

# Empowering Women-led Chitarpur Sewing Cluster with Solar PV in Jharkhand, India

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## Abstract

The increasing adoption of renewable energy, particularly solar photovoltaic (PV) systems, has emerged as a pivotal solution for addressing energy access challenges in rural areas. This paper presents an impact assessment of a Solar PV installation project in the Chitarpur sewing cluster, Ramgarh, Jharkhand, implemented by The Energy and Resources Institute (TERI). The project aimed to improve energy access for 150 micro and household-based sewing enterprises, addressing challenges in productivity and reliability of power supply. Using a mixed-methods approach, the study gathered data through surveys, interviews, and stakeholder consultations across the villages of Laarikala, Dulmi, and Sosokala. The findings highlight significant socio-economic and environmental benefits. Beneficiaries experienced substantial income growth, with increases ranging from ₹1,000 to ₹5,000, and improved working hours due to reliable electricity. Women, as primary earners in these households, were empowered through enhanced productivity, financial independence, and improved living conditions. Furthermore, the project reduced reliance on fossil fuels and kerosene, contributing to better air quality and environmental sustainability. The study underscores the transformative potential of renewable energy in rural livelihoods.

**Keywords:** Renewable Energy, Solar PV, Impact assessment, Energy Access, Socio-economic, Rural development

## INTRODUCTION

Global reliance on fossil fuels, including coal, oil, and gas, remains the dominant contributor to climate change, responsible for over 75% of global greenhouse gas emissions and nearly 90% of all carbon dioxide emissions. To avert the worst impacts of climate change, it is essential to halve emissions by 2030 and reach net-zero by 2050, according to the United Nations [6]. In recent years, renewable energy has emerged as a key solution. By the end of 2020, renewables accounted for 29% of global electricity

generation, with more than 256 GW of new capacity—primarily wind and solar PV—added in that year alone, representing a 10% increase in total renewable power capacity by 2023 [1], solar PV alone made up three-quarters of the global renewable capacity additions, and future growth is expected to accelerate as solar and wind power become increasingly cost-competitive, backed by supportive policies [4].

In this global shift, India's announcement that it aims to reach net-zero emissions by 2070 and meet 50% of its electricity requirements from renewable energy by 2030 marks a hugely significant moment in the fight against climate change [3]. By pursuing this ambitious agenda, India is pioneering a model of economic development that moves away from carbon-intensive pathways, providing a potential blueprint for other developing nations. India has set a target to reduce the carbon intensity of its economy by 45% by the end of the decade, achieve 500 GW of renewable energy capacity by 2030, and ultimately reach net-zero carbon emissions by 2070 [2]. These commitments not only signal India's leadership on the global climate stage but also demonstrate how developing economies can drive the transition to a low-carbon future [7].

Despite these national efforts, around 300 million people in India, mostly in rural areas, still lack access to electricity, relying on kerosene for lighting. This creates severe socio-economic, health, and environmental impacts, with kerosene contributing to poor indoor air quality and associated health issues. Decentralized, off-grid solar PV solutions offer a promising alternative for these energy-poor communities, providing cleaner, safer, and more sustainable energy access [5].

## BACKGROUND

The Energy and Resources Institute (TERI) conducted an impact assessment study on a project aimed at scaling up solar photovoltaic (PV) systems in the Chitarpur sewing cluster of Ramgarh, Jharkhand. This initiative was designed to address critical energy access challenges faced by micro and household-based enterprises in rural areas, thereby reducing their reliance on conventional fuels. These enterprises, particularly sewing units, are vital to the local economy but are struggling to compete with automated garment manufacturing units in urban areas due to limited access to affordable and reliable energy.

