Leveraging OpenStreetMap for Solar Energy Expansion in Bangladesh

Mapping for Sustainable Energy and Equitable Access

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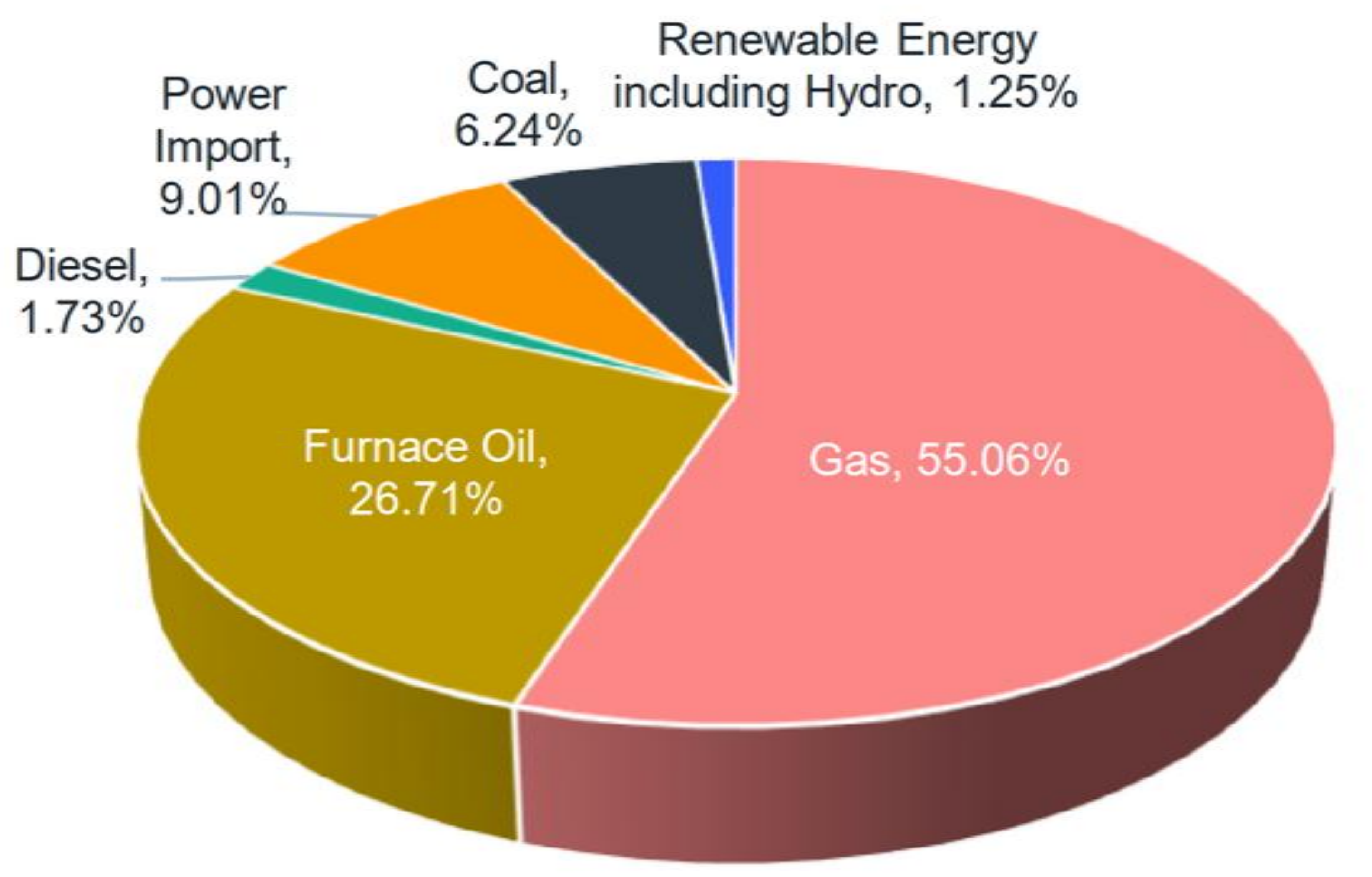
Overview of the Energy Landscape of Bangladesh

The **energy consumption per capita 344 kgoe (kilograms of oil equivalent),** which has been raised by **22% from 2013 to 2019.**

(Energy Consumption in Bangladesh, 2021)

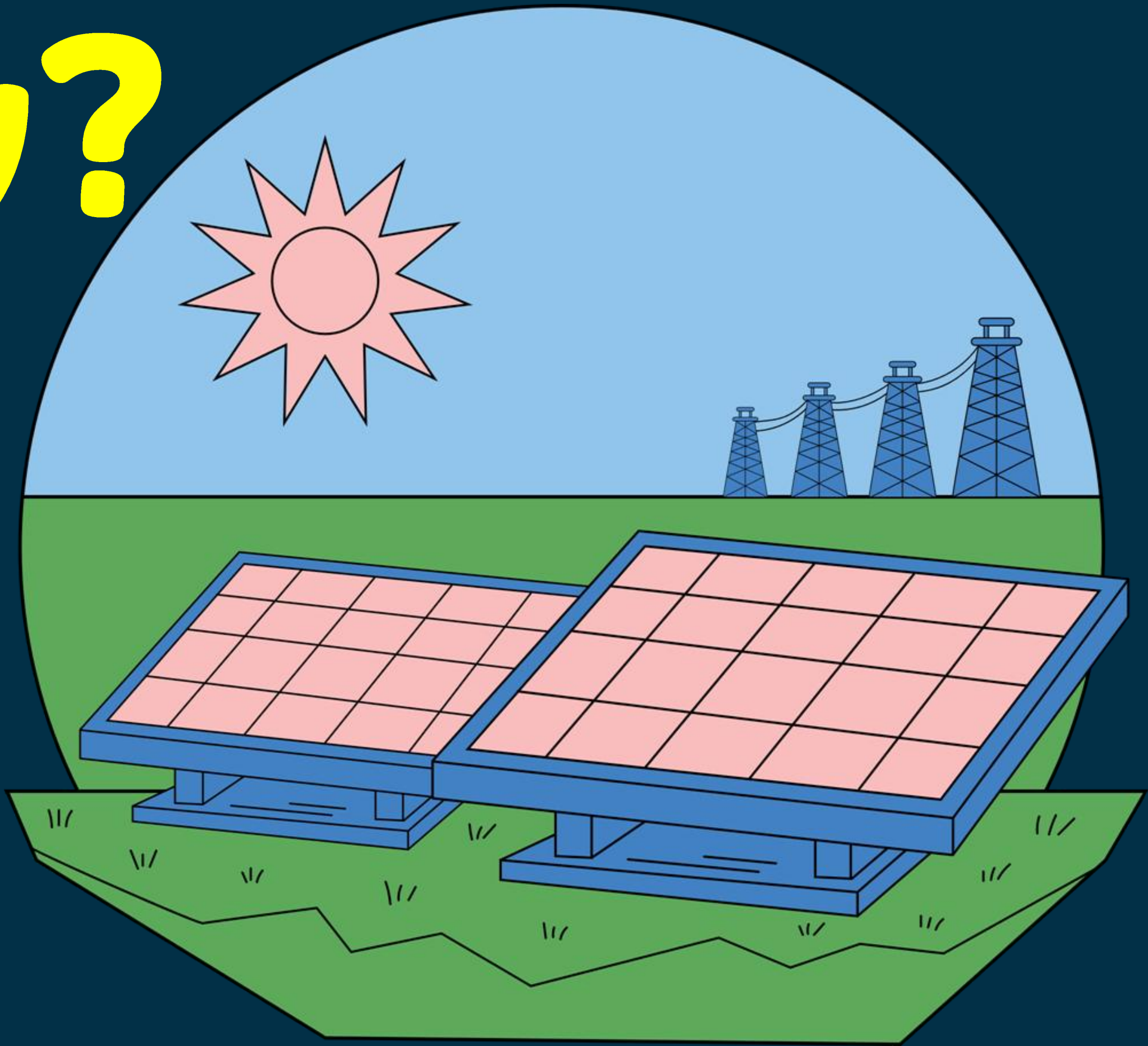
Bangladesh faced **higher natural gas prices in 2022**, halting imports and causing **significant blackouts**. Prices remained high, with imports resumed in January 2023, expected to continue until 2026.



