Kashf Foundation Focus Note Series
July 2024

Outcomes from Solar Photovoltaic (PV) Microgrid Pilot in Rural Community in Punjab

Kashf Foundation in partnership with SAMA^Verte tested the efficacy of solar micro grid in improving the economic and living condition of residents in a rural community in Bakirabad. The focus note showcases key findings of the results of the pilot a year post initiation.

Access to energy is fundamental to improving the quality of life and is imperative for economic development. Goal number seven of UN-SDGs is commitment to ensure access to affordable, reliable and modern energy for all by 2030. Lack of access to modern energy services is also referred to as energy poverty, which occurs when households' energy consumption decreases to a degree that negatively impacts their health and well-being. Reduction in energy consumption is normally driven by factors including lack of affordable energy, low income and low electrical efficiency.

Like any other deprivation, energy poverty hits the most vulnerable the hardest. Women being the main consumers of energy at home are at greater risk of being impacted by energy poverty, which increases the care burden on them and also exposes them to higher level of toxins (higher engagement in the use of fuels in cooking and lighting). Furthermore, studies on the impact of energy poverty reveal lower literacy levels as well as poor health outcomes for children living in it.

Estimates show that energy poverty in Pakistan has increased over the last decade; from 19.2% households experiencing it in 1999 to 28.6% in 2019 (Ashar Awan, 2022)[1]. The issue seems to have only gotten worse with substantial increase in energy tariffs and increase in general inflation over the last year. The fact that the average consumption per electricity connection in Pakistan stands at a 20 year low (2,000 GWh in 2007 to 1,500 GWh 2023) is a sign that Pakistan has lagged behind in prosperity. Shortage of reasonably priced electricity is causing hardship for people across the country and is also impacting the growth rate of the economy.

It is therefore imperative to make alternative sources of energy accessible to all. Solar energy offers a promising solution in resolving the gap in energy access, especially for the most vulnerable. With coordination and concentrated efforts from all stakeholders and the right financing mechanism, solar products can be made available as a tool to combat energy poverty.

To understand the impact of solar energy on low income households, Kashf Foundation, in partnership with SAMA^Verte, tested a Solar Microgrid model, under the Cotton Inset Scheme, in a rural community in Bakirabad, in district Khanewal. The focus note showcases major findings of the impact and experience of managing a microgrid solar model, one year post installation.

[1]Awan et al (2022); Energy poverty trends and determinants in Pakistan: Empirical evidence from eight waves of HIES 1998-2019

Background

The Cotton Inset scheme is a business model which connects large UK brands with small cotton farmers. The brands are dependent on cotton for garment production and are coming under increasing pressure to improve the sustainability of their business, reinvest in the supply chain and reduce their greenhouse gas emissions impact. The farmers, who tend to be on the poverty line, have limited access to accessible, affordable and sustainable energy for basic services, such as lighting, refrigeration, cooling and cooking.

The Carbon Inset Scheme Project, financed by Innovate UK and implemented by SAMA^Verte in partnership with Pilio UK, aims to provide solar energy to cotton growing villages to enable the use of clean energy, subsequently leading to reduction in carbon footprint in the cotton supply chain.

Under the project, Bakirabad was selected as an area of intervention due to rural household's engagement in cotton farming. To facilitate the shift to cleaner sources of energy, SAMA^Verte[2] *(formerly known as HIMA^Verte, an environment consultancy company working towards provision of innovative solutions for sustainable development)* brought in the technical solution and Kashf Foundation provided financial access through microloans, to enable residents of Bakirabad to make the shift to cleaner energy.

Before project initiation, Kashf Foundation undertook a needs assessment through FGDs with residents of the community to understand the demand for a solar product and challenges in energy access faced by the community. The results of the assessment showed that the community members had considered shifting to solar energy due to an average of 10 hours of loan shedding (when electricity is not available) in a day during the summer season, which was disrupting their everyday life. They cited lack of knowledge about solar product, high initial cost and high maintenance cost as reasons for not being able to adopt solar solutions. On the question of what product would they want to prioritize shifting to solar energy, respondents preferred lights and fans to save themselves from the scorching heat and be able to go about their day. Furthermore, demand of having the fodder machine and water pump on solar was also received. The discussion was also meant to assess the community's willingness and capacity to pay for the solar product.

