Redesigning Off - Grid Solar Home System Pricing in Munger District of Bihar : A Case Study

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Abstract

This case study discussed the challenges faced in designing solar home systems and providing solar energy options to rural households in Munger District of Bihar by two social enterprises - SEWA Bharat and SELCO. The findings of the primary research revealed that deep understanding of consumer needs and affordability can help develop innovative & customized solutions to the energy - deficit in rural India. Such innovations not only promote renewable energy product acceptance at the consumer level, but also help the country reduce its energy intensity. The primary data were collected by us through personal interviews of SEWA Bharat employees and individual households during January-March 2016.

Keywords : **rural customer needs, solar home system, innovative pricing**

JEL Classification: M31, Q42, R21

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The Solar Home System (SHS) has changed the lives of thousands of rural households in Munger district of Bihar by providing an affordable alternative electricity option.

As reported by Mehra Zabeen, a SEWA member from Kharagpur block in Munger district and user of SELCO solar home system :

> Three years have passed since SHS was installed in my house. Since then, we have not faced any product-related problem. There is electricity available when a guest is visiting, for the children to study, as well as for some other household works. (Irshad Ali, personal communication, January 11, 2016)

According to a working woman member from Saroini SEWA Self Help Group (SHG) from Village-Bhavikura, Munger :

> We go to the jungle early in the morning to collect fresh leaves for the leaf-plate making. We make leaf - plates in the evening, after completing all household work. The solar lighting has helped us to work under bright light for a longer duration and thus helps us get best prices during the peak season. (Irshad Ali, personal communication, January 11, 2016)

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Another SEWA member from Dahrahra, Munger reported, "The solar light has replaced the kerosene lantern in our house with increased illumination and thus enabling us to work for extended hours during night" (Irshad Ali, personal communication, January 11, 2016).

Several other similar stories authenticate the success of SELCO solar home system (SHS). SHS has helped housewives, professional women, and small retailers in carrying out their daily routine works without difficulty and for extended hours. SELCO collaborated with SEWA Bharat in 2010 in the Munger district of Bihar for distribution of SHS as the only alternate for electricity in the absence of Grid power. Started initially on a pilot project basis with 57 households, it eventually became a notable success story for providing solar electricity option at affordable cost to the poor rural households. Easy installment based payment system, product design as per the requirement of the rural households, easy to carry & install, and excellent post purchase services were found to be the primary reasons for the success of this business model.

SEWA Bharat members, mostly women, initially faced numerous problems in the collection of the regular monthly installment from the customers. The rising bad debt and default rate in the payment process forced the SHGs to look for various alternative ways of pricing the products considering poor affordability of the households. The case analyzes and documents the problems faced by SEWA Bharat members in the collection of monthly installments in the beginning and their experiments towards customer-friendly new mechanisms in marketing of SHS in the remote and poor district of Munger, Bihar. Interviews and data collection for the case study were done between January - March 2016 by us followed by telephonic interviews with the SEWA Bharat members regarding any doubt till May 2016.

About SEWA Bharat

SEWA Bharat is a part of the Self-Employed Women's Association (SEWA) movement, established in the early 1980s. It started from Gujarat, and by the end of 2013, it had incorporated more than 1.9 million women members from the unorganized sector representing 13 states of India. It reaches out to deprived women population of the country working in the informal sector (street vendors, domestic workers, construction workers, agricultural labourers, home - based workers) (SEWA Bharat, n.d.a.).

In Bihar, SEWA Bharat started in Munger District in 1981. Till now, it has worked with more than 100,000 informal women workers on problems of income, employment, and social security. SEWA Bharat works in areas like resettlement of suppressed castes, livelihoods, health and social security, microfinance, and individual projects on solar light systems (SEWA Bharat, n.d.b.). They create general public awareness, providing finance, hold regular training of the members, and other related supporting activities. The Indian Tobacco Company (ITC) is the leading partner of SEWA Bharat in Munger district, facilitating and aiding livelihood and development activities under their corporate social responsibility (CSR) program. SEWA Bharat also receives funds from some national and international organizations in carrying out its development activities (SEWA Bharat, n.d.c.).