Energy Mix in Power Generation 2021-22

Source: IEEFA

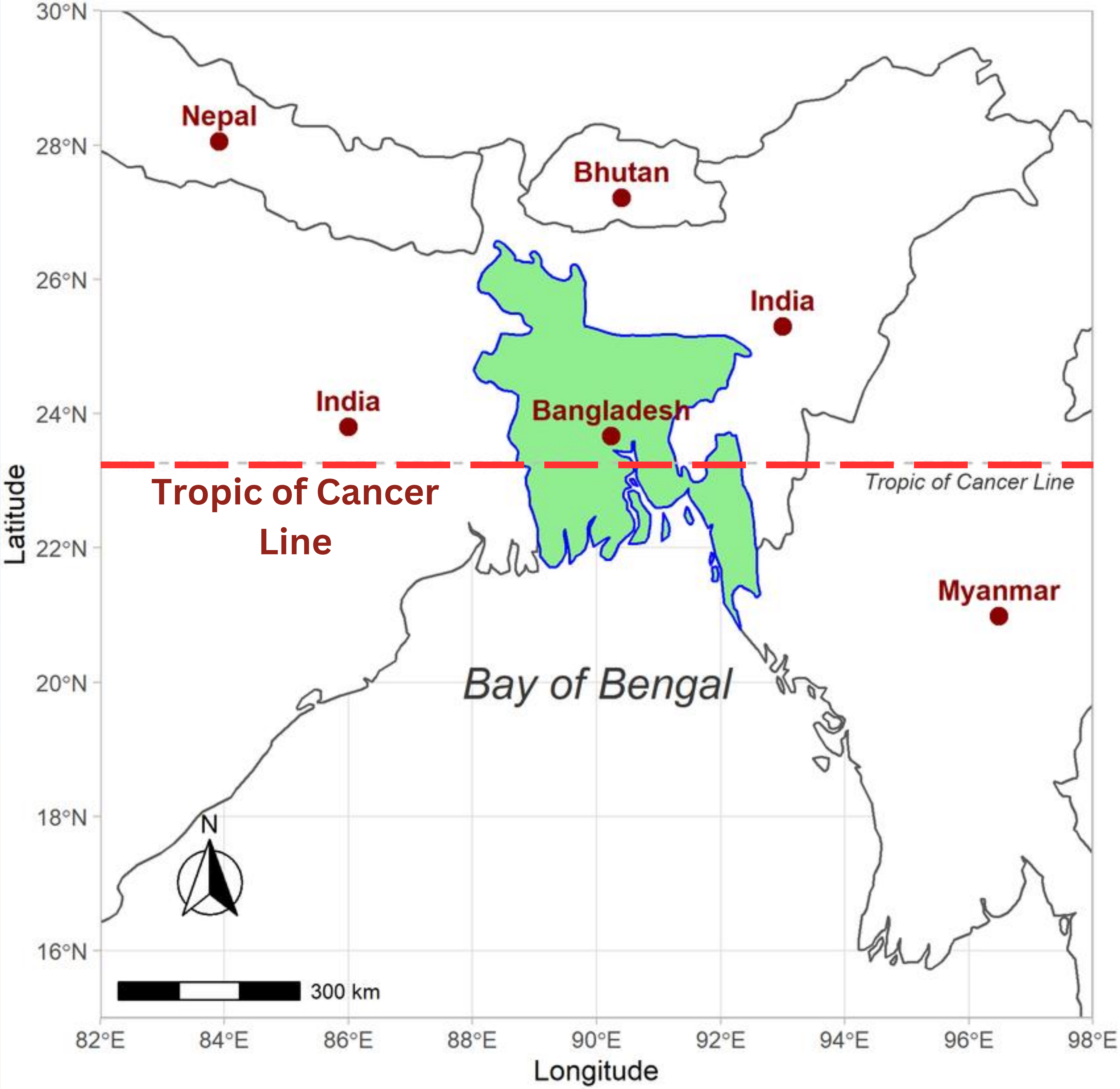
Why focusing on solar energy?



Geographical Location of Bangladesh

Bangladesh is situated between **20°34' to 26°38' north latitude** and **88°01' to 92°41' east longitude.**

The **tropic of cancer (23.5° N)** passes through the divisions of Khulna, Dhaka and Chittagong Divisions.



