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# The Role of Social Business in Promoting Clean Energy Access for Women: Case Study from Bangladesh

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**Abstract**

Access to clean energy remains a critical challenge for sustainable development, mainly affecting women in rural Bangladesh who experience disproportionate energy poverty due to gender inequalities. This research investigates the role of social businesses in addressing energy poverty by enhancing women's access to clean energy technologies, building vocational skills, and strengthening disaster resilience in marginalized communities. The study employs a mixed-methods approach, combining an extensive literature review, structured interviews, surveys, site visits, and direct observations at two rural schools powered by solar energy under the social business model. Data collected from these case studies include academic performance, enrollment trends, vocational training outcomes, and disaster preparedness impacted by solar electricity initiatives. Findings demonstrate that solar energy access facilitated by social businesses significantly improves educational outcomes, increases female student enrollment and participation in extracurricular activities, and empowers women economically through vocational training programs, such as sewing. Additionally, solar-powered infrastructure enhances community resilience during natural disasters by providing reliable, sustainable energy. Despite the positive impacts, resource constraints and sociocultural challenges persist, limiting wider adoption. This study suggests scaling social business models to bridge financial barriers, enhance capacity-building programs, and implement community engagement. Expanding social business initiatives can play a transformative role in promoting gender equality, sustainable energy adoption, economic empowerment, and climate resilience in developing rural settings.

***Keywords***: *clean energy, energy poverty, gender, social business, women's empowerment*

***Abstrak***

*Penggunaan tenaga bersih kekal sebagai cabaran kritikal bagi pembangunan mampan, khususnya memberi kesan besar kepada wanita di kawasan luar bandar Bangladesh yang mengalami kemiskinan tenaga akibat ketidaksamarataan jantina. Kajian ini meneliti peranan perniagaan sosial dalam menangani isu kemiskinan tenaga dengan meningkatkan akses wanita kepada teknologi tenaga bersih, membina kemahiran vokasional, serta memperkukuh daya ketahanan komuniti terpinggir terhadap bencana.*

*Kajian ini menggunakan pendekatan kaedah campuran yang merangkumi tinjauan literatur menyeluruh, temu bual berstruktur, soal selidik, lawatan tapak, dan pemerhatian langsung di dua buah sekolah luar bandar yang dikuasakan oleh tenaga solar di bawah model perniagaan sosial. Data yang dikumpul daripada kajian kes ini termasuk prestasi akademik, corak pendaftaran pelajar, hasil latihan vokasional, serta tahap persediaan bencana, yang kesemuanya dipengaruhi oleh inisiatif tenaga solar.*

*Dapatan kajian menunjukkan bahawa akses kepada tenaga solar yang dipermudahkan oleh perniagaan sosial memberi kesan positif yang signifikan terhadap peningkatan prestasi pendidikan, peningkatan kadar pendaftaran pelajar perempuan, penglibatan aktif dalam aktiviti kokurikulum, serta pemerkasaan ekonomi wanita melalui program latihan vokasional seperti jahitan. Selain itu, infrastruktur berasaskan tenaga solar turut meningkatkan ketahanan komuniti semasa bencana alam dengan menyediakan sumber tenaga yang boleh diharapkan dan lestari.*

*Walaupun impaknya positif, kekangan sumber dan cabaran sosio-budaya masih wujud, mengehadkan pelaksanaan secara meluas. Kajian ini mencadangkan peluasan model perniagaan sosial bagi merapatkan jurang kewangan, memperkukuh program pembinaan kapasiti, dan melaksanakan penglibatan komuniti secara menyeluruh. Pengembangan inisiatif perniagaan sosial berpotensi memainkan peranan transformatif dalam mempromosikan kesamarataan jantina, penerimaan tenaga mampan, pemerkasaan ekonomi, serta ketahanan terhadap perubahan iklim dalam konteks luar bandar negara membangun.*

## Introduction

Access to clean energy is a universal requirement, a catalyst for development, and a key component in the fight against climate change. However, the most vulnerable communities, particularly in the developing world, often evade its advantages. Due to gender differences, women are affected disproportionately in these areas, and energy poverty continues to be a significant barrier to socioeconomic advancement. Women in many developing countries face numerous obstacles to acquiring clean energy solutions, which exacerbates gender inequality as well as energy poverty. In order to achieve broader sustainable development goals as well as the empowerment of women, it is crucial to address these interrelated challenges. Social businesses have become powerful change agents in this landscape by committing to addressing social and environmental issues. These organizations specialize in bridging the gap between clean energy availability, environmental sustainability, and disaster resilience by developing novel strategies catered to the particular requirements of women in marginalized communities. However, the specific ways in which social business benefits developing countries like Bangladesh by increasing access to clean energy, gender empowerment, and disaster resilience have not been much explored.

## Objectives

This study aims to explore how social business initiatives in rural Bangladesh can effectively address energy poverty faced by women by enhancing their access to clean energy technologies, building their capacity through vocational training, and improving the disaster resilience of communities. By examining empirical evidence from solar energy projects in rural schools and associated vocational programs, the research seeks to demonstrate the multifaceted role of social business in empowering women economically and socially, while contributing to sustainable development and disaster preparedness.

## Significance of the Study

Women's unequal access to renewable energy solutions exacerbates socioeconomic inequalities and environmental degradation in developing countries. Social businesses have become powerful catalysts for change in this field because of their dedication to a positive social and environmental impact. These businesses specialize in bridging the gap between clean energy availability, environmental sustainability, and disaster

resilience by developing innovative approaches targeted to the particular needs of women in marginalized communities. This research provides insightful information on the potential for social business to impact rural communities and women's empowerment. It highlights their role in promoting gender equality and their contribution to disaster preparedness by examining the strategies they apply to promote clean energy access for women.

