

ASSESSING THE DECLINE OF SOLAR HOME SYSTEMS IN BANGLADESH

TRENDS, CHALLENGES & DETERMINANTS

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Executive Summary

Bangladesh's Solar Home System (SHS) programme, led by the Infrastructure Development Company Limited (IDCOL) with support from government and development partners, was once among the most successful off-grid renewable energy initiatives in the world, installing over 4.1 million systems and reaching more than 20 million people by 2018. In recent years, however, adoption has declined sharply as grid electricity has expanded into previously off-grid areas and as free-panel programmes such as TR/KABITA have reduced demand for market-based systems. High upfront costs, weak after-sales service, loan repayment difficulties, and limited technological upgrading have further eroded consumer confidence. This study was undertaken to examine both the supply and demand-side drivers of this decline and to identify viable pathways for revitalising or replacing SHS as Bangladesh works towards its renewable energy targets for 2041.

The study is based on a nationally representative household survey of 480 respondents across all eight divisions of Bangladesh, covering IDCOL SHS, TR/KABITA, and personally purchased rooftop solar users. A multi-stage sampling design selected 40 Primary Sampling Units using probability-proportional-to-size methods, with snowball sampling of eligible households within each unit. The survey is complemented by a review of cross-country experience with residential solar adoption and by qualitative evidence intended to inform follow-up key informant interviews.

The findings show an overall system functionality rate of only 45.98 per cent, with IDCOL SHS and TR/KABITA units performing similarly poorly relative to personally purchased rooftop systems, which are functional in over three-quarters of cases. Battery-related failures are the leading cause of discontinuation across installation types, compounded by the expansion of grid electricity and, to a lesser extent, financial and technical constraints. Mean user satisfaction stands at 7.38 out of 10 overall, but diverges sharply between TR/KABITA users (8.21) and IDCOL SHS users (5.98), pointing to uneven service delivery. Despite these shortcomings, latent demand remains strong, with more than two-thirds of respondents willing to adopt low-cost solar solutions in future. Reported informal payments are limited but not absent, underscoring the continued importance of institutional safeguards.

The study recommends strengthening battery quality standards and lifecycle support, particularly through a shift towards lithium-ion technology; building local repair and technical service networks; standardising and holding service delivery agencies to long-term quality assurance; promoting residential rooftop solar with net metering; supporting hybrid systems that combine grid and off-grid solar; enabling structured upgrade pathways for existing users; introducing flexible financing for rooftop and upgraded systems; strengthening governance and consumer protection; and aligning decentralised solar programmes with Bangladesh's long-term energy transition planning.

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Acronyms

BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka
BREB	Bangladesh Rural Electrification Board
DC	Direct Current
HIES	Household Income and Expenditure Survey
IDCOL	Infrastructure Development Company Limited
KABITA	Kajer Binimoy Taka (Food/Money for Work Programme)
KII	Key Informant Interview
LED	Light Emitting Diode
MoDMR	Ministry of Disaster Management and Relief
NESCO	Northern Electricity Supply Company
PPS	Probability Proportional to Size
PSU	Primary Sampling Unit
PV	Photovoltaic
RDGD	Rural Development and Co-operatives Division
SHS	Solar Home System
SREDA	Sustainable and Renewable Energy Development Authority
TR-KABITA	Test Relief – Kajer Binimoye Taka

1. Introduction and Objectives

The Solar Home System (SHS) programme in Bangladesh has globally been recognised as one of the most successful off-grid renewable energy initiatives. Launched in the early 2000s, the programme aimed to provide electricity to rural and remote areas where grid extension was not economically viable. The Infrastructure Development Company Limited (IDCOL), with support from the government and development partners, played a central role in implementing and scaling up the programme. A number of other public-private agencies were involved in the implementation as well.

At its peak, the SHS programme installed over 4.1 million systems by 2018, bringing electricity to more than 20 million people (Cabraal et al., 2021). These systems not only improved household lighting and enabled small-scale income-generating activities but also contributed to social benefits such as better education outcomes and enhanced communication through mobile phone charging.

However, in recent years, the SHS programme has seen a decline in adoption. The expansion of the national grid, which now reaches many previously off-grid areas, offers a more stable and cheaper electricity supply, diminishing the need for off-grid solutions. Additionally, government initiatives such as the TR/KABITA Social Safety Net programme, which distributes free solar panels, have further reduced demand for SHS systems. The SHS sector also faces several challenges, including high upfront costs, difficulties in loan repayment, a lack of after-sales service, and limited technological upgrades (Cabraal et al., 2021). Additionally, challenges such as loan defaults and system maintenance issues have further dampened enthusiasm for SHS (Hellqvist & Heubbaum, 2023). These factors have undermined consumer confidence, contributing to the programme's decline.

Furthermore, the evolving energy landscape in Bangladesh, with an increased focus on grid-based renewable energy projects, has shifted policy priorities, leaving the SHS programme with diminishing financial and institutional support (Cabraal et al., 2021). These factors collectively pose a risk to the sustainability of the SHS programme and raise concerns about its future contribution to Bangladesh's renewable energy targets.

By examining both supply and demand-side challenges, this study presents a comprehensive understanding of the barriers impeding SHS adoption and usage and explores potential strategies to revitalise or replace the SHS programme so that the household end solution for Bangladesh's renewable energy transition remains viable. The findings are intended to offer valuable insights for policymakers, development agencies, and renewable energy stakeholders. With Bangladesh striving to achieve its renewable energy targets by 2041, addressing the challenges facing SHS is crucial for sustaining momentum in the country's renewable energy transition.

This survey aims to investigate the declining use of SHS in Bangladesh, with a particular focus on identifying the underlying factors behind this trend and proposing strategies for viable alternatives or revitalising the sectors. The study will assess both supply and demand-side challenges while considering the broader renewable energy transition goals of the country.

The objectives of the study are as follows:

- a) Assessing the status of Solar Home Systems (SHS) in Bangladesh, including the scale of adoption and recent patterns indicating a decline,
- b) Identifying the key factors contributing to the decreasing usage of SHS,
- c) Putting forward policy recommendations regarding possible alternatives for solar based solutions at household level.

2. Literature Review

The Solar Home System (SHS) programme in Bangladesh has been widely recognised as a pioneering initiative for rural electrification in off-grid areas. Since its inception in the early 2000s, the programme has successfully provided electricity to millions of households, particularly in remote and coastal regions where grid extension is either economically unfeasible or technically challenging (Cabraal et al., 2021; Sharif & Mithila, 2013). The programme's decentralised approach, supported by the Infrastructure Development Company Limited (IDCOL) and development partners, has enabled widespread adoption through microcredit schemes and partnerships with private service providers (Najmul Hoque & Kumar Das, 2013). The deployment of SHS has been instrumental in improving access to basic electricity services, allowing households to engage in lighting, charging mobile phones, and small-scale productive activities. Research shows that hybrid mini-grid solutions, including solar PV systems, can complement SHS initiatives in off-grid coastal areas, further enhancing energy access and local development (Alam and Bhattacharyya, 2016). Despite its initial success, recent studies indicate a decline in adoption due to factors such as grid expansion, programme fatigue, loan repayment challenges, and limited technological upgrades (Hellqvist & Heubaum, 2023; Saim & Khan, 2021). These observations underscore the need to evaluate both supply- and demand-side factors in sustaining rural electrification through SHS.

2.1 Cross-Country Cases of Residential Solar PV Adoption

Comparative evidence from global contexts reveals the diverse pathways through which residential solar photovoltaic (PV) technologies have diffused and highlights the roles of economic, institutional, social, and policy determinants in shaping adoption outcomes. Systematic reviews of residential solar PV adoption demonstrate that despite high technical potential worldwide, adoption patterns vary markedly across regions due to differences in financial incentives, market structures, regulatory frameworks, and socio cultural dynamics (Wu et al., 2025; Schulte et al., 2021). High upfront costs and lack of consumer recognition remain among the most persistent barriers internationally, even where the long run economic viability of solar PV is established (Wu et al., 2025). Policy instruments such as subsidies, rebates, feed in tariffs, and net metering schemes have been widely implemented in high income contexts to lower financial obstacles and stimulate household uptake, with evidence showing positive effects on adoption rates where these mechanisms are sustained and predictable (Wu et al., 2025).

In developed economies like Germany, research has documented the importance of peer effects and social networks in facilitating residential PV adoption. Empirical studies indicate that the presence of PV adopters within a social circle increases the likelihood of others adopting, as potential adopters gain information, normative support, and confidence through interpersonal interactions (Scheller et al., 2021). Similar patterns of information diffusion have been observed in the United States and parts of Europe, where community norms and visibility of rooftop systems contribute to adoption behaviour beyond strictly economic considerations (Schulte et al., 2021). These social dynamics often interact with supportive policy environments, such as tax incentives and net metering, which together create enabling conditions that are less common in lower income regions.

In contrast, adoption experiences in the Global South often reflect structural, financial and institutional constraints. Studies in South Asia and Africa highlight that households face significant funding barriers due to limited access to affordable credit and weak policy support, which dampens demand even where solar PV presents a compelling alternative to unreliable grid electricity (Mustafa et al., 2024; Schulte et al., 2021). Research from Pakistan illustrates that rural households' adoption of solar PV is influenced by demographic and socioeconomic factors such as age and income, with older and relatively better off households more likely to adopt systems where informal financing or community support is available (Ahmar et al., 2022). Broader literature reviews of developing country contexts find that economic constraints, limited technical capacity, and regulatory impediments significantly hinder uptake, suggesting that conventional subsidy mechanisms are necessary but not sufficient without complementary measures to strengthen markets and technical support (Decoding Solar Adoption, 2025; Schulte et al., 2021; Wu et al., 2025).

Additionally, cross country studies suggest that contextual energy access conditions critically shape adoption trajectories. In regions with near universal grid access, such as Seychelles and parts of Eastern Europe, adoption of household solar is driven more by environmental attitudes and perceived economic benefits rather than by energy necessity, and policy incentives like rebates can have a pronounced effect on diffusion ((Oliva & Atehortua Santamaria, 2025)). Conversely, in contexts where grid reliability is low or absent, households often pursue solar PV as a substitute for conventional electricity despite financial barriers, yet uptake remains constrained without institutional mechanisms that address financing, after sales service, and market trust (Schulte et al., 2021; Wu et al., 2025). Cross country comparative reviews also reveal that adoption determinants include not only economic and technical factors but also demographic, social, and regulatory dimensions such as education, awareness, and the presence of enabling policy frameworks (Solar PV adoption review, 2023).

These diverse international experiences underscore that while residential solar PV adoption is globally relevant, the specific combination of drivers and obstacles differs markedly across regions. High income countries demonstrate how cohesive policy incentives and social diffusion mechanisms can accelerate adoption, whereas developing countries illustrate how financial barriers, limited institutional capacity, and regulatory gaps can suppress diffusion even amidst high solar potential. Integrating these cross country insights into the evaluation of Bangladesh's SHS programme decline enriches understanding of the multifaceted drivers of household solar adoption and highlights the importance of tailored policy and market strategies that reflect local socioeconomic and institutional realities.

2.2 Determinants of Solar PV Adoption

Multiple studies have examined the determinants of solar PV adoption at the household level, emphasising the interplay of economic, social, and technical factors. Economic affordability, access to microcredit, and the availability of subsidies are frequently cited as critical drivers (Najmul Hoque & Kumar Das, 2013; Cabraal et al., 2021). Technical reliability, including battery longevity and system performance, strongly influences household trust and continued use of SHS (Hellqvist & Heubaum, 2023). Social and behavioural factors, such as peer influence, awareness, and education, also play a significant role in adoption decisions (Kabir et al., 2017). Furthermore, external contextual factors, including the expansion of the national electricity grid and alternative electrification programmes, affect the relative attractiveness of SHS compared to grid electricity (Saim & Khan, 2021). Collectively, these determinants underscore the importance of a comprehensive analytical approach that integrates household choice, technical reliability, market conditions, and policy environments when evaluating SHS adoption patterns in Bangladesh.

2.3 Impact of SHS at the Household Level

The deployment of SHS has generated a range of economic, social, and environmental impacts at the household level. Empirical studies indicate that access to solar electricity improves educational outcomes by enabling students to study after dark, enhances communication through mobile phone charging, and supports small-scale income-generating activities such as home-based businesses (Samad et al., 2013; Kabir et al., 2017). Health benefits have also been reported due to reduced reliance on kerosene lamps, which decreases indoor air pollution and associated respiratory risks (Sharif & Mithila, 2013). Social impacts include increased community engagement, improved gender equity in household energy decision-making, and greater empowerment through access to information and technology and extending home-based productive hours, thereby strengthening their bargaining power within the household (Kabir et al., 2017). However, studies also highlight limitations, such as system failures, insufficient after-sales support, and loan repayment challenges, which can diminish these benefits and discourage sustained adoption (Hellqvist & Heubaum, 2023; Saim & Khan, 2021). These findings highlight the importance of addressing both technical and institutional constraints to maximise the developmental impact of SHS programmes and ensure their sustainability within Bangladesh's broader renewable energy transition.

2.4 Lessons Learned

The recent stagnation of SHS adoption in Bangladesh reflects underlying structural and institutional constraints in sustaining decentralised energy solutions. Declining uptake, driven by grid expansion, repayment challenges, and limited technological upgrading, indicates that early programme momentum has not translated into long term resilience. This suggests that off grid strategies must evolve alongside changing energy systems and household demands. Despite its success in rapidly expanding rural electrification, the SHS programme illustrates the difficulty of sustaining gains without adaptive policy and market mechanisms. While microcredit-based delivery and strong institutional coordination enabled large scale adoption, the lack of evolution in product design, service delivery, and regulatory support has constrained continued growth. This highlights the need to shift from expansion to consolidation and upgrading.

A key lesson is that financial access alone is insufficient for sustained adoption. Although credit and subsidies reduce upfront costs, long-term engagement depends on system reliability, maintenance, and user trust. Weak after sales support undermines confidence and limits continued use, emphasising the importance of strengthening service ecosystems alongside financing.

Cross-country evidence reinforces the role of coherent and stable policy environments. Sustained incentives such as net metering and fiscal benefits have driven adoption in advanced markets, whereas fragmented policy frameworks in developing contexts hinder diffusion. For Bangladesh, scaling next generation solutions will require better alignment of incentives, regulations, and institutional roles.

The literature also highlights the importance of social and behavioural dynamics. Peer effects, awareness, and visibility influence household decisions, yet these factors remain underutilised in Bangladesh's SHS model. Incorporating community-based diffusion strategies could strengthen demand, particularly for newer technologies. Technological rigidity further limits sustainability. The inability of SHS to meet rising energy needs underscores the importance of modular and upgradeable systems. Integrating the SHS with hybrid models or enabling transitions to rooftop solar can help maintain relevance and avoid technological lock in.

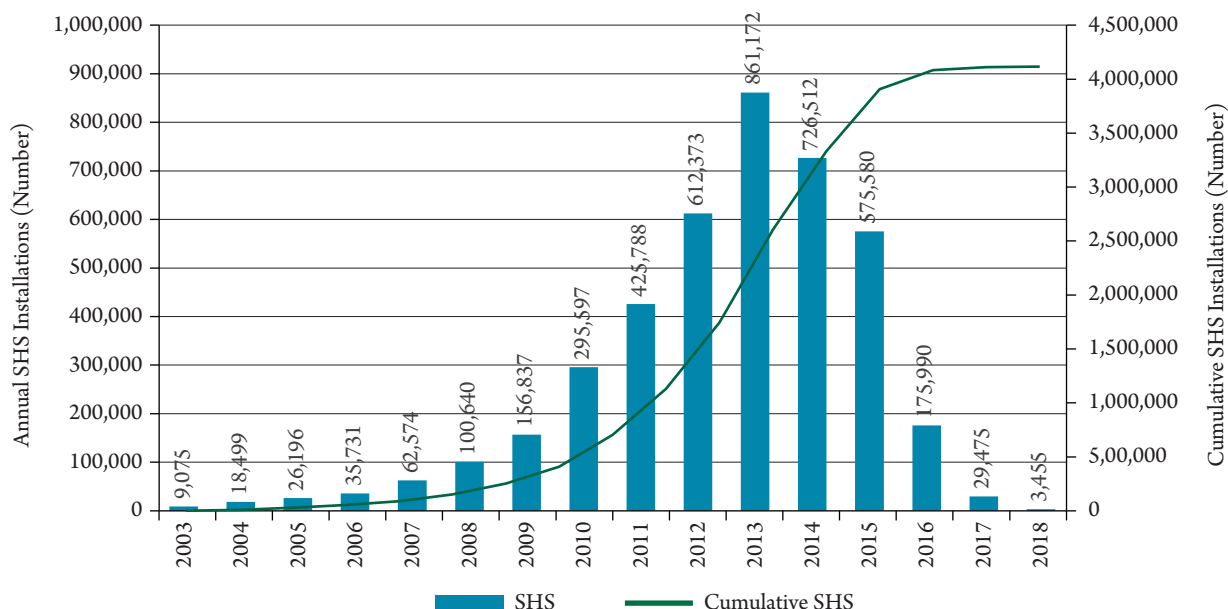
Finally, the interaction between the SHS and grid expansion points to the need for systemic coordination. Off grid solutions should be repositioned as complementary within a broader energy framework rather than transitional. Aligning SHS with grid development and distributed energy strategies is essential for long term sustainability. Overall, the evidence suggests a shift towards a sustainability-oriented approach that integrates financing, service quality, policy coherence, and technological adaptability to support continued growth in residential solar adoption.