Development of Micro-Grid Product

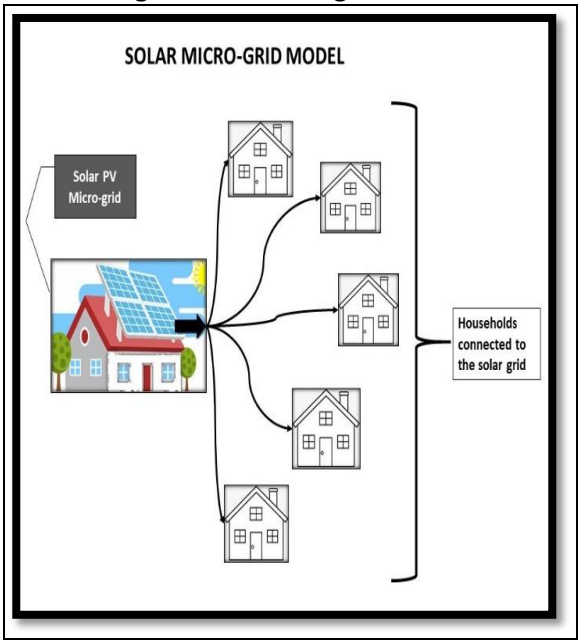
Following the needs assessment results, SAMA^Verte and Kashf Foundation engaged in a series of discussions to develop a product in line with the needs of the community members of Bakirabad, and finalized the following key features of the product:

1. Solar Photovoltaic (PV) microgrid established at a central point in the community [5.4 kW]
2. Participating households connected to the solar micro grid were offered a product bundle consisting of appliances supported by solar. The bundle included:
    i. One battery with a one year warranty
    ii. One DC pedestal fan with two year warranty
    iii. Three LED bulbs with two year warranty
    iv. One mobile charging socket with two year warranty

While the Solar PV microgrid (installed in the community) was subsidized through project funding from Innovate UK, credit to purchase products supported by solar energy, which would be installed in the client's house, was provided by Kashf Foundation to the community members who needed it.

[2] https://samaverte.com/

Fig 1: Solar Micro-grid Model



The product bundle was made available to the clients at a mere cost of Rs.36,000, on equal monthly installments payable over the course of a year. A small subsidized fee to maintain the microgrid was also collected by SAMA^Verte with monthly installment of the loan. Under the pilot, Kashf Foundation provided credit to ten households for the purchase of the product bundle.

SAMA^Verte commissioned a community member to be the point of contact between the community and SAMA^Verte, and built his capacity in maintaining the solar grid and providing aftersales services to the households connected to the grid.

The pilot project offered the following advantages:

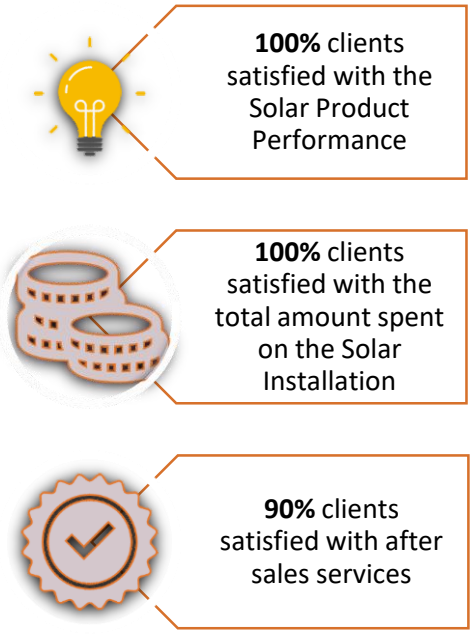
- Provision of an opportunity to assess the impact of solar solution at a very minimal cost to the client
- With the power being generated at the grid, Solar PV microgrid offered the advantage of meeting the fluctuating energy needs of every household
- After sales services were ensured and feedback was regularly sought on the performance of the grid and after sales services by Kashf Foundation and *SAMA^Verte.*

Impact of Solar Micro grid

One year post pilot, by May 2024, nine out of ten clients had completed their loan with Kashf. In June 2024, Kashf Foundation undertook an end of the pilot survey with all ten participating households with the objective of (1) assessing client satisfaction with the product (2) satisfaction with after sales services (3) change in utility bills if any (4) impact on the quality of life (5) suggestions and recommendations on improvement.

Interviews with the clients showed satisfaction with product performance and value of money for the product.

Fig 2: Client Satisfaction with Product



On perception regarding electricity charges, 90% respondents believed that they were paying lower electricity bills post solar grid connection compared to residents of the same locality who did not have access to solar energy.

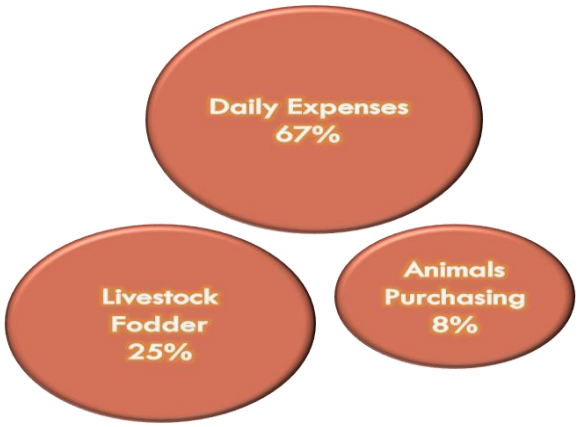
Comparison of electricity bills for May 2024 with May 2023 showed an average reduction of 44% in electricity bill over a year for the participating household. The table below shows change in electricity bills over a year; from May 2023 to May 24. Eight out of ten clients experienced reduction in electricity charges over the year. The one client who reported a significant increase in electricity bill reported extensive use of fodder machine and water pump, which were not being operated on solar, leading to high electricity consumption.

