



Exploring Solar Energy Utilization for Sustainable Development in Pakistan: Lessons from al-Sīrah al-Ṭayyibah

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ABSTRACT

This study intends to explore solar energy utilization for sustainable development from Sīrah's perspectives. It is essential to assess the solar energy potential of Pakistan, evaluating the environmental factors that may impact its adoption, proposing strategies for its integration and examining both the benefits and challenges associated with subject matter. Pakistan, with its diverse geography and climate, holds significant solar energy potential, making it an ideal candidate for large-scale solar projects. This research aims to provide an understanding of the possibilities and limitations of solar energy utilization in Pakistan. The article's findings shed light on the feasibility of integrating solar energy technologies within the Pakistani context, considering economic, environmental and cultural aspects. It addresses challenges such as financing, technology implementation and public perception, while maximizing benefits like reduced carbon emissions, energy cost savings and increased energy security. In conclusion, this research article aspires to contribute to the discourse on sustainable energy in Pakistan by drawing inspiration from al-Sīrah al-Ṭayyibah. Pakistan can lay the foundation for a cleaner and more sustainable energy future navigating a path toward energy security, community well-being, and environmental preservation, all while drawing inspiration from the ethical foundations of its cultural and religious heritage.

Keywords: *Solar energy, al-Sīrah al-Ṭayyibah, Sustainable development, Pakistan, public perception*

Mention in the table a brief sketch of Second author's Contribution:- (Maximum two Authors allowed only)



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1. Introduction

Pakistan faces a formidable challenge on the path to sustainable development: a growing demand for energy, persistent energy shortages, and the urgent need to address environmental concerns. In this context, the exploration of solar energy utilization emerges as a beacon of hope. Solar energy not only offers a renewable and environmentally friendly alternative but also aligns with the principles and values of *Sirah*, the life and teachings of the Prophet Muhammad (peace be upon him).

The energy landscape in Pakistan has been marked by a perpetual struggle to meet the demands of a rapidly expanding population and industrial sector. Frequent power outages have disrupted daily life, hindered economic growth, and created a sense of frustration among the populace. At the same time, the environmental toll of conventional energy sources, such as fossil fuels, has become increasingly evident, contributing to air pollution and climate change.

Recognizing the need for sustainable solutions, Pakistan has embarked on a journey to harness its abundant solar energy resources. Government policies and initiatives have been put in place to incentivize solar energy adoption, from large-scale solar farms to individual rooftop installations. However, the success of these initiatives relies not only on technological advancements but also on aligning them with the values ingrained in the fabric of Pakistani society. Solar energy is not an ordinary blessing, even Allah Himself swore by it, saying:

﴿وَالشَّمْسُ وَضُحَاهَا﴾¹

(By the sun and its light.)

Moreover, Qur'ān states:

﴿وَجَعَلَ الشَّمْسُ سِرَاجًا﴾²

(And made the sun a burning lamp)

¹ Al-Qur'ān (91:1).

² Al-Qur'ān (71:16).

This paper seeks to explore the potential of solar energy utilization in Pakistan through the unique lens of Prophetic teachings. Al-Sīrah al-Ṭayyībah encompasses the exemplary life of the Prophet Muhammad, who emphasized values such as community welfare, resource conservation, environmental consciousness and social justice. By drawing parallels between solar energy initiatives and these timeless principles, we aim to derive lessons that can guide Pakistan's sustainable development journey.

"Mostly localities in Pakistan lack access to the countrywide grid and in such situation, solar energy can be beneficial for these areas. Pakistan is recognized as having enormous potential for solar energy, and the newly developed maps would provide better insight into the resource base."³

In the following sections, this paper described the solar energy landscape in Pakistan, highlight the principles of Al-Sīrah al-Ṭayyībah, and analyze case studies that exemplify the harmonization of these principles with solar energy projects.

Additionally, it provides recommendations for policymakers, emphasizing the potential for solar energy to not only address energy challenges but also contribute to the broader goals of sustainable development in Pakistan. As we explored the intersection of solar energy and Al-Sīrah al-Ṭayyībah, we hope to inspire a holistic approach to sustainability, one that is rooted in both technological innovation and the timeless values that have guided generations.