3. Overview of Bangladesh's SHS

Beyond expanding rural electrification, SHS improved household lighting, enabled mobile phone charging, supported small-scale income-generating activities, and contributed to broader social outcomes, including improved educational opportunities and enhanced access to communication. The historical growth trajectory of the programme is presented in Figure 1, while the geographic concentration of SHS installations across Bangladesh is illustrated in Figure 2.

Despite these achievements, the SHS programme has experienced a notable decline in recent years. Rapid expansion of the national electricity grid has reduced dependence on off-grid energy solutions by providing households with a more reliable and affordable source of electricity. At the same time, government-supported initiatives such as the TR/KABITA Social Safety Net Programmes (SSNPs) have altered the market for conventional SHS installations. Additional challenges including high upfront investment costs, loan repayment difficulties, inadequate after-sales services, limited technological upgrading, battery failures, and declining institutional support have further constrained the sustainability of the programme (Cabraal et al., 2021; Hellqvist & Heubaum, 2023). Together, these factors have weakened consumer confidence and reduced incentives for continued investment in SHS.

Figure 1 Trend in SHS Use in Bangladesh



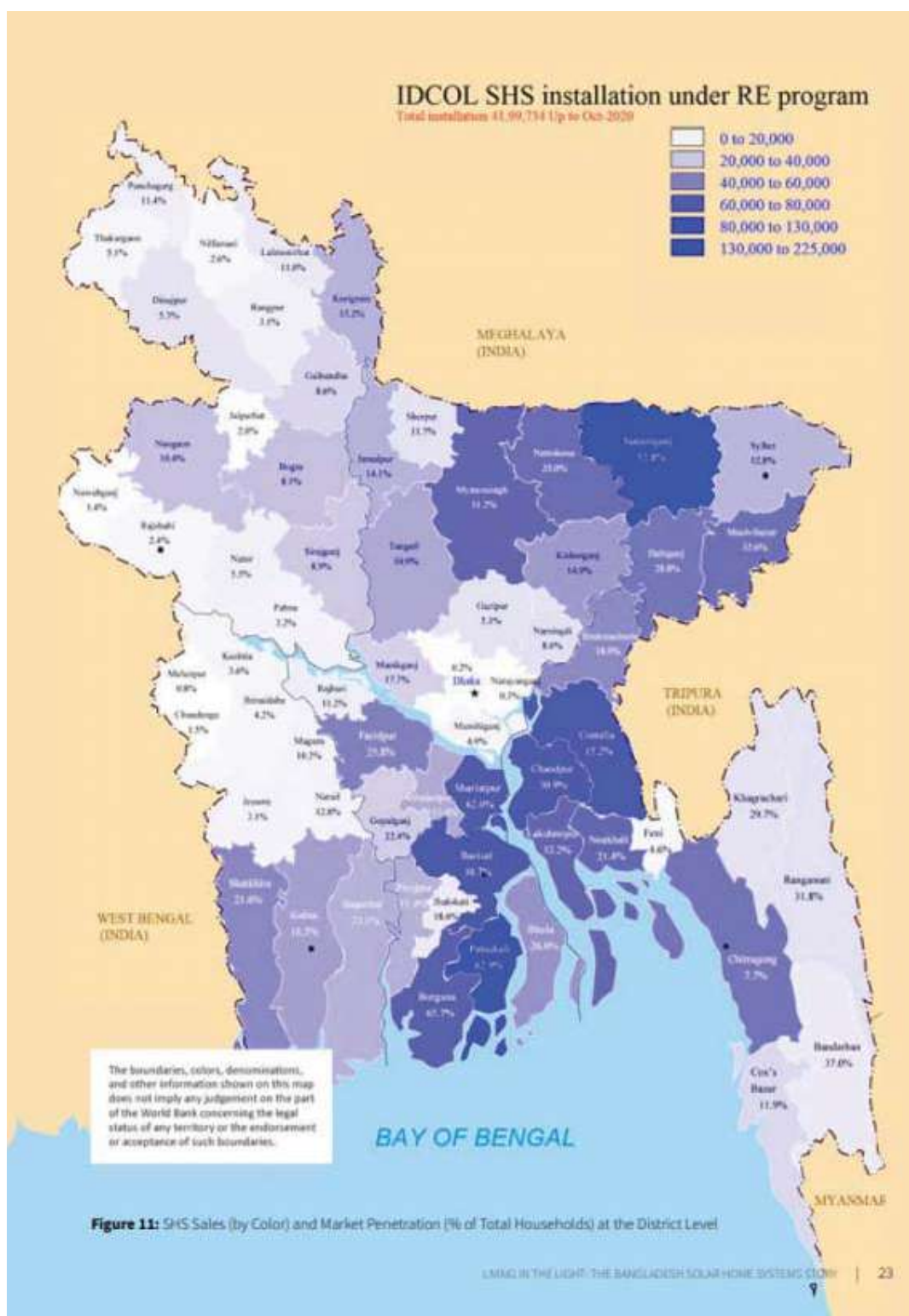
Source: Collected from World Bank (Cabraal et al., 2021).

The changing energy landscape in Bangladesh has also shifted policy attention towards grid-connected renewable energy systems, leaving decentralised household solar solutions with comparatively lower institutional and financial priority. These developments raise important questions regarding the long-term role of SHS within Bangladesh's renewable energy transition and highlight the need to reassess the programme's strengths, limitations, and future potential.

Against this backdrop, the study undertakes a nationally representative primary survey of 480 households across Bangladesh, complemented by community-level information collected from local repair service providers and solar equipment sellers. It examines the current status of Solar Home Systems across different acquisition models, including IDCOL SHS, TR/KABITA, and personally purchased rooftop systems, and investigates the technical, financial, institutional, and behavioural factors influencing their continued use or discontinuation. By incorporating both household and community-level perspectives, the study captures the interplay between user experiences, maintenance ecosystems, and local market conditions.

The study further assesses demand-side behaviour, technical performance, market dynamics, and institutional arrangements to identify the principal drivers behind the observed decline in SHS adoption. Through an integrated analysis of household experiences and broader structural constraints, it evaluates the sustainability of decentralised solar technologies within Bangladesh's evolving energy landscape while identifying opportunities for revitalising household-level renewable energy through improved technologies, maintenance systems, financing mechanisms, and policy support. The findings are intended to inform policymakers, implementing agencies, development partners, and other stakeholders in designing strategies that strengthen decentralised renewable energy systems and support Bangladesh's transition towards a resilient and inclusive low-carbon energy future.

Figure 2 Density of SHS Use in Bangladesh



Source: Collected from World Bank (Cabral et al., 2021).

4. Analytical Framework

The analytical framework for this study is designed to capture the complex interplay of factors influencing the adoption, usage, and sustainability of SHS in Bangladesh.

4.1 Demand-side Issues

At the core of this framework is the concept of household energy choice. Households make decisions on energy technologies based on a combination of economic, social, and technical considerations. Economic factors include the upfront cost of SHS installation, access to microcredit or loan facilities, the affordability of repayment schedules, and the long-term financial benefits of using solar energy compared to alternative energy sources such as kerosene or grid electricity (Cabraal et al., 2021). Socio-cultural factors also shape household decisions, as preferences may be influenced by local norms, gendered energy use patterns, and social learning, including the experiences and opinions of neighbours and community members. Perceived reliability is another important determinant, as households weigh the anticipated durability of SHS components and the availability of timely after-sales service when deciding whether to adopt or continue using solar systems (Hellqvist & Heubaum, 2023). These combined factors form the demand-side dynamics of the SHS sector, highlighting why household behaviour is central to understanding patterns of adoption and decline.

4.3 Technological Issues

Technical performance and the economics of repair represent a second critical dimension of the framework. SHS sustainability depends not only on initial installation but also on the reliability and maintenance of system components, particularly batteries, solar panels, and inverters. Frequent failures or performance degradation can erode consumer confidence, reduce system lifespans, and lead to increased costs for households. The availability of trained technicians, access to spare parts, and affordability of repairs are crucial for maintaining user satisfaction and ensuring that systems remain operational over time (Cabraal et al., 2021; Hellqvist & Heubaum, 2023). The interaction between technical reliability and economic incentives is particularly important in microcredit-based models, where timely loan repayment may depend on uninterrupted electricity provision. Therefore, technical failures and repair costs are not merely operational challenges but directly influence household adoption decisions and the long-term viability of SHS programmes.

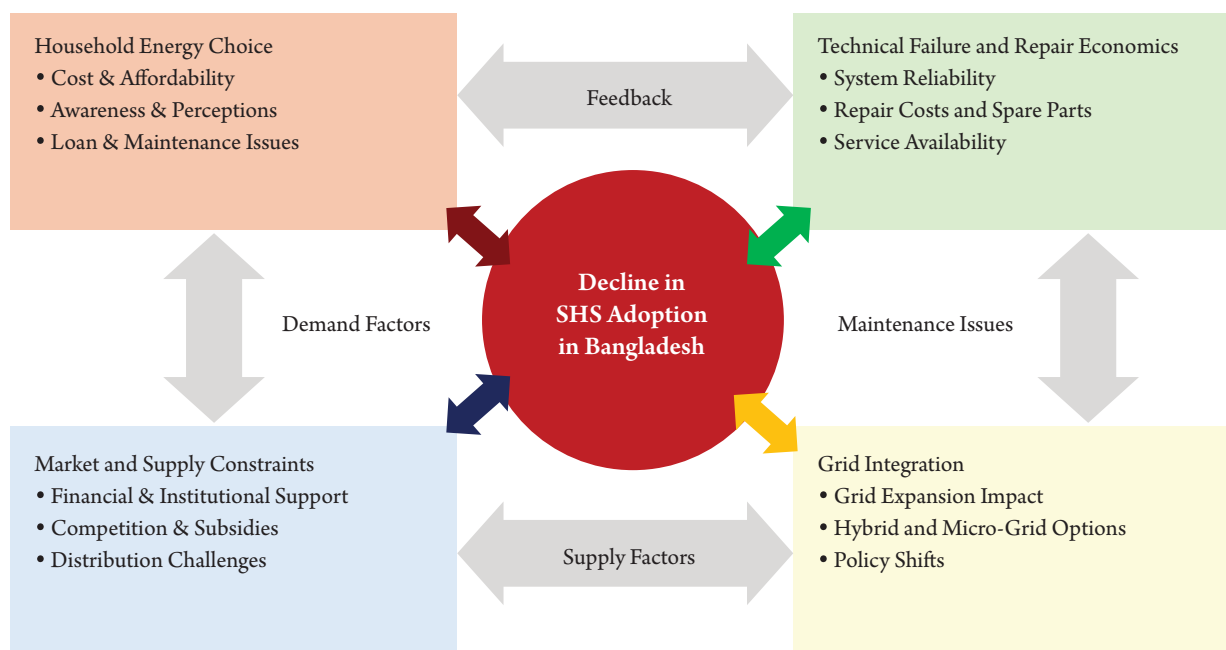
4.3 Supply-side Issues

Market and supply-side constraints constitute the third dimension of the framework. The SHS programme in Bangladesh has historically relied on institutional support from the government, development partners, and the Infrastructure Development Company Limited (IDCOL) to scale installations and provide financing mechanisms (Cabraal et al., 2021). However, challenges such as limited technological upgrades, inadequate distribution networks, competition from free solar distribution programmes like TR/KABITA, and declining institutional focus have constrained market growth. Additionally, the availability and efficiency of service networks directly impact both adoption and continued use, as households depend on reliable supply chains for replacement parts, maintenance, and technical support. These supply-side factors interact closely with household perceptions, creating a feedback loop in which weak market support reduces confidence and dampens demand, while declining demand further weakens market viability.

These interconnected market and supply-side constraints, together with household-level, technical, and broader energy system factors, are synthesised in the analytical framework presented in Figure 3, which illustrates the pathways through which these dimensions interact to influence SHS adoption outcomes in Bangladesh.

Finally, the interaction between grid expansion and off-grid energy solutions is a critical component of the analytical framework. The rapid growth of the national electricity grid has provided households in many previously off-grid areas with more reliable and often cheaper electricity, which in turn reduces the relative attractiveness of SHS (IEA, 2020). This substitution effect has contributed to the observed decline in SHS adoption. At the same time, opportunities for complementarity exist, such as integrating SHS with hybrid

Figure 3 Analytical Framework for Adoption of SHS in Bangladesh



Source: Author's Illustration.

systems or localised microgrids to provide supplementary or backup energy. Government policy and financing priorities have increasingly favoured grid-connected renewable energy projects, which has implications for the institutional support available to off-grid systems like SHS (Cabraal et al., 2021). Understanding these dynamics is essential to developing strategies that either revitalise the SHS sector or transition households towards alternative, sustainable energy solutions without undermining the progress achieved in rural electrification.

In relation to the figure, the analytical framework can be further understood as a set of interlinked pathways through which multiple constraints converge to explain the decline in SHS adoption in Bangladesh. Household energy choice sits at the centre of the framework, directly shaping adoption outcomes, but it is simultaneously influenced by four surrounding domains. Demand-side factors such as cost, affordability, awareness, perceptions, and loan and maintenance burdens directly affect households' willingness and ability to adopt or sustain SHS use. These are closely linked with supply-side conditions, where market and institutional constraints, including financing support, subsidy structures, and distribution challenges, shape both the availability and attractiveness of SHS solutions. Technical performance introduces an additional reinforcing mechanism, as system reliability, repair costs, and service availability feed back into user perceptions and long-term affordability considerations, often amplifying negative experiences. Finally, grid integration acts as a structural external force, where grid expansion, evolving policy priorities, and the emergence of hybrid or microgrid solutions alter the relative competitiveness of SHS. The directional relationships indicated in the figure highlight that these factors do not operate in isolation but interact dynamically, creating feedback loops that can accelerate the decline in adoption when constraints across multiple domains align.

5. Methodology

5.1 Target Population

The target population for this survey comprises users of solar panels obtained through three main acquisition channels: beneficiaries of the IDCOL Solar Home System (SHS) programme, recipients of solar panels under the TR KABITA Social Safety Net Programme, and households that acquired solar panels through

direct purchase from the market. These groups have been selected to capture the full range of solar adoption experiences in Bangladesh, encompassing both programme-supported and market-based dissemination models. This classification is essential for understanding how different acquisition mechanisms influence the sustainability of solar usage, particularly in the context of reported declines.

This approach is directly aligned with the objectives of the assignment. In order to assess the extent of solar adoption and identify emerging patterns of decline, it is important to examine users across both subsidised and non-subsidised systems. The inclusion of both current and former users allows the study to explore not only adoption but also discontinuation, providing insight into the key factors contributing to reduced usage of SHS. The resulting analysis will inform the integration of survey findings with Samakal's investigative media reports (Hossain & Imtiaz, 2026) and support the design of follow-up qualitative research, including key informant interviews (KIIs) and case studies.