The country gets a normal daily solar irradiation of 4.2–5.5 kWh/m2 can create roughly 1,862.5 kWh/m2which per year

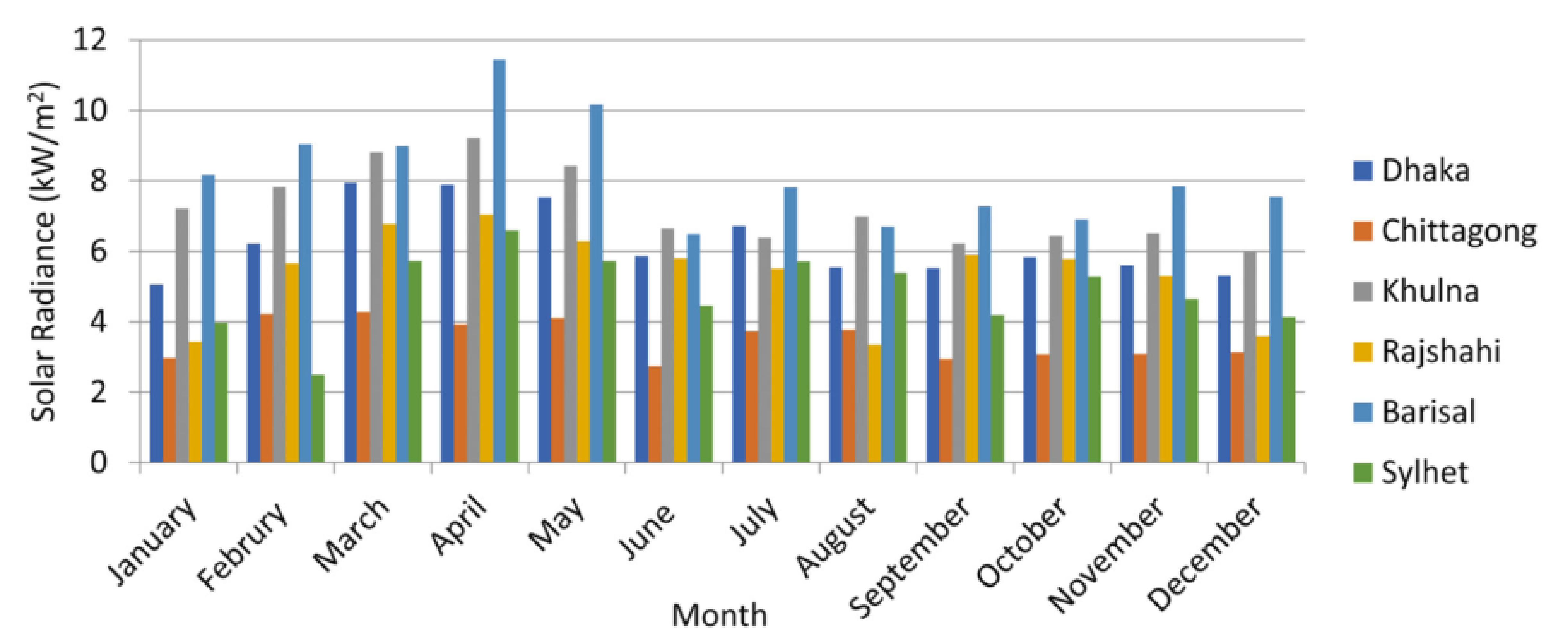
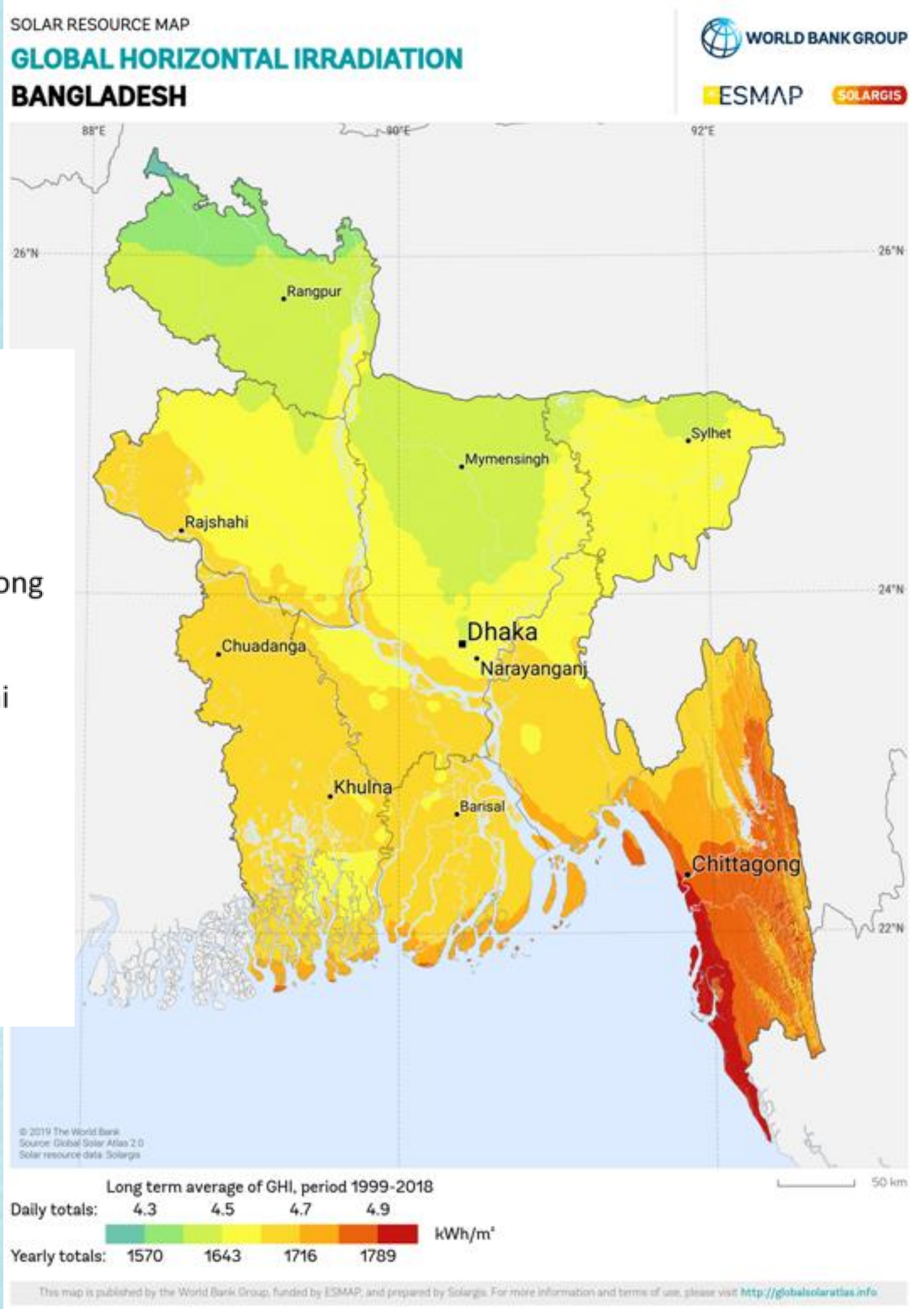


Figure 2. Monthly solar radiance in various divisions of Bangladesh [27].