2. Solar Energy Landscape in Pakistan

Pakistan is blessed with abundant solar energy potential, making it a prime candidate for harnessing solar power as a sustainable energy source. The country's geographical location, climate and solar radiation levels contribute to its significant solar energy resources.

We have to support promoting solar energy practices and attract local and foreign investors to invest in solar power projects. solar

³ Asif, M., Going Solar. Dawn News, March 20, 2017.

*energy has the potential to solve Pakistan's energy crises in a short time period.*⁴

Here's an overview of Pakistan's solar energy potential:

2.1. Solar Irradiation Levels

Pakistan enjoys an average solar irradiation level of approximately 5-7 kWh per square meter per day, which is among the highest in the world. This abundance of sunlight provides a substantial foundation for solar energy generation.⁵

2.2. Geographical Diversity

Pakistan's diverse geography, ranging from deserts in the south to mountainous regions in the north, offers a variety of environments suitable for solar energy installations. Different regions experience varying levels of solar radiation, allowing for tailored solar projects.

2.3. High Solar Insolation

Several regions in Pakistan, including parts of Sindh and Balochistan, experience over 300 sunny days annually, making them ideal for solar power generation. These areas have consistently high levels of solar insolation, ensuring efficient energy production.⁶

2.4. Reduced Environmental Impact

Solar energy production in Pakistan can significantly reduce the environmental impact associated with fossil fuel-based energy generation. It helps mitigate air pollution, greenhouse gas emissions and the depletion of finite fossil fuel resources.

2.5. Energy Security

Solar energy can enhance energy security in Pakistan by reducing dependence on imported fossil fuels. This can lead to a more stable and

⁴ Irfan, Muhammad, Zhen-Yu Zhao, Munir Ahmad, and Marie Claire Mukeshimana. 2019. "Solar Energy Development in Pakistan: Barriers and Policy Recommendations" *Sustainability* 11, no. 4: 1206. <https://doi.org/10.3390/su11041206>

⁵ Power Policy, Part.1, Alternative and Renewable Energy Policy 2019 by Alternative Energy Development Board (Islamabad, Govt. of Pakistan, 2020) p.3

⁶ <https://nwfc.pmd.gov.pk/new/monthly-reports.php>

retrieved on Feb. 29, 2023

self-reliant energy supply, reducing the nation's exposure to global energy market fluctuations.

2.6. Rural Electrification

Solar energy can be a transformative force in rural areas where access to the national power grid is limited. Off-grid and micro-grid solar systems can provide clean and reliable electricity to remote communities, improving living standards and economic opportunities.

2.7. Job Creation

The growth of the solar energy sector can create jobs in manufacturing, installation, maintenance and research and development. This can contribute to poverty reduction and economic development.

2.8. Sustainability Goals

Pakistan's commitment to sustainability and the reduction of greenhouse gas emissions, as outlined in its climate change policy⁷, aligns with the expansion of renewable energy sources, including solar power. It is notable statement that:

*Geographically, Pakistan is actual placed to use solar energy as a key source of electricity in the country. In order to harness and realize maximum solar energy potential, government needs a more holistic approach to improve the share of solar energy in the overall energy mix of the country.*⁸

Despite its significant solar energy potential, Pakistan faces several challenges in fully realizing this potential. These challenges include financing constraints, lack of infrastructure, policy inconsistencies and public awareness. However, the government's initiatives and international collaborations, along with the alignment of solar energy projects with the principles of sustainability found in Al-Sīrah al-Ṭayyibah, provide hope for a brighter and more sustainable energy future in Pakistan.

⁷ <https://www.nrsp.org.pk/gcf/docs/National-Climate-Change-Policy-of-Pakistan.pdf> retrieved on Feb. 29, 2023.

⁸ Bakhtiar, F.; Ahmed, A. A Review of Solar Energy in Pakistan: Current Status and Future Prospects. *Science* 2017, 36, 189–195.