## Background And Context

### *Gender and Energy Poverty*

In developing nations, gender dynamics are inextricably linked to energy access. Energy poverty is typically characterized in energy studies as a lack of access to electricity and reliance upon burning solid biomass inefficiently for household energy needs, causing pollution (Sanjeevikumar, Sharmeela, et al., 2021). Women in rural and remote regions are more exposed to energy poverty than their male counterparts. They frequently face the brunt of energy poverty as they are often in charge of domestic duties and food preparation, spending hours every day collecting firewood, relying on conventional, polluting energy sources, e.g., smoky cookstoves, and doing household chores in poor lighting (Energy 4 Impact (Powered by Mercy Corps, n.d.). Women usually have less control over resources and decision-making, including those pertaining to energy, as a result of gender inequalities in economic opportunities and education.

### *Social Businesses as Catalysts*

In order to address these challenges, social businesses have become potent change agents. Professor Muhammad Yunus, the recipient of the Nobel Prize, established the Yunus Center to promote the idea of social business, which refers to enterprises that prioritize a social mission over financial gain. These companies frequently place a strong emphasis on empowering marginalized populations, particularly women, by giving them access to affordable financing, training, and sustainable energy resources. According to the United Nations (2009), social business provides women equal access to and control over economic and financial resources, hence promoting gender equality and women's empowerment, as well as equitable and sustainable economic growth and development. The graph below illustrates the impact of social business across different countries and how they are effectively driving women's empowerment by providing them with resources, education, and opportunities to participate more actively in their communities.

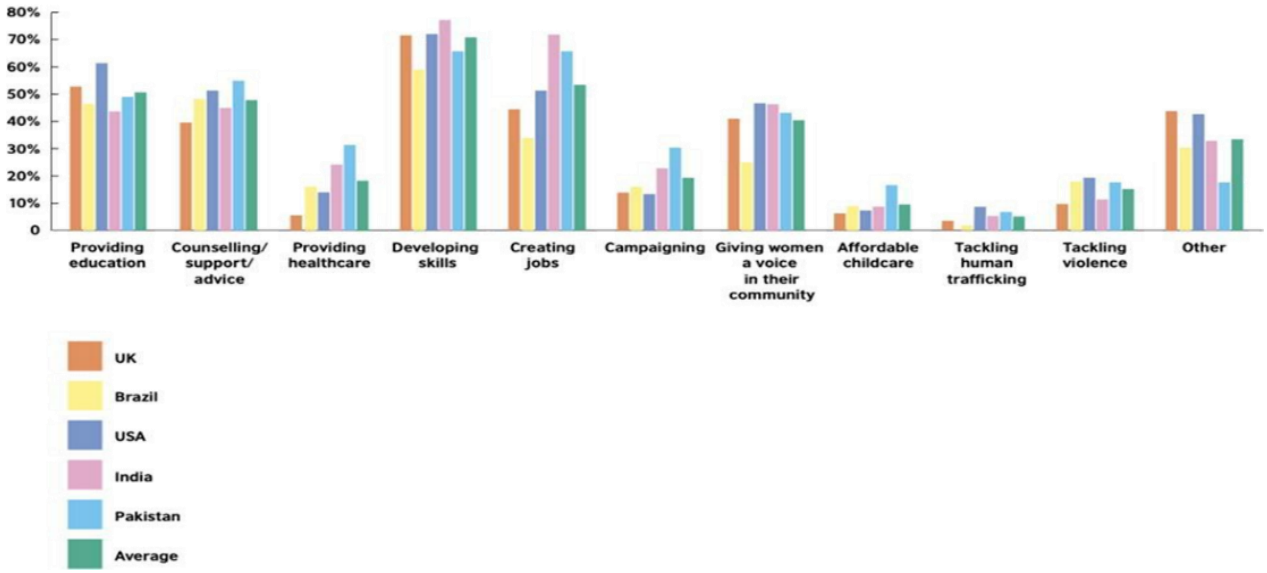


**Figure: 1** "Social Business and Women Empowerment (2017)"

**Eminate: Social Business Case Study**

Eminate, a Bangladeshi organization that ran a social business project providing solar electricity and internet connectivity to rural schools, served as an instructive case study. Its solar projects provided solar electricity to local schools in rural Netrokona. Eminate's motto is to emanate marginalized communities, based on the principle that providing access to clean energy and

educational resources will empower them, particularly women and youth. The project emphasizes creating a positive social impact rather than prioritizing financial gain, contributing to long-term benefits for the communities it serves. It is dedicated to combating gender disparity by providing women with access to clean energy, education, and vocational training. Besides addressing energy poverty, Eminate is deeply involved in dealing with environmental issues. By promoting the use of solar power, the organization helps reduce reliance on fossil fuel electricity generation, thereby contributing to lower carbon emissions and mitigating the effects of climate change in rural areas. Unfortunately, due to heavy load shedding, rural areas of Bangladesh still rely on diesel generators. This environmental focus is integral to Eminate's mission of fostering sustainable development. This paper examines two case studies of schools that benefited from their solar projects: Koilong Puranbari Private Primary School (case study1), which received solar power in 2021, and Koilong Alefuddin Girls School (case study 2), a girls-only school which was connected in

2022. The latter also provides vocational training to both students and women in the community, contributing to economic empowerment and skill development. Initially, Eminate funded these solar installations through crowdfunding campaigns. The organization generates revenue through several channels with its social business project, such as:

- Tuition Fees: Schools pay fees that contribute to the overall funding model.
- Savings on Utility Costs: The transition from diesel generators and traditional electricity to solar power has significantly reduced operating costs for the schools, including savings on electric bills and diesel expenses.
- Vocational Training Fees: Vocational training programs are offered in the school, with fees collected from students.
- Income from Trainees: Products made by trainees are sold, generating additional income for the schools
- Consultancy: Provides specialized advisory services to other institutions and businesses interested in adopting solar energy solutions

The impact of Eminate's initiative extends beyond mere connectivity and clean energy access. For example, the installation of solar power, low-power computers (Raspberry Pi 4), and internet connectivity at the schools has not only facilitated educational activities but also enabled vocational training in sewing in the second school. Digital sensors have been installed in schools, which enable remote monitoring of energy consumption; a feature that proved significant during recent cyclones. This remote monitoring revealed unexpected nighttime electricity demand, showcasing the schools' ability to serve as flood shelters thanks to their solar-powered infrastructure. Eminate's projects enhance educational and vocational opportunities while promoting energy sustainability and resilience in rural communities. By focusing on marginalized communities, particularly women, Eminate helps bridge the gap in energy access and promotes gender equality, thus enabling these communities to achieve greater economic independence and social mobility.