The Problem of Electricity and SEWA Bharat Initiative

Access to reliable electricity for lighting purposes has been the key challenge before the people and Government of Bihar. In Bihar, almost 80% of the households in rural areas have no access to electricity ("80 percent of rural households in Bihar have almost zero access to power," 2015). Bihar, with an electricity access index of 8.1, has the lowest aggregated index among all the states surveyed ("80 percent of rural households in Bihar have almost zero access to power," 2015). Even though the households are electrified, the power supply is irregular and many times, it is limited to 3 - 4 hours a day, that too with frequent voltage fluctuation. The Census of India 2011 indicated that close to 89% of rural households in Bihar continue to depend on kerosene for lighting and firewood, cow dung, and chips for cooking (Mallapur, 2015).

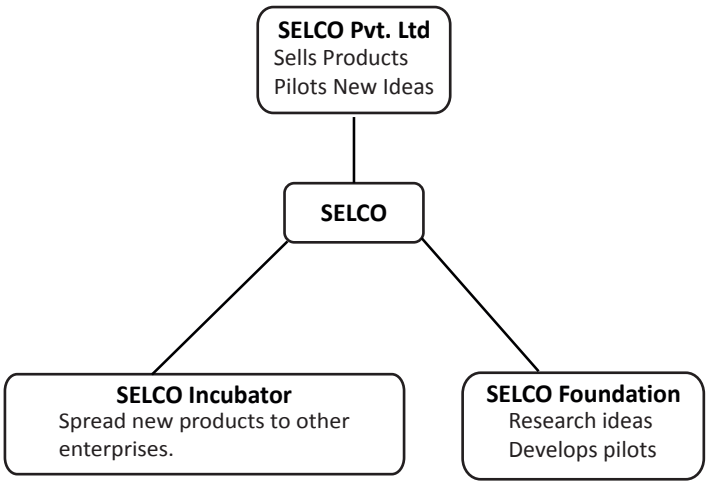
To address the electricity problem, SEWA Bharat in 2010 in partnership with SELCO started a SEWA Savera intervention model in Kharagpur block of Munger district in Bihar. The goal of the program was to provide clean, reliable, and affordable energy for lighting through a decentralized renewable energy system. The creation of regular awareness about renewable energy, organizing training camps, and easy installment based payment mechanism, the performance of the products, live benefits demonstration, and noble post sales services by the organization established a confidence among the consumers. All these measures boosted the sales of the products and made it a big success.

About SELCO

The SHS is sold by SEWA Bharat and supplied by SELCO. It is a social enterprise, established in 1995 to provide sustainable energy services to underserved households and businesses. Over the last 20 years, SELCO has successfully served over thousands of customers, improving their lives and livelihoods, employing about 375 dedicated workforces through its 45 energy service centres across Karnataka, Gujarat, Maharashtra, Bihar, and Tamil Nadu (ENVIS Centre on Renewable Energy and Environment, 2015). Over the years, the company has framed a distinctive and unique business model which brings the benefits of clean energy at an affordable price to rural India through financial and technological innovation (SELCO India & REEEP, n.d.). SELCO has shown that empowering rural customers can be economically, socially, and environmentally sustainable. The target consumers for SELCO are the poorest of the poor, and they just do not go for low-hanging fruits while retailing the products. The SHSs range from small 12W systems to larger systems for institutions like NGOs and schools. Till date, they have sold over 200,000 such products (SELCO India, n.d.).

SELCO, to keep stride with time, deal with competition and provide products as per the current requirements of their target consumers, and continuously spend on research and development. For this reason, SELCO has established a platform of three distinct units for assistance in the business process: Selco Private Limited, Selco Foundation, and Selco Incubator (Figure 1). Selco Private Limited handles the sales of solar home systems. When it encounters a problem or issue that cannot be resolved using current design or technology, Selco Foundation carries out research to look into the problem to find a way out. Selco Foundation then develops a solution and pilots it through Selco Private Limited. If the pilot is successful, the new solution is developed into a new product

Figure 1. Different Units of SELCO



Source : SELCO India (n.d.)

and sold through the private limited company. Operational products, designs, and processes are then replicated by disseminating information to other enterprises through the Selco Incubator.