In 2020-21, the project initiated by TERI sought to design and demonstrate a feasible solar hybrid solution within the Chitarpur sewing cluster. The

technology demonstration in one of sewing enterprise households was a success which received well acceptance followed by increased demand from local sewing enterprises for the replication of solar units across their operations. Around 50 enterprises expressed their interest for adopting such solar systems, committing to contribute 50% of the installation costs by



Figure 1: Stakeholders Engaged

themselves, and sought additional gap funding from TERI. The same was taken up and the pilot project was taken up by mobilizing CSR fund from Central Coalfields Limited (CCL). The impact was quite visible and well appreciated by various stakeholders. Recognizing this significant impact this could have on the local economy, TERI pursued with Central Coalfields Limited (CCL), Ranchi, to secure the necessary funding to scale the initiative to 150 sewing enterprises, including provisions for 10% of the participants to come from the poorest households in year 2023-24. The communities were mobilized with the help of the not-for-profit organization AGRAGATI, which organized frequent capacity-building programmes and meetings with the beneficiaries as they are familiar with the locale and beneficiaries. These sewing enterprises face numerous challenges that threaten their long-term sustainability. Limited awareness, lack of investment capacity, and barriers to accessing low-cost finance often prevent them from adopting clean, energy-efficient technologies. As a result, these enterprises suffer from reduced productivity and competitiveness, exacerbated by unreliable

power supply from the local grid, which forces many to rely on manual stitching operations.

## PROJECT IMPLEMENTATION MODEL

### Scaling up Solar PV Systems

- The project targets the installation of Solar PV hybrid systems in 150 sewing enterprise households, with a focus on ensuring that at least 10% of the beneficiaries are from the most economically disadvantaged households in the Chitarpur cluster.

### Awareness, Training, and Capacity Building

- TERI conducted awareness, training, and capacity-building programs to educate the enterprises about the day-to-day operations of the solar systems. Additionally, 2 to 3 local rural youths were trained for post-installation maintenance to ensure sustainability.

### Monitoring and Reporting

- The project includes ongoing monitoring, reporting, and sharing of experiences to ensure transparency, track progress, and facilitate knowledge exchange among stakeholders.

### Enhancing Branding and Visibility

- The initiative also aims to enhance the branding and visibility of CCL, Ranchi, in the region, positioning the organization as a key supporter of sustainable rural development.

Figure 2: Key Objectives of the Project

## OBJECTIVE OF THE IMPACT ASSESSMENT

The impact assessment aims to provide a comprehensive evaluation of the socio-economic, environmental, and technological impacts of installing Solar PV panels in the Chitarpur district. The study's core objectives are to assess the effectiveness of these solar installations in addressing energy needs, improving the quality of life for the local population, and advancing sustainable development goals. Additionally, the assessment seeks to understand the perceptions, experiences, and behavioral changes among the beneficiaries, with the goal of identifying potential challenges and areas for improvement in the adoption and utilization of renewable energy solutions. The impact assessment study has been conducted in the villages of Laarikala, Dulmi, and Sosokala of the Ramgarh district of Jharkhand with over 18 beneficiaries.

The Solar PV systems installed in these rural areas also provide significant environmental benefits, enhancing the sustainability of energy use. These systems are hybrid machines that operate on solar energy while simultaneously charging a battery (Figure 3). This dual functionality ensures that households have access to electricity during the evening or in situations

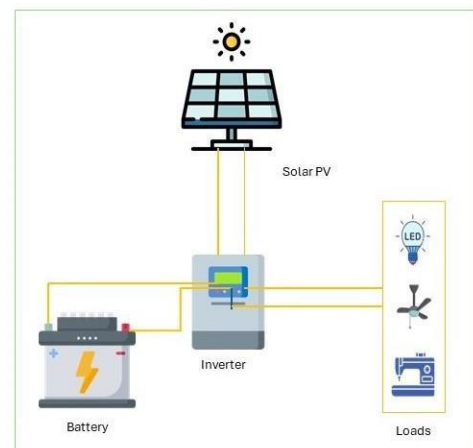


Figure 3: Solar PV for powering sewing machine

where grid power is unavailable. When solar

energy is not sufficient or during periods of no sunlight, the battery provides backup power for 4 to 5 hours, ensuring a reliable energy supply. This technological adoption not only supports their immediate needs but also contributes to long-term environmental benefits by decreasing reliance on fossil fuels and minimizing carbon emissions.