3. Government Initiatives and Practical Work

Pakistan has initiated the implementation of several successful solar energy projects that demonstrate the country's commitment to harnessing its solar energy potential and addressing its energy challenges. These projects showcase various scales and applications of solar energy technology. Here are some notable examples:

3.1. Quaid-e-Azam Solar Power Plant (QASP)

Located in Bahawalpur, Punjab, the Quaid-e-Azam Solar Power Plant is one of the largest solar power plants in Pakistan. With an installed capacity of 1000 MW, QASP contributes significantly to the national grid, reducing Pakistan's reliance on fossil fuels. The project is part of the government's efforts to promote renewable energy and reduce greenhouse gas emissions.

3.2. Sarai Gambila Solar Micro-grid

Situated in the KPK province, the Sarai Gambila Solar Micro-grid project provides clean and reliable electricity to a remote, off-grid village. This project demonstrates the potential of solar micro-grids to improve energy access and living conditions in isolated areas.

3.3. Shamsabad Solar Power Plant, Attock

The Shamsabad Solar Power Plant, situated in Attock, Punjab, has a capacity of 20 MW. It provides clean and reliable electricity to the national grid. The project showcases the potential for private sector participation in Pakistan's solar energy sector.

3.4 UET Peshawar Solar Project

UET Peshawar implemented a solar energy project on its campus to reduce its reliance on Conventional sources of energy. The project includes a 100 KW solar PV system that generates clean electricity for the university. This initiative not only reduces the university's carbon footprint but also serves as an educational tool for students.

3.4. Punjab Solar Home Solution Program

The Punjab government initiated a program to provide solar home solutions to rural households without access to the national grid.

Under this program, solar panels and battery systems are installed in homes, improving energy access and quality of life.

3.5. Solar-Powered Mosque

The "Green Mosque" in Faisalabad, Punjab, is Pakistan's first mosque to be entirely powered by solar energy. Solar panels on the mosque's roof generate electricity for lighting, fans, and other needs, setting an example for sustainable places of worship.

3.6. Solar Streetlights

The city of Peshawar has implemented solar-powered streetlights, reducing electricity consumption and contributing to improved urban lighting and safety. Solar streetlights offer a sustainable solution for urban areas and reduce the strain on the national grid.

3.7. Solar-Powered Tubewells

Solar energy has been harnessed for powering agricultural tubewells in rural areas, where water for irrigation is essential. These solar-powered tubewells reduce reliance on fossil fuel-powered pumps and enhance agricultural sustainability.

Solar energy initiatives taken by Government of Pakistan have a transformative impact on communities and the environment in Pakistan. They enhance community welfare, reduce resource consumption, promote environmental sustainability, ensure equitable access to clean energy and foster environmental awareness.

4. Challenges and Barriers in Solar Energy Adoption

Despite the significant solar energy potential in Pakistan, there are several challenges and barriers that hinder its widespread adoption and growth in the country. These challenges encompass technical, financial, regulatory, and social aspects. Notably

"It is encouraging to see that the courts are ready to study the impact of such state failures in responding to basic energy crises"

on the common man and taking up such matters as a national emergency.”⁹

Here are some of the key challenges and barriers in solar energy adoption in Pakistan:

4.1. High Initial Costs

The upfront cost of purchasing and installing solar panels and associated equipment can be prohibitive for many individuals and businesses. This financial barrier discourages potential adopters from investing in solar energy systems.

4.2 Limited Access to Financing

Access to affordable financing options for solar installations is limited. While some financing schemes exist, they may not be widely accessible, especially in rural areas.

4.3. Intermittent Energy Production

Solar energy production is intermittent and depends on weather conditions and daylight hours. Without effective energy storage solutions, this intermittency can lead to inconsistent power supply, which is a concern for businesses and residential consumers.

4.4. Grid Integration Challenges

Integrating solar power into the existing electricity grid can be technically complex and costly. The grid infrastructure may need upgrades to accommodate distributed solar generation.

4.5. Policy and Regulatory Hurdles

Inconsistent policies, complex regulations, and bureaucratic red tape can create uncertainty for investors and project developers. Streamlining the regulatory framework is crucial to attract investments in solar energy projects.

