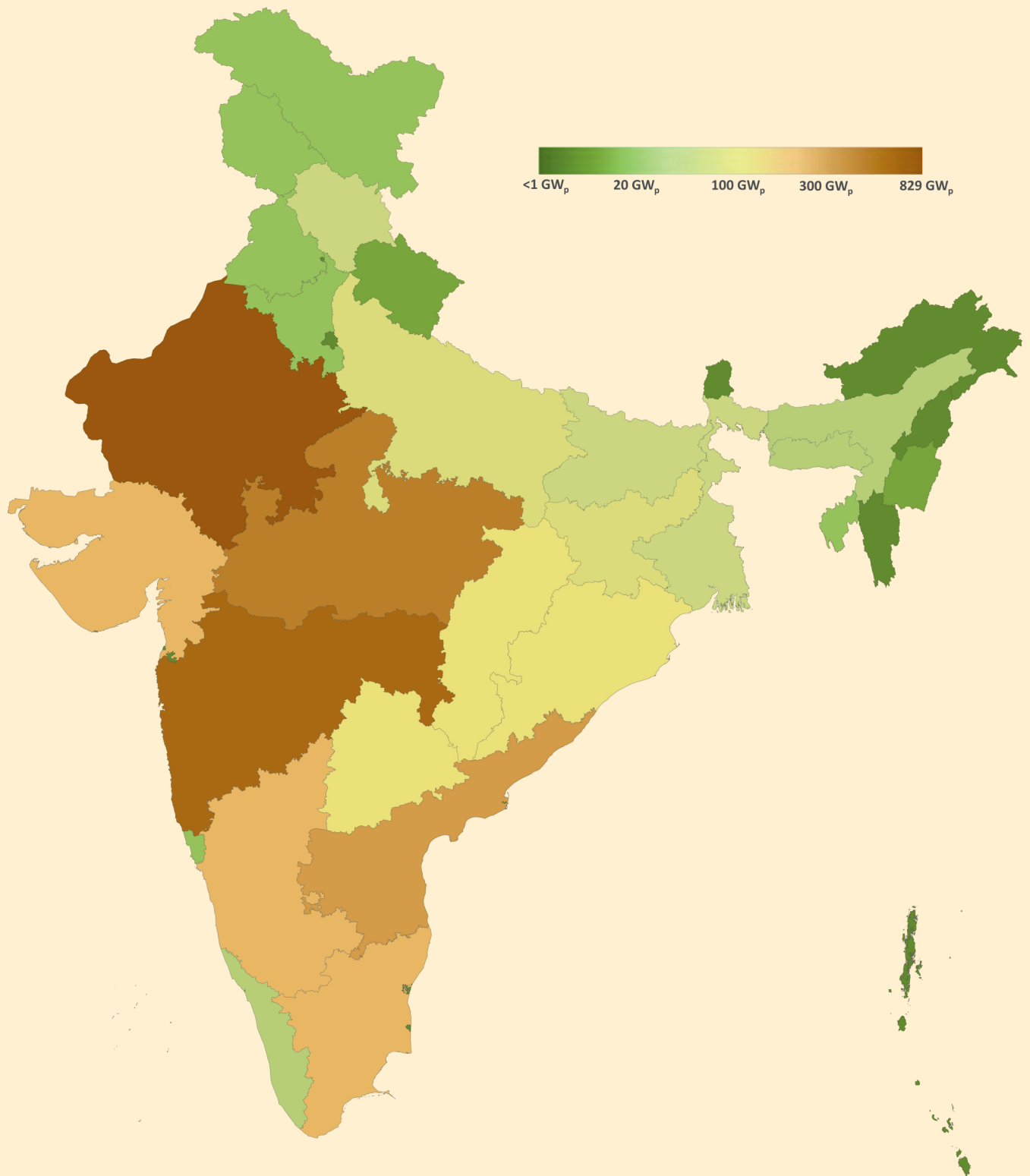
Recognizing the diverse ways solar energy can be harnessed, NISE will expand its potential assessment framework to include emerging and complementary solar applications such as floating solar, rooftop and agrivoltaics.

4. Integration with National and State-Level Energy Planning

NISE's periodic assessments and portal-based data will be directly linked to national and state energy planning frameworks. This will enable:

- Prioritization of high-potential zones for ultra-mega solar parks.
- Strategic allocation of resources for grid strengthening and infrastructure development.
- Alignment of solar deployment with India's Panchamrit targets i.e. energy independence by 2047, and net-zero commitments by 2070.

Through a combination of continuous potential updates, a dedicated geospatial portal, and application-specific assessments, NISE aims to provide a scientific, transparent, and policy-relevant foundation for India's solar roadmap. This approach ensures that solar energy continues to drive the nation's clean energy transition, maximize resource efficiency, and reinforce India's position as a global leader in renewable energy innovation.



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