The selection of sewing enterprises for the project followed specific criteria, ensuring that the neediest population received the benefits. For general category enterprises, criteria included owning a sewing machine and motor, daily engagement in the stitching business, and the ability to contribute ₹19,000 towards installation costs. For economically weaker households, criteria focused on woman-headed households or those with women as primary earners, households recognized as below poverty line (BPL), or those affected by disability or chronic illness, with a reduced contribution of ₹8,000. This model aimed to ensure that even the most financially vulnerable households could participate, empowering them to improve their livelihoods without excessive financial strain. By adopting a participatory approach and securing initial investments from the enterprises, the project fostered a sense of ownership among the beneficiaries, ensuring the long-term sustainability of the intervention.

## **AWARENESS AND SENSITIZATION EFFORTS**

TERI organized a series of awareness and sensitization camps across the Chitarpur cluster, where the benefits of the solar energy project were communicated to local enterprises. The camps highlighted the successes of similar initiatives in the region, addressing financial concerns and providing solutions through direct engagement with TERI professionals and local community mobilizers. The capacity-building efforts for the Solar PV installation project encompass a range of practical training and support to ensure effective system maintenance and operation. Beneficiaries are instructed on using dry cloths to clean the panels and

maintaining them with a wooden stand to optimize solar exposure and protection. Additionally, they receive guidance on the proper methods for switching the system on and off. To support ongoing maintenance, beneficiaries are provided with a customer care and support number, offering a reliable point of contact for any issues or queries.

## **ENHANCED PRODUCTIVITY AND INCOME**

The data collected from the beneficiaries of the Solar PV installation project in the Chitarpur sewing cluster shows substantial improvements in both income levels and productivity. On average, beneficiaries experienced an income increase ranging from ₹1,000 to ₹5,000, with the majority seeing significant financial gains. This uplift in income highlights the positive impact that reliable access to solar energy has had on their ability to expand their businesses and generate higher earnings. The increase in income is particularly notable among those who were previously constrained by unreliable power supplies, as the new energy source has allowed them to scale up their operations. Some beneficiaries have experienced more moderate increases in income, ranging from ₹150 to ₹1,200. The beneficiaries in this category belong to the low-income group, and the impact of the Solar PV installation represents a very significant shift in their income and overall quality of life. For households that previously had no access to reliable light or electricity, this intervention marks a transformative change in their livelihoods. The access to solar energy has provided these families with a stable and sustainable power source, enabling them to increase their productivity and generate higher incomes. The increase in income, coupled with the ability to work more hours, has not only enhanced the financial stability of these households but also provided them with greater economic security. The availability of reliable electricity has reduced their dependence on manual labor and allowed them to invest more time and effort into their businesses.

In terms of productivity, the intervention has led to a marked increase in work hours for many of

the beneficiaries. Prior to the installation of the Solar PV systems, most enterprises reported working between 4 to 6 hours daily, limited by inconsistent power supply and manual labor. After the installation, these enterprises now report working between 8 to 10 hours daily, with some even extending their workday to 10 to 12 hours. This increase in working hours reflects a significant boost in productivity, as the solar energy has enabled them to work more efficiently and consistently without interruptions.

Furthermore, the data suggests that the Solar PV systems have helped reduce idle time and improved the overall work-life balance for many entrepreneurs. With reliable energy access, beneficiaries can now maintain a more consistent work schedule, which not only enhances productivity but also reduces the stress and uncertainty associated with power outages. Overall, the intervention has led to substantial improvements in both the economic and operational aspects of these rural enterprises, positioning them for greater sustainability and competitiveness in the long run.

## **SOCIO-ECONOMIC AND LIVELIHOOD TRANSFORMATION**

The installation of Solar PV systems in the Chitarpur sewing cluster has been a transformative intervention, not only increasing the incomes of low-income households but also significantly improving various aspects of their daily lives. This initiative has brought about a profound change in how these families live and work, creating ripple effects that have enhanced their overall well-being, empowerment, and prospects for the future.

