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Original Article

# Exploring Renewable Energy Challenges and Opportunities in Solapur District [Maharashtra]: A Path towards Sustainable Development

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***Abstract***

*Renewable energy also known as 'green energy' which is made from natural resources. There are various renewable energy sources like solar energy, wind power, hydropower, geothermal, ocean energy, biomass and hydrogen energy. Green energy is very crucial for our sustainable future, because it offers numerous benefits over fossil fuels. Moreover, it helps reduce greenhouse gas emissions and improve air quality for our better health. In fact, renewable energy protects ecosystems, conserves biodiversity and minimizes environmental pollution. By using local renewable resources, our nation can become more self-dependent and less reliant on oil price fluctuations and geopolitical instability. On November 13, 2024, the central government reported that India's renewable energy sector reached a major milestone in 2023, creating about 1.02 million jobs nationwide. The central government highlighted India's expanding role in the global clean energy transition. India has emerged as a key contributor to this surge with its dedication to green job creation and sustainable economic development. Solapur, a district located in the southern part of Maharashtra, has a significant potential for renewable energy, particularly solar and wind power, given its geographic and climatic conditions. However, several challenges hinder the full realization of this potential, ranging from infrastructure limitations to policy-related issues. In this paper an attempt has been made to explore the renewable energy landscape of Solapur district, identifying key challenges and opportunities along with region's renewable energy potential to ensure sustainable growth.*

***Key Words:*** *Renewable energy, Sustainable growth, Economic development, Infrastructure.*

## Introduction

The global energy sector is increasingly shifting toward renewable sources of energy to mitigate the adverse effects of climate change and reduce dependency on fossil fuels. India, as one of the world's fastest-growing economies, is actively exploring alternate energy to meet its growing energy demands sustainably. Solapur district, located in Maharashtra, has favourable conditions for renewable energy generation, especially solar and wind power. The district has huge potential in the renewable energy landscape of India. Therefore, this research paper examines the renewable energy potential of Solapur district, the challenges faced in this sector, and the opportunities that can be leveraged for economic and sustainable development of the study region.

## Objectives

The Present study aims to explore potential of renewable energy resources, challenges in this sector along with better opportunities for economic and sustainable development of Solapur district.

**Data Base and Methodology**: The entire analysis for the present investigation is based on secondary data. The secondary data is collected from different websites, project reports, articles, research papers, etc. The collected data is processed and analyzed.

## Study Region

For the present investigation Solapur district is selected as the study region. Geographically Solapur district is located between 17$^0$ 10' to 18$^0$ 32' North latitudes and 74$^0$ 42' to 76$^0$ 15' East longitudes on the Deccan plateau.



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According to Koeppen's climatic classification, Solapur district comes under the category of dry climate or arid and semi-arid climate. The entire district is drained by the Bhima River and its tributaries. Argo-climatically, the district falls under the rain shadow region of Maharashtra.

**Renewable Energy Potential in Solapur District**

Solapur receives high levels of solar radiation due to its geographical location. The district is part of India's solar belt, which receiving around 300 sunny days per year. The average solar insolation in this region is about 5.5 to 6.5 kWh/m²/day, making it an ideal location for solar power generation. The study region is also known for its favourable wind conditions. The district's wind energy potential has been identified as a source of renewable energy generation with wind speeds averaging between 5 to 6 meters per second. Hence, Solapur district presents an opportunity for both onshore and offshore Windmill development.

Apart from solar and wind energy, the district has potential in biomass power generation. Both agriculture and animal husbandry sector produce substantial amounts of residue, which can be converted into biomass energy. Biomass-based power generation systems can help utilize waste products effectively, providing an additional renewable energy source for the study region.

