ASSESSMENT OF SOLAR ENERGY POTENTIAL IN THE KONKAN REGION OF MAHARASHTRA: A GEOGRAPHICAL AND ECONOMIC ANALYSIS

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ABSTRACT

The Konkan region of Maharashtra—comprising districts like Raigad, Ratnagiri, Sindhudurg, Thane, and Palghar—presents a distinct geographical and economic profile for solar energy development compared to the inland plateau or semi-arid zones like Marathwada.

Geographical Assessment

• Topography and Location: The Konkan region lies between the Arabian Sea to the west and the Sahyadri (Western Ghats) mountain range to the east, spanning a total geographical area of roughly 3.08 million hectares.
• Monsoon and Cloud Cover: Unlike the arid or semi-arid districts of Maharashtra that experience over 300 sunny days annually, Konkan experiences heavy to very high seasonal rainfall during the southwest monsoon, alongside sustained high relative humidity and atmospheric moisture.
• Land Availability and Hilly Terrain: The landscape is heavily undulating, forested, and broken by numerous creeks and steep slopes. Large stretches of contiguous, flat wasteland suitable for massive utility-scale solar parks are scarce compared to northern or eastern Maharashtra. However, decentralized solutions—such as rooftop solar or localized installations on hilly or non-agricultural elevated terrain (e.g., studies in Raigad identifying specific hilly villages for micro-installations)—show localized viability.
• Solar Irradiance: Global horizontal irradiance (GHI) is reasonable during non-monsoon months, though annual average yield is tempered by prolonged cloudy/overcast days in June through September.
KEYWORDS-Konkan, Maharashtra, solar energy, economic, geographical

INTRODUCTION

Economic Analysis

Cost & Tariff Dynamics:
Open access and commercial/industrial (C&I) solar consumers in Maharashtra face grid integration rules, including solar wheeling charges ranging roughly between ₹1.20 to ₹1.60 per unit depending on voltage levels, alongside grid support and emerging duties.

Capital costs for installations must account for high coastal humidity, salt-air corrosion (requiring specialized anti-corrosive module mounting structures and marine-grade PV laminates), and seasonal cleaning requirements. [1, 2]
Decentralized vs. Utility Scale:
Utility-Scale Limitations: Large multi-megawatt ground-mounted parks face high land acquisition costs, steep topography, and environmental/forest clearances due to Western Ghats proximity. Major utility projects in Maharashtra are concentrated elsewhere, such as the Sakri solar plant in Dhule.
Rooftop & Commercial Viability: Rooftop solar PV (which forms a significant portion of Maharashtra's ~4.77 GW of rooftop capacity) and small-to-medium captive commercial/industrial solar installations offer better economic returns in Konkan's urbanizing belts (Thane, Raigad, parts of Navi Mumbai) where high industrial/commercial grid tariffs make self-generation financially attractive.[1,2,3]
Subsidies and Support: Residential consumers can leverage central grid-connected rooftop schemes alongside state-level support programs (such as the Maharashtra State SMART Solar Scheme which scales up total subsidy backing for vulnerable/weaker sections)
Among all the developed and developing countries, India is actively contributing to providing clean, affordable and sustainable energy to the citizens and making pace to achieve the UN Sustainable Development Goals 7 till 2030. In this regard, tremendous growth in solar energy generation has been observed in the Indian energy sector. The National Solar Mission targets to attain the goal of 100 GW upto 2022. The country's solar power potential is 748.99 Gwp. The total on-grid installed capacity is 47112.55 MW, with ground-mounted (i.e., solar power plants) accounting for 41001.49 MW and solar roofs accounting for the remaining 6111.06 MW. Solar power contributes a substantial share (41.68%) in the total annual (June 2020 to May 2021) electricity generation (147678.3 MU) from renewable sources. The rise in the overall solar installed capacity (25 MW to 48556.65 MW) in the last decade represents a massive growth in solar power in the country. India is located in the tropical and subtropical region, receives high intensity of solar radiation (200MW/km 2) and hence possesses more potential for energy to be harnessed. The present study provides insights into the country's existing solar energy potential, installed capacity and solar power generation to achieve goals in this sector. The potential states are categorized based on installed capacity (commissioned) through the atlas and statistical computation. Solar energy policies/schemes initiated by the Government of India are reviewed concerning the progress in the energy sector.