## Literature Review

### Gender Inequality and Energy Poverty

Climate change and energy poverty remain two of humanity's most critical challenges, with disproportionate impacts on women and girls, especially in developing countries. Traditional gender roles often

place the burden of household energy collection and use on women, exposing them to "time poverty" and health risks from indoor air pollution caused by biomass fuels (United Nations International Development Organization, 2022). In Bangladesh, over 90% of rural households rely on biomass for cooking, creating serious health hazards due to particulate matter exposure (Accenture and Global Alliance for Clean Cookstoves, 2012). Bangladesh ranks among the top 20 countries with the poorest access to clean fuel and cooking technologies (International Energy Agency, 2021). This energy poverty exacerbates gender inequality by limiting women's economic and educational opportunities, thereby restricting social mobility and perpetuating poverty (Cecelski et al., 2023).

Recent studies highlight that women in rural Bangladesh spend nearly six hours daily on unpaid domestic work, including cooking and fuel collection, a phenomenon identified as "time poverty" that critically reduces their opportunities for income generation and education (Inspira, 2025). Indoor air pollution from biomass cooking causes over 113,000 premature deaths annually in Bangladesh, disproportionately affecting women and children (Koomson & Danquah, 2021; UN Women & IUCN, 2022). Additionally, women represent only 10% of Bangladesh's energy sector workforce, reflecting a significant untapped potential in energy transition and entrepreneurship (Inspira, 2025).

Socioeconomic determinants such as income inequality and education level further deepen the gender gap in energy access. Women with lower socioeconomic status face greater hardships accessing modern energy, reinforcing cycles of deprivation (Manusher Jonno Foundation, 2024). Addressing this gap supports Sustainable Development Goals, particularly SDG 5 (Gender Equality) and SDG 7 (Affordable and Clean Energy) (United Nations, 2015). Development efforts emphasize the need to empower women as energy entrepreneurs and leaders, thereby accelerating broader community benefits (Inspira, 2025).

**Social Business: Catalysts for Change**

Gender disparities in clean energy sectors persist globally, limiting women's access to financing and leadership (United Nations International Development Organization, 2022). Social businesses, operating with social impact at their core rather than profit maximization, are instrumental in addressing these disparities (Yunus, 2017). They focus on removing systemic barriers and promoting inclusive models that boost women's participation in clean energy markets.

***Social Business and Affordable Financing***

The clean energy sector still has a male-dominated workforce, with 32% of full-time employees being women, and women-led businesses and startups obtaining less funding (United Nations International Development Organization, 2022). Women frequently encounter obstacles when trying to access conventional sources of financing, notably banks and microfinance institutions. Women's limited access to traditional financial institutions reinforces energy poverty. Social business bridges this gap by giving them access to affordable financing, such as microloans for clean energy goods and services, e.g., solar lighting and clean cookstoves. Financial inclusion has been shown to reduce energy poverty significantly. A recent study by Sen et al. (2023), using survey data from the Bangladesh Household Income and Expenditure Survey held during 2010 and 2016, shows that households with financial inclusion experience significantly lower rates of acute and severe energy poverty by 13% and 33%, respectively, compared to those without financial inclusion. Rural areas benefit more noticeably from financial services, enhancing access to clean energy solutions (Koomson & Danquah, 2021). Female-headed households are statistically less likely to experience severe energy poverty, signaling the importance of gender-sensitive financial inclusion (Kumar Sen et al., 2023).

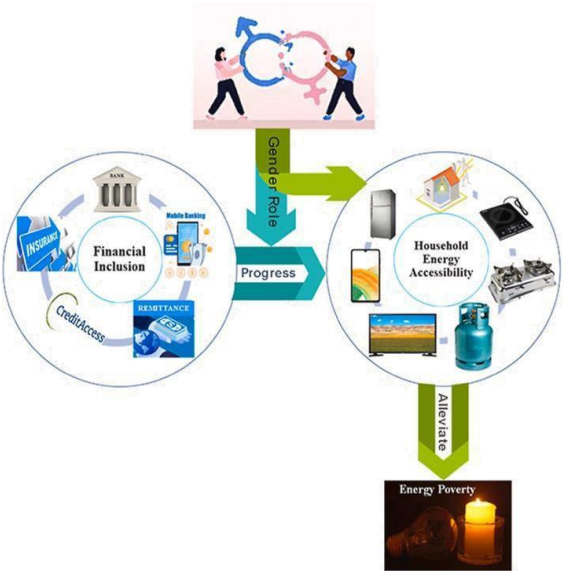


**Figure 2:** Role of gender in the financial inclusion-energy poverty nexus
Source (Kumar, Sen et al., 2023)

***Social Business and Capacity Building***

In the context of promoting clean energy through social business, capacity building will help rural women develop knowledge and skills to use and maintain renewable technologies e.g. clean cookstoves, which will empower them to effectively harness clean energy and decrease their dependence on conventional biomass. It also provides them with entrepreneurship training to run clean energy initiatives. Women could act as change agents by starting cleantech businesses, manufacturing goods with renewable energy, and advocating for sustainable energy (United Nations International

Development Organization, 2022), which will provide them with diverse employment opportunities. According to Kumar, Sen et al. (2023), The average income of residents of developing nations is lower than that of residents of developed nations; therefore, enhancing household income through capacity building and technical training is critical for transforming energy use patterns. Capacity building trains and develops skills for women, both as end-users and potential entrepreneurs in the clean energy sector, thus empowering them to be in charge of their economic well-being and energy needs. Grameen Shakti's success in training thousands of women as agents of clean cooking and biogas technologies exemplifies how capacity development fosters sustainable energy adoption and women's economic empowerment (WePower, 2021).

