

# Microfinance Interventions in Renewable Energy: Enhancing the Living Standard of Rural Households

[ Tahsina Khan ]

**Abstract**— This paper reviews the glimpses of microfinance interventions in renewable energy technologies to promote rural electrification through Solar Home Systems. In this regard, the present study highlights the strategic issues, implementation and dissemination of renewable energy technology in Bangladesh to enhance the living standard of rural households. By critically reviewing the research concentrations and findings of pertinent studies, this paper attempts to fill the gap of present literature on sustainability of solar energy dissemination programs by addressing the practice of micro-finance in a developing country like Bangladesh. The study attempts to add value to the existing literature in two ways: first, it reviews the rationale of microfinance for providing access to renewable energy. By doing that the paper makes an appraisal on the resulting living standard improvement and captures the prevailing constraints in the sustainability of the program. The study concludes with an emphasis on the need for further research on formulating relevant micro-finance policy to expedite the renewable energy ventures.

**Keywords**— *Microfinance, Renewable Energy, Living Standard, Rural Households.*

## I. Introduction

Improved energy supply is essential for socio-economic development and poverty alleviation. Access to energy has a great impact on the life situation of rural population by influencing their economic productivity, health, education, and gender-related issues (Khan and Mahmood, 2009). Currently, 1.317 billion people worldwide suffer a destitute supply of electricity of which 99.8% live in rural areas of developing countries like Bangladesh (Komatsu et al., 2013). To upgrade the socio-economic condition and to lighten poverty, electricity sector has been prioritized by all the Governments. Despite the rapid economic growth in Bangladesh, more than 6 percent growth in gross domestic production, the overall incidence of electrification for households is 60 percent for the nation but much lower in the rural areas at only 42.5 percent (Bangladesh Bureau of Statistics, 2012). Renewable energy technologies such as Solar Home Systems (SHSs) are well-matched to provide electricity needed to address the acute electricity shortage in rural households (Morris Ellen et al., 2007). Hence, supply of electricity can be significantly improved if people in underprivileged communities are provided with microfinance loans to purchase and utilize the modern energy services from SHSs (Geslain and Gaeng, 2009)

Recognizing this, various Government and Non-Government organizations have applied relevant microfinance schemes for distributing SHSs to the rural areas where the lower income population is deprived of basic energy services. Solar Home Systems are small photovoltaic systems that transform solar energy into electricity, which does not require any kind of conventional fuels. The major components of SHS are solar panels, batteries, charge controllers, and some electric appliances (e.g., lamps, small fans, or televisions) which can be operated with minimum training (Rabbani & Ahsan, 2012).

More than 4.4 million SHSs have already been installed in the off-grid rural areas of Bangladesh Till July 2016 by the Infrastructure Development Company Limited (IDCOL), thus proving almost 18 million beneficiaries with solar electricity which is around 11% of the total population of Bangladesh. (IDCOL, 2016). This rapid growth of SHS in Bangladesh indicates that it is possible to use the microfinance approach to disseminate renewable energy services among the rural population (Brik et al., 2011). The present study is aimed to examine the rationale of microfinance interventions in SHS dissemination to upgrade the living standard of rural population. In addition to this, this paper also addresses the constraints in this regard to ensure the sustainability of the program.

The paper proceeds in six stages, first it presents the background of the study. Part two specifies the research methodology followed by part three with a brief literature review on the SHS dissemination supported by the utilization of micro-finance schemes. Discussion on the research concentration and a conceptual framework representing the microfinance interventions to promote living standard of rural households have been discussed in the fourth part of the study. The fifth part highlights the improvement of rural living standard followed by challenges of SHS program and possible strategic actions identified in part six. Finally, the study concludes with an emphasis on relevant policy formulations and further research in promoting the diffusion of renewable energy.

## II. Research methodology

The present study is intended to fulfill the research objectives by applying an extensive and systematic literature search, conducted at Google Scholar, Elsevier, Research Gate, IEEE, JSTOR and Science Direct platforms to identify existing relevant studies. The pertinent studies have been analyzed on the basis of research concentration and subsequent findings. Both qualitative and quantitative evidences, scrutinized from these literatures, have been appraised to study the microfinance interventions in promoting SHSs usage among rural households enhance their living condition. Additionally, an exploratory review on the progress status and impact assessment discussions of selected studies has been critically appraised in this study to

summarize the prevailing challenges for the sustainability of the program.