To identify and categorise respondents accurately, the survey includes a set of screening questions. These determine whether a respondent owns a solar panel, whether the system is currently functional, whether it is being used to meet electricity needs, and how it was acquired. Based on the answers to these questions, respondents are classified into the relevant user group and sub-population, ensuring that the collected data is both analytically rigorous and directly relevant to the research objectives.

5.2 Sample Size Calculation

The survey was conducted with a total sample size of $n_h=480$ households

We find the sample size with the formula

$$n_h = \frac{Z^2 r(1-r)}{\tilde{n} p e^2} * Deff * NonResponse$$

Z= Z value at 95% confidence interval which is 1.96

r= Estimate of the variable of interest; taken at 0.072251 (calculated from HIES 2022)

$\tilde{n}$ = Household size; taken at standard of 6

p = Proportion of the target population to total population; taken as 1

e = Margin of error; considered at 0.15

Deff = Design effect; taken at a standard of 2

Non-Response = Rate of non-response; taken at a standard of 10%

Thus, we obtain $n=482$ which is rounded to $n=480$ for even cluster size.

5.3 Sampling Method

This survey employs a multi-stage sampling approach. In the first stage, Primary Sampling Units (PSUs) are selected using the Probability Proportional to Size (PPS) method with explicit stratification to ensure that larger PSUs have a higher probability of selection. In the second stage, households are selected based on snowball sampling from user households within the PSU.

Households are screened using predefined screening questions until 12 households from the target population are successfully surveyed in each PSU. In cases where a selected household does not belong to the target population or there is non-response, it was substituted by another household from the target population to maintain the required sample size.

The screening was ensured in a way that from each location 75 per cent of the households covered possessed solar installations from IDCOL SHS or TR/KABITA programme. The rest 25 per cent of the households were selected who possess personally purchased solar installations.

To ensure geographic representation and robust findings, the survey employed a Multi-stage Sampling Method, which ensured national and regional representation. The distribution was structured as follows:

- The survey covered all 8 divisions of Bangladesh to ensure national representation.
- Forty (40) Primary Sampling Units (PSUs) was selected from the existing 717 PSUs across the country specified according to HIES 2022 dataset by the Bangladesh Bureau of Statistics (BBS).
- From each PSU, 12 households were selected to participate in the survey.

5.4 Domain and Coverage of the Survey

The survey geographically covered the following districts and upazillas incorporating 40 locations. The detailed geographical distribution of the sample across divisions, districts, and the corresponding number of surveyed households is presented in Table 1.

The survey covered user information from 12 households from each of the 40 locations on the demand side and covered local repair and sellers at the community level at the same locations to capture the supply side. The spatial distribution of the survey locations across Bangladesh is illustrated in Figure 4, highlighting the geographical coverage of the study and the locations from which demand- and supply-side information was collected.

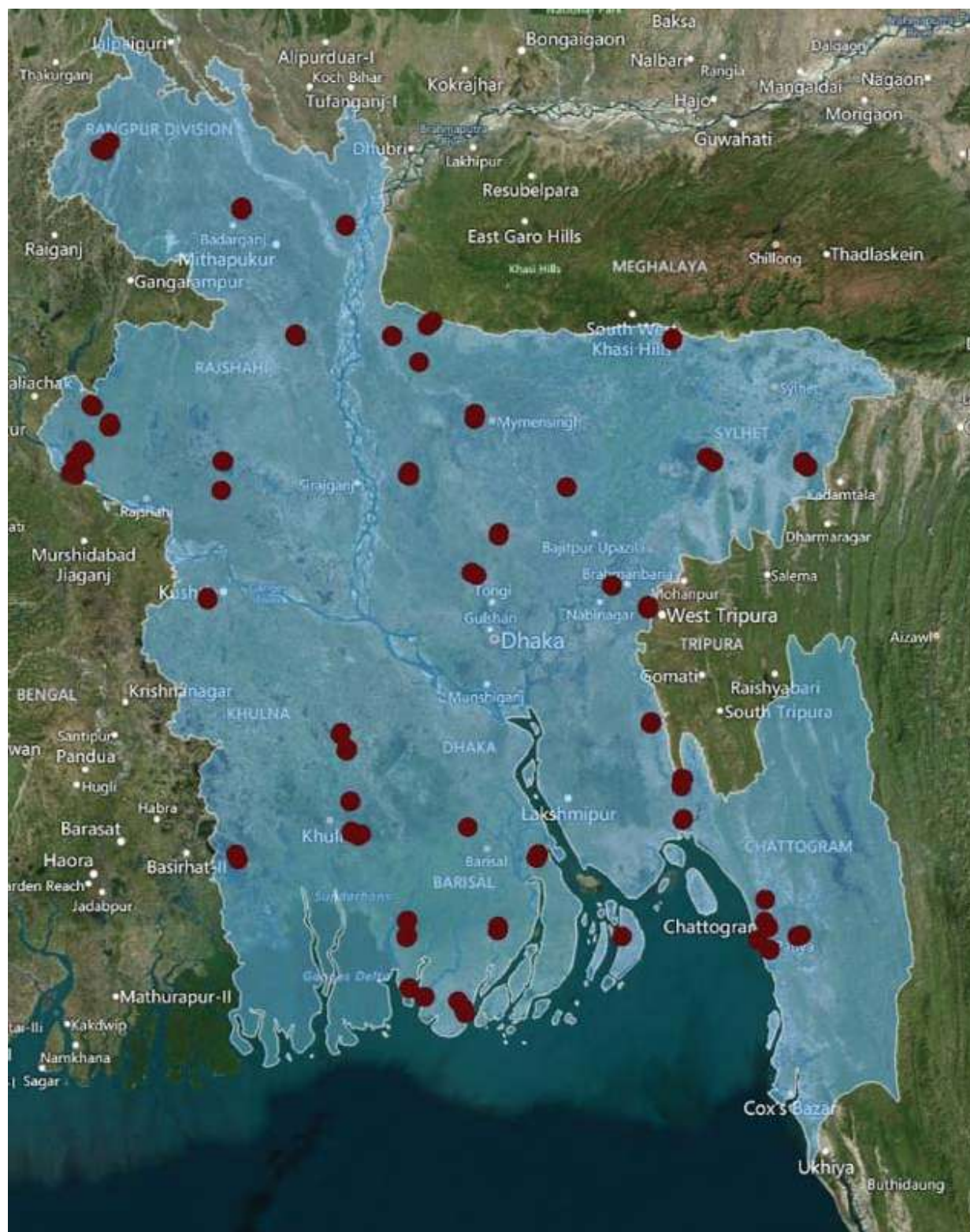
The survey instruments were designed to capture the multidimensional factors influencing SHS adoption and continued use, covering both community-level supply-side conditions and household-level demand-side characteristics. The key domains, variables, indicators, and corresponding measures included in the survey are summarised in Table 2. The different domains covered at the community level and the household level are as follows:

Table 1 Geographical Distribution of the Sample

Division	District	Number of Households
Barisal	Bhola, Patuakhali, Barguna, Pirojpur,	84
Chattogram	Brahmanbaria, Noakhali, Feni, Chattogram, Cumilla	96
Dhaka	Gazipur, Tangail, Kishoreganj	48
Khulna	Kushtia, Khulna, Satkhira, Narail	72
Mymensingh	Jamalpur, Mymensingh, Sherpur	36
Rajshahi	Natore, Chapainawabganj	60
Rangpur	Thakurgaon, Kurigram, Rangpur, Gaibandha	48
Sylhet	Sunamganj, Habiganj, Moulvibazar	36
Total		480

Source: Author's calculation.

Figure 4 Map of Survey Locations



Source: Author's illustration.

Table 2 Domains of the Survey

Dimension	Variable	Indicators	Measure
Community Modules			
Demographics	Location	Administrative regions	Categorical
	Respondent Type	Type of respondent for supply information	Categorical
Price	Price of Solar components	Summer Price	Numeric
		Winter Price	Numeric
Repair	Repair Service	Service-wise cost of repair	Numeric
		Repair Frequency	Numeric
		Frequent Cause of Repair	String
		Affordability of repairs	Binary
	Repair Service Provider	Contracting Organisation	String
		Other jobs performed by repairperson	Categorical
Household Modules			
Demographics	Location	Administrative regions	Categorical
	Household Head Characteristics	Gender	Binary
		Age	Numeric
		Marital Status	Categorical
		Education	Categorical
		Occupation	Categorical
		Family Size	Numeric
Programme	Organisation	Name of programme	Categorical
		Name of Partner Organisation (PO)	Categorical
Access	Grid	Access to grid electricity	Binary
		Grid connection time	Date
	Solar	Time of last use of Solar	Date
Solar Installation Features	Component List	Quantity of Solar Home System owned by Household	Numeric
	Functionality	Current functionality of system	Numeric
		Damage Status	Binary
	Damage and Repair History	Repair Status	Binary
		Repair Time (number of days)	Numeric
		Repair Cost	Numeric
		Repair Cost Bearer	Categorical
		Last use of Battery	Date
Battery Charge Duration		Numeric	
Financing	Installation	Time of Installation	Date
		Source of knowledge of programme	Categorical
		Installation cost	Numeric
	Loan Details	Loan Status	Binary
		Loan Validity time	Date
		Installment frequency	Numeric
		Installment amount	Numeric
		TR programme Details	Application Status
	Eligibility Status		Binary
	Bribery	Bribery Solicitation	Binary
		Bribe Paid	Binary
		Amount of Bribe	Numeric

(Table 2 contd.)

(Table 2 contd.)

Dimension	Variable	Indicators	Measure
Built Environment and Energy use	Housing	Building material of house	Categorical
		Number of rooms in house	Numeric
	Power Use	Power Outage (Loadshedding) Duration (Summer and Winter)	Numeric
		Monthly Electricity Bill	Numeric
		Fuel used for cooking	Categorical
		Primary source of lighting	Categorical
		Electric Appliance Quantity owned	Numeric
	Solar Electricity Use	Frequency of use	Categorical
		Cause of not using	Categorical
		Purpose of Use	Categorical
		Quantity of appliances run by solar	Numerical
	Quality of Solar	Illumination of full room	Binary
		Sufficiency of light for studying	Binary
Future Use	Preference for use	Satisfaction Score for SHS	Likert Scale
		Interest in future use of cheap solar systems	Likert Scale
	Financing Preference Equipment needs	Affordability Range	Categorical
		Mode of financing	Categorical
		Solar Package Preference	Likert Scale

Source: Prepared by the authors.

6. Overview of the Solar Home System Programme

6.1 Programme Design and Institutional Architecture

The following table presents the distribution of Solar Home System (SHS) installations across implementing organisations and indicates a strong concentration within a few key institutions. The data shows that the Infrastructure Development Company Limited (IDCOL) accounts for more than 74 per cent of all installations, making it by far the largest implementing agency. This is followed by the Ministry of Disaster Management and Relief (MoDMR), which contributes roughly 25 per cent of installations. Other institutions such as the Bangladesh Rural Electrification Board (BREB), Northern Electricity Supply Company (NESCO), German Agency for International Cooperation (GIZ), and the Rural Development and Co-operatives Division (RD CD) account for only marginal shares. This distribution highlights the central role played by IDCOL in scaling SHS deployment in Bangladesh and suggests a high level of institutional reliance on its implementation framework (Shazeed et al., 2026). The distribution of SHS installations across different implementing organisations and agencies is presented in Table 3, highlighting the relative contribution of each institution to the expansion of SHS deployment in Bangladesh.

Table 3 Distribution of SHS Across Implementing Organisations/Agencies

Agency	Number	Percentage
BREB	15250	0.25
NESCO	13952	0.23
IDCOL	4494162	74.44
GIZ	400	0.01
MoDMR	1513619	25.07
RD CD	200	0.003
Total	6,037,583	100

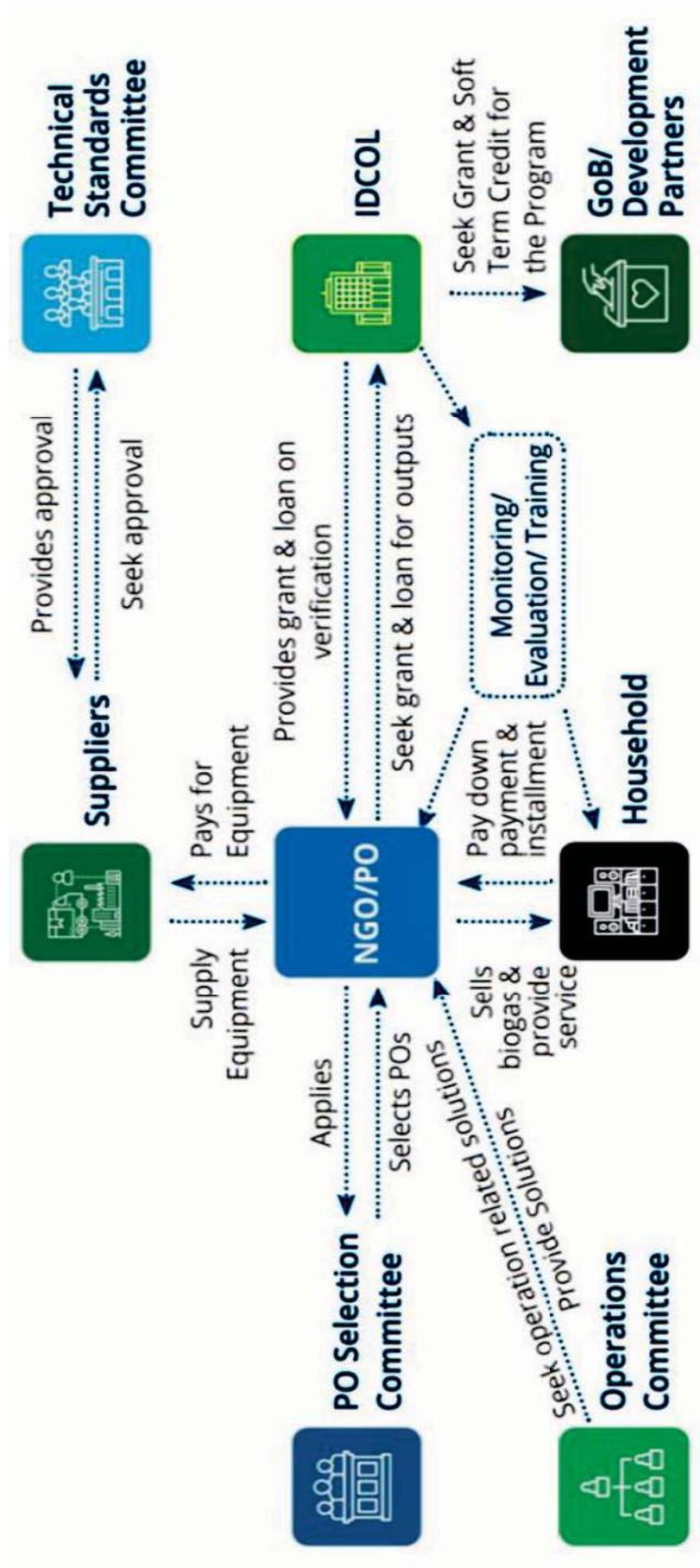
Source: Author's calculation.

Given its dominant role, IDCOL has emerged as the principal architect of the SHS implementation framework in Bangladesh. Although other organisations, such as BREB, have introduced solar programmes, many of these initiatives have broadly adapted the implementation structure pioneered by IDCOL, often with minor contextual adjustments. As a result, the IDCOL framework largely defines the institutional relationships and operational interactions among meso-level actors involved in the SHS programme (Shazeed et al., 2026). Figure 5 illustrates the interaction channels among these meso-level actors within IDCOL’s model.

The following table summarises the main operational features of the IDCOL SHS implementation model. The model is structured around a hybrid financing arrangement combining loans and grants, designed to lower the upfront cost of solar systems for households. Under this arrangement, financial resources flow from the government to IDCOL and subsequently to partner organisations (POs), which are typically microfinance institutions or similar implementing agencies. These POs procure standardised SHS components from approved suppliers and oversee installation at the household level. Households repay the cost of the system through installment-based payments and ultimately gain ownership after completing loan repayment. Historically, grants covered nearly 50 per cent of the system cost, but the grant share has gradually declined to approximately 25 per cent, increasing the relative role of credit financing in the programme (Shazeed et al., 2026). The key operational features of the IDCOL SHS implementation model, including financing arrangements, institutional roles, procurement mechanisms, and ownership structure, are summarised in Table 4.