**Clean Energy and Disaster Vulnerability**

In the rural areas, women are still heavily dependent on traditional biomass, which, when inefficiently burnt, releases high volumes of black carbon, making indoor air pollution a major concern for women and girls. This combination of pollution and increased heat increases health hazards for women and is responsible for nearly 2 million deaths each year worldwide, mostly among women and children living in the poorest communities (UN Women & IUCN, 2022). Exposure to indoor air pollution from solid fuel used for cooking results in 4.3 million premature deaths per year, with women and children accounting for 60% of these deaths (Koomson & Danquah, 2021). Renewable energy technologies promoted by social businesses help mitigate these risks. By giving them access to lighting, cooking, etc. that are not reliant on fossil fuels or energy sources which can be disrupted by disasters, clean energy lessens disaster vulnerabilities. Women's health can also be improved through renewable energy. Improved cookstoves, for instance, are more effective in terms of energy efficiency, pollution control, and improve user safety (Dutta et al., 2017). According to the World Health Organization (2006), investing in clean cooking stoves and fuel will repay itself many times over in reduced illness and increased economic benefits. Social business promoting clean energy to women in developing nations not only improves their lives but also enhances disaster resilience and contributes to reducing pollution. Moreover, clean energy access creates new economic opportunities through job and enterprise creation, contributing to poverty alleviation and increased resilience among women in vulnerable rural settings (WePower, 2021). Successful gender-inclusive energy initiatives thus represent

critical pathways to achieving multiple sustainable development goals concurrently.

## Methodology

For this study, an inclusive approach was taken to the concept of social business and the organization Eminate, taking that approach, and its outcome. An extensive literature review on social business, women's empowerment, and clean energy in developing nations was conducted, which formed the foundation for the empirical studies and helped identify the primary research questions. The framework is focused on examining the role of social business in providing clean energy access for women in rural Bangladesh in the context of women's empowerment. The empirical approach phase included structured interviews, site visits, and data analysis. The questionnaires included both qualitative and quantitative questions. Direct observations were made during site visits to the rural Bangladeshi schools where the organization's initiative was put into practice. The implementation and operation of digital sensors, solar energy technology, and the use of solar electricity in the school and community were also documented. To support the case study's objectives and analysis, throughout the investigation, relevant findings from the literature were applied, which supported the significance of women's empowerment, disaster resilience, and access to clean energy in developing nations and highlighted the potential contribution of social business to solving these issues.

### Data: Sources and Collection

To ensure the accuracy and reliability of the research findings, structured surveys were conducted involving various stakeholders from both the schools and the vocational training program. These surveys consisted of administering pre-designed questionnaires (Appendix), which served as the primary data collection instruments. The questionnaires were carefully crafted to align with the study's objectives, aiming to gather both quantitative and qualitative data on the impact of clean energy access, women's empowerment, and capacity building. Site visits were conducted at the rural schools to collect observational data and facilitate interactions with school personnel and community members, providing valuable qualitative insights. Interviews were held in person at the schools and over the telephone in line with respondents' preferences, supplementing questionnaire responses with more nuanced information. Participants included teachers, students, and parents from the schools, along with trainers and trainees from the vocational program. The questionnaires incorporated a mix of closed-ended questions for measurable outcomes, such as

changes in academic performance and income levels from vocational activities, and open-ended questions to explore perceptions of gender roles and empowerment. Detailed interview guides complemented the questionnaires to explore relevant themes in depth. Observational notes captured the practical effects of renewable energy access and documented the operation and benefits of solar technologies and sensors within the community.

**Study Population and Sampling**

The study population consisted of key stakeholders involved in two rural schools in Netrokona, Bangladesh, where social business initiatives provided solar energy access and vocational training. Each school operates with a single large teaching hall accommodating students from grades one through five. To ensure comprehensive representation across grades, two students from each grade were purposively selected for interviews, along with one parent per student, totaling ten student-parent pairs per school. Both teachers from each school (two per school) were also interviewed. For the vocational training program, the sample included the trainer, ten trainees, and their parents. Purposive sampling allowed for purposeful selection based on context relevance, increasing the validity of qualitative insights obtained. The surveys incorporated structured questionnaires designed to capture measurable impacts related to changes in academic performance, vocational income, and perceptions of gender roles. The sample size, while limited, was sufficient for a detailed case study approach consistent with established qualitative research practices that prioritize depth over breadth (Denscombe, 2014).

**Data Analysis**

The case studies were written with a comprehensive understanding of all the qualitative and quantitative data collected, ensuring that the findings accurately reflect the experiences and outcomes observed in both schools. The qualitative data, particularly the detailed responses from interviews and surveys, were integral to understanding the full impact of the solar electricity initiatives on the educational environment and vocational training programs. Content analysis was carried out on the information gathered from the observations and interviews. In order to identify recurrent themes relating to women's empowerment and access to clean energy, interview transcripts were meticulously analyzed, which enabled them to identify insights and patterns from the qualitative data. Smart solar monitoring system was used to analyze quantitative data, such as trends of electricity usage tracked by sensors. In order to enhance the reliability and validity of the results,

multiple data sources and procedures were used. A more comprehensive understanding of the research objective was attained by comparing interview responses with empirical data.