### III. Literature Review

Renewable energy is generally defined as those that are abundant in nature and derived from natural process with no depletion in the course of utilization, such as sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy usually supplies energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services (Ellabban Omar et al., 2014). Globally, there are an estimated 7.7 million jobs linked with the renewable energy industries, with solar photovoltaics being the largest renewable employer (IRENA, 2015). Several researches have been conducted by the scholars around the world on the prospect of renewable energy technology. However, limited number of relevant literature has been found reviewing the role of micro-finance to provide access to renewable energy. Microfinance, in simple terms, can be described as small loans offered to poor households to foster self-employment and income generations (Armendáriz and Morduch, 2005). The study of Morris et al, 2007 revealed that the microfinance sector has grown 12 percent per year in total outreach over the last decade and reached over 500 million people across the globe with wide range of financial services. Recognizing this fact, many financial institutions and NGOs have introduced loans to purchase modern energy systems that can reduce monthly energy expenditures and enhance living standard.

Research studies by Islam Tasbirul et al. (2014), Rahman Saydur et al. (2013), Ullah Habib et al. (2012), Mondal & Denich, (2010), Islam Rofiqul et al. (2008) have illustrated a comprehensive discussion on the comparison of selected renewable energy potentials in Bangladesh and identified the solar PV power system as one of most promising renewable energy source to supply electricity. Researchers have also focused on the socio-economic benefits and environmental implications of SHS interventions in addressing rural development. In the papers by Azimoh Leonard et al. (2015), Ahammed & Taufiq (2008), Sovacool and Drupady (2011), Komatsu et al. (2013), Asaduzzaman et al. (2013), the authors have confirmed the positive relationship between access to electricity on enhancing the household convenience and economic productivity of the SHS users. In addition to this, adoption of SHSs results in the decline in carbon dioxide emissions from kerosene and other fossil fuels replacement, thus contributing in the diminutions of harmful greenhouse gases and lessens the impact of climate change (Hoque S.M. Nazmul et al., 2013, Islam Tasbirul et al., 2014, Pulak and Bhagirath, 2015).

However, few research studies emphasized the financing mechanisms to address the high initial costs of SHS adoption (Cabraal et al., 2000, Komatsu et al., 2011). Access to modern energy services can be significantly improved if people in underprivileged communities are provided with microfinance loans to pay for the services. As the main barrier to the access to stand alone renewable energies solution is the high initial cost, microfinance has been implemented as a solution to overcome this barrier (Rouf Kazi Abdur, 2012, Roth and Glemaerc, 2012 ).

## IV. Micro-financing the access to renewable energy

### A. Need for Renewable energy

Since, poor people must have access to modern energy services to alleviate poverty and income inequality, the primary challenge in the Bangladesh energy sector is to provide universal access to electricity by 2021, in line with Government targets. At present there is high-unsatisfied demand for energy, particularly in rural areas which is increasing by more than 8% annually (Hamid Riazul, 2013). The lack of access to electricity has economic consequences for some of the poorest regions in the country. According national survey, two divisions in the country with the highest incidence of poverty - Barisal and Rangpur, have the lowest percentage of rural households with access to electricity, at 32 and 24 percent, respectively (Bangladesh Bureau of Statistics, 2012).

Low-income developing countries like Bangladesh are very much vulnerable to the disruptions arising from the continuing energy crisis (SREP, 2015). Research reveals natural gas lies at

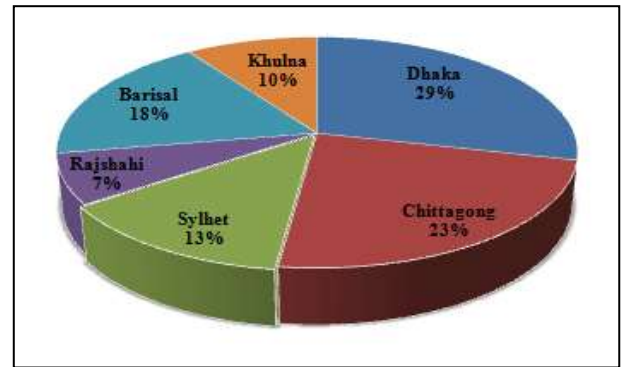


Figure 1. Dissemination status of solar home system in six divisions of Bangladesh

the core of the country's energy usage, accounting for around 72% of the total commercial energy consumption and 81.72% of the total electricity generation. With the increasing fuel price in the international market and reduction of gas reserve in the country, Gov of Bangladesh is urgently required to look for alternative sources of energy i.e., renewable energy (Ullah Habib et al., 2012). Bangladesh has a vast potential for renewable energy, solar energy in particular and the natural availability of this alternative energy creates opportunities of growth in power sector (Rahman et al., 2013). Bangladesh is situated between 20.30 and 26.38 degrees north latitude and 88.04 and 92.44 degrees east which is an ideal location for solar energy utilization (Islam Tasbirul et al., 2014).