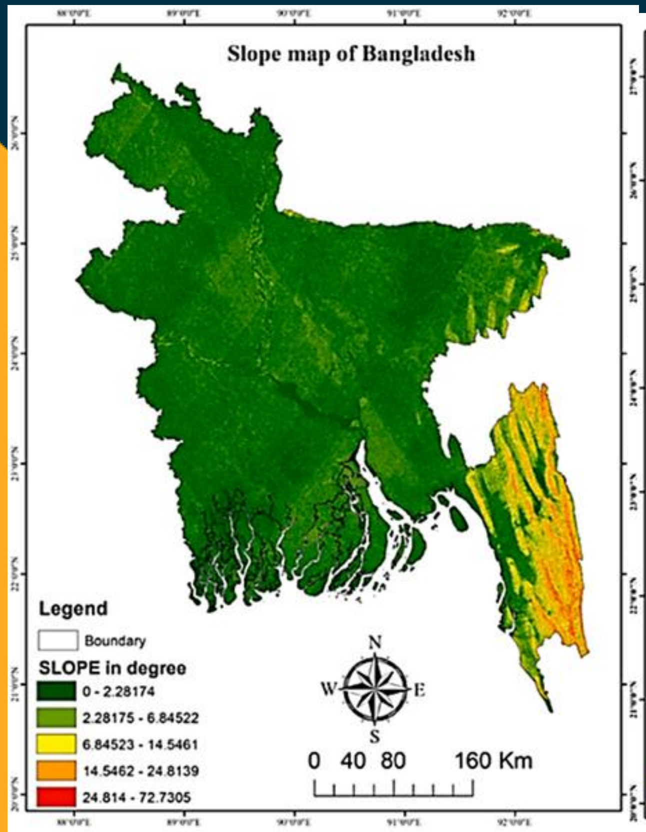
(Siddique et al., 2021)

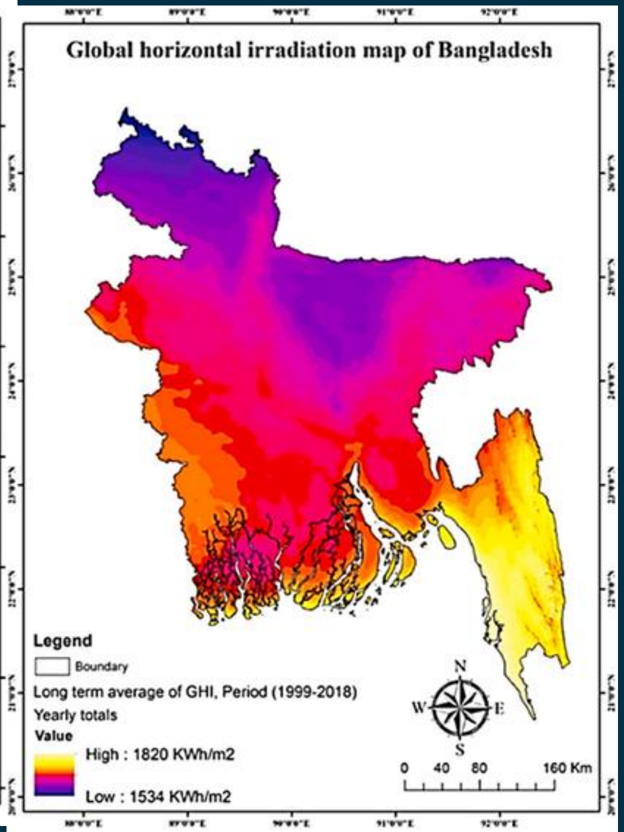


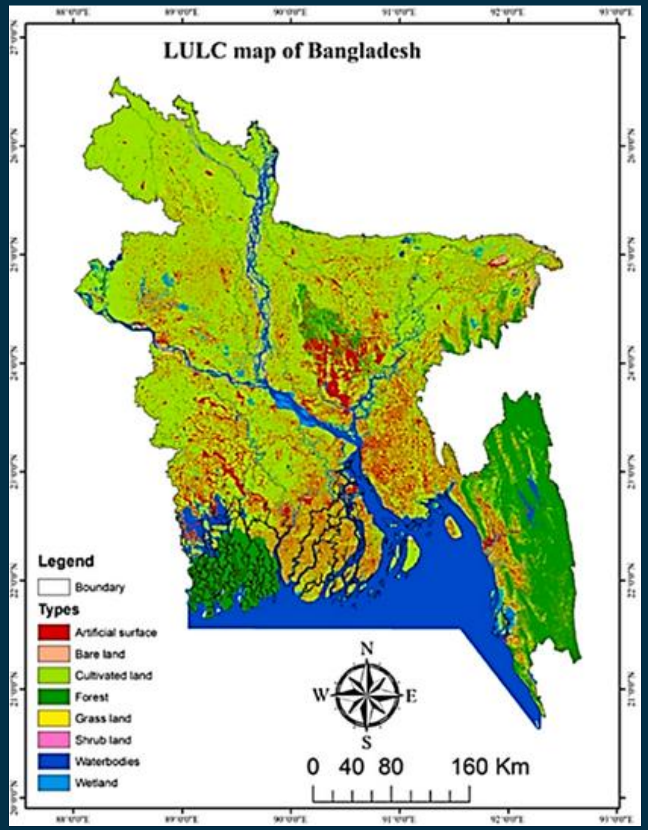
Bangladesh possesses a capability of 50,174 MW electricity generation from solar PV