Figure 5

IDCOL's Model of Distribution



Source: IDCOL's website.¹

¹https://idcol.org/idcol_new/public/renewable/solar-home-system-program

Table 4 SHS Programme Description of IDCOL

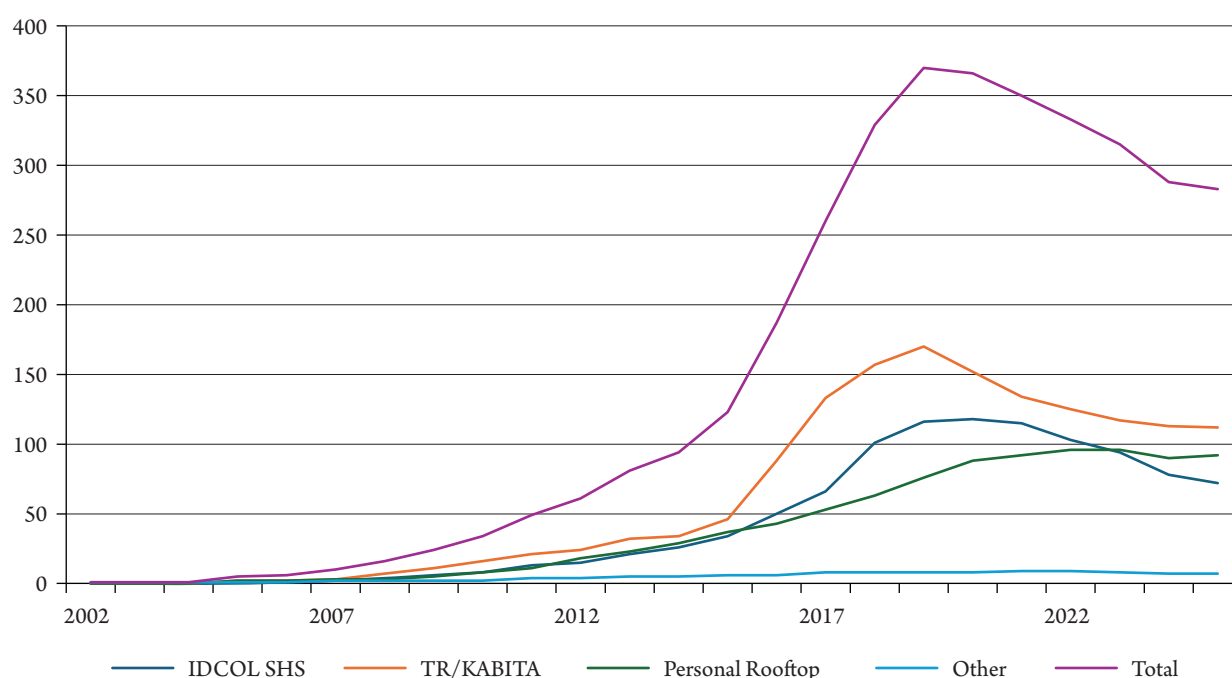
Domain	SHS Model Description
Financing Flow	Government → IDCOL → Partner Organisations (POs) → Households
Financing Modalities	
(Loan: Grant)	75:25
Implementing Entities	MFIs and Partner Organisations
Procurement	POs purchase SHS equipment from approved suppliers
Delivery mechanism	Installation by POs
End-user payment	Installment-based payment system
Ownership	Household ownership after repayment

Source: Prepared by authors from the findings of KII and desk review.

Note: Currently the grant is around 25 per cent, which was around 50 per cent previously.

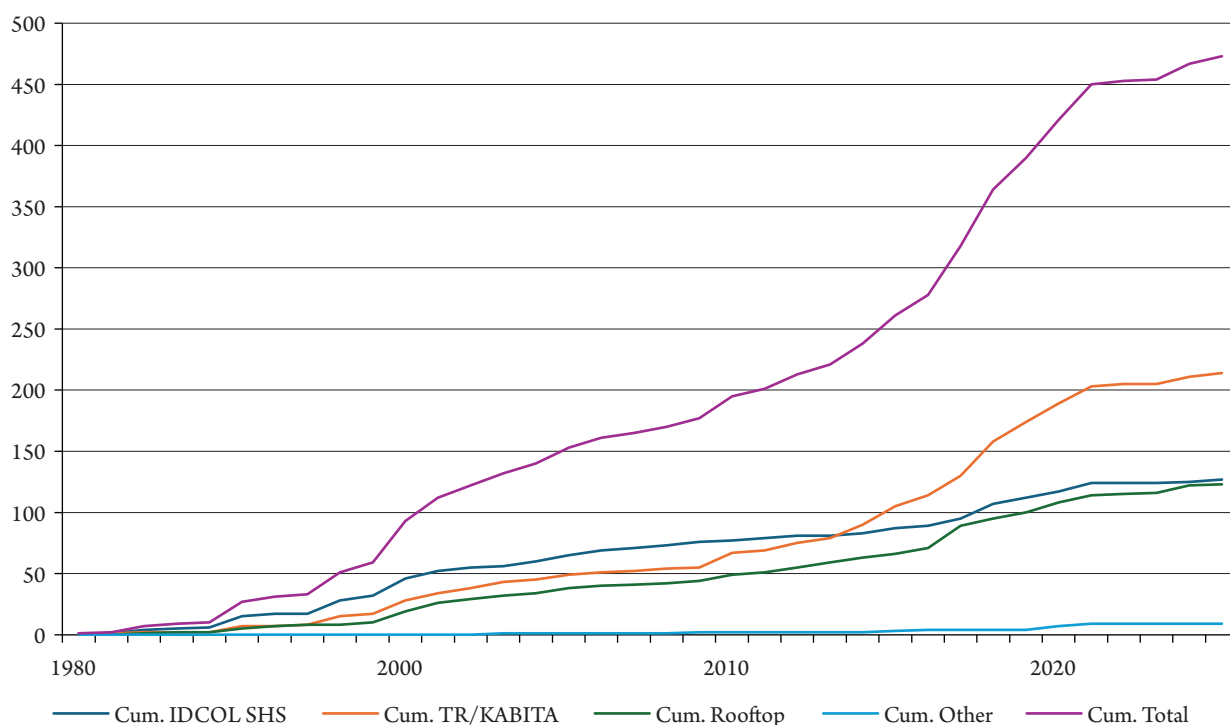
6.2 Policy Shifts and Market Contraction

The annual trends in active users reveal a clear rise and gradual decline in off-grid solar adoption across all installation types. Total active users increased steadily from the early 2000s, reaching their peak in 2019, driven primarily by the rapid scale-up of IDCOL SHS and TR/KABITA systems. The IDCOL SHS category saw moderate early growth and maintained momentum into the late 2010s, peaking in 2020 before tapering off as older units fell out of use. TR/KABITA installations expanded more robustly, becoming the dominant type by the late 2010s, but they too show a downward trend in recent years. In contrast, Personal Rooftop systems displayed consistent, steady growth throughout the period, indicating an emerging preference for household-level solar solutions outside large donor-driven programmes. The small but persistent other category remained marginal but shows signs of steady retention with minimal drop-offs. Overall, this pattern highlights how off-grid solar expanded rapidly during the mid-2010s but now faces challenges sustaining growth, with declining active

Figure 6 Active Users Across Time From Sample Households

Source: CPD-SHS Survey 2025.

Figure 7 Cumulative Grid Users Across Years From Sample Households



Source: CPD-SHS Survey 2025.

systems pointing to aging infrastructure and limited replacement or upgrade activity. These trends underline the need for renewed investment and policy support to maintain and expand rural solar electrification, especially through diversified models that can adapt to changing user needs. The temporal pattern of active SHS users across different installation categories is illustrated in Figure 6, showing the expansion and subsequent decline of different solar adoption pathways among surveyed households.

The grid connection data reveals a gradual yet significant increase in grid access among households that also adopted solar installations. For IDCOL SHS users, grid connections started as early as 1980 but remained sparse until the mid-1990s, after which there was a modest uptick as illustrated in Figure 8. Notable increases are seen around 1995, 1998, and 2000, when multiple households connected to the grid, indicating early rural electrification drives overlapping with SHS adoption.

The TR/KABITA category shows a slightly delayed but sharper surge. While grid connections begin in the late 1980s, the numbers stay relatively low until the early 2000s. A clear acceleration appears from 2010 onward, with notable peaks in 2015, 2017, and especially 2018, when a considerable share of households under this scheme received grid electricity—reflecting more aggressive grid expansion policies reaching rural and marginal areas previously reliant on TR/KABITA installations.

For Personal Rooftop users, grid connection has a steadier, low-level presence in the early years but demonstrates small consistent increments each decade, with a sharper jump visible around 2017. This trend implies that personal rooftop adopters likely belonged to semi-urban households gradually covered by grid extensions.

The Other category remains minimal but shows a few connections, mostly clustered in recent years, pointing to smaller or less formal installations aligning with broader grid access.

Overall, the cumulative numbers show that while solar systems provided early access to electricity in off-grid areas, the progressive expansion of the national grid has steadily replaced this dependence which is especially

visible in the large peaks of the late 2010s. This trend highlights the grid’s growing reach and underlines why many earlier solar households now report grid access alongside or instead of solar systems. The cumulative increase in grid connections among the SHS households over time is presented in Figure 7, highlighting the growing overlap between solar adoption and expanding grid electrification.

7. Empirical Findings

7.1 Current Status of SHS

The data in the table below presents the functionality status of Solar Home Systems (SHS) by installation type, specifically IDCOL SHS and TR/KABITA, along with their overall share. The results indicate that 48.84 per cent of IDCOL SHS units are functional, compared to 44.29 per cent of TR/KABITA units, yielding an overall functionality rate of 45.98 per cent. In contrast, 51.16 per cent of IDCOL SHS units and 55.71 per cent of TR/KABITA units are reported as non-functional. These figures underscore notable challenges related to system maintenance and sustainability across both installation categories. The distribution of functional and non-functional systems across different installation categories is presented in Table 5.

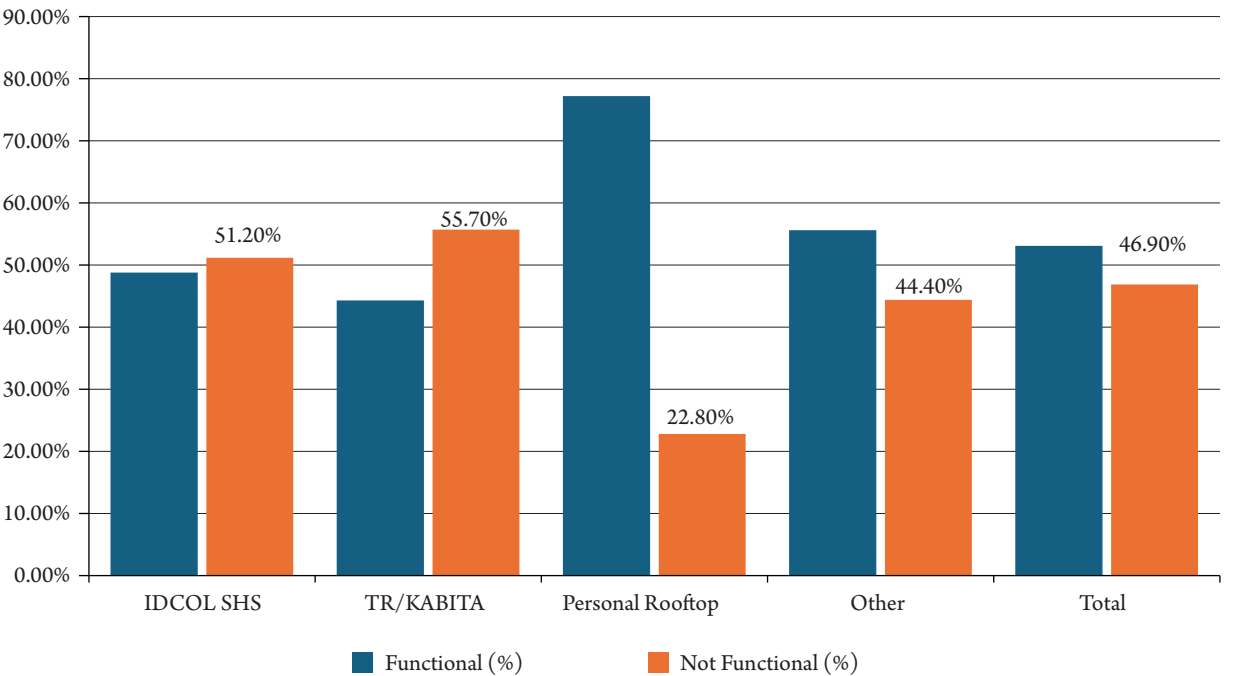
Table 5 **Functionality Status Across Installation Type**

Installation Type	Functional (Freq.)	Functional (%)	Not Functional (Freq.)	Not Functional (%)
IDCOL SHS	63	48.80%	66	51.20%
TR/KABITA	97	44.30%	122	55.70%
Personal Rooftop	95	77.20%	28	22.80%
Other	5	55.60%	4	44.40%
Total	260	53.10%	220	46.90%

Source: CPD-SHS Survey 2025.

The variation in functionality status across installation types is further visualised in Figure 8, illustrating

Figure 8 **Functionality Status Across Installation Types**



Source: CPD-SHS Survey 2025.

differences in system performance and sustainability outcomes.

7.2 Technical Performance and Reliability

The survey data indicates that battery-related problems dominate system failures, accounting for more than 77 per cent of reported malfunctions. Environmental shocks such as lightning strikes represent a much smaller share (around 14 per cent), while issues such as loose connections and low-quality products appear only marginally. This pattern suggests that the durability, quality, and maintenance of batteries constitute the most critical technical bottleneck in sustaining Solar Home System (SHS) functionality. Strengthening battery standards and improving maintenance support could therefore substantially reduce system downtime and extend the operational life of solar installations. The distribution of reported repair causes across SHS users is summarised in Table 6, highlighting the dominance of battery-related failures.

Table 6 Common Causes of Needing Repairs

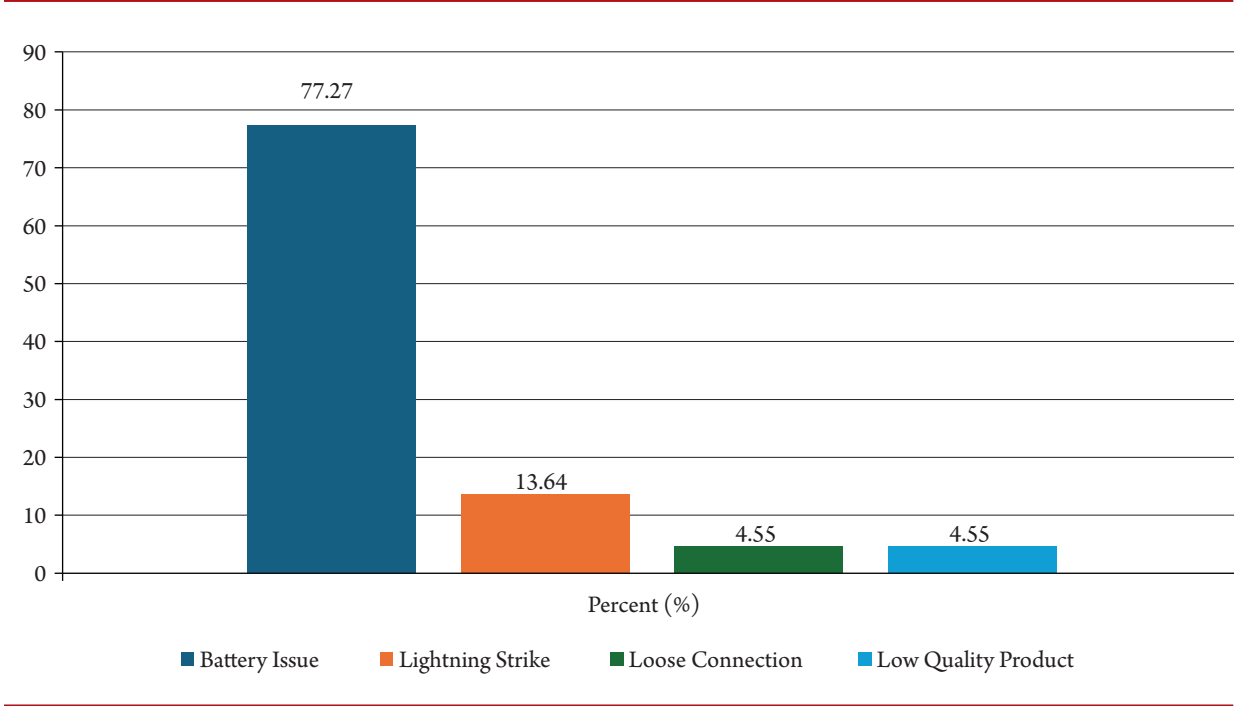
Cause of Repair	Percentage (%)
Battery Issue	77.3%
Lightning Strike	13.6%
Loose Connection	4.6%
Low Quality Product	4.6%
Total	100%

Source: CPD-SHS Survey 2025.