4.6. Lack of Awareness

Many potential consumers are unaware of the benefits and incentives available for solar energy adoption. Raising awareness about

⁹ Hameed, N. Solutions for Energy Crises in Pakistan. Islamabad Policy Research Institute (IPRI), 2015; Volume II. Available online: <http://www.ipripak.org/wp-content/uploads/2016/01/sfecpii.pdf> (accessed on 10 January 2024).

solar technology, its cost-effectiveness, and government incentives is essential to overcoming this barrier.

4.7. Quality Assurance

Ensuring the quality and reliability of solar panels and components is vital. Substandard or counterfeit products can lead to system failures and undermine trust in solar technology.

4.8. Maintenance and Technical Expertise

Adequate maintenance and technical expertise are required to keep solar installations operating efficiently. The lack of trained technicians and maintenance services can be a barrier, especially in rural areas.

4.9. Land Acquisition

Large-scale solar projects often require significant land, and acquiring suitable land can be challenging. Land disputes and land use conflicts can delay project development.

4.10. Transmission and Distribution Losses

Pakistan's electricity transmission and distribution system experiences losses, and these losses can affect the efficiency and viability of solar energy projects. Moreover, unauthorized connections and energy theft are prevalent in some areas, affecting the financial viability of solar projects and the overall energy distribution system.

4.11. Political and Economic Stability

Political instability and economic uncertainties can deter investments in long-term solar projects. Investors seek a stable and predictable environment for their investments.

4.12. Resource Constraints

Government agencies responsible for promoting renewable energy may lack the necessary resources, expertise, and capacity to effectively support solar energy initiatives.

4.13. Cultural and Social Factors

Cultural norms and social perceptions about renewable energy and its adoption can influence the willingness of individuals and communities to embrace solar technology.

Addressing these challenges and barriers requires a coordinated effort from the government, private sector and civil society. Policymakers need to create a conducive environment for investment, while public awareness campaigns can help educate consumers about the benefits of solar energy. Additionally, innovations in financing models, technological solutions for energy storage and improvements in grid infrastructure can contribute to overcoming these obstacles and realizing Pakistan's solar energy potential.

5. Lessons from Al-Sīrah Ṭayyibah

Al-Sīrah al-Ṭayyibah is a source of inspiration for each and every walk of life and offer valuable lessons that can guide individuals and communities towards a more sustainable and responsible way of life. The principles and teachings found in Al-Sīrah al-Ṭayyibah, the life and actions of the Prophet Muhammad (peace be upon him), provides a rich ethical and moral framework that aligns seamlessly with the principles of sustainability and environmental stewardship. By following the example set by the Prophet Muhammad and adhering to these principles, individuals and communities can work towards a more sustainable and environmentally conscious way of life, benefiting both present and future generations. Here are some key lessons from Al-Sīrah Al-Ṭayyibah relevant to sustainability and environmental stewardship:

5.1. Resource Conservation and Moderation

The Prophet Muhammad encouraged moderation and the avoidance of excess in consumption, emphasizing the responsible use of resources. It was narrated on the authority of Abdullah bin Amr that the Messenger of Allah, may Allah bless him and grant him peace, passed by Sa'd while he was performing ablution, and he said:

((ما هذا السرف؟ فقال: افي الوضوء إسراف؟ قال: "نعم وإن كنت على نهر جار-))¹⁰

"What kind of extravagance is this?" He said. : Is there extravagance in ablution? He (peace and blessings of

¹⁰ Muhammad bin Yazīd Ibn Majah, *Al-Sunan*, Book: At-Tahārah (Riyadh: Dār us Salām li Nashr wa al-Touzī, 2009), Hadith: 455.

Allah be upon him) said: "Yes, even if you are sitting on the bank of a flowing canal."

