

Renewable Energy Utilization for Future Sustainability: An Approach to Roof-Mounted Photovoltaic Array Systems and Domestic Rooftop Rainwater Harvesting System Implementation in a Himachal Pradesh, India

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Abstract : This scientific paper presents a thorough investigation into the integration of roof-mounted photovoltaic (PV) array systems and home rooftop rainwater collection systems in a remote community in Himachal Pradesh, India, with the goal of optimum utilization of natural resources for attaining sustainable living conditions by 2030. The study looks into the technical feasibility, environmental benefits, and socioeconomic impacts of this integrated method, emphasizing its ability to handle energy and water concerns in remote rural regions. This comprehensive method not only provides a sustainable source of electricity but also ensures a steady supply of clean water, promoting resilience and improving the quality of life for the village's residents. This research highlights the potential of such integrated systems in supporting sustainable conditions in rural areas through a combination of technical feasibility studies, economic analysis, and community interaction. There would be 20690 villages and 1.48 million homes (23.79% annual growth rate) in Himachal Pradesh if all residential buildings in the state had roof-mounted photovoltaic arrays to capture solar energy for power generation. The energy produced is utilized to power homes, lessening dependency on traditional fossil fuels. The same residential buildings housed domestic rooftop rainwater collection systems. Rainwater runoff from rooftops is collected and stored in tanks for use in a number of residential purposes, such as drinking, cooking, and irrigation. The gathered rainfall enhances the region's limited groundwater resources, easing the strain on local wells and aquifers. Although Himachal Pradesh of India is a Power state, the PV arrays have reduced the reliance of village on grid power and diesel generators by providing a steady source of electricity. Rooftop rainwater gathering has not only increased residential water supply but it has also lessened the burden on local groundwater resources. This helps to replenish groundwater and offers a more sustainable water supply for the town. The neighbourhood has saved money by utilizing renewable energy and rainwater gathering. Furthermore, lower fossil fuel consumption reduces greenhouse gas emissions, which helps to mitigate the effects of climate change. The integrated strategy of installing grid connected rooftop photovoltaic arrays and home rooftop rainwater collecting systems in Himachal Pradesh rural community demonstrates a feasible model for sustainable development. According to "Swaran Jayanti Energy Policy of Himachal Pradesh", Himachal Pradesh is planned 10 GW from rooftop mode from Solar Power. Government of India provides 40% subsidy on solar panel of 1-3 kw and subsidy of Rs 6,000 per kw per year to encourage domestic consumers of Himachal Pradesh. This effort solves energy and water concerns, improves economic well-being, and helps to conserve the environment. Such integrated systems can serve as a model for sustainable development in rural areas not only in Himachal Pradesh, but also in other parts of the world where resource scarcity is a major concern. Long-term performance and scalability of such integrated systems should be the focus of future study. Efforts should also be made to duplicate this approach in other rural areas and examine its socioeconomic and environmental implications over time.

Keywords : renewable energy, photovoltaic arrays, rainwater harvesting, sustainability, rural development, Himachal Pradesh, India

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