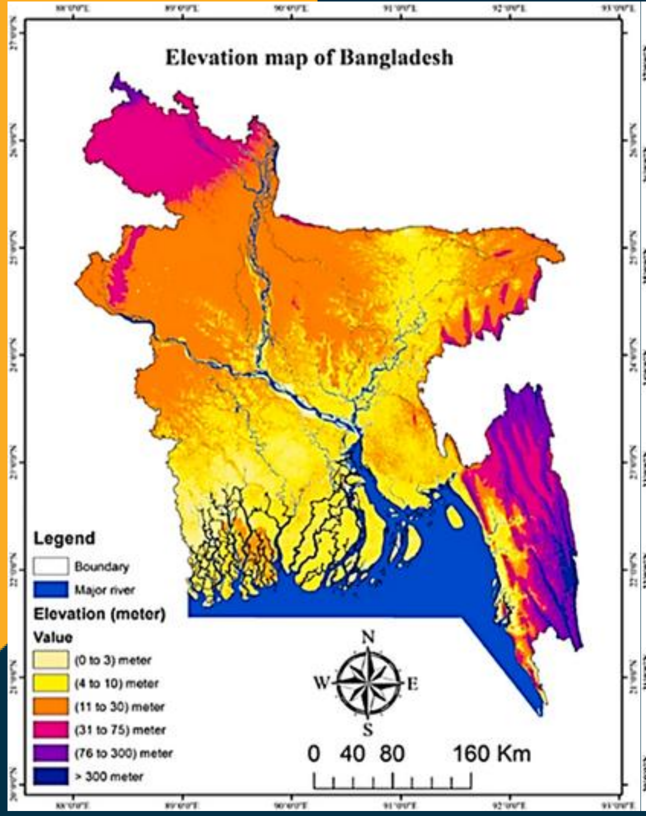
Parameters

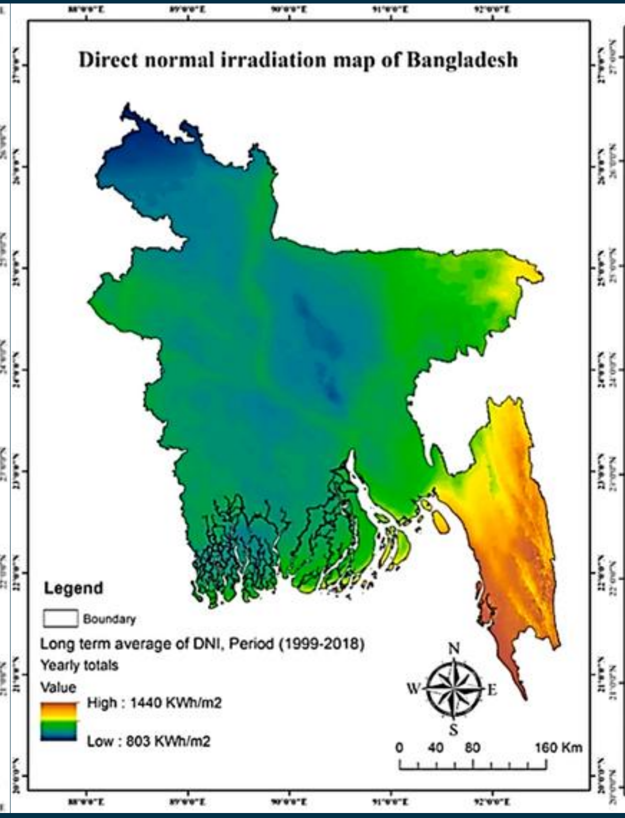
- Slope
- Elevation
- LULC
- Relative Humidity
- Global Horizontal Irradiation
- Direct Normal Irradiation
- Distance from Protected Area