5.2. Protection of Natural Resources

The Prophet Muhammad prohibited the destruction of natural resources, including the wanton cutting down of trees and the pollution of water sources.¹¹

5.3. Humility and Gratitude Toward Nature

The Prophet Muhammad taught gratitude for the blessings of the natural world, fostering a sense of responsibility for caring for the Earth. Abdullah bin Umar narrated :

((لَعَنَ النَّبِيُّ صَلَّى اللَّهُ عَلَيْهِ وَآلِهِ وَسَلَّمَ مَنْ مَثَّلَ بِالْحَيَوَانَ-))¹²

"The Prophet (PBUH) has cursed the person who imitates animals. "

5.4. Ethical Treatment of Animals

The Prophet emphasized humane treatment of animals and forbade cruelty to them, promoting compassion toward all living creatures. So many examples are there in life of Muhammad (PBUH). Prophet Muhammad (PBUH) said:

((وَالشَّاةُ إِنْ رَجِمَتْهَا، رَجَمَكَ اللَّهُ))¹³..

"If you have mercy on a goat, Allah will have mercy on you."

5.5. Environmental Accountability

The Prophet Muhammad taught that humans are accountable for their actions, including their impact on the environment, emphasizing ethical responsibility. Abu Saeed al-Khudri (may Allah be pleased with him) says that the Messenger of Allah (peace and blessings of Allah be upon him) stood up to deliver a sermon, and in that sermon he also said:

((إِنَّ الدُّنْيَا خَضِرَةٌ حُلْوَةٌ، وَإِنَّ اللَّهَ مُسْتَخْلَفُكُمْ فِيهَا، فَنَاظِرٌ كَيْفَ تَعْمَلُونَ، الْا

فَاتَّقُوا الدُّنْيَا، وَاتَّقُوا النَّسَاءَ))¹⁴

¹¹ Abu Bakr Ahmad ibn Husayn al-Bayhaqi, *Al-Sunan Al-Kubrā*, (Beirut, Dār al-Kutub al-Ilmiyah, 2003) Hadith: 11571.

¹² Bukhari, *Al-Jāme al-Sahīh*, Book: Sacrifices & Hunting, Hadith: 5196.

¹³ Ahmad bin Hanbal, *Al-Musnad*, (Lahore, Maktabah Rahmaniyyah) Hadith: 20363

¹⁴ Ibn Majah, *Al-Sunan*, Book: Al-Fitn, Hadith 3959.

"The world is green and sweet, Allah is going to make you a caliph in it, so He will see." How do you act? Listen! Protect yourself from the world, and from women too."

5.6. Non-Excessiveness and Moderation

Al-Sīrah al-Ṭayyibah encourages a balanced and moderate way of life, discouraging extravagance and overconsumption.

On the authority of Sayyida Aisha (may Allah be pleased with her) that the Messenger of Allah, peace and blessings be upon him, said:

((سَدِّدُوا، وَقَارِبُوا وَاعْلَمُوا أَنَّ لَنْ يُدْخَلَ أَحَدَكُمْ عَمَلُهُ الْجَنَّةَ، وَأَنَّ أَحَبَّ الْأَعْمَالِ إِلَى اللَّهِ أَدْوَمُهَا وَإِنْ قَلَّ-))¹⁵

(Take a middle course and do not fly high and keep on doing good deeds. There is something that should be done forever, even if it is little.)

5.7. Stewardship of the Earth

The Prophet Muhammad is described as a "steward of the Earth" in Islamic tradition, highlighting the role of humans as caretakers of the environment.¹⁶

5.8. Equitable Distribution of Resources

The principles of social justice and equitable distribution of resources found in Al-Sīrah al-Ṭayyibah emphasize fairness and addressing disparities in access to resources.¹⁷

These lessons from Al-Sīrah al-Ṭayyibah provide a profound ethical and moral foundation for individuals and communities to practice responsible living, sustainability and environmental stewardship while also promoting social justice and the well-being of all.

6. Conclusion

In conclusion, the exploration of solar energy utilization in Pakistan, guided by the principles and teachings of Al-Sīrah , reveals a

¹⁵ Muḥammad bin Ismā'īl Al-Bukhārī, *Ṣaḥīḥ Bukhārī*, trans Dr. Muḥammad Muhsin Khan. Saudi Arabia: Maktabah Dār al-Salām 1997.