Figure 9 provides a graphical representation of the primary causes of SHS repairs, reinforcing the concentration of failures around battery-related issues.

Repair time statistics further illustrate differences in system servicing efficiency. On average, repairs take about

Figure 9 Cause of Repair



Source: CPD-SHS Survey 2025.

3.21 days for IDCOL SHS systems and 2.5 days for TR/KABITA installations, producing an overall average of 2.72 days. Although average repair durations are relatively short, the distribution is uneven: the maximum reported repair time reaches 20 days for IDCOL systems, compared to seven days for TR/KABITA systems. The larger standard deviation for IDCOL systems also indicates greater variability in repair responsiveness. Together, these results suggest that while routine repairs are generally completed within a few days, institutional differences in service delivery may influence reliability and user experience. Table 7 presents the descriptive statistics of repair duration across different SHS installation categories, including average repair time and variation in service responsiveness.

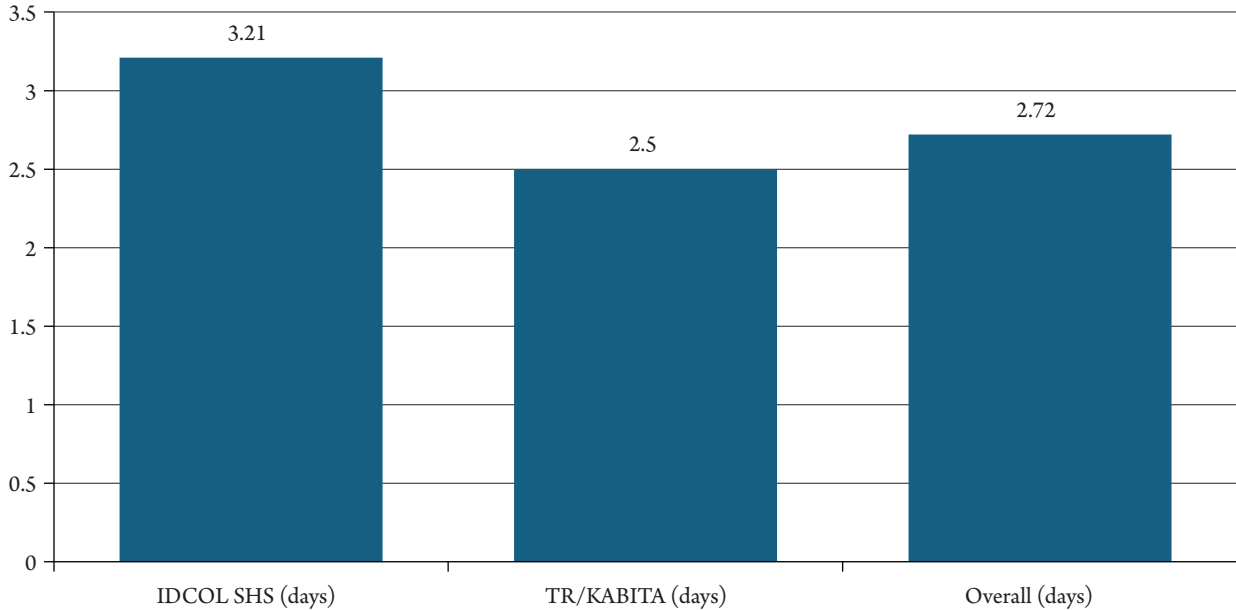
Table 7 Average Days Taken to Repair

Statistic	IDCOL SHS (days)	TR/KABITA (days)	Overall (days)
Mean (average)	3.21	2.5	2.72
Standard deviation	3.6	1.8	2.5
Minimum	1	1	1
Maximum	20	7	20
Observations (repairs)	29	64	93

Source: CPD-SHS Survey 2025.

The comparative distribution of repair duration across installation categories is illustrated in Figure 10.

Figure 10 Average Days Taken to Repair

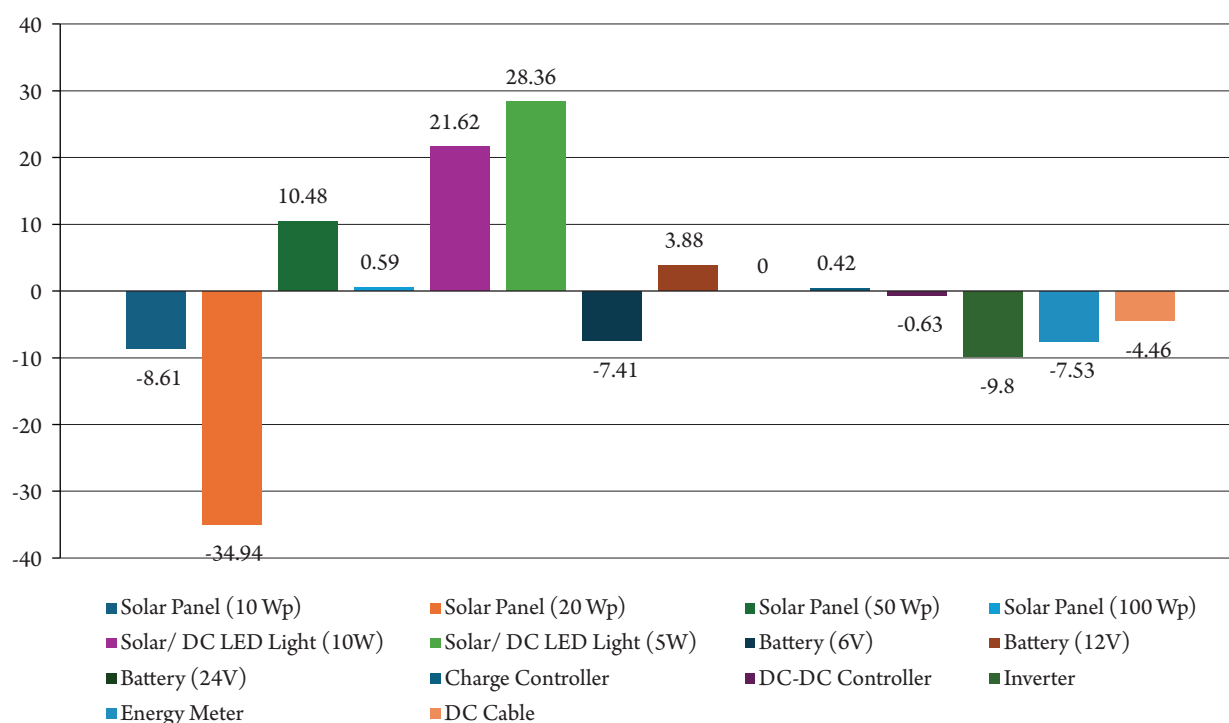


Source: CPD-SHS Survey 2025.

7.3 Solar Panel and Equipment Market

Seasonal price patterns reveal moderate fluctuations in solar component markets. Solar DC LED lights and medium-sized panels (50 Wp) tend to become more expensive in winter, likely reflecting increased demand during shorter daylight periods. In contrast, smaller panels such as 20 Wp units exhibit the largest price decline (34.85 per cent), indicating weaker demand during colder months. Battery prices remain relatively stable across seasons, and most other components including controllers, inverters, and cables show minimal price variation.

Figure 11 Per cent Deviation of Winter Price From Summer Price



Source: CPD-SHS Survey 2025.

Overall, the evidence suggests that the SHS component market is relatively stable, with only modest seasonal demand-driven price adjustments. The seasonal variation in solar component prices is illustrated in Figure 11, showing the percentage deviation of winter prices from summer prices across different components.

Repair cost data highlights the affordability of routine maintenance relative to more technical repairs. Basic maintenance services such as battery water refilling cost on average BDT 152, whereas component replacement or correcting faulty installation costs roughly BDT 270. Wire connection repairs fall between these categories at BDT 220. This cost structure suggests that while routine maintenance remains relatively affordable, more technical repairs can impose a noticeable financial burden on low-income households, potentially discouraging timely servicing. The average cost of different repair services reported by households is presented in Table 8, highlighting the relative affordability of routine maintenance compared with component-level repairs.

Table 8 Cost of Repair Service

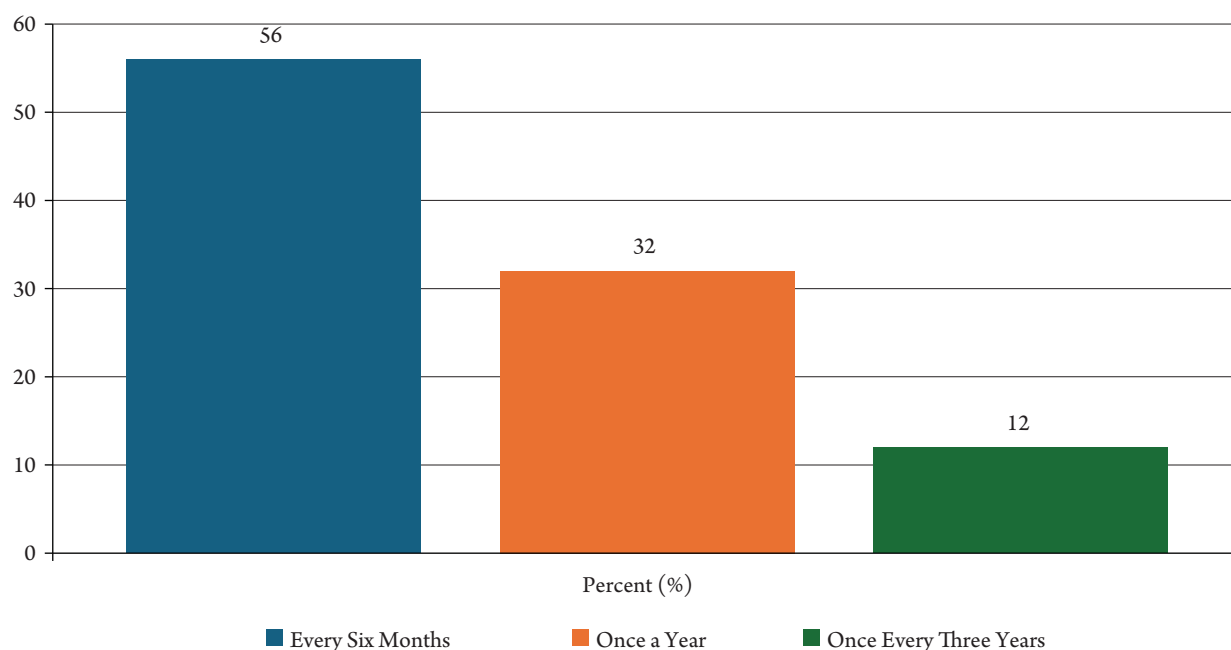
Repair Service	Average Cost (BDT)
Water Refill for Battery	152
Replacement of Parts	276
Correction of Faulty Installation	272
Fixing Wire Connection	220

Source: CPD-SHS Survey 2025.

7.4 Supply Side Response

Repair frequency data indicates that solar systems require relatively regular maintenance. More than half of the respondents report servicing their systems every six months, while about one-third conduct repairs annually. Only a small share reports repair as infrequently as once every three years. This pattern implies that

Figure 12 Supply Side Frequency of Repair Requests



Source: CPD-SHS Survey 2025.

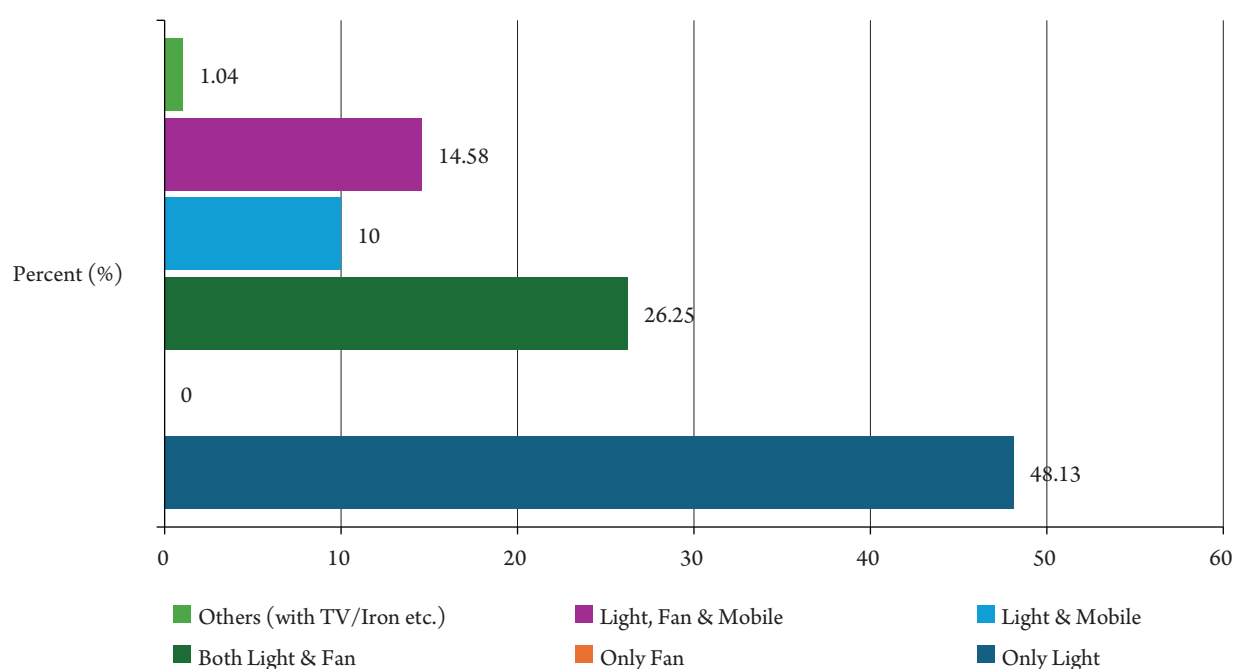
SHS operation is not maintenance-free and relies on a functional repair ecosystem. Accessible and affordable technical support, therefore, remains essential for sustaining system reliability and long-term adoption. The frequency distribution of repair requirements reported by households is presented in Figure 12, demonstrating the recurring nature of maintenance needs within SHS systems.

7.5 Energy Use, Service Level, and Substitution

Solar energy use is concentrated primarily on essential low-power services. Most households rely on solar systems for electric lighting, reflecting the technology's core role in addressing basic energy access. A significant share also operates fans alongside lighting, indicating incremental improvements in household comfort. Mobile phone charging is another common use, reflecting the growing importance of digital connectivity. Higher power appliances such as televisions and irons remain relatively rare due to system capacity constraints. Overall, usage patterns align closely with the limited generation capacity of typical SHS installations, reinforcing their role as a solution for basic rather than comprehensive household energy needs. The combinations of household appliances powered by SHS are illustrated in Figure 13, demonstrating the concentration of solar use around essential electricity services.

Load shedding remains a critical contextual factor influencing solar adoption. On average, households experience 3 to 4 hours of daily outages, with IDCOL SHS users reporting slightly lower levels than TR/KABITA and personal rooftop users. However, the wider distribution among personal rooftop households indicates that some regions experience substantially higher outage levels. This variability suggests that solar adoption is often motivated by the need to cope with unreliable grid electricity rather than solely by environmental considerations. Figure 14 presents the average load-shedding exposure reported by households across different installation categories, highlighting the contextual role of electricity reliability in shaping solar demand.