**Challenges to Renewable Energy Development in Solapur District**

1. **Lack of Infrastructure**
   One of the major barriers to adoption of renewable energy in Solapur district is the lack of robust infrastructure. Although renewable resources like solar and wind are abundant, but the transmission infrastructure is insufficient to transport electricity from remote areas to demand centres. It means that upgrading the grid infrastructure to accommodate renewable energy systems is a major challenge in the study region.
2. **Capital Investment and Financing**
   The initial capital investment required for setting up renewable energy systems, particularly both solar and wind energy plants, is very high. However, the financial support for small and medium-scale renewable energy projects in rural areas is limited. Therefore, access to affordable financing remains an important barrier for local entrepreneurs and farmers to invest in renewable energy technologies.
3. **Government Policies and Regulatory Barriers**
   India has a national renewable energy policy, but there is often a lack of specific regional level policies for districts such as Solapur district. This regulatory gap is the major challenge for seamless integration of renewable energy projects. Also issues like land acquisition, delays in approvals, and insufficient incentives for smaller-scale projects at the regional level can slow down the progress of renewable energy.
4. **Lack of Skilled Manpower**
   The renewable energy is an innovative sector, which requires a skilled manpower for project installation, operation along with its maintenance. However, Solapur district currently lacks an adequate number of skilled professionals in renewable energy technologies, which can slow down project implementation as well as reduce the efficiency of existing systems.
5. **Environmental and Social Issues**
   Generally, renewable energy is known for environment friendly alternative source of energy, but large-scale projects can impact the local biodiversity and societies. The installation of solar and wind power projects may affect agricultural activities along with natural habitat of local flora and fauna. Besides this, peoples can face issues like land use changes as well as displacement by large-scale solar and wind power projects.

**Opportunities for Renewable Energy in Solapur District**

1. **Government Support and Initiative**
   Solapur district can take advantage from various incentives and subsidies available at the national and state levels. Other government agencies are offering schemes to promote the adoption of renewable energy in both rural and urban areas. So, study region can become beneficiary of these schemes to attract investment in renewable energy sector's infrastructure like solar and wind power projects.
2. **Community Participation and Awareness**
   The involvement of local communities in the renewable energy adaptation can accelerate the development of large-scale solar and wind projects in the study region. Community-led renewable energy projects required for the sustainable development of Solapur district.
3. **Technological Advancements and Skill Development**
   In Solapur district, there is an opportunity to become local expertise and technological advancements in the sector of renewable energy. For this, training programs and capacity-building initiatives are needed to develop skilled manpower. Also, advancements in battery storage technologies, smart grid technologies and its integration can address the intermittent nature of renewable energy generation storage solutions.
4. **Utilization of Biomass Potential**
   The agriculture sector is the backbone Solapur district, which can play a crucial role in promoting renewable energy development activities. Huge amount of agricultural waste and animal residues can be used for biomass power generation.
   'Solapur Bioenergy Systems Pvt. Ltd.' is the first of its kind, large-scale municipal solid waste treatment and processing plant in Solapur. This project is the "Road Model" for Maharashtra state. It has been operational since 2013 and capable of generating up to 400 tons per day of waste, which segregated into organic and inorganic fraction. Further, the organic fraction is converted into biogas and high-quality fertilizers.

5. **Decentralization of Renewable Energy Projects**
   The study region is dominated by large rural population, which is still lagging-behind in the adaptation of renewable energy sources. Therefore, it's a big opportunity for Solapur district to decentralize renewable energy solutions like rooftop solar panels, mini-grids, and small-scale wind turbines. This could play crucial role in improving renewable energy access and reducing dependence on polluting and traditional sources of energy.
6. **A Path for Sustainable Development**
   Both large-scale and small-scale renewable energy projects can reduce greenhouse gas emissions and air pollution, which is beneficial for local communities' health and environmental degradation. Moreover, it creates significant employment opportunities in the renewable energy sector and helps economic development of the Solapur district.

**Conclusion:**

Present study discovers that Solapur district has enormous potential for renewable energy sources like solar, wind, and biomass power. But, several challenges exist, such as lack of infrastructure facilities, deficiency of skilled manpower, high initial investment required, and regulatory barriers. However, there are substantial opportunities to overcome these challenges through effective policy implementation, technological advancements, community awareness, utilization of agriculture potential, etc. In short, Solapur district can emerge as a leader in renewable energy sector and commits to sustainable development will not only meet local energy demands but also play a pivotal role in the country's renewable energy transition.

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**Conflicts of interest**
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