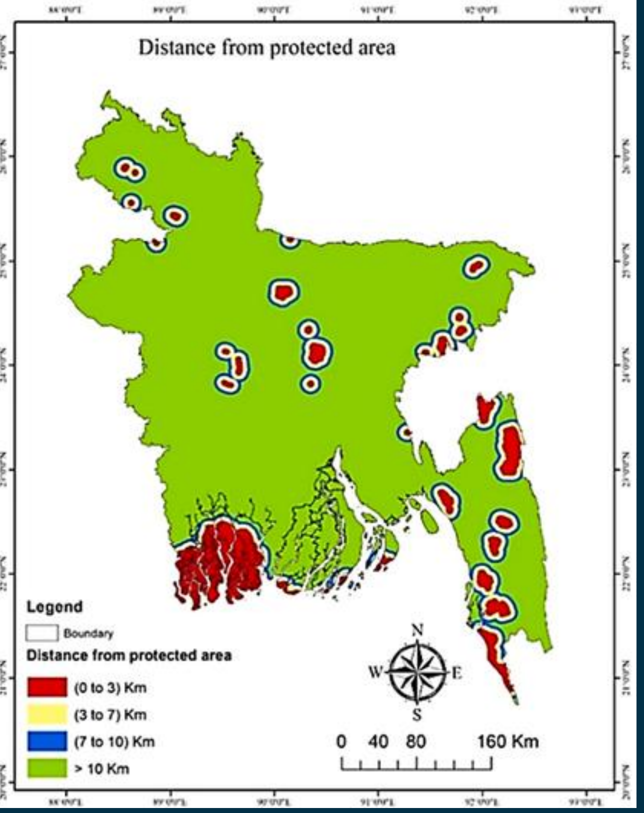


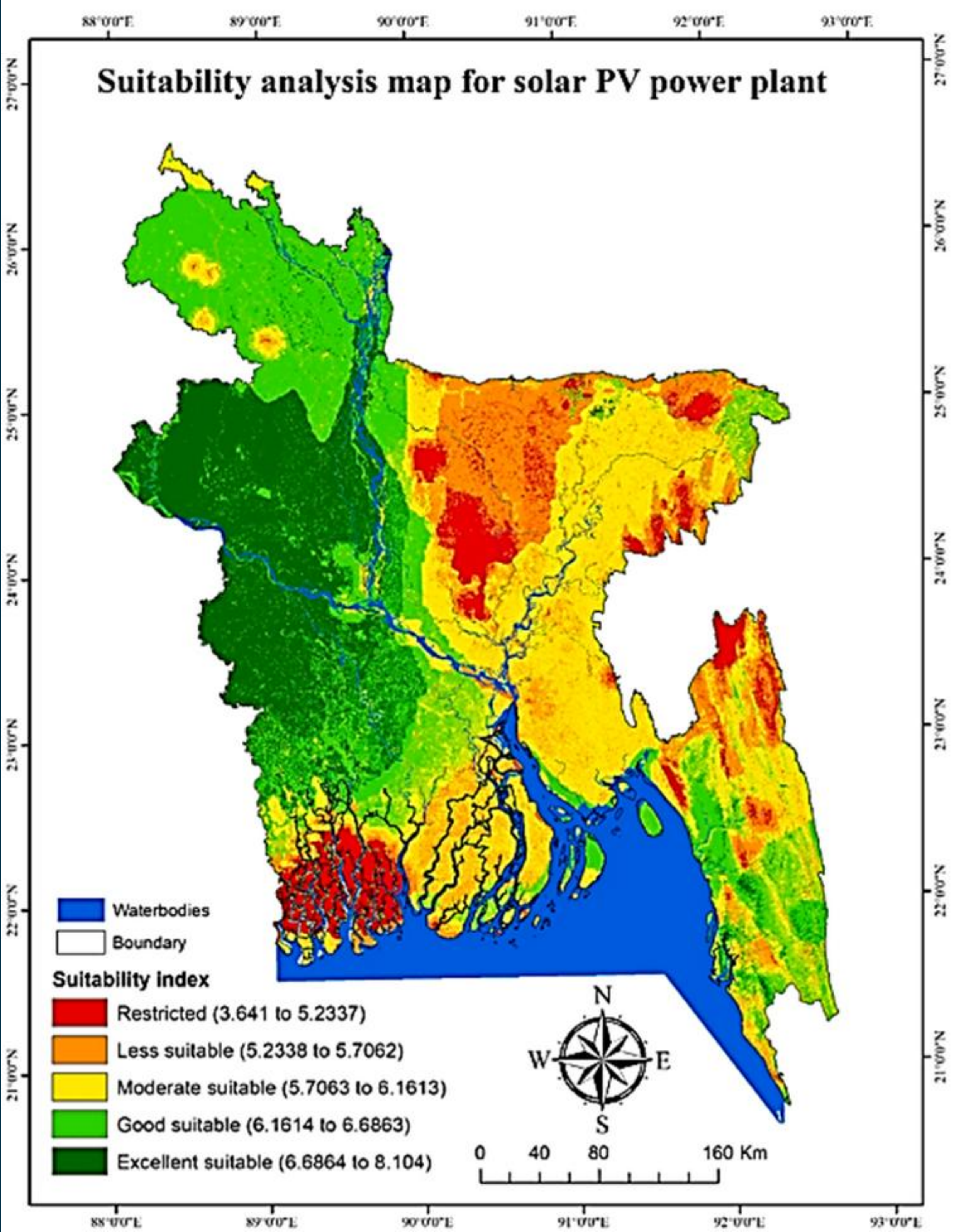






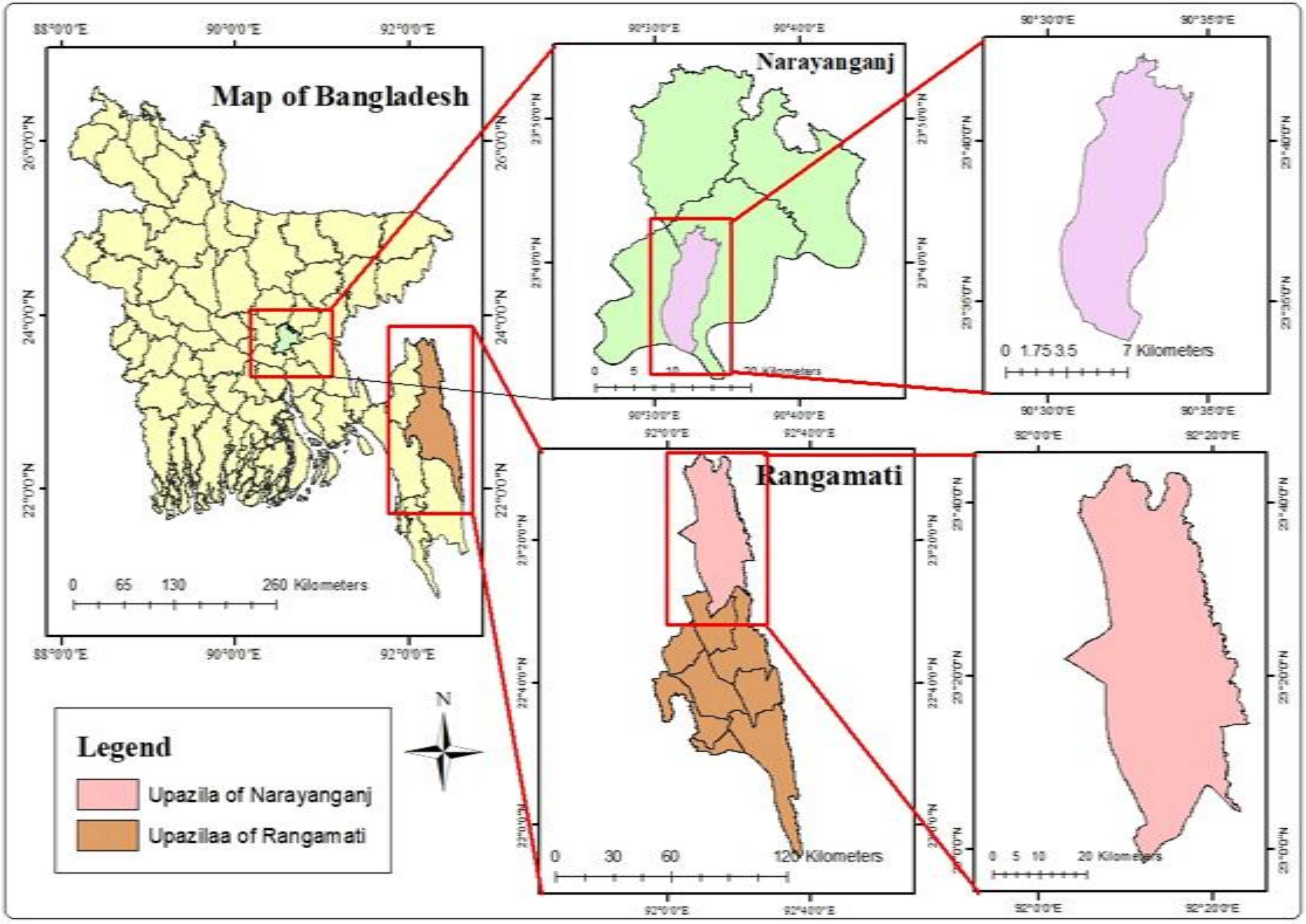






(Rana & Moniruzzaman, 2024)

Objectives



1. To map suitable locations for solar energy infrastructure using OSM
2. To track the adoption of solar home systems (SHS)
3. To identify and address areas with limited energy access
4. To support equitable energy distribution and sustainable development

Rural and industrial zones as key focus areas

Rural

A significant portion of rural areas remains **underserved by centralized power grids**.