## Case Presentations and Findings

A Bangladeshi organization, Eminate's social business project, which provided solar electricity and internet connectivity with low-power Raspberry Pi 4 computers to rural schools for women, served as an instructive case study. One of the schools also provides vocational training in sewing. As they are in remote areas without a reliable grid-tied electricity system, solar energy with battery storage provides students with long hours of electricity for education and vocational training. In addition, digital sensors have been installed, enabling remote monitoring of energy consumption. This revealed unexpected nighttime electricity demand during cyclones and storms, showcasing the schools' ability to serve as flood shelters due to their solar connections. With newfound stitching skills and improved access to electricity through solar energy, these women have been empowered to develop the self-confidence to pursue additional income-generating options and apply for microcredit loans. The data collected covered relevant questions that reflect positive changes observed in the school's functionality and the study habits of students since the introduction of solar electricity. Participation and attendance of women increased both in the classroom and vocational training, and access to clean energy affected the students' learning experiences.

### Case Study 1

Koilong Puranbari Private Primary School, situated in the rural area of Netrokona, Bangladesh, received its solar electricity connection in 2021. The school serves a growing number of students, both male and female, and has faced challenges related to frequent load shedding and inadequate lighting and air circulation. The solar installation was intended to address these issues and enhance the overall educational experience, including the increased number of students in extracurricular activities (ECA) and improved academic performance.

**Table 1**: Total Number of Enrolled and Female Students in School

| Year | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|
| Total Female Students | 31 | 37 | 42 | 42 | 55 |
| Total Students | 90 | 103 | 109 | 111 | 127 |

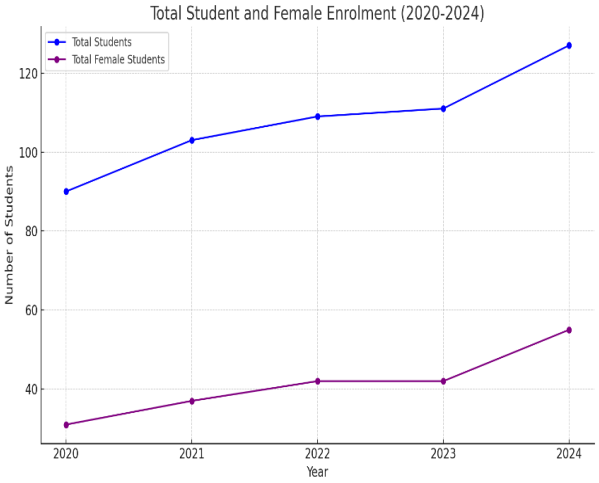


**Figure 3** Total Number. of Students and Female Enrolment

Figure 3 illustrates the enrollment trends of total students and total female students from 2020 to 2024. The number of total students steadily increases each year, starting from around 90 in 2020 to 127 by 2024. The enrollment of female students also shows a consistent rise, although at a slower rate, starting from 31 in 2020 to 55 in 2024. The gap between the total students and female students suggests that while female enrollment is increasing, the total student body is growing at a faster rate, indicating a larger proportion of male students over the years.

**Table 2**: "Total Number of Enrolled and Female Students in ECA"

| Year | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|
| Total Female Students | 7 | 6 | 20 | 22 | 30 |
| Total Students | 10 | 16 | 30 | 36 | 50 |

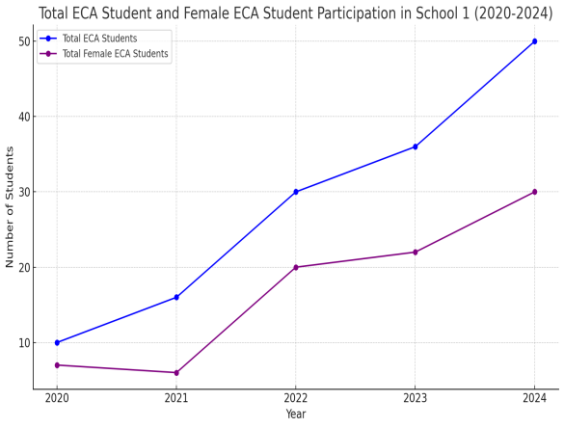


**Figure 4** Total no of Students and Female ECA participation

Figure 4 shows the participation trends of total ECA students and female ECA students from 2020 to 2024. The participation in extracurricular activities has grown significantly over the years, starting from 10 students in 2020 to 50 students by 2024. There is a consistent upward trend with a sharp increase between 2023 and 2024. The number of female students participating in ECA also increases over the period, starting from 7 in 2020 and reaching 30 by 2024. However, the growth is slower compared to the total ECA students,

indicating that while female participation is increasing, it constitutes a smaller portion of the total ECA student body. The gap between the total and female students shows that while female participation in ECA is increasing, the overall growth in ECA participation includes a larger proportion of male students.

***Key Findings***

The availability of solar electricity has positively influenced academic performance at the school. Students reported increased motivation and better study habits due to the reliable power supply. The latest survey conducted in 2024 revealed that 68% of students rated the improvement in their study habits as 4 on a scale of 1 to 5, indicating a significant positive impact. Additionally, two students from Class 5 received government scholarships, highlighting the academic advancements made possible by the improved learning environment. The steady increase in student enrollment from 90 in 2020 to 127 in 2024 also suggests that the improvements brought about by solar electricity have made the school more attractive to both students and parents. The school's ability to provide a consistent and comfortable learning environment, despite the challenges of load shedding, has likely contributed to this growth. The number of students participating in ECA has grown significantly since the introduction of solar electricity, from 10 students in 2020 to 50 students in 2024. The growth is particularly notable among female students, who accounted for 60% of the total ECA participants by 2024. The introduction of activities such as art, music, and Holy Quran recitation classes has enriched the students' educational experience, contributing to their holistic development. The data also reveals that although there was a slight dip in female participation in ECA in 2021, this was due to their involvement in other training programs. By 2022, the number of girls in ECA had increased significantly, demonstrating the school's success in balancing academic and extracurricular activities (ECA). The reliable solar-powered electricity has enabled students to engage more in computer-based learning, which has contributed to higher educational outcomes. Teachers reported that students were more interested in learning when they had access to technology, leading to better retention of information and improved test scores. This aligns with the survey results, where a majority of students rated their study habit improvements highly after the installation of solar power. The implementation of solar electricity at the school has been largely successful, with no significant challenges reported by the school administration. However, to sustain and further enhance

these benefits, it is recommended that the school continues to expand its extracurricular offerings and explore additional technological resources to support computer-based learning. The introduction of solar electricity at the school has been a transformative initiative, leading to improved academic performance, increased student enrollment, and greater participation in extracurricular activities. The reliable power supply has not only mitigated the challenges posed by load shedding but has also created a more engaging and conducive learning environment for the students.