Table 1: Change in Electricity Bills

Client No.	%age Change in Electricity Bill (May 2024 and May 2023)
1	-29%
2	29%
3	-39%
4	-18%
5	178%
6	-56%
7	-30%
8	-62%
9	-61%
10	-62%

When asked about the areas where the clients were using the money saved from the electricity charges in, 67% were spending it to cover daily expenses, 25% on spending on livestock fodder and 8% reported purchasing an animal with the saved amount.

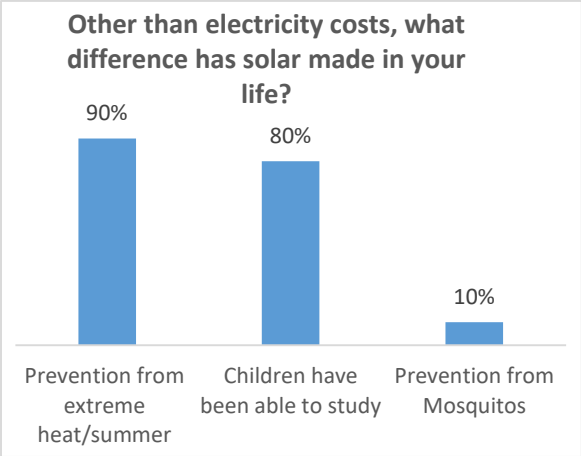
Fig 3: Areas Where the Saved Amount Was Being Used



On the impact of solar product on the quality of life of clients, 90% felt that improved availability of energy has led to escape from the scorching heat in summers. 80% of the respondents mentioned that since the installation of solar product, the children in the house have been able to study better. 10% reported escape from mosquitoes due to improved availability of electricity in the night.

The results are in line with similar studies undertaken across the world on the impact of energy access on education and health outcomes for low income families[3].

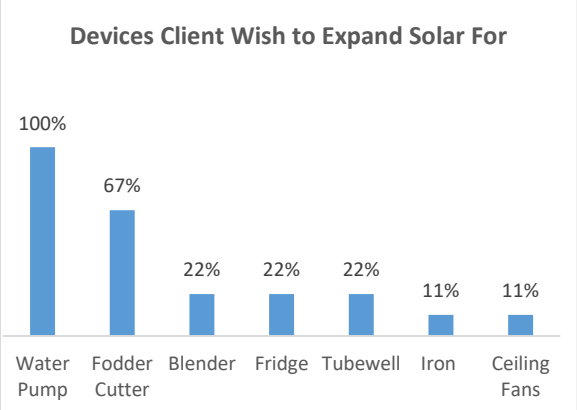
Fig 4: Impact of Solar on Quality of Life



[3]Katocha et al (2023). "Energy poverty and its impact on health and education: a systematic review".

On the question of converting other appliances on solar energy, 90% of the participating households wanted to have other appliances run on solar as well. Respondents prioritized converting water pumps and fodder machines on solar energy, since both men and women in the household had to adjust schedules and had to take an increased burden of care work, as water and fodder had to be arranged from outside the house in the absence of electricity, increasing the hours spent in undertaking the activity.

Fig 5: Demand for Additional Devices on Solar



On the areas of improvement, respondents reported facing issues with battery charging, leading to issues in energy backup in the night and non-availability of some spare parts which caused delays in repair turnaround time.

However, respondents reported being satisfied with the after sales services and with the exception of one client, none reported having to pay additional charges for repair/maintenance due to the appliances being covered under warranty.

Conclusion

The pilot, though limited, suggests positive impact of solar energy on the financial well-being and on the quality of life of the participating households. It offers the potential in making electricity accessible for low income communities and bridge the gap between the supply and demand of electric energy.

The pilot also shows solar PV microgrid as a potential way to increase energy availability in remote and underserved off-grid areas, where expanding the grid is not practical or cost-effective, giving communities dependable and sustainable electricity.

It further shows readiness of communities to shift to cleaner energy sources. However, the shift to clean energy is still expensive and for adoption of solar solutions among the low income households, there is still a need to take a multi-faceted approach in developing solar solutions that offer

1. Cost effective solar products and appliances supported by solar
2. Efficient after sales services
3. Easy availability of spare parts
4. Awareness raising sessions to educate communities on solar solutions and their maintenance
5. Capacity building programs for the local communities to help them setup and manage solar systems for local skill development and employment generation

The above can only be achieved through concentrated efforts that should bring together law makers, researchers, donors, development specialists and financial institutions to collaborate to handle the lingering issue of affordability, scalability and accessibility in making solar energy accessible and thus tackle energy poverty.

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