Figure 13 Appliance Combinations Run by Solar



Source: CPD-SHS Survey 2025.

7.6 Financial Viability and Affordability

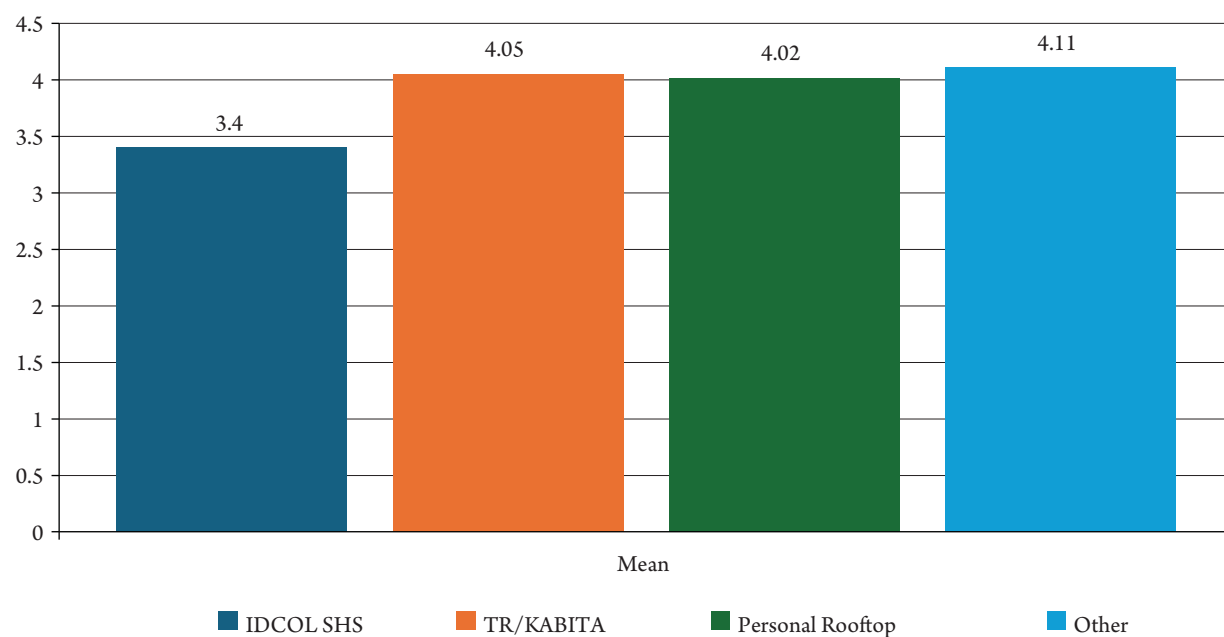
Installation costs vary substantially across system types. TR/KABITA users report the lowest average costs, consistent with subsidised or community-based installation models. IDCOL SHS systems fall in the mid-range, while personal rooftop installations are considerably more expensive, reflecting larger system sizes and private financing arrangements. The wide cost ranges observed in the data, including some zero-cost responses, further indicate the presence of subsidies, grants, or diverse financing structures. These differences highlight the importance of institutional design in determining the accessibility of solar technologies. The variation in installation costs across SHS categories is presented in Figure 15, illustrating differences associated with financing models and system types.

Affordability perceptions confirm that most rural households can only finance lower-cost systems. Approximately 45 per cent of respondents consider systems priced around BDT 12,000 affordable, while about 29 per cent can afford up to BDT 25,000. Very few households identify higher price ranges as feasible, and more than 21 per cent report that none of the listed options fall within their budget. These results underscore the continued importance of subsidies, microfinance, or installment-based payment models in expanding access to solar technologies among lower-income households. Figure 16 presents households' reported affordability thresholds, demonstrating the importance of accessible financing mechanisms for future SHS expansion.

7.7 User Perception and Decision to Stop Use

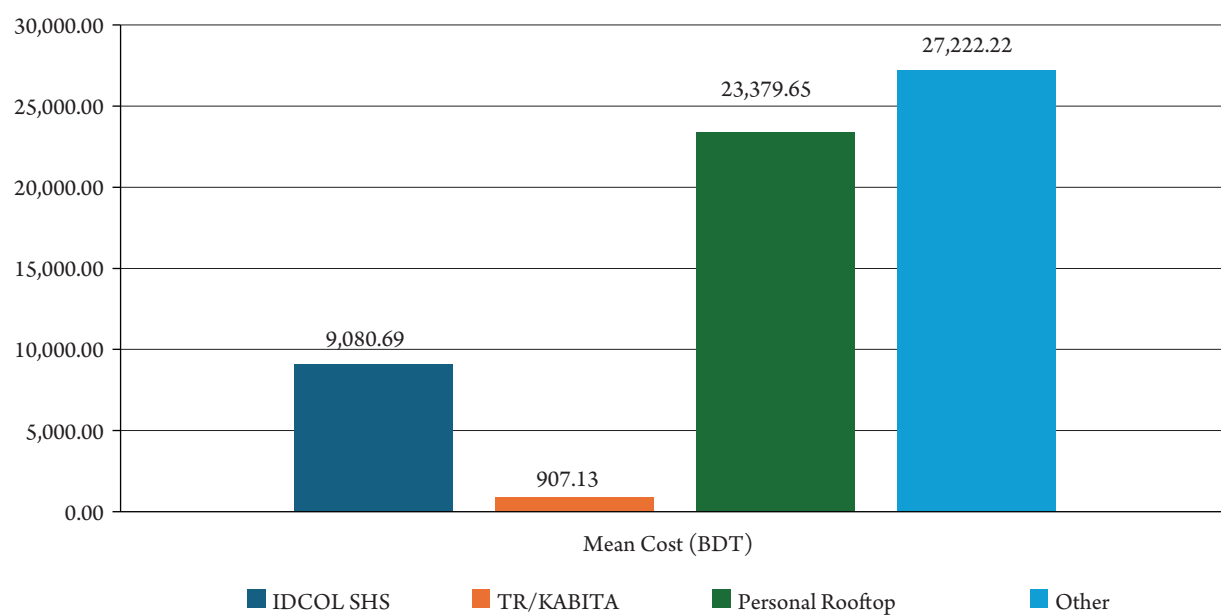
Battery-related issues again emerge as the most significant factor behind discontinuation of solar systems across installation types. In addition, the expansion of grid electricity reduces reliance on SHS, particularly among TR/KABITA and personal rooftop users. Financial constraints and technical challenges also contribute to discontinuation in some cases. Taken together, these findings suggest that both technical reliability and evolving energy alternatives shape the long-term sustainability of solar adoption. The reported reasons for discontinuing SHS use are presented in Figure 17, illustrating the combined influence of technical, financial, and grid-related factors.

Figure 14 Average Loadshedding Hours by Installation Type



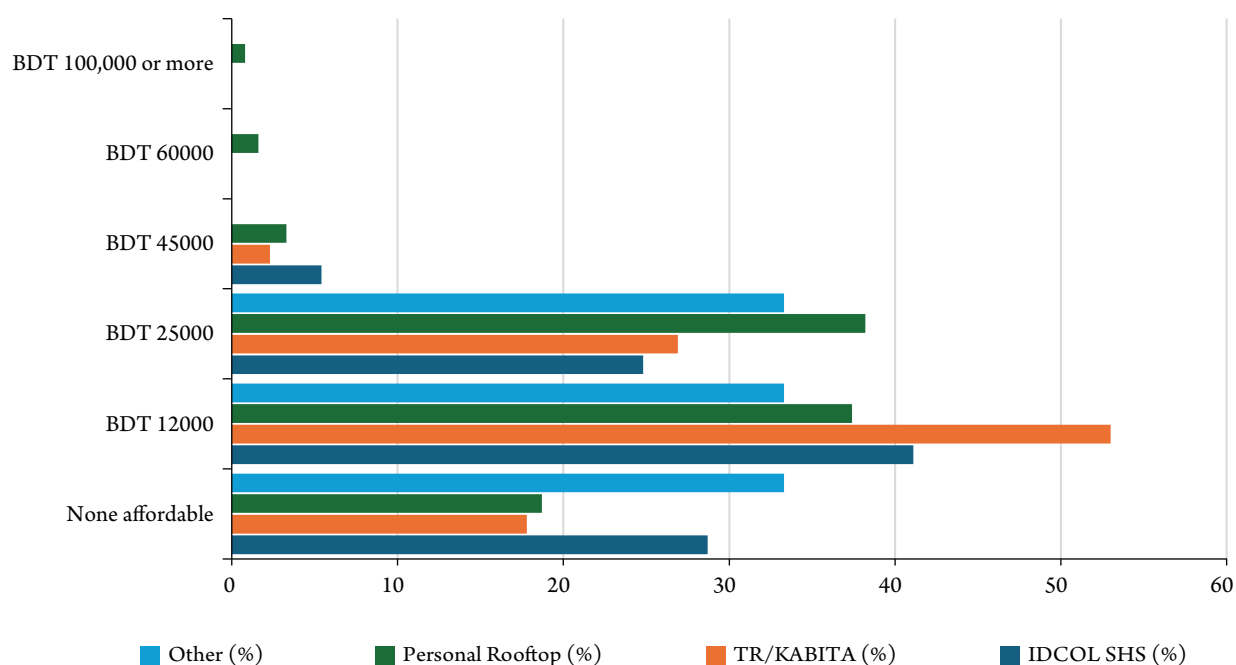
Source: CPD-SHS Survey 2025.

Figure 15 Installation Cost



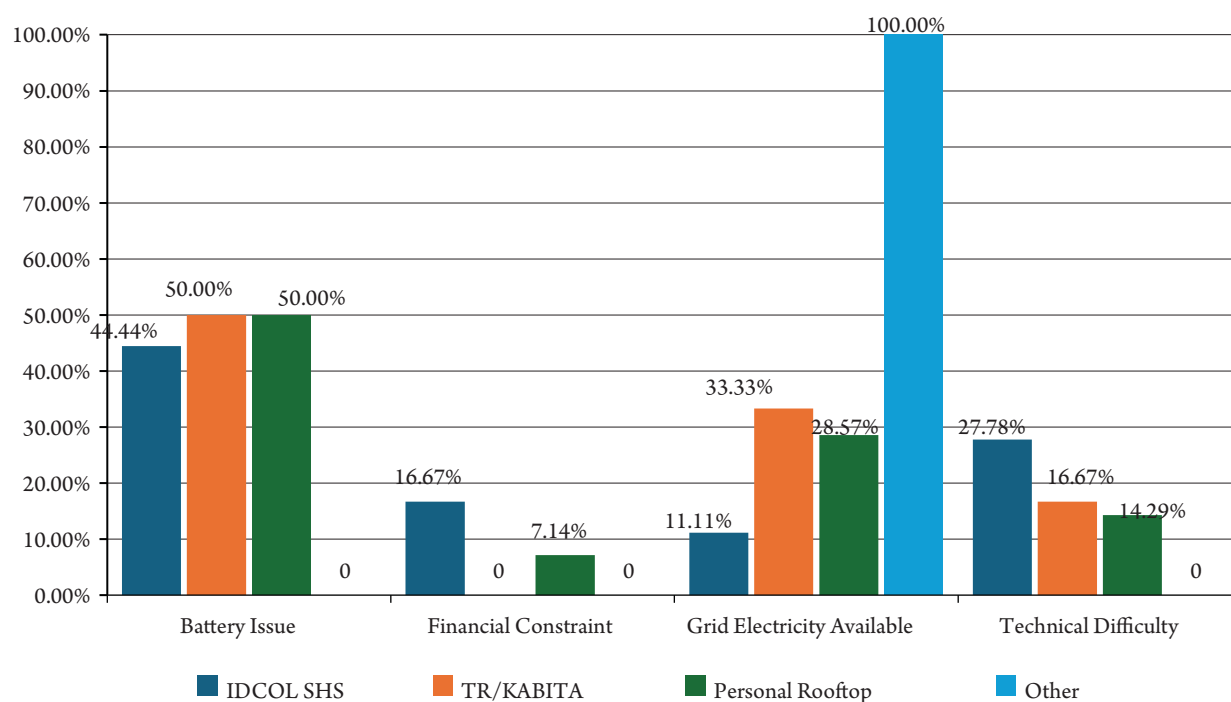
Source: CPD-SHS Survey 2025.

Figure 16 Affordability Range



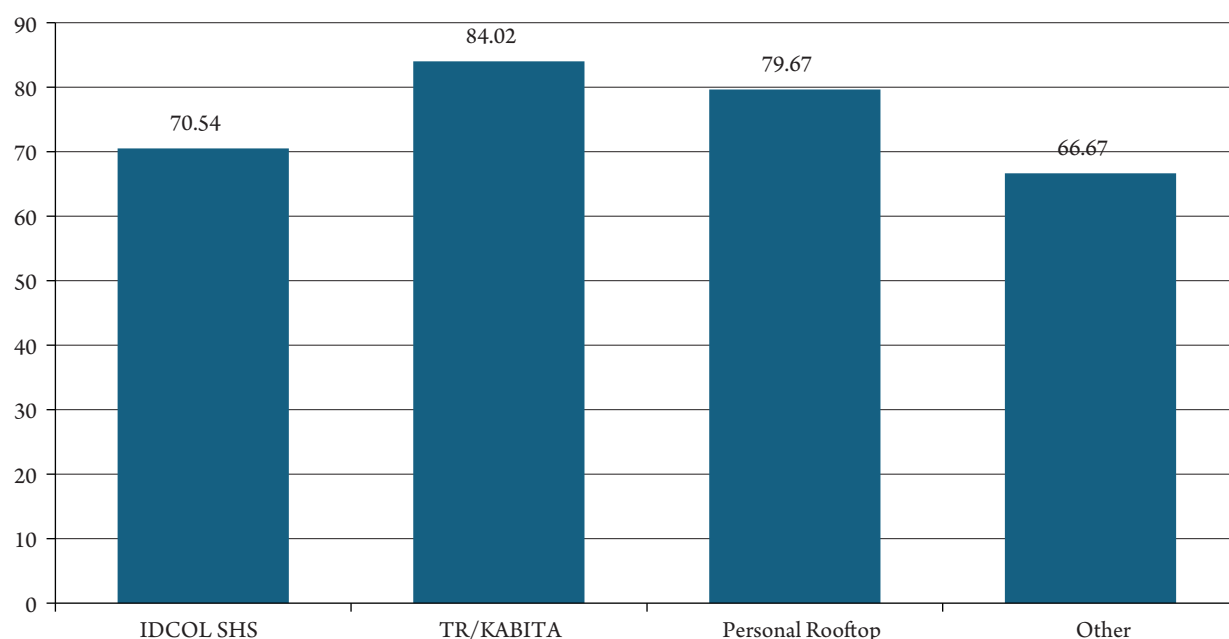
Source: CPD-SHS Survey 2025.

Figure 17 Reasons for Discontinuing Use



Source: CPD-SHS Survey 2025.

Figure 18 Interest in Future Use



Source: CPD-SHS Survey 2025.

Despite these challenges, user attitudes towards future solar adoption remain positive. More than two-thirds of the respondents express willingness to adopt low-cost solar connections, with particularly strong interest among TR/KABITA users (84 per cent) and personal rooftop users (around 80 per cent). Even among IDCOL SHS users, willingness remains above 70 per cent. This indicates that demand for solar energy remains strong, if systems are affordable, reliable, and appropriately designed for household needs. Figure 18 illustrates household willingness to adopt future solar solutions, highlighting the persistence of latent demand despite current system challenges.

8. Implications for Just Energy Transition

8.1 Substituting Significance in User's Satisfaction

The survey findings highlight several implications for advancing a just energy transition in the context of rural solar electrification. Differences in user satisfaction across installation models point to uneven service experiences that could affect the long-term sustainability of decentralised solar adoption. Households using TR/KABITA systems report significantly higher satisfaction (average 8.21 out of 10) compared with 5.98 among IDCOL SHS users, resulting in an overall mean satisfaction score of 7.38. The larger variation in IDCOL responses further suggests inconsistencies in system performance, maintenance quality, or service delivery across locations. From a just transition perspective, this indicates that institutional design, service delivery mechanisms, and the reliability of after-sales support play a critical role in shaping user trust and long-term technology acceptance.