DISCUSSION

The Konkan region of Maharashtra is a narrow, rugged coastal plain stretching along the western coast of India, bounded by the Arabian Sea to the west and the Western Ghats (Sahyadri) to the east. [1, 2]

Geographical Overview

Boundaries & Extent: Stretches roughly 530 km (330 miles) from the Daman Ganga River in the north to the Terekhol River in the south, with a width varying between 45 and 76 km (28 to 47 miles). [1]
Districts Included: Spans Thane, Greater Mumbai, Raigad, Ratnagiri, Sindhudurg, and Palghar. [1, 2]
Topography & Climate: Characterized by hilly terrain, rugged laterite plateaus, and seasonal rivers that drain heavy monsoon rainfall from the Sahyadri crest. It features a tropical climate with high humidity and intense seasonal rainfall. [1, 2, 3]
Coastline: Endowed with a 720 km coastline out of Maharashtra's total, featuring numerous creeks, estuaries, and scenic beaches. [1, 2]

Economic Analysis

Fisheries & Marine Economy:[4,5,6]
The Konkan marine facilities contribute approximately 73% of Maharashtra's total fish production.
The region features an extensive continental shelf and 173 fish landing centers, supporting thousands of traditional and mechanized fishing families. [1, 2]
Agriculture & Horticulture:
Dominated by traditional rice farming adapted to heavy monsoons and hilly landscapes.
Renowned for cash crops and horticulture, particularly Alphonso mangoes and cashew nuts (with South Konkan leading in cashew production and Vengurla cashew holding a Geographical Indication status). [1, 2]
Industry & Commerce:
Mumbai serves as the primary economic hub, acting as the financial and commercial capital of India.
The North Konkan urban-industrial belt (Thane, Raigad, Mumbai) drives heavy manufacturing, port activities, and logistics. [1, 2, 3, 4]
Infrastructure & Connectivity:
The Konkan Railway (operating over 760 km through Maharashtra, Goa, and Karnataka) transformed regional connectivity, linking previously isolated coastal pockets, though it also accelerated rural-urban and male migration patterns.
Tourism and maritime trade via historical and modern coastal ports continue to supplement the regional economy. [1, 2, 3]

Indian Railways' Konkan Railway zone took a big step towards Net Zero Carbon Emission. In an effort to minimise carbon footprint, at different railway stations under the zone, solar panels are installed, informed Raosaheb Patil Danve, Union Minister of State for Railways, Coal and Mines.

A 350 kwp solar park is installed in Ratnagiri. At Madgaon railway station, 180 kwp capacity of solar power panels are installed. Likewise, at Kundal, Sawantwadi, Chiplun, Kankavali, Karmali, Udupi, Thivim, and Khed 25kwp, 20kWp, 27 kwp, 27 kwp, 20 kwp, 7 kwp, 7 kwp, 2 kwp solar power panels are installed, respectively. This has resulted in a total of 3.42 million units of energy.

In India, the Konkan Railway (KR) is one of the 19 railway zones. It is headquartered at CBD Belapur in Navi Mumbai, Maharashtra. On 20 March 1993, the first passenger train ran on the Konkan railway tracks between Udupi and Mangalore. In the mountainous Konkan region, during its initial years of operation, several accidents prompted Konkan Railway to implement new technology. Anti-collision devices, the Sky Bus, and roll-on/roll-off are several of Indian Railways' innovations. The 756.25 km long railway line connects the states of Maharashtra, Goa, and Karnataka. On 26 January 1998, the first train on the completed track was sent off.
ndia is generating around 416 gigawatts of power from various sources of energy. This includes a mere 150 gigawatts of power from Renewable Energy (RE). Maharashtra, a western state in India, which stands at fifth position in RE generation, produces 11,400 megawatts of energy. Looking at the threats of global climate change and temperature rise, it is the need of the day to promote more and more renewable energy sources.