**Case Study 2**

Koilong Alefuddin Girls School, an all-girls institution also located in rural Netrokona, received its solar electricity connection in 2022. In addition to regular academic classes, the school also offers a vocational training program in sewing, designed to empower female students and other women in the community. The school aims to provide skills that contribute to economic independence and gender equality.

**Table 3**: Total Numbe of Students Enrolled and in ECA

| Year | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|
| Total Students | 45 | 50 | 60 | 66 | 75 |
| Total Students in ECA | 0 | 0 | 0 | 13 | 20 |

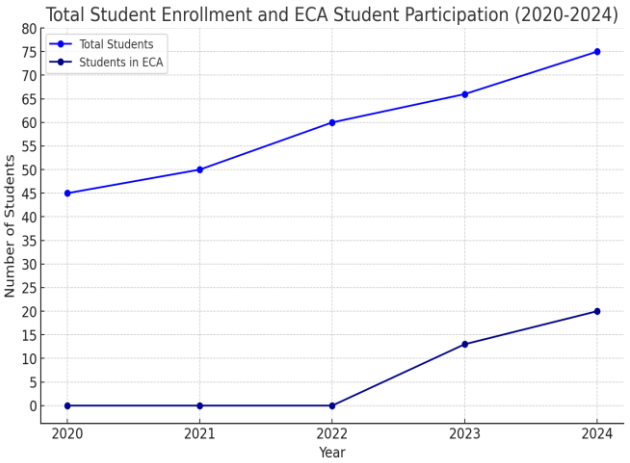


**Figure 5** Total Number of Students Enrolled and ECA Participation

Figure 5 displays the total student enrollment and the participation of students in extracurricular activities (ECA) from 2020 to 2024, and both of them show an upward trend. There is a consistent increase in the total number of students each year. The number of students started at 45 in 2020 and rose steadily each year, reaching 75 by 2024. Before the intervention of solar electricity in 2022, the school did not provide any ECA classes. The school started

ECA from 2023 and participation grew notably, from 13 to 20 within a year.

**Table 4**: Total no. of Trainees and Average Income

| Year (Half yearly) | 2021 -1 | 2021- 2 | 2022-1 | 2022-2 | 2023-1 | 2023-2 | 2024 |
|---|---|---|---|---|---|---|---|
| No. of trainees | 0 | 0 | 40 | 48 | 48 | 52 | 50 |
| Average Monthly Income (BDT) | 0 | 0 | 3500 | 3500 | 4500 | 4500 | 6000 |

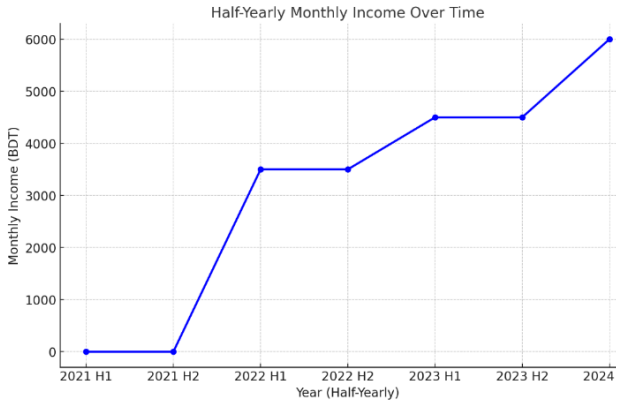


**Figure 6** Half yearly Average Monthly Income

Figure 6 illustrates the progression of average monthly income (in BDT) from the first half of 2021 to the first half of 2024. The vocational training program launched in 2022, resulting in an initial income rise to 3,000 BDT, marking the start of income generation. Income grew and stabilized at 4,500 BDT from 2023 H1 until the year's end. In 2024 H1, there was a sharp rise to 6,000 BDT. The overall trend shows a steady income increase from 2022 onwards, reflecting the positive impact of the vocational training program.

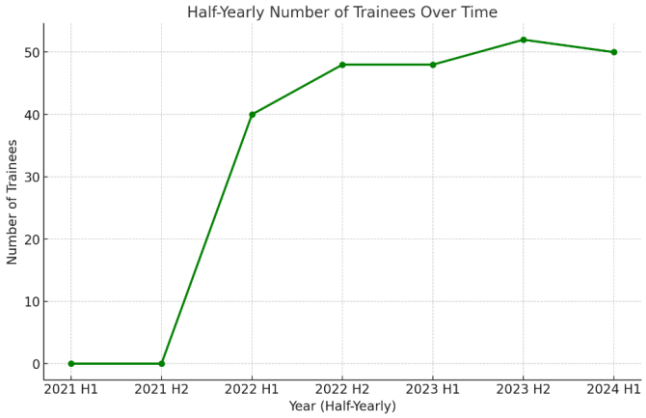


**Figure 7** Half yearly no. of Trainees

Figure 7 shows the number of trainees over time. Vocational training started in 2022, leading to a rapid increase from 0 to 40 trainees in the first half of 2022. The number stabilized at 48 by the first half of 2023, then rose to 52 toward the end of 2023. A dip to 50 occurred in 2024 due to the classroom capacity limit set by the trainer.