For example, when SELCO wanted to direct solar home systems among fishermen communities, the firm first identified that the fishermen did not have an effective way of drying fish. Hence, the fishermen's income was affected due to decay. SELCO Foundation developed a solar-powered dryer which was first demonstrated and then retailed.

Need Identification and Product Development

Due to irregularity in the power supply, the rural area people use kerosene for general lighting in the evening. On an average, each household consumes 5 - 6 litres of kerosene. The household expenditure on kerosene includes 2 litres supplied from the Public Distribution System (PDS) at ₹15 per litre and the remaining at market price (or from the black market) at the rate of ₹ 30 - ₹ 35 per litre. Furthermore, the light provided by the kerosene lamp is quite faint, which gets extinguished while moving from one place to another, and danger of harm due to fire cannot be estimated. The mobile phone (torch) is the essential gadget used by the majority of the households in the village. Due to the inconsistent supply of electricity, the charging of the mobile phone is a main concern. People visit a nearby town, traveling for 6 - 8 kilometers each way, more than twice a week, and every time they pay ₹5 for charging their mobile handset. The total cost for lighting and mobile charging comes to around ₹ 200 - ₹ 250 per month, besides the extra effort, time, and energy spent for the same (REEEP & Climate Parliament, n.d.).

SELCO, by partnering with SEWA Bharat, studied the problem and designed a decentralized renewable SHS consisting of the following components : two LED lights (2.4 watt, 1.2 watt), one battery (15 ampere), one charge controller (5 ampere), and one solar panel (12 watt) along with one mobile charging point. This medium was the initial product in the package sold by the company through SEWA Bharat. The SHS, apart from charging a mobile phone, provides 4 hours of lighting on a daily basis, along with 2-3 days of backup. The company assured of two services and filling of battery water in a year, free of cost.

(1) Introductory Phase of the Project : The pilot project was undertaken in 2010 in Kharagpur block of Munger district in Bihar with off-grid electrifying 57 households (ENVIS Centre on Renewable Energy and Environment, 2015). This initiative was financed by SEWA Bharat's microfinance extension through a woman SHG which took the responsibility of collection of repayment of loans from end-user households. In the beginning, SEWA Bharat and its SHGs members faced a lot of problems in convincing the people about the benefits. Four broad problems were noticed by SEWA Bharat among SHGs related to the purchase of the SHS : (a) A household may not require it, (b) people were not able to understand or SEWA Bharat members were not able to pursue the people appropriately. As revealed by one of the SEWA members in Kharagpur block, it was quite difficult and time consuming in explaining things to people in rural areas. Many times, awkward and difficult questions were raised, which must be answered, (c) not able to pay, and (d) only a few members of the SHGs were ready to purchase the solar system.

Therefore, various measures were adopted by SEWA Bharat to address the matters. First, the products were sold on easy monthly installments. Second, if one or two members of a group agreed to install the products, then loan was sponsored by the group, and if more members came forward, in such a case, loans were financed through a bank. Since most of the households installing the SHS were poor and were not able to make the payment for the system at once ; so, SEWA Bharat went for deferred credit method of payment. Each user had to pay a monthly instalment of ₹130 per month for 4 years. The project was successful. A subsidy of ₹2100 was transferred to consumers on each SHS by SEWA Bharat through National Bank for Agriculture and Rural Development (NABARD) under Central government schemes.