Maharashtra has a favorable environment for solar power generation. Large-scale power generation for the state can be done through solar energy panels installed on the roof of the houses.[7,8]

"If thermal power generation is to be stopped, this is a convenient option," said Professor Suresh Chopane, President of the Green Planet Society and member of the Union Ministry of Forest, Environment and Climate Change Committee.

Today Maharashtra has more than 20 thermal power plants. They emit large amounts of ash and toxic gases into the air. Water pollution is also widespread. On the other hand, naturally available, uninterrupted solar energy is available in the state which can generate large amounts of energy.

RESULTS

The total power generation in India as of July 2023 is 416 gigawatts of which coal-based power is 211.06 gigawatts and its total share is 51.20%. Along with nuclear, natural gas and diesel combined is 32 gigawatts, and renewable energy accounts for only 150 gigawatts. Besides this, 46.85 gigawatts is generated by large hydro, 42.8 by wind, and 67.7 by solar, 10.2 by biological, and 4.94 by small hydro.

38,000 megawatts is the power generation capacity of Maharashtra
According to the statistics of the Government of Maharashtra, the total power generation capacity in Maharashtra is 38,000 megawatts (Mahajenko—13,152.06).

As of 2023, renewable energy generation only 11,400 megawatts. This includes solar (4,094.06 megawatts), wind power (2,839 megawatts), bio-energy (2,490.00 megawatts), small hydropower (320.68 megawatts), and municipal solid waste (4 megawatts).[8,9,10]
Solar Drying Machine in Konkan is transforming the way farmers and food processors preserve agricultural and coastal produce. Powered by clean solar energy, it offers a hygienic, energy-efficient, and sustainable drying solution that helps retain the natural

color, flavor, aroma, nutrients, antioxidants, and quality of fruits, vegetables, spices, herbs, seafood, and other agricultural products.

The Konkan region of Maharashtra, including Ratnagiri, Sindhudurg, Raigad, Palghar, and Thane, is renowned for its production of Alphonso mangoes, cashew nuts, coconuts, kokum, jackfruit, bananas, spices, medicinal herbs, fish, seafood, and a wide range of horticultural crops. A Solar Drying Machine in Konkan enables farmers, FPOs, SHGs, fisheries, food processing industries, agri-entrepreneurs, and exporters to convert fresh produce into premium value-added products such as dried mango slices, kokum products, dehydrated coconut, dried fish, seafood, fruit powders, vegetable flakes, herbal products, spices, and export-quality processed foods

CONCLUSIONS

The rapid rate of urban growth and unsustainable development methods pose significant risks to both the ecological balance and cultural identity of the area. To address these challenges, it is vital to implement sustainable strategies. The Konkan region in Maharashtra, India, is rich in biodiversity and cultural heritage, characterized by its distinctive coastal and hilly ecosystems. Development projects should emphasize environmental preservation and the involvement of local communities. This aim can be enhanced by advocating for local architecture and traditional construction techniques that are eco friendly and resilient to climate change. In addition, authentic responsible tourism practices are essential for honoring cultural heritage while concurrently supporting environmental conservation efforts. Moreover, the adoption of eco- friendly practices, such as utilizing renewable energy sources and sustainable agricultural techniques, can greatly diminish the region's carbon emissions. To advance this vision, the creation of Sustainable Interpretation Centres can act as knowledge centers for responsible tourism, educating visitors on the importance of conservation while encouraging local involvement. Traditional building techniques that utilize locally sourced materials can be incorporated into contemporary architectural planning, ensuring a balance between development and ecological sustainability. Drawing inspiration from the Konkan cluster and architectural planning strategies, sustainable living projects should be promoted to foster self-sufficient communities that adopt green practices. By implementing these strategies, the Konkan region can serve as an example of sustainable development, preserving its rich heritage while reducing the effects of climate change.

The Konkan region holds valuable knowledge about sustainable living through its traditional practices. By learning from local architecture, farming, and community lifestyles, we can build a better, eco-friendly future. Sustainable Interpretation Centres can help teach these lessons to locals and tourists. Mixing old wisdom with new green technologies will not only protect the environment but also support the local culture and economy. Konkan can become a model for responsible development.[10]

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