Over the last 20 years, microfinance has played an imperative role in developing the socio-economic opportunities available to poor people (Morris Ellen et al., 2007). The remarkable growth of MFIs in the last couple of years has been partly supported by a market oriented approach to provide financial services to lower-income people (Roth and Glemaerc, 2012). This approach has been characterized by minimizing the operating costs, reasonably pricing the products and most importantly, understanding

the needs and limitations of the customers. This marketing capability – to better understand the needs of lower-income people and then develop, test and scale-up customized financial services to meet their clients’ needs – develop the MFIs’ capability to offer financing solutions for the poor people’s energy needs. Recognizing the important role that energy can play in supplementing the efforts to alleviate poverty, many Micro-Finance Institutions (MFIs) have introduced loans to the rural clients to purchase and install SHSs that can reduce monthly energy expenditures improve living condition of rural households.

### B. Dissemination of Solar Home System

In Bangladesh, the SHS program has been implemented through the state-owned Infrastructure Development Company Limited, IDCOL in collaboration with Government bodies, local and international donor agencies providing required technical and financial support. IDCOL operates the renewable energy program through a network of 56 partner organizations (POs), mainly NGOs –including some of the largest in the country like Grameen Shakti, Brac, Rural Services Foundation, Bengal Solar etc. that utilize their expertise in micro-credit to have greater reach in the rural community for making SHS installations affordable to the rural clients. IDCOL provides refinancing facility to the POs and channels grants to reduce the SHSs' costs as well as support the institutional development of the POs. In addition, IDCOL also provides technical, logistics, promotional and training assistance to the POs. (IDCOL, 2016)

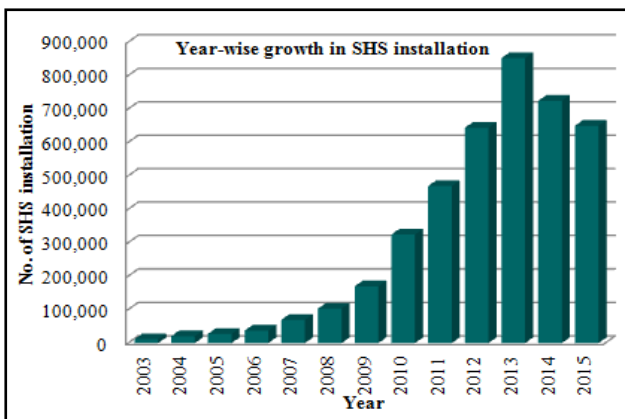


Figure 2. Year wise growth in solar home system installation in Bangladesh

The POs play the role of equipment dealers to disseminate SHS on a commercial basis based on Micro-finance schemes. Such financial offers have been designed to enable homeowners and businesses to acquire the necessary capital they need to finance the installation of the system. In addition to providing micro-credit loans to rural clients, the POs take care of promotional activities, sales management as well as the installation and maintenance of systems.

### C. Microfinance interventions of Partner Organizations

POs are provided several incentives as grants and refinancing by IDCOL for micro-financing the purchase of SHS households for the on installments. Households make down payments as well as monthly installments. POs receive the credit from IDCOL at 6% rate and pay back in 6-8 years. Households pay 12% interest and pay back in 3 years (Asaduzzaman M. et al., 2013). By offering the clients installment based payment system through microfinance, Grameen Shakti and other POs have been trying to overcome the high upfront cost of installing solar home systems, increase consumers’ awareness about renewable energy usage and provide technical training on solar technologies to the rural workforce (Sovacool and Drupady, 2011). This rapid growth of micro-financing in SHS indicates that it is feasible to promote renewable energy technology to the base of the income pyramid (Morris Ellen et al., 2007).

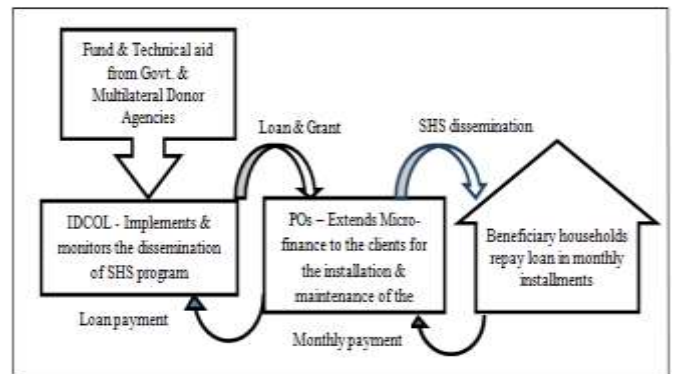


Figure 3. Flow of funds for Microfinancing the dissemination of solar home system