8.2 Affordability Pressures, Technical Reliability, and Perception Risks

Beyond satisfaction differences, the evidence of frequent repairs, battery-related failures, and non-trivial maintenance costs points to an emerging affordability challenge. For low-income households that initially adopted SHS as a pathway to energy access, recurring repair expenses or declining system performance may gradually erode the perceived value of the technology. When maintenance becomes costly relative to household

income, or when systems fail to meet evolving energy needs, users may abandon solar solutions once grid electricity becomes available. Such dynamics risk undermining part of the progress achieved in expanding decentralised renewable energy, particularly in communities where solar systems once served as the primary source of electricity.

In relation to this risk, the interaction between technical reliability and affordability can contribute to growing disillusionment with this technology. If households begin to associate solar systems with recurring battery failures, inconsistent performance, or weak service support, confidence in decentralised renewable solutions may weaken over time. This perception risk is particularly important in the context of large-scale programmes implemented by the IDCOL and the MoDMR, which together account for the majority of SHS installations in the country. A deterioration in user experience within these flagship initiatives could therefore influence broader perceptions of solar technology in rural energy markets.

8.3 Persistent Demand and Pathways for a Just Transition

At the same time, the findings also reveal an important countervailing dynamic that sustains optimism for the future of decentralised renewables. Despite technical and financial challenges, a substantial majority of respondents continue to express willingness to adopt low-cost solar solutions in the future. This suggests that households still recognise the value of solar energy, particularly as a means of coping with unreliable grid electricity and meeting essential energy needs. In this sense, the existing user base represents a reservoir of latent demand that could support further expansion if system reliability improves and financing models remain accessible.

Taken together, the results suggest that rural solar electrification in Bangladesh is approaching a critical juncture. Affordability pressures and declining user confidence could slow or partially reverse earlier gains if technical and service shortcomings remain unaddressed. Nevertheless, the persistence of strong interest in solar solutions indicates that the foundations for continued adoption remain intact. Advancing a just energy transition will therefore require renewed policy attention to system quality, battery durability, affordable maintenance services, and inclusive financing mechanisms, ensuring that early adopters are not left behind



Source: CPD-SHS Survey 2025.

while new users can continue to access decentralised renewable energy. Differences in satisfaction levels across installation categories are presented in Figure 19, providing further evidence on how service quality and institutional arrangements influence user experience.

9. Institutional Legal and Operational Challenges

9.1 Incidence and Nature of Informal Payments

The survey evidence suggests that direct corruption associated with solar installation remains relatively limited. Only about 2 per cent of the respondents report being asked for a bribe, while roughly 1 per cent acknowledge having paid one. Among those who reported paying a bribe, the average amount is approximately BDT 2,100, although the variation in reported payments indicates that such incidents are not standardised and may depend on local circumstances. Taken at face value, these figures imply that bribery is not a widespread or systematic barrier within the installation process.

9.2 Institutional Safeguards and Accountability Gaps

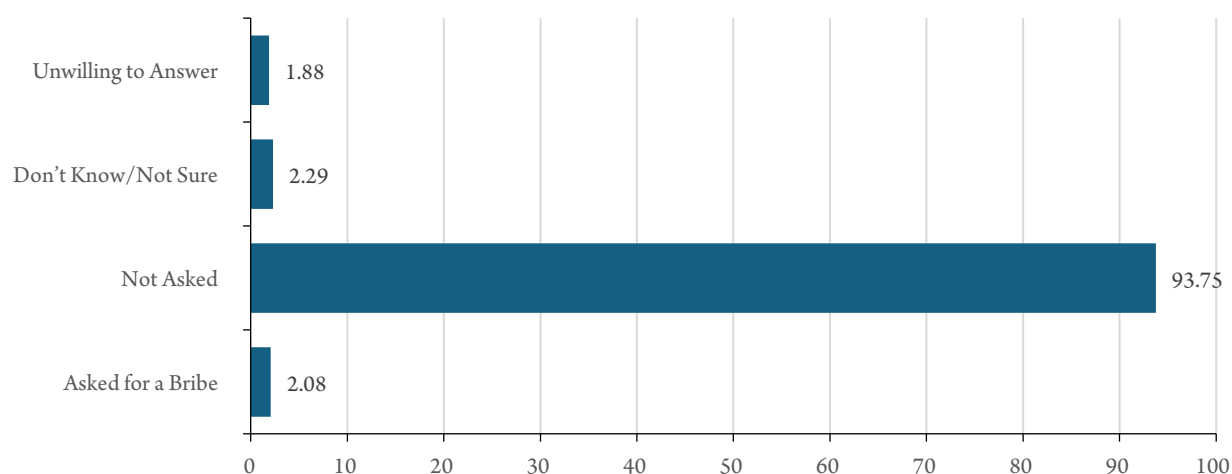
At the same time, the presence of even a small number of such incidents highlights the importance of maintaining institutional safeguards as decentralised energy programmes expand. Solar electrification initiatives often involve multiple implementing actors, including government agencies, partner organisations, local technicians, and financial intermediaries. In such multi-layered delivery systems, weak oversight or ambiguous accountability structures can create opportunities for informal payments, particularly in remote areas where monitoring capacity is limited. Ensuring transparent procurement procedures, standardised service charges, and accessible grievance mechanisms therefore remains essential to preserving program credibility.

Moreover, perceptions of fairness and procedural integrity are central to sustaining trust in publicly supported energy programmes. Even isolated cases of bribery can undermine confidence among households that already face financial constraints when adopting new technologies. If users perceive installation or servicing processes to be opaque or dependent on informal payments, participation in future renewable energy initiatives may decline. This risk is particularly relevant in large-scale programmes coordinated by institutions such as the IDCOL and the MoDMR, where maintaining public confidence is essential for continued expansion.

9.3 Governance and Regulatory Coordination Challenges

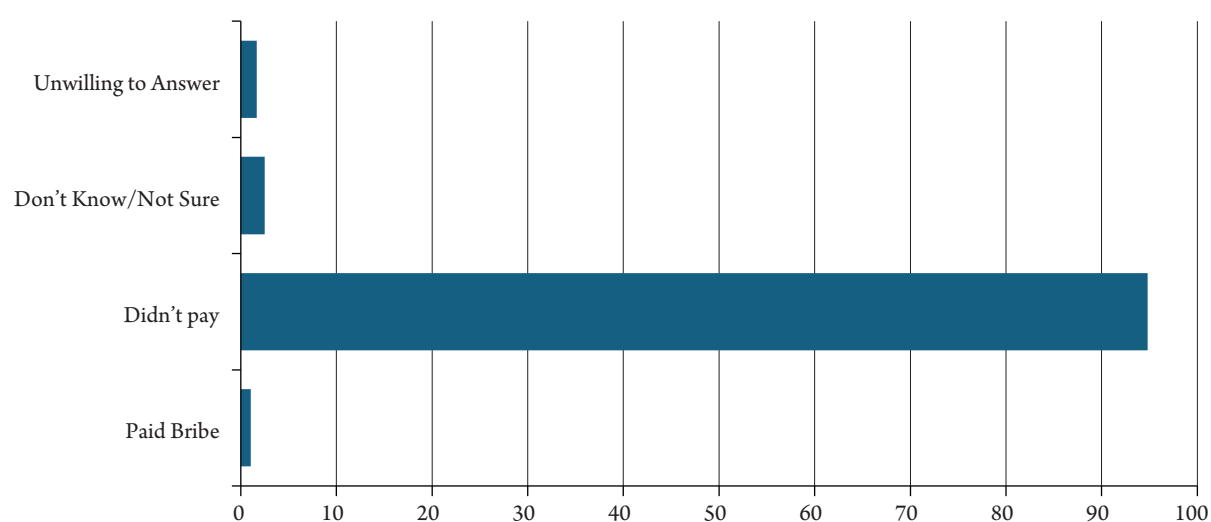
Finally, the findings underscore the broader governance challenge of balancing rapid deployment with effective regulatory oversight. As solar programmes scale and diversify across implementing agencies and financing models, institutional coordination and monitoring frameworks must evolve accordingly. Strengthening reporting requirements, clarifying operational guidelines, and improving local-level accountability can help ensure that decentralised renewable energy programmes remain both efficient and socially equitable. Addressing these governance dimensions is therefore critical for safeguarding the long-term legitimacy and sustainability of Bangladesh's solar electrification efforts. The reported incidence of users being asked for informal payments is presented in Figure 20, indicating the limited but important presence of such experiences. Figure 21 presents the proportion of households reporting actual bribe payments, providing additional evidence on the scale of informal payment practices within SHS implementation.

Figure 20 Percentage of Users Who Were Asked for Bribe



Source: CPD-SHS Survey 2025.

Figure 21 Percentage of Users Who Paid Bribe



Source: CPD-SHS Survey 2025.

10. Recommendations

10.1 Strengthen Battery Quality Standards and Lifecycle Support

Since battery failures account for the majority of technical problems, improving battery durability and maintenance systems should be prioritised. Regulators and implementing agencies should enforce stricter technical standards for batteries and require certified suppliers to meet minimum lifecycle benchmarks. Integration of new generations of Lithium-ion batteries instead of the Lead-acid batteries would improve capacity and reliability. In addition, structured maintenance packages and battery replacement schemes should be integrated into solar programmes so that households are not burdened with unexpected repair

costs. Improving battery reliability would directly reduce system downtime and help sustain confidence in decentralised solar technologies.

10.2 Develop Local Repair and Technical Service Networks

The evidence suggests that SHS installations require periodic service, often within six-month intervals. Establishing decentralised repair ecosystems, including trained local technicians and community-level service centers, would make maintenance faster and more affordable. Standardising service fees and providing training programmes for solar technicians could further improve the reliability of the repair ecosystem. Such measures would reduce the likelihood of system abandonment and help preserve the value of existing solar investments.

10.3 Standardising Service Delivery Agencies and Maintaining Quality Assurance

The service delivery agencies are a key piece of the SHS ecosystem which requires further standardisation. Their role being that of a financial and technical intermediary and over-dependence on SHS contracts as a partner organisation has resulted in the dissolution or regional withdrawal of services of many agencies as funding discontinued. There should be scope for agencies to maintain a regional presence for continued maintenance, warranty and upgradation service in coordination with local utilities. The dependence of most consumers on local electricians for maintenance paints a poor picture of the availability of these agencies for long term maintenance services, under the current terms. The quality and functionality status ought to be examined systematically to maintain retention of the SHS installations. The current standard checks for proper installation and technical standards soon after installation, without any medium or long-term supervision. Without a long-term examination, there is risk of degradation and malfunction unbeknownst to financing authorities. This should be remedied with periodic check-ups and a grievance redressal channel for consumers.

10.4 Promote Residential Rooftop Solar with Net Metering

Given the increasing availability of grid electricity in many areas, the next phase of solar adoption should emphasise residential rooftop solar integrated with net metering mechanisms. Under net metering arrangements, households can feed surplus electricity generated from rooftop solar panels back into the grid and receive credit on their electricity bills. Currently, net-metered residential rooftop installations provide around 2.9 MWp electricity to the national grid, which shows that the residential rooftop solar model still has a lot of potential to grow. Expanding awareness, simplifying application procedures, and ensuring efficient grid integration would make rooftop solar more attractive to households that already have grid access. Encouraging this transition would allow solar users to shift from small off-grid systems towards more productive grid-connected generation.

10.5 Support Hybrid Solar Systems Combining Grid and SHS

As grid expansion progresses, many households may gradually discontinue off-grid solar systems once reliable electricity becomes available. Instead of allowing these systems to become obsolete, policymakers should promote hybrid configurations that integrate solar generation with grid electricity. Hybrid systems can supply essential loads during grid outages while allowing households to rely on grid power when needed. Currently, according to the National Renewable Energy Database maintained by SREDA, 60,37,583 Solar Home Systems supply around 263.46 MWp at an off-grid capacity. Integrating this into the grid by upgrading existing SHS installations would allow this additional capacity to be available as a renewable source of electricity. Such configurations would preserve earlier investments in solar infrastructure while strengthening household energy resilience in areas still experiencing load shedding.

10.6 Facilitate System Upgrades for Existing Solar Users

Many existing SHS installations were designed to meet basic energy needs such as lighting and phone charging. However, household energy demand often increases over time as incomes rise and new appliances become necessary. While the average SHS installation ranges from 10-200 Wp, the average residential Rooftop Solar installations have a capacity of around 4 kWp, ranging from 1-50 kWp. This divergence in system size is a marker of structure integrity, roof space and affordability, but it also highlights the inadequacy of SHS installations in

meeting rural energy needs as they evolve. Providing structured upgrade pathways for existing solar users would help retain them within the renewable energy ecosystem. This could include modular panel expansion, higher-capacity batteries, and inverter upgrades that allow households to power additional appliances or integrate with rooftop systems. Facilitating system upgrades would also reduce the likelihood that households abandon solar solutions once their energy needs grow.

10.7 Introduce Flexible Financing for Rooftop and Upgraded Systems

Affordability constraints remain a key barrier to expanding solar capacity beyond small SHS units. The current cost of installation for SHS users is around BDT 9 thousand. The discontinuation of installation payments by households who can no longer afford the system is a key consideration regarding affordability. Expanding microfinance programmes, low-interest credit lines, and installment-based financing specifically for rooftop solar and system upgrades would enable more households to adopt larger and more productive installations. Blended financing models combining public subsidies, concessional loans, and private investment could further reduce upfront costs and accelerate adoption. Tying the use of the solar installations to income-generating activities would incorporate the bankability of the programme and provide upgradation plans within the consumer's financial capability.

10.8 Strengthen Governance, Transparency, and Consumer Protection

Although reported cases of bribery are limited, with average amount among those reported being BDT 2100; maintaining transparent governance structures remains important for sustaining public trust. Proper financial audit information should be collected for facilitating organisations and their status needs to be publicly disclosed. Clear operational guidelines, transparent service charges, and accessible grievance redress mechanisms should be institutionalised across solar programmes. Periodic monitoring and community-level oversight can help ensure that solar installations and associated services remain fair, efficient, and accountable.

10.9 Align Decentralised Solar Programmes With Long-Term Energy Transition Planning

Finally, solar home systems, rooftop solar, and hybrid energy systems should be integrated within broader national energy transition strategies. As Bangladesh expands grid infrastructure and renewable energy generation, decentralised solar technologies can complement the grid by providing distributed generation and backup capacity. Aligning SHS programmes with rooftop solar expansion and net metering policies would help transform early-stage off-grid electrification efforts into a more integrated and sustainable renewable energy ecosystem.