Rural areas often have **open land and rooftops ideal** for renewable installations.

Leveraging **local resources** to reduce dependency on fossil fuels

Industrial Zones

Industrial zones, which are **energy-intensive hubs** driving GDP growth, require **efficient and reliable energy supply** to maintain productivity and competitiveness.

Industries benefit from renewable energy integration, such as rooftop solar or hybrid systems, **ensuring uninterrupted power during grid outages and lowering operational costs**.

Advances in microgrids, battery storage, and renewable hybrid systems can simultaneously address the unique energy challenges of rural and industrial settings

Role of OpenStreetMap in Solar Mapping

Mapping rooftops, open fields, and public infrastructure suitable for solar panels

Mapping Rooftops

Utilize the **building footprint** of OSM

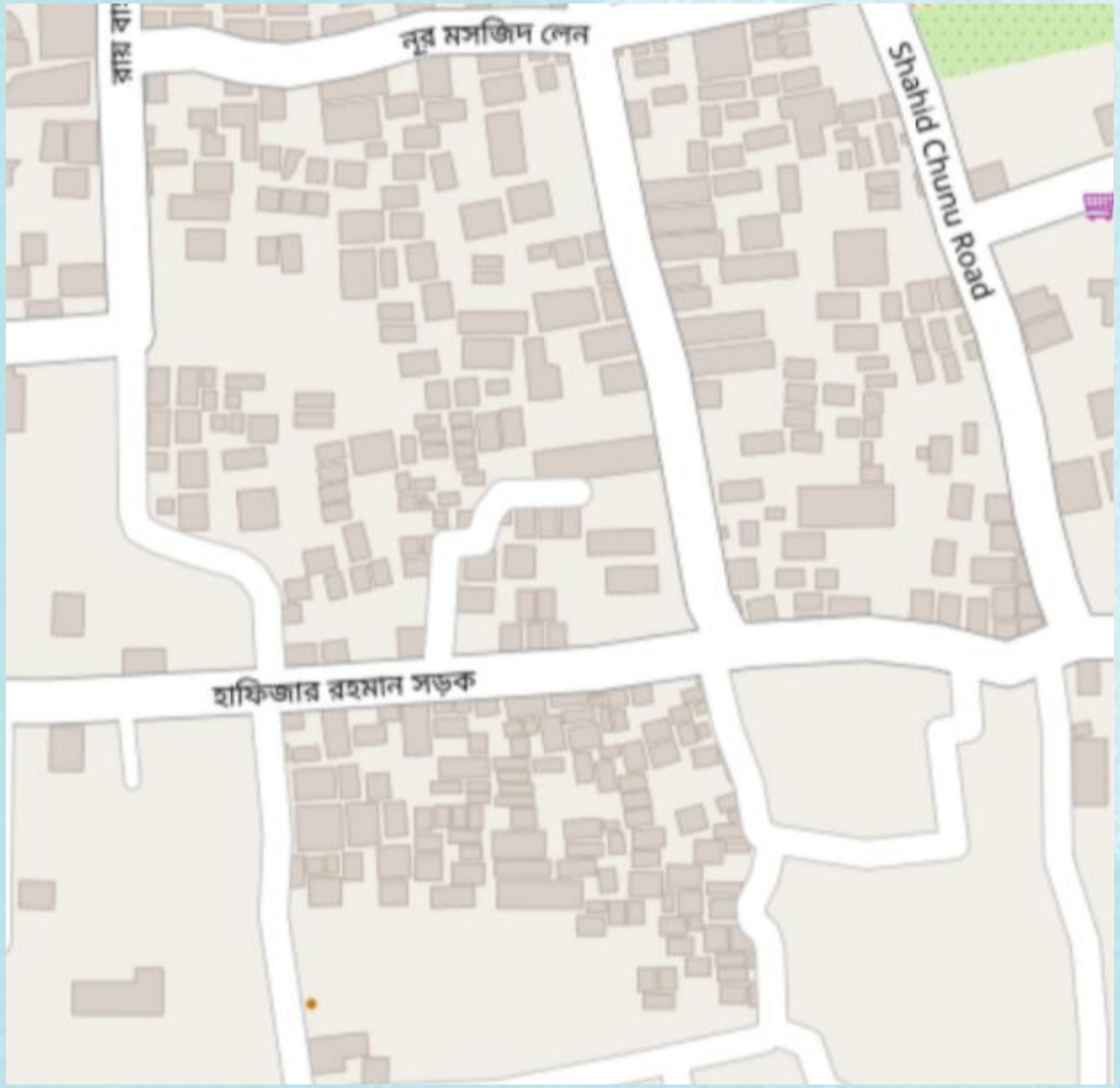
- **Roof Geometry**
- **Roof Size**

Using specific **OSM tags**

- **building:roof:shape**
- **building:levels**
- **roof:material**

Stakeholders can assess the structural suitability of rooftops for solar installations

the **modeling of shadow effects** and **potential solar radiation on rooftops** can be done combining the **elevation data**