***Key Findings***

The introduction of solar electricity has significantly enhanced both the academic and vocational training environments. Reliable power has ensured consistent lighting and air circulation, creating a more comfortable and effective learning space. This has been particularly beneficial for vocational training sessions, where good lighting is essential for detailed

sewing work. The number of trainees in the vocational training program grew steadily from 40 in the first batch of 2022 to a maximum of 50 trainees per batch in 2024. The decision to limit the number of trainees to 50 per batch in 2024 was made to maintain the quality of training, given the limited resources such as sewing machines and training hours. The vocational training programs have led to a substantial increase in the monthly earnings of trainees, from BDT 3500 in 2022 to BDT 6000 in 2024. This income has provided women with greater financial independence and has empowered them to contribute to their families' livelihoods. The consistent increase in earnings reflects the growing skills and confidence of the trainees, as well as the demand for their products in the local market. The vocational training programs have played a crucial role in promoting gender equality by equipping women with marketable skills. Trainees have gained not only more financial independence but also increased influence in household decision-making processes. The ability to contribute economically has elevated their status within their families and communities, challenging traditional gender roles. There has been an increase in participation of women in community decision making processes due to their access to clean energy which has changed the perceptions of roles of women within the community. They are becoming leaders in their community as a whole, encouraging the usage of clean energy solutions resulting in more gender equality and women empowerment.

One challenge identified was the limitation of resources, particularly the number of sewing machines available for training. This constraint led to the decision to cap the number of trainees to ensure that the quality of training remained high. To sustain and expand the program, it is recommended that additional resources, such as more sewing machines and training materials, be provided. Moreover, some challenges related to community dynamics, such as jealousy and resistance from other villagers, were reported by the parents. These issues highlight the need for ongoing community engagement to ensure the continued success and sustainability of the clean energy and vocational training initiatives.

**Disaster Preparedness**

Data from the sensors revealed how the solar-powered lighting and sensors kept the schools operating during power loss. Having access to solar power contributed to disaster resilience in the schools. The solar-powered lighting allows the schools to operate during cyclones or other disasters, providing the students and others in the

community a secure and well-lit environment. During cyclones, the sensors detected exceptional nighttime electricity consumption. This also confirmed the usage of the schools as a flood shelter in case of emergencies. This is aiding the women, school staff, and the community members to reduce their disaster vulnerability.

**Recommendations**

In comparison to other developing nations, energy poverty in Bangladesh is considered severe. Kumar Sen et al. (2023) revealed that a significant portion of the population, mainly in rural and remote areas in Bangladesh, still lacked electricity access (18% of the total rural population in 2019), and about 41% of the total population of the country was deprived of clean cooking facilities in 2016. Although social business is known to alleviate energy poverty, the growth of social business still remains limited. While microfinance organizations have been successful in reaching poorer women, they currently reach only a fraction of those who need financial services (United Nations, 2009). Women, especially those living in rural areas and urban slums, are often deprived of formal financial services due to legal, sociocultural, etc. barriers (United Nations, 2009). Social business addresses the underfunding of women-led organizations, and it has the potential to bridge these financial barriers. According to the British Council (2017), social businesses empower women by providing them access to financing, markets, and networks, along with assisting them to develop their knowledge and skill set. Besides, they are also effective catalysts for reducing gender gaps in energy access. Nevertheless, it is still an underutilized source of finance for gender equality (British Council, 2017).

Key factors such as improved quality of life, women's empowerment, and environmental benefits highlight the importance of expanding the reach and impact of social business for promoting clean energy for women. Despite this evidence, there is still a significant gap in their widespread adoption. The finding of this study highlights the urgent need for social businesses to commit themselves more firmly to actively engage in such ventures. In many areas, adoption of social business centered on sustainable energy for women is still very limited due to limited access to finance, cultural constraints, lack of awareness, etc. There is an urgent need for more social businesses to actively participate in clean energy initiatives that target women in order to solve these issues and take advantage of this enormous opportunity for positive change. This should include not just the development and dissemination of clean energy technologies but also partnerships, educational programs,

and public awareness campaigns that make clean energy solutions more accessible. According to research by UN Women & IUCN (2022), renewable energy in Bangladesh remains significantly underdeveloped, with a total installed capacity of only 766.8 MWp, accounting for around 3% of the total installed capacity. The on-grid capacity is 417 MWp, and the off-grid capacity is 349.79 MWp. This needs to be addressed, and overall substantial work is required for advancement in this sector.

## Future Work

Both case studies illustrate the significant impact of solar electricity on education and economic empowerment in rural Bangladesh. The introduction of solar power has not only improved the academic performance and enrollment rates at both schools but also empowered women through vocational training programs, contributing to gender equality and economic independence. The author would like to launch training initiatives for the female students and staff of the school on clean cooking stoves and study the impact of social business in tackling health challenges for rural women. This will also empower them to make use of and actively manage clean energy solutions. Eventually, the author would then survey these women to determine the health benefits of adopting clean cooking fuels and energy sources. Further study will also be conducted on other such cases. The influence of social business in the renewable energy sector will be further investigated in the future through a number of interviews. In-depth interviews will be conducted with female representatives of social enterprises operating in the clean energy sector of Bangladesh, exploring their training programs, challenges they faced in empowering women, and strategies to provide affordable financing. Furthermore, successful women entrepreneurs who have developed clean energy businesses in Bangladesh will be interviewed in order to discover their experiences, the difficulties they encountered, and the role social business played in assisting their projects. This will help recognize the effects that entrepreneurship in renewable energy has had on their lives and communities.