Visit Book: Al-Riqā'q, Ḥadīth: 6464. <https://sunnah.com/bukhari:6464>

¹⁶ Ibn Majah, *Al-Sunan*, Book 13, Hadith 231

¹⁷ Al-Bukhari, *Ṣaḥīḥ Bukhārī*, trans Dr. Muḥammad Muhsin Khan. Book 24, Hadith 516

promising path towards sustainable development. Pakistan, a nation grappling with energy challenges and environmental concerns, stands to benefit significantly from harnessing its abundant solar energy potential. The lessons drawn from *Al-Sīrah* offer valuable insights for shaping a more responsible and ethical approach to solar energy adoption. Throughout this exploration, we have highlighted several key points; solar energy landscape in Pakistan, government initiatives and practical work to promote solar energy Challenges and Barriers in Solar Energy Adoption, Lessons from *Al-Sīrah* . After concluding the article, several recommendations and policy implications are placed for consideration.

As Pakistan continues its journey toward a more sustainable and environmentally conscious future, it is essential that the nation leverages its solar energy potential in harmony with the timeless principles espoused in *Al-Sīrah al-Ṭayyībah*. This synergy between renewable energy and ethical values holds the promise of not only powering Pakistan's development but also enriching the lives of its people while preserving the beauty and vitality of the environment for generations to come.

7. Recommendations and Policy Implications

Recommendations and policy implications may play a critical role in furthering the adoption and success of solar energy initiatives in Pakistan, especially when aligned with the principles of *Al-Sīrah al-Ṭayyībah*. Here are several recommendations and policy implications to consider and Government of Pakistan should:

- 7.1. Ensure stable and consistent policies that support solar energy adoption over the long term. Frequent policy changes can deter investments.
- 7.2. Continue and expand *incentive mechanisms* such as feed-in tariffs, tax exemptions and subsidies to make solar installations more affordable and attractive to individuals, businesses and investors.
- 7.3. Expand net metering programs to allow more residential and commercial users to connect solar installations to the grid, allowing them to benefit from surplus electricity generation.

7.4. Promote community engagement and awareness about the benefits of solar energy through religious institutions and local leaders, emphasizing the alignment with ethical and religious values.

7.5. Encourage the *local manufacturing* of solar panels and components, which can stimulate economic growth and *job creation* while reducing import costs.

7.6. Invest in research and development (R&D) for solar technology advancements, energy storage solutions and grid integration to make solar energy systems more efficient and reliable.

7.7. Strengthen and enforce regulations requiring comprehensive Environmental Impact Assessment EIAs for solar energy projects to ensure they are environmentally responsible and do not harm local ecosystems.

7.8. Develop *training* programs for technicians and engineers in solar energy system design, installation and maintenance to build a skilled workforce that can support the growth of the solar industry.

7.9. Establish and enforce *quality assurance standards* for solar panels and components to ensure that consumers receive reliable and high-quality products.

7.10. Foster collaboration between the public and private sectors, research institutions and civil society organizations to drive innovation and create an ecosystem that supports solar energy development. Moreover, promote community ownership models for solar projects, allowing local communities to have a stake in renewable energy generation and ensuring equitable distribution of benefits.

7.11. Consider offering tax incentives or subsidies for religious institutions, such as mosques and madrasas, to install solar panels and demonstrate the alignment of solar energy with ethical and religious values.

7.12. Develop green financing options and microloans specifically designed for solar energy projects, making it easier for individuals and communities to invest in solar installations.

7.13. Invest in grid modernization to accommodate increased solar energy integration and reduce grid instability issues, ensuring a smooth transition to renewable energy sources.

7.14. Implement carbon pricing mechanisms to reflect the true environmental cost of fossil fuels and create financial incentives for transitioning to cleaner energy sources like solar.

7.15. Establish a comprehensive monitoring and evaluation framework to assess the social, economic and environmental impacts of solar energy projects and policy implementations.

By implementing these recommendations and policy implications, Pakistan can accelerate its transition to a sustainable energy future while aligning with the principles of Al-Sīrah al-Ṭayyibah. This approach not only addresses energy challenges but also promotes community welfare, ethical resource use and environmental stewardship, reflecting the values of responsibility and sustainability.

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