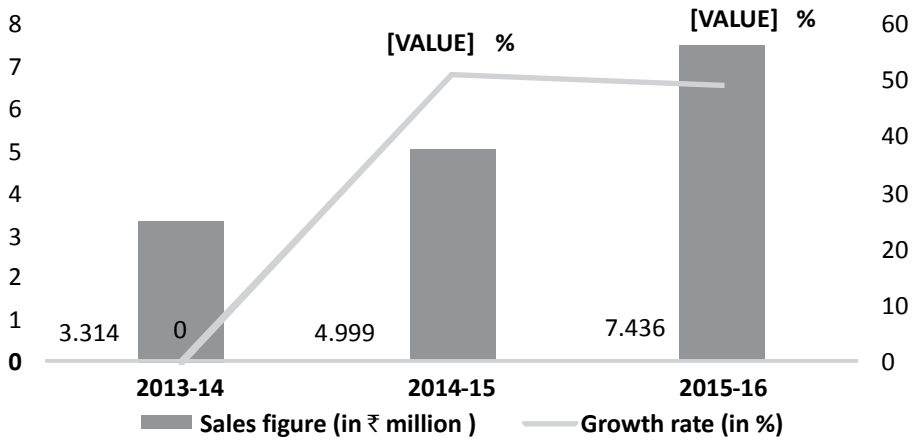
(2) After-Sales and Servicing Facility Provided by SEWA Bharat and SELCO : A robust emphasis was to increase the longevity of the energy systems. The technician of the program looks after installations, training, and after-sales services of the products and its components. Local technicians are trained to install lights, service systems on a regular basis, and handle household technical complaints. Beginners and refresher professional training are conducted on a regular basis to guide users on product maintenance.

SEWA women frequently visit the villages and try to create awareness about climate change, how to use products, how to operate, and regular maintenance. Most of the time, problem arises related to the fuse of the system. SEWA Bharat SHG members dealing with solar home lighting are trained to repair fuse and handle similar other minor complaints with the products.

(3) Impact of the SHS on Rural Households : The household installment for SHS was saved on a monthly basis by the households. Previously, the households used to spend some ₹ 200 - ₹ 250 on illumination. In addition, the bright LED light made it easier to complete domestic chores, children could read and study comfortably, it improved the efficiency and increased the working hours of household working women and men, there was no longer fear of fire from kerosene lamps, no extinguishing problem of the lamp upon moving from place to place, and small retailers could open shops till late in the night. With the use of SHS, households became more independent, they were now no longer reliant on kerosene, candles, or hope of grid-based electricity (SELCO India & REEEP, n.d.). Better lighting motivated children to study, and the cases of eye irritation and coughing due to inhaling fumes emitted under kerosene light were reduced. All these health benefits for the family were not noticed in the short term, but may become evident in the years to come (Natarajan & Nalini, 2015). The fact that households procured and paid for the system steered a sense of ownership, which improved obligation of using the system properly. The system (although not the primary motivator of the project) helped in controlling carbon emissions by reducing the use of kerosene (Kansal & Pathania, 2016).

(4) Moving from Pilot to Main Stream : The positive response from the consumers about the products enhanced the morale of both SELCO and SEWA Bharat. The human resources and organizational support from SEWA

Figure 2. Sales Figures of SELCO SHS in Munger District of Bihar



Source: Prepared by the authors based on the data provided by the company.

Bharat was a major thrust for SELCO to continue with the project on a large scale. This project has been operational since April 2012, and has sold more than 2000 SHS in Munger (1785 SHS only in Kharagpur block till February 2016) (Irshad Ali, personal communication, January 13, 2016). The Figure 2 provides the sales of SELCO SHS in Munger district over the past 3 years, and it is quite impressive.

(5) SHS Financing Facility : SEWA Bharat facilitates financing of end-users by linking them to credit schemes of nationalized banks. Currently, members are provided finance by Bihar Khatriya Grameen Bank under Jawaharlal Nehru National Solar Mission (JNNSM), a flagship program of Government of India. Financing is provided through own institutions of SEWA Bharat. SEWA members can choose a financial scheme as per their repayment capacity and cash flow. For the products to be reasonable, subsidy for end-users is mobilized from government bodies and institutions including NABARD (as part of JNNSM, the Government of India initiated a subsidy scheme to help individuals and organizations acquire these solar energy systems at reduced costs. The project is implemented by Indian Renewable Energy Development Agency Ltd. (IREDA) through NABARD. On March 15, 2012, the scheme was revised again, which provides 40% subsidy on capital investment of Solar PV Systems for items situated in both urban and rural areas in India.).

The program started by SEWA Bharat was initially reserved only for SHG members. Thus, women who were part of SEWA Bharat SHG were given priority. First, group members were convinced about the benefits of installing the SHS. Then, if at least 8-10 members agreed, then SEWA Bharat applied for a loan on behalf of the SHG. Owing to the credibility of SEWA Bharat's previous relations and its track record, loans were sanctioned without problems by Bihar Khatriya Grameen Bank (at 11.75% interest rate) (SELCO India & REEEP, n.d.).