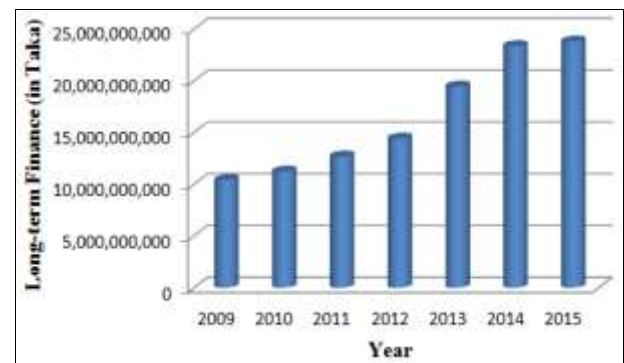


Figure 4. Growth in renewable energy finance

### v. Improvement in the living standard of rural households

Both qualitative and quantitative evidences, analyzed from the impact assessment literature of SHS, have been appraised in the present study to exhibit the energy development implications for rural families:

- **Convenience in household chores:** By the usage of SHS, rural people can avail better lighting

conditions, comfort from electric fans and convenience in regular in-house tasks.

- **Reduction in energy costs:** SHSs reduces the energy cost incurred for lighting facilities, and thus ease the strained households' budget.
- **Access to information:** Increased access to information about market opportunities and prices from the usage of electronic home appliances like mobile phones, televisions and radios.
- **Enhanced educational opportunities:** Access to solar electricity benefits the students with extended study hours at night and promotes the educational performance of rural students.
- **Economic productivity:** Improved lighting facilities from SHSs support rural businesses increase their productivity through extended working hours after dark.
- **Employment generation:** Job opportunities for technicians and local youth in solar industries have been supported by the domestic production of SHS components. According to national renewable energy program, SHS program has provided livelihood to 75,000 people by creating jobs in a green industry (IDCOL, 2016).
- **Better health & safety conditions:** Adaptation of SHSs in the rural communities reduces harmful in-house air pollution resulting from kerosene vapors, thus contributes in improving health and safety conditions among the most vulnerable groups within the nation.
- **Environmental benefits:** With the prevalence of 4.4 million SHSs, more than 242,000 tons of carbon dioxide emissions has been avoided each year which is one of the primary sources of greenhouse gas emissions in developing nations (IDCOL, 2016).
- **Gender aspects:** Inclusion of women as solar energy technicians in village based technology centers to disseminate solar electricity has enhanced their social-economic value in the communities and upholds women empowerment.

## VI. Constraints and required strategic actions in the dissemination of renewable energy

Since the distribution of SHS is a capital-intensive business, partner organizations currently highly depend on soft loans for refinancing the SHS. The long-term success of an established market for SHS in Bangladesh will therefore largely require an ongoing provision of soft loans to partner organizations for refinancing SHS. At present, monitoring of the program is only conducted by IDCOL, focusing mainly on the quantity and technical aspects of distributed SHS. A systematic monitoring of the results of the intervention needs to be implemented by the stakeholders involved (Asaduzzaman M. et al., 2013).

Research papers on the progress scenario and sustainability of SHS programs by Cabraal et al., (2000), Ahammed and Taufiq, (2008), Rabbani and Ahsan, (2012), Komatsu et al., (2011), Urmee T. and Harries D., (2011), Asaduzzaman M. et al., (2013) have revealed that sustainable growth in renewable energy market for rural electrification requires the removal of financial, technical and institutional constraints that limit the growth of renewable energy diffusion. The following table summarizes the prevailing challenges and strategic actions for further up-scale and providing better services:

TABLE I. CONSTRAINTS & STRATEGIC ACTIONS

Challenges	Mitigations
Lack of awareness	Demonstration of the technology to the rural population. Organizing promotional campaigns
High initial cost of SHS equipment	Offering tailored micro-financing schemes addressing the affordability and energy needs of the rural households. Connecting solar home systems with centralized mini-grids to enable more rural households to access renewable electricity at a lower cost.
Lack of quality assurance and availability of solar accessories	IDCOL needs to strengthen its quality control and regulatory affairs committee. Regular supervision on the manufacturing standard of SHS equipment.
Low after-sales service support	Training local technicians on solar technology will yield better results. Trained service personnel can educate the users on the proper usage and maintenance of the system.

## VII. Conclusion

SHS presents a promising alternative to conventional electricity for the millions of people living in the remote rural areas of Bangladesh. The program helps to build a sense of ownership and technology transfer to the users. Due to the technical and financial limitations, the SHS is not expected to resolve all the problems of rural electrification. Yet, SHS Program in Bangladesh has become a replicable model worldwide by benefitting about 18 million people are with solar electricity to enhance their living standard. The study attempts to add value to the existing literature in two ways: first, it reviews the rationale of microfinance in access to renewable energy and by doing that the paper makes an appraisal on the resulting improvement in living standard for rural households. Second, this study offers useful insights to policy makers and industry experts in designing the financial, technical and institutional strategies for solar energy endeavors. The paper concludes with outlines of progress, remaining challenges and policy implications for sustainability of renewable energy dissemination.

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