Prior to this project, these households had little to no access to electricity, which constrained their productivity and limited their quality of life. Now, with Solar PV systems providing power, households can operate one sewing machine, a fan, and a bulb simultaneously. This has created a safer, more comfortable working environment, allowing women, who are primarily engaged in sewing, to extend their working hours and increase their output. Where previously they

could only work a few hours during daylight, they can now work into the evening, doubling their productivity and income. This newfound ability to work longer hours has empowered them economically, giving them financial independence and greater decision-making power within their families.

The benefits of Solar PV go beyond increased work hours and income. Children, who earlier could only study during daylight, now have the opportunity to study after dark. The electric lighting allows them to devote more time to their education, which has already led to improved academic performance and better career prospects. Women, who used to struggle with basic household tasks like chopping vegetables in dim light, can now perform these tasks safely and efficiently. This small yet significant change has reduced the risk of accidents, such as cutting their fingers, which were common before the installation of electric lights. Additionally, the presence of a fan in their workspaces has brought much-needed relief from the scorching heat, improving the comfort of their living and working conditions. The ability to see clearly with electric bulbs has also alleviated eye strain, which used to be a major issue for women sewing in poorly lit conditions. With motor-operated sewing machines, they no longer have to endure the physical strain of manual sewing. The reduction in stress on their legs, backs, and hands has led to better physical and mental health, enabling them to work more efficiently and with greater ease. This transformation has also allowed women to take on more orders and complete them on time, making them reliable partners in the supply chain. As a result, their reputations as dependable workers have grown, leading to increased demand for their services. The ability to experiment with new designs and stay updated with the latest trends in sewing has further enhanced their skills, positioning them for future growth and expansion.

The impact of Solar PV extends to the social and cultural dimensions of their lives as well. With access to electricity, women can now cook under proper lighting, inspiring them to explore new dishes and prepare more nutritious meals for their families. They can also charge their mobile

phones, ensuring they stay connected and informed. The presence of electric lighting has also improved their ability to perform religious rituals with greater happiness and contentment. Additionally, the ability to host relatives in a more comfortable environment has strengthened social bonds and rejuvenated family life. Moreover, the enhanced lighting has directly contributed to improved safety, especially for women. In rural areas, reliable lighting is crucial for security, and the installation of Solar PV has provided these households with a greater sense of safety and well-being. The Solar PV installation has catalyzed a comprehensive transformation in the lives of these low-income households. From increased incomes and improved productivity to better education for children and enhanced safety, this intervention has touched every aspect of their lives. The empowerment that comes with financial independence and improved living conditions has given these women and their families a new sense of hope and possibility for the future. This project is a testament to the transformative power of clean and reliable energy, especially for vulnerable populations, and its far-reaching impact on social and policy development in rural areas.

The success of the Solar PV installation in the Chitarpur sewing cluster has not only improved the current socio-economic conditions of the beneficiaries but has also sparked aspirations for future growth. Beneficiaries have expressed satisfaction with the intervention, noting its positive impact on their lives. Encouraged by these results, they are now considering diversifying their income sources beyond sewing. They see the potential of using the Solar PV systems for various other entrepreneurial activities, such as setting up digital studios, offering printer services, and exploring other sectors.

## **ROOT CAUSES OF ELECTRICITY FAILURE IN RURAL AREAS**

Electrification in rural areas has been a persistent challenge, with many villages facing unreliable electricity supply. In Sosokala, data collection and stakeholder interactions revealed that the root cause of electricity failure is the widespread use

of electric stoves. During peak usage hours, particularly in the morning and at night, the stoves place a heavy load on the electrical system, causing frequent supply disruptions. The absence of feasible LPG supply in these villages forces residents to rely on electric stoves as a time-saving and resource-efficient alternative, despite the strain it places on the grid. With LPG transportation costs from cities being prohibitively high, villagers often resort to traditional chulhas, which have adverse health effects due to indoor air pollution. The electric stove, while a more convenient option, exacerbates the electricity supply issues, creating a vicious cycle of energy insecurity.