(6) Expanding Target Consumers and Product Development : The successful delivery of the products, positive word of mouth, and live demonstration amplified the demand for the SHS. Assessing the market, SEWA Bharat liberated the 'members only' options. SHS was made available to the retailers who were willing to sell the products, provided they pay half of the price money to SEWA Bharat during supply. SEWA Bharat charges some amount as commission from these retailers.

The demand for the products came from the various segments of the population. Many small retailers, shopkeepers, and business people who were earlier dependent on candles, electricity, and generators found SHS as a better substitute. Thus, to accommodate the need, SELCO further customized the products package with

Table 1. Various Types and Schemes for Solar Home System

Sr. No.	Various SHS	Company Price (in ₹)	Discount Selling Price from SEWA Bharat (in ₹)
1	2 light (1.2W, 2.4W LED) + 1 Mobile charger + 1 battery 15AMP +1 controller 5AMP+1 solar plate of 12W	7350	4600-5700*
2	2 light (2×2.4W LED)+1 Mobile charger+1 battery 20AMP+ 1 controller 5AMP+1 solar plate of 20W+1 D.C. fan of 9W	11200	8200
3	1 light (3.6W LED)+1 Mobile charger+1 battery 15AMP+ 1 controller 5AMP+1 solar plate of 12W	6600	4000
4	2 light (2×3.6W LED)+1 Mobile charger+1 battery 20AMP+ 1 controller 5AMP+1 solar plate of 18W	9500	6500
5	4 light (4×2.4W LED)+1 Mobile charger+1 battery 20AMP+ 1 controller 5AMP+1 solar plate of 20W	12400	9500

Source: Data collected from SEWA Bharat Munger office.

*Note: The variable cost structure for Sr. No. 1 is as per the installment period selected by the customers.

Table 2. Warranty Available on Various Solar Home System Parts

SHS part	Warranty
Solar Panel	8 years
Battery	5 years
Control Unit (Charge controller)	5 years
LED	1 year
No warranty for mobile phone charging unit	

Source: Data collected from SEWA Bharat Munger office.

attractive options. SEWA Bharat provides the subsidy of ₹ 2100 - ₹ 2500 on various SHS products range. They even came out with products that can be used to run a fan. The Table 1 provides various SHS models developed by the firms (see Appendix Figure A1 and Appendix Figure A2 for various SHS sold by the organization).

The company also provides warranty for the various items of SHS. The warranty is only for technical fault and not the error or interface made by the consumers. For example, many people tried to operate a fan with previous SHS, which was not compatible. Hence, in case of tampering, warranty becomes null and void. The Table 2 provides the detail of warranty of various SHS items.

(7) Problems Faced by SEWA Bharat Women Workers : SEWA Bharat has undertaken the additional responsibility of collecting repayment of loans from the doorsteps of the consumers. The monthly installment schemes appeared relatively attractive initially to both SHGs and consumers. But, later on, it became a very tedious and problematic job for SEWA Bharat SHG workers (appointed for the collection of installment on a regular basis). Many times, people defaulted in making an orderly payment. Delaying and irregular payment of the installment posed a problem as observed by SEWA Bharat SHG women workers. In such a condition, bad debt and default rate rose over a period of time. This delay in making monthly installment payments further raised the bad debt with the bank. The most obvious reason for this, as stated by one of the members, was that people in villages are poor, they do not always have the cash to pay, and they hardly manage their bread and butter. Many customers stop or deny paying installments if the solar system does not function. They pressurized SHG women to resolve the issue (when problem is created by themselves). Such problems were faced by the SHG women on a daily basis.