## Conclusion

This paper has highlighted the critical role social business plays in improving women's access to clean energy in developing nations by creating innovative approaches that cater to the particular needs of women, therefore empowering them in the process. e.g., creating economic empowerment through micro-entrepreneurship. Eminate's efforts are directly linked to reducing energy poverty in rural areas by ensuring access to reliable and

sustainable energy sources. The installation of solar power in schools not only enhances educational opportunities but also contributes to the broader goal of energy security. By reducing dependence on traditional and often unreliable energy sources, such as diesel generators, social business helps to alleviate the energy poverty that plagues many rural communities. The study also revealed significant results and observations about the positive impacts of solar electricity, including disaster resilience and women's empowerment through vocational training combined with clean energy access. The introduction of solar electricity in Case 1 has been a transformative initiative, leading to improved academic performance, increased student enrollment, and greater participation in extracurricular activities. The reliable power supply has not only mitigated the challenges posed by load shedding but has also created a more engaging and conducive learning environment for the students. The solar electricity initiative in Case 2 has had a profound impact on both academic and vocational training outcomes. The reliable power supply has improved the learning environment, while the vocational training program has empowered women economically and socially. The increase in trainees' earnings and their growing influence within their families underscore the success of the program. However, addressing resource limitations and community challenges will be crucial for sustaining these benefits in the long term. Furthermore, by enabling schools to serve as flood shelters during disasters, Eminate's solar projects improve community resilience and reduce vulnerability to energy disruptions during emergencies. This dual focus on providing clean energy and enhancing disaster preparedness illustrates how social businesses can play a pivotal role in reducing energy poverty while fostering sustainable development. Social business also allows women to act as social drivers and contribute to eradicating social issues related to gender inequality. Although social business has been promising in women's empowerment and promoting clean energy access for women, it requires considerable expansion and adoption. Future research could focus on long-term assessment of social business impacts on women's empowerment, income, and environmental sustainability. By addressing the challenges, social businesses can significantly help achieve sustainable development goals and enhance the lives of women in marginalized areas.

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**Conflict of Interest**

The author declares there is no conflict of interest associated with this research.

**References**

Accenture, & Global Alliance for Clean Cookstoves. (2012). Global alliance for clean cookstoves Bangladesh market assessment sector mapping. In *Clean Cooking Alliance*. https://cleancooking.org/reports-and-tools/bangladesh-market-assessment-sector-mapping/

British Council. (2017). Activist to entrepreneur: The role of social enterprise in supporting women's empowerment. In *www.britishcouncil.org*. British Council. link

Cecelski, E., Oparaocha, S., & SDG Action. (2023, March 2). *The lack of gender targets for clean energy is harming women and Girls*. SDG Action. link

Denscombe, M. (2014) *The Good Research Guide: for Small-Scale Social Research Projects*. 5th edn. Maidenhead: Open University Press.

Dutta, S., Kooijman, A., Cecelski, E., & ENERGIA. (2017). Energy Access and Gender Getting the Right Balance. In *documents.worldbank.org*. The World Bank. https://documents1.worldbank.org/curated/en/463071494925985630/pdf/115066-BRI-P148200-PUBLIC-FINALSEARSFGenderweb.pdf

Energy 4 Impact (Powered by Mercy Corps). (n.d.). *Energy 4 Women | Energy 4 Impact*. Energy4impact.org. Retrieved September 21, 2023, from https://energy4impact.org/impact/energy-4-women

International Energy Agency. (2021). *Tracking SDG7: The Energy Progress Report, 2021*. https://www.iea.org/reports/tracking-sdg7-the-energy-progress-report-2021

Inspira (2025) 'Tackling Energy Poverty for Women in Bangladesh', Inspira Advisory and Consulting, September. Available at: https://inspira-bd.com/tackling-energy-poverty-for-women-in-bangladesh/ (Accessed: 18 September 2025).

Koomson, I., & Danquah, M. (2021). Financial inclusion and energy poverty: Empirical evidence from Ghana. *Energy*

*Economics*, *94*. https://doi.org/10.1016/j.eneco.2020.105085

Kumar Sen, K., Chandra Karmaker, S., Hosan, S., Chapman, A., Kamal Uddin, Md., & Baran Saha, B. (2023). Energy poverty alleviation through financial inclusion: Role of gender in Bangladesh. *Energy*, *282*, 128452–128452. https://doi.org/10.1016/j.energy.2023.128452

Manusher Jonno Foundation (2024) *Assessment of Gender Impacts in Renewable Energy Technologies in Bangladesh*. Dhaka: MJF

Sanjeevikumar Padmanaban, S., Sharmeela, C., Sivaraman, P., & Bo Holm-Nielsen, J. (2021). *Residential microgrids and rural electrifications*. Academic Press.

UN Women, & IUCN. (2022). State of gender equality and climate change in Bangladesh. In *asiapacific.unwomen.org*. link

United Nations. (2009). 2009 World Survey on the Role of Women in Development . In *un.org*. United Nations. https://www.un.org/womenwatch/daw/public/WorldSurvey2009.pdf

United Nations International Development Organization. (2022, March 15). *Gender and Energy*. Www.youtube.com. https://www.youtube.com/watch?v=yKyVxhTQrOk

WePower. (2021, January 31). *Sohel Ahmed, Managing Director, Grameen Shakti, Bangladesh*. www.youtube.com. https://www.youtube.com/watch?v=MU3Y8sy52A8

WePower (2021) *Clean Energy and Women's Economic Empowerment: Case Studies and Impact Overview.* Washington, DC: World Bank Group. Available at: link (Accessed: 18 September 2025)

World Health Organisation. (2006). Fuel for Life: Household Energy and Health. In *iris.who.int*. https://iris.who.int/bitstream/handle/10665/43421/9241563168_eng.pdf?sequence=1

Yunus, M. (2017, January 4). Social Business - the Business Model of the future? | London Business School. In *YouTube*. London Business School- Leading Minds. https://www.youtube.com/watch?v=RNSTRfw_-DE