In contrast, the village of Laari faces an even more dire situation, with electricity supply being virtually non-existent. The electrical infrastructure is severely lacking, with poorly maintained poles and inadequate connectivity to city grids and markets. Homes are scattered and distant from each other, making it challenging to ensure consistent power distribution. For many households in Laari, the only reliable source of light comes from Solar PV systems. Economic conditions are so dire that even a modest increase in expenses, such as 10 rupees, can be a significant burden for these families. The low-lit rooms strain residents' eyes, further emphasizing the critical need for livelihood enhancement interventions. In the villages of Laari, sewing remains the primary occupation for many households. Here, even a modest increase in income, such as 100 rupees, holds significant value for these families. The lack of electricity leaves rooms dim and unlit, making daily tasks difficult and reducing productivity. However, the introduction of Solar PV systems has become a beacon of hope for these sewing clusters. The solar-powered rooms not only illuminate their homes but also provide the necessary energy to keep their sewing machines running, allowing them to sustain their livelihoods.

In both Sosokala and Laari, poor weather conditions exacerbate the electricity problems. Crooked and damaged poles pose additional risks, including potential damage to standing crops, fires, and threats to the safety of both livestock and residents. These villages illustrate

the multifaceted nature of energy poverty in rural areas, where inadequate infrastructure, economic constraints, and environmental factors converge to create a cycle of energy deprivation. The challenges faced by these communities underscore the urgent need for targeted interventions that not only provide immediate relief but also address the root causes of electricity failure to ensure long-term, sustainable development.

### **FINANCIAL AWARENESS AND LANDSCAPE:**

To ensure the sustainability and future readiness of the Solar PV project, financial literacy has been a key component of the initiative. The project, which began with pooled support and contributions from beneficiaries, underscores the need for robust financial planning and understanding. To address this, financial literacy programs were organized involving key stakeholders, including Self-Help Group (SHG) heads and panchayat leaders. During community interactions, these stakeholders shared valuable insights on financial management, including case studies of successful loan applications, procedural guidance, and an overview of available interest rate options, including as low as 1%.

The SHG head demonstrated how women's empowerment through financial literacy has enabled them to manage and repay loans effectively. By showcasing real-life examples and providing information on financial procedures, beneficiaries were better informed about their options, fostering a sense of independence and confidence in managing their financial responsibilities. Since women do not own most of the financial resources such as existing patriarchal systems exacerbate the situation in rural areas.

### **WAY FORWARD**

The impact assessment of the Solar PV project in the Chitarpur sewing cluster of Ramgarh, Jharkhand, vividly demonstrates the transformative power of renewable energy in rural development. This initiative has not only addressed critical energy access challenges but has catalyzed significant socio-economic,

environmental, and empowerment outcomes. By scaling up solar photovoltaic systems to 150 sewing enterprises, including provisions for the most economically disadvantaged households, the project has fundamentally shifted the livelihoods of numerous families. The reliable access to solar energy has enabled beneficiaries to extend their working hours, improve productivity, and significantly increase their incomes. This economic upliftment is particularly poignant in a context where even modest increases in earnings can have profound effects on household stability and growth. The ability to work beyond daylight hours and operate sewing machines without manual intervention has empowered women, providing them with greater financial independence and decision-making power within their households.

The Solar PV systems have also brought about substantial improvements in the quality of life. Enhanced lighting has not only improved work conditions but has also facilitated children's education and improved household safety. Women can now perform daily tasks with ease, reduce health risks associated with poor lighting, and experiment with new designs, furthering their skills and economic opportunities. The environmental benefits of the project are equally noteworthy. By reducing dependence on fossil fuels and providing a sustainable energy source, the initiative contributes to a cleaner, greener environment and sets a precedent for renewable energy adoption in rural areas.

The project's success extends beyond the immediate benefits to the participants. It has fostered a ripple effect, with other residents expressing a strong desire to join the initiative, driven by the visible improvements in their neighbors' lives. This growing interest underscores the broader potential for scaling similar interventions across rural areas, creating pathways for sustainable development and poverty alleviation. The Solar PV project in the Chitarpur sewing cluster serves as a powerful example of how targeted, sustainable interventions can drive comprehensive social transformation. By addressing energy access challenges, empowering women, enhancing economic opportunities, and promoting environmental stewardship, the project has set a

benchmark for future rural development initiatives.

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