(8) Measures Adopted by SEWA Bharat to Control Bad Debt : To overcome the problem and increase the sales of the products, SEWA Bharat changed its strategy. To reduce the fault rate in loan repayment of the products, they started experimenting with lucrative schemes like one-time payment, down payment, and other similar flexible mechanisms of selling SHS. Questions were raised by SEWA Bharat members regarding benefits which they will receive if purchased on a one-time basis and within a year. Thus, SEWA Bharat decided to redesign the price and transfer the interest and other savings to the customers. The various plans stated by SEWA Bharat are as follows:

The customers willing to purchase the products on a one-time basis need to pay only ₹ 4600. The consumers willing to purchase on six-months installment have to pay ₹ 4900 (₹ 1600 as down payment and ₹ 550 in monthly installments). The one-year installment paying consumers were charged ₹ 5300 (₹ 1700 as down payment and ₹300 in monthly installments). The one-year installment amount for SHS with the fan cost ₹ 8240 (₹ 2000 as a one-time payment and ₹ 520 as a monthly installment for one year). Still, those not able to afford were charged ₹160 (now, earlier it was ₹ 130) per month over 4 years.

Other Business Models Run by SEWA Bharat

Apart from lighting systems, SEWA Bharat is working on different business models of renewable energy (solar).

(1) SEWA Bharat has provided one member in the village with a solar mobile charging station. With this facility, villagers need not to go outside the village just for recharging their cell phones. This business model, on the one hand, reduced the daily effort, time, and money for the local people, and on the other hand, provided some means of livelihood to one member in a village.

(2) Lack of finance to start a business and irregular power to support such startup is a fundamental concern in Bihar. The problems are faced by shopkeepers providing Internet and printing facilities on a daily basis. SEWA Bharat offers the entire setup of computer and printer working on solar energy. This method provides employment in the area, and they can pay the installments from the system monthly earnings.

(3) Women in villages after long hours of household work get tired. So, SEWA Bharat provided them with sewing machines operating on solar power. The machine running on solar power reduces their effort and extends their working hours in the evening.

(4) SEWA Bharat is working on a mini-grid which is to be operated soon. Mini-grid for Mahdeva village of Bariarpur block in Munger district on the pilot project is already planned. It will connect 40 - 42 households in the village. The total project cost is around ₹ 1.2 - ₹1.3 million, which is funded by MIT University of USA. A mini grid, also sometimes referred to as a "micro-grid or isolated grid," can be defined as a set of renewable electricity generators and with energy storage systems interconnected to a distribution network that meets the needs of power to a localized group of customers (Energypedia, n.d.).

Apart from the above business models, SEWA Bharat is planning to come up with products on solar-powered water purification and solar water pump.

Future Challenges

Three challenges are to be faced by SELCO and SEWA Bharat in the near future associated with SHS. First, the Government of India is inclined towards electrifying villages. Under Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJU), ₹760 billion (Deendayal Upadhyaya Gram Jyoti Yojana, n.d.) has been sanctioned for completing and improving rural electrification. It replaces the existing Rajiv Grameen Vidyutikaran Yojana (RGGVY). Due to various schemes and projects (attention of the Government of Bihar towards electricity), the condition of electricity is improving continuously ("PM launches new scheme for power reforms in rural areas," 2015). It is a challenge to be faced by SELCO and SEWA Bharat in particular and all other renewable energy manufacturers in general. How to make the SHS beneficial, favourable, and competitive even when electricity is available is going to be a big challenge. The companies need to calculate the per unit price of grid electricity and compare with their options. Second, although the project is a success ; still, it is operating and sold in only two districts of Bihar. The organizations need to make available their products in other parts of the state before competitors capture the market. However, whether SEWA Bharat possesses infrastructure and distribution network to handle such challenges is not known. Third, observing the opportunity in the renewable sector, many local and international firms are also joining the race and are coming up with innovative ideas. Thus, it is upto SELCO and SEWA Bharat how to deal with their competitors having deep pockets.

Managerial Implications

The case study has important learnings for firms offering innovative products or solutions for rural customers. The affordability of rural poor customers must be factored in while pricing the products /services. Apart from affordability, the needs of the rural segment are different and need to be fulfilled in different ways as has been shown in the case of two entrepreneurial firms - SELCO and SEWA Bharat in rural Bihar.

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Appendix

Figure A1. Normal Solar Home System and its Various Components (SEWA Bharat Office at Munger in Bihar)

Figure A2. Solar Home System with Fan, Sewing Machine, and its Various Components (SEWA Bharat Office at Kharagpur Block)

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