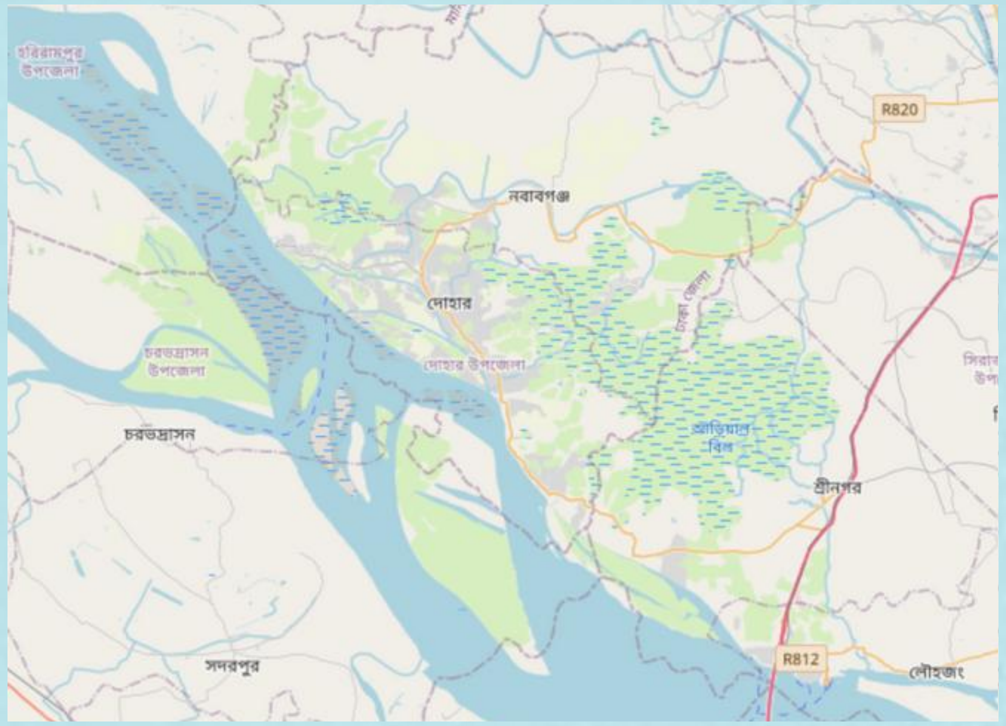
Mapping Open Fields

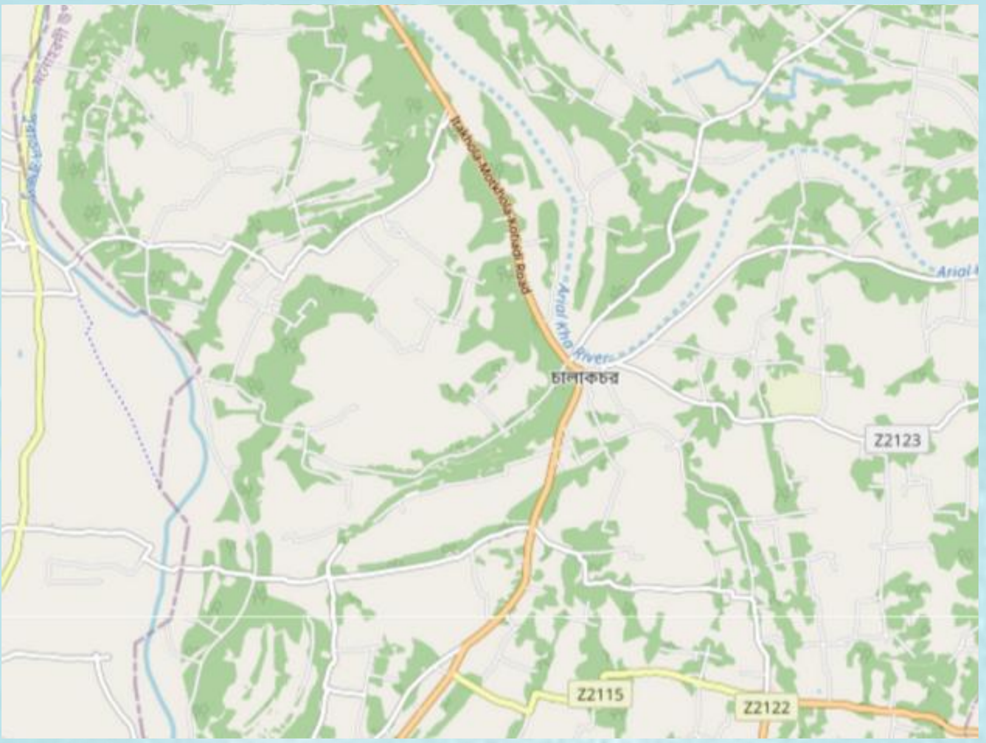
OSM includes **tagged areas** for helping locate spaces **suitable for ground-mounted solar panels**

agriculture (landuse=farmland)

grasslands (landuse=meadow)

barren land (landuse=brownfield)





Features like **protected areas, water bodies, and high-density urban zones** are marked, aiding in **identifying feasible open areas** while **avoiding environmentally sensitive regions.**

Areas with insufficient or outdated data can be addressed by **assigning tasks through the HOT Tasking Manager and organizing mapathons.**

This approach leverages the extensive mapping community's manpower, ensuring comprehensive and up-to-date information for the project.

Integration of OSM Data with Solar Radiation Analysis

Integrating OSM data with solar radiation datasets or prepared map

↓

Calculate the **average solar energy incident on rooftops and land surfaces**

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Elevation and vegetation data in OSM, combined with **LiDAR or DEM data**, enable **shading simulations for improved accuracy.**

↓

Identify **suitable infrastructure and land** surface for Solar PV installation

Tools and Platforms

JOSM

Allows **detailed editing** of OSM data, **tagging buildings and fields** **supports plugins like buildings_tools** for efficient mapping geospatial layer integration

Google Earth Engine

Integrates OSM with **global solar datasets for large-scale modeling.**

QGIS Plugins

Tools like **Solar Radiation Analysis** integrate OSM vector layers with raster-based solar calculations.

Tagging rural households and off-grid communities using SHS

Use OpenStreetMap (OSM)to **tag households or communities with SHS installations**

Add **relevant tags to indicate SHS usage**

solar:home_system=yes

Use mobile mapping tool **KoboToolBox** to collect field data on **SHS locations, capacities, and statuses.**

Analyze and visualize collected SHS data

Benefits of tracking SHS adoption

Use mapping to locate **off-grid areas or regions with low SHS adoption**

Integrate geospatial data (e.g., power lines, substations) with SHS data to identify **regions needing targeted interventions**

Collaborate with local energy providers or NGOs to update and verify SHS data regularly.

Periodically update SHS data in OSM to reflect new installations or changes.

Highlighting regions for targeted off-grid or mini-grid solar projects

Challenges

- Areas with insufficient or outdated OSM data may require significant fieldwork and validation.
- Mapping, surveying, and processing geospatial data can require significant time and resources.
- Data accuracy and accessibility
- Engagement of stakeholders and communities

Thank You