- Ahmar, M., Ali, F., Jiang, Y., Wang, Y., & Iqbal, K. (2022). Determinants of adoption and the type of solar PV technology adopted in rural Pakistan. *Frontiers in Environmental Science*, 10, Article 895622.
- Alam, M., & Bhattacharyya, S. (2016). Decentralized Renewable Hybrid Mini-Grids for Sustainable Electrification of the Off-Grid Coastal Areas of Bangladesh. *Energies*, 9(4), 268. <https://doi.org/10.3390/en9040268>
- Cabraal, A., Ward, W. A., Bogach, V. S., & Jain, A. (2021). *Living in the Light: The Bangladesh Solar Home Systems Story*. World Bank. <https://hdl.handle.net/10986/35311>
- Hellqvist, L., & Heubaum, H. (2023). Setting the sun on off-grid solar?: Policy lessons from the Bangladesh solar home systems (SHS) programme. *Climate Policy*, 23(1), 88–95. <https://doi.org/10.1080/14693062.2022.2056118>
- Hossain, Z., & Imtiaz, H. (2026). 47 percent of solar home systems no longer work properly. *Samakal*. <https://en.samakal.com/bangladesh/170847178/-percent-of-solar-home-systems-no-longer-work-properly>
- IEA (2020). *Renewables 2020*. IEA, Paris <https://www.iea.org/reports/renewables-2020>, Licence: CC BY 4.0
- Najmul Hoque, S. M., & Kumar Das, B. (2013). Present status of solar home and photovoltaic micro utility systems in Bangladesh and recommendation for further expansion and upgrading for rural electrification. *Journal of Renewable and Sustainable Energy*, 5(4), 042301. <https://doi.org/10.1063/1.4812993>
- Oliva, E. J. D., & Atehortua Santamaria, R. (2025). Decoding Solar Adoption: A Systematic Review of Theories and Factors of Photovoltaic Technology Adoption in Households of Developing Countries. *Sustainability*, 17(12), 5494. <https://doi.org/10.3390/su17125494>
- Saim, M. A., & Khan, I. (2021). Problematizing solar energy in Bangladesh: Benefits, burdens, and electricity access through solar home systems in remote islands. *Energy Research & Social Science*, 74, 101969. <https://doi.org/10.1016/j.erss.2021.101969>
- Samad, H. A., Khandker, S. R., Asaduzzaman, M., & Yunus, M. (2013). *The Benefits of Solar Home Systems: An Analysis from Bangladesh*. The World Bank. <https://doi.org/10.1596/1813-9450-6724>
- Schulte, E., Scheller, F., Sloot, D., & Bruckner, T. (2021). *A meta analysis of residential PV adoption: the role of perceived benefits and behavioral antecedents*. arXiv.
- Scheller, F., Graupner, S., Edwards, J., Weinand, J., & Bruckner, T. (2021). *Active peer effects in residential photovoltaic adoption: evidence from Germany*. arXiv.
- Sharif, I., & Mithila, M. (2013). Rural Electrification using PV: The Success Story of Bangladesh. *Energy Procedia*, 33, 343–354. <https://doi.org/10.1016/j.egypro.2013.05.075>
- Shazeed, A., Moazzem, K. G., & Mohammed, S. (2026). *Bridging micro and meso-level linkages to accelerate distributed renewable energy adoption in Bangladesh*. Centre for Policy Dialogue (CPD).
- Wu, J., Zhang, Y., Zhu, L., & Li, H. (2025). Residential solar photovoltaic adoption: review of potential, barriers and incentives. *Energy and Buildings*, 339, 115766.
- Decoding Solar Adoption. (2025). Decoding solar adoption: a systematic review of theories and factors of photovoltaic technology adoption in households of developing countries. *Sustainability*, 17(12), 5494.

Mustafa, M., Malik, M. O. F., & Maqsoom, A. (2024). Barriers to solar PV adoption in developing countries: regression and AHP approach. *Sustainability*, 16(3), 1032.

Solar PV adoption review. (2023). Solar PV adoption at household level: systematic review of factors influencing adoption. *Energy Strategy Reviews*, 50, 101178.

Table 1 Geographical Distribution of the Sample

Division	District	Thana/Upazilla	Ward	No. of HH
Barisal	Bhola	Bhola Sadar	Char Samaiya	12
Barisal	Patuakhali	Kalapara	Baliatali	12
Barisal	Barguna	Barguna Sadar	M Baliatali	12
Barisal	Pirojpur	Mathbaria	Ward No. 06	12
Barisal	Barguna	Patharghata	Ward No. 08	12
Barisal	Patuakhali	Patuakhali Sadar	Kamalapur	12
Barisal	Pirojpur	Mathbaria	Dhanisafa	12
Chattogram	Brahmanbaria	Nabinagar	Barail	12
Chattogram	Noakhali	Hatiya	Tamaraddi	12
Chattogram	Brahmanbaria	Akhaura	Ward No. 08	12
Chattogram	Feni	Feni Sadar	Ward No. 12	12
Chattogram	Chattogram	Patiya	Ward No. 08	12
Chattogram	Chattogram	Doublemooring	Ward No. 27	12
Chattogram	Cumilla	Sadar Dakkhin	Pashchim Jorkanan	12
Chattogram	Chattogram	Anwara	Barashat	12
Dhaka	Gazipur	Kaliakair	Mouchak	12
Dhaka	Gazipur	Sreepur	Ward No. 05	12
Dhaka	Tangail	Ghatail	Ward No. 04	12
Dhaka	Kishoreganj	Kishoreganj Sadar	Jashodal	12
Khulna	Bagerhat	Fakirhat	Bahirdia Mansa	12
Khulna	Kushtia	Mirpur	Amla	12
Khulna	Khulna	Terokhada	Terokhada	12
Khulna	Satkhira	Satkhira Sadar	Balli	12
Khulna	Narail	Lohagara	Shalnagar	12
Khulna	Narail	Lohagara	Ward No. 04	12
Mymensingh	Jamalpur	Bakshiganj	Nilakkhia	12
Mymensingh	Mymensingh	Muktagachha	Kumargata	12
Mymensingh	Sherpur	Jhenaigati	Nalkura	12
Rajshahi	Natore	Naldanga	Khajura	12
Rajshahi	Chapainawabganj	Chapainawabganj Sadar	Ward No. 03	12
Rajshahi	Chapainawabganj	Nachole	Nachole	12
Rajshahi	Chapainawabganj	Chapainawabganj Sadar	Shahjahanpur	12
Rajshahi	Chapainawabganj	Gomastapur	Ward No. 07	12
Rangpur	Thakurgaon	Thakurgaon Sadar	Jamalpur	12
Rangpur	Kurigram	Ulipur	Dhamshreni	12
Rangpur	Rangpur	Rangpur Sadar	Maminpur	12
Rangpur	Gaibandha	Gobindaganj	Ward No. 02	12
Sylhet	Sunamganj	Bishwambharpur	Palash	12
Sylhet	Habiganj	Nabiganj	Bausa	12
Sylhet	Moulvibazar	Kulaura	Kadipur	12
			Total	480

Source: CPD-SHS Survey 2025.

Table 2 District-wise Functionality Status

District	IDCOL SHS (%)	TR/KABITA (%)	Overall (%)
Bagerhat	—	37.50%	37.50%
Barguna	87.50%	50.00%	66.67%
Bhola	0.00%	0.00%	0.00%
Brahmanbaria	43.48%	—	43.48%
Chapainawabganj	55.56%	64.71%	60.00%
Chattogram	32.26%	—	32.26%
Cumilla	22.22%	—	22.22%
Feni	77.78%	—	77.78%
Gaibandha	—	33.33%	33.33%
Gazipur	0.00%	0.00%	0.00%
Habiganj	—	80.00%	80.00%
Jamalpur	100.00%	75.00%	77.78%
Khulna	—	0.00%	0.00%
Kishoreganj	—	18.18%	18.18%
Kurigram	100.00%	—	100.00%
Kushtia	—	25.00%	25.00%
Moulvibazar	—	100.00%	100.00%
Mymensingh	—	88.89%	88.89%
Narail	—	30.00%	30.00%
Natore	0.00%	62.50%	55.56%
Noakhali	0.00%	12.50%	11.11%
Patuakhali	28.57%	27.27%	27.78%
Pirojpur	33.33%	33.33%	33.33%
Rangpur	—	90.00%	90.00%
Satkhira	—	100.00%	100.00%
Sherpur	—	42.86%	42.86%
Sunamganj	100.00%	85.71%	90.00%
Tangail	—	0.00%	0.00%
Thakurgaon	100.00%	71.43%	75.00%

Source: CPD-SHS Survey 2025.

Table 3 Damage/ Malfunction Status

Response	IDCOL SHS (%)	TR/KABITA (%)	Overall (%)
Yes (Has malfunctioned)	71.32%	68.95%	69.83%
No (Never malfunctioned)	28.68%	31.05%	30.17%
Total (100%)	100%	100%	100%

Source: CPD-SHS Survey 2025.

Table 4 Warranty Coverage

Response	IDCOL SHS (%)	TR/KABITA (%)	Overall (%)
Yes (Had warranty)	23.91%	1.99%	10.29%
No (No warranty)	76.09%	98.01%	89.71%
Total (100%)	100%	100%	100%

Source: CPD-SHS Survey 2025.

Table 5 District-wise Warranty Coverage

District	IDCOL SHS (%)	TR/KABITA (%)	Overall (%)
Barguna	0.00%	0.00%	0.00%
Bhola	0.00%	0.00%	0.00%
Brahmanbaria	69.23%	—	69.23%
Chapainawabganj	0.00%	0.00%	0.00%
Chattogram	5.56%	—	5.56%
Cumilla	11.11%	—	11.11%
Feni	66.67%	—	66.67%
Gaibandha	—	0.00%	0.00%
Gazipur	0.00%	0.00%	0.00%
Habiganj	—	0.00%	0.00%
Jamalpur	—	0.00%	0.00%
Khulna	—	50.00%	50.00%
Kishoreganj	—	11.11%	11.11%
Kurigram	40.00%	—	40.00%
Moulvibazar	—	11.11%	11.11%
Mymensingh	—	0.00%	0.00%
Natore	0.00%	0.00%	0.00%
Noakhali	0.00%	0.00%	0.00%
Patuakhali	0.00%	0.00%	0.00%
Pirojpur	0.00%	0.00%	0.00%
Rangpur	—	0.00%	0.00%
Sherpur	—	0.00%	0.00%
Sunamganj	100.00%	0.00%	30.00%
Tangail	—	0.00%	0.00%
Thakurgaon	0.00%	0.00%	0.00%

Source: CPD-SHS Survey 2025.

Table 6 Repair/Replacement Status

Response	IDCOL SHS (%)	TR/KABITA (%)	Overall (%)
Yes (Repaired or replaced)	31.52%	42.38%	38.27%
No (Not repaired or replaced)	68.48%	57.62%	61.73%
Total (100%)	100%	100%	100%

Source: CPD-SHS Survey 2025.

Table 7 District-wise Repair or Replacement

District	IDCOL SHS (%)	TR/KABITA (%)	Overall (%)
Barguna	33.33%	20.00%	23.08%
Bhola	0.00%	0.00%	0.00%
Brahmanbaria	15.38%	—	15.38%
Chapainawabganj	57.14%	33.33%	50.00%
Chattogram	0.00%	—	0.00%
Cumilla	11.11%	—	11.11%
Feni	77.78%	—	77.78%

(Table 7 contd.)

(Table 7 contd.)

District	IDCOL SHS (%)	TR/KABITA (%)	Overall (%)
Gaibandha	—	55.56%	55.56%
Gazipur	0.00%	0.00%	0.00%
Habiganj	—	90.00%	90.00%
Jamalpur	—	85.71%	85.71%
Khulna	—	50.00%	50.00%
Kishoreganj	—	0.00%	0.00%
Kurigram	80.00%	—	80.00%
Moulvibazar	—	88.89%	88.89%
Mymensingh	—	100.00%	100.00%
Natore	0.00%	50.00%	42.86%
Noakhali	0.00%	0.00%	0.00%
Patuakhali	28.57%	9.09%	16.67%
Pirojpur	0.00%	33.33%	16.67%
Rangpur	—	83.33%	83.33%
Sherpur	—	40.00%	40.00%
Sunamganj	100.00%	85.71%	90.00%
Tangail	—	0.00%	0.00%
Thakurgaon	100.00%	85.71%	87.50%

Source: CPD-SHS Survey 2025.

Table 8 Mean Installation Cost

Installation Type	Number of Observations	Mean Cost (BDT)	Std. Dev. (BDT)	Min (BDT)	Max (BDT)
IDCOL SHS	129	9,080.69	11,647.94	0	45,000
TR/KABITA	219	907.13	4,049.69	0	40,000
Overall	348	3,936.99	8,716.64	0	45,000

Source: CPD-SHS Survey 2025.

Table 9 District-wise Satisfaction Scores

District	Mean (IDCOL SHS)	Mean (TR/KABITA)	Overall Mean
Bagerhat	-	8.38	8.38
Barguna	8.5	8.8	8.67
Bhola	8	8	8
Brahmanbaria	2.78	-	2.78
Chapainawabganj	7.72	8.29	8
Chattogram	3.16	-	3.16
Cumilla	8.67	-	8.67
Feni	8.78	-	8.78
Gaibandha	-	7.11	7.11
Gazipur	7	7.85	7.65
Habiganj	-	8	8
Jamalpur	10	9.13	9.22
Khulna	-	7.38	7.38
Kishoreganj	-	7.73	7.73
Kurigram	7.44	-	7.44

(Table 9 contd.)

(Table 9 contd.)

District	Mean (IDCOL SHS)	Mean (TR/KABITA)	Overall Mean
Kushtia	-	8.63	8.63
Moulvibazar	-	8.33	8.33
Mymensingh	-	9	9
Narail	-	8.65	8.65
Natore	6	8	7.78
Noakhali	8	7.63	7.67
Patuakhali	8	8.36	8.22
Pirojpur	9	7.67	8.33
Rangpur	-	7.5	7.5
Satkhira	-	9	9
Sherpur	-	9.43	9.43
Sunamganj	9.33	8.57	8.8
Tangail	-	8.11	8.11
Thakurgaon	7	7.57	7.5

Source: CPD-SHS Survey 2025.

Table 10 District-wise Interest in Future Solar Use

District	IDCOL SHS Yes %	TR/KABITA Yes %	Overall Yes %
Bagerhat	-	100	100
Barguna	62.5	50	55.56
Bhola	100	100	100
Brahmanbaria	86.96	86.96	86.96
Chapainawabganj	33.33	23.53	28.57
Chattogram	70.97	70.97	70.97
Cumilla	55.56	55.56	55.56
Feni	66.67	66.67	66.67
Gaibandha	-	77.78	77.78
Gazipur	100	100	100
Habiganj	-	100	100
Jamalpur	100	100	100
Khulna	-	100	100
Kishoreganj	-	100	100
Kurigram	88.89	88.89	88.89
Kushtia	-	100	100
Moulvibazar	-	100	100
Mymensingh	-	100	100
Narail	-	100	100
Natore	0	0	0
Noakhali	100	100	100
Patuakhali	71.43	54.55	61.11
Pirojpur	100	100	100
Rangpur	-	90	90
Satkhira	-	100	100
Sherpur	-	85.71	85.71
Sunamganj	100	100	100

(Table 10 contd.)

(Table 10 contd.)

District	IDCOL SHS Yes %	TR/KABITA Yes %	Overall Yes %
Tangail	-	100	100
Thakurgaon	100	100	100
Total	70.54	84.02	79.02

Source: CPD-SHS Survey 2025.

Table 11 District-wise Affordability Range

District	Non-Affordable (%)	BDT 12,000 (%)	BDT 25,000 (%)	BDT 45,000 (%)	BDT 60,000 (%)	BDT 100,000+ (%)	Total (%)
Bagerhat	0	41.7	58.3	0	0	0	100
Barguna	45.8	29.2	25	0	0	0	100
Bhola	0	83.3	16.7	0	0	0	100
Brahmanbaria	12.5	54.2	29.2	4.2	0	0	100
Chapainawabganj	75	8.3	12.5	4.2	0	0	100
Chattogram	41.7	44.4	11.1	2.8	0	0	100
Cumilla	8.3	58.3	25	8.3	0	0	100
Feni	0	33.3	50	16.7	0	0	100
Gaibandha	25	58.3	16.7	0	0	0	100
Gazipur	0	33.3	45.8	12.5	8.3	0	100
Habiganj	0	66.7	33.3	0	0	0	100
Jamalpur	0	83.3	16.7	0	0	0	100
Khulna	0	50	41.7	8.3	0	0	100
Kishoreganj	0	91.7	8.3	0	0	0	100
Kurigram	41.7	33.3	25	0	0	0	100
Kushtia	0	83.3	16.7	0	0	0	100
Moulvibazar	0	50	41.7	8.3	0	0	100
Mymensingh	0	75	25	0	0	0	100
Narail	0	4.2	83.3	12.5	0	0	100
Natore	91.7	0	8.3	0	0	0	100
Noakhali	0	83.3	16.7	0	0	0	100
Patuakhali	29.2	37.5	33.3	0	0	0	100
Pirojpur	25	45.8	29.2	0	0	0	100
Rangpur	15.4	61.5	23.1	0	0	0	100
Satkhira	0	58.3	41.7	0	0	0	100
Sherpur	8.3	58.3	33.3	0	0	0	100
Sunamganj	0	33.3	58.3	8.3	0	0	100
Tangail	0	83.3	16.7	0	0	0	100
Thakurgaon	18.2	54.5	27.3	0	0	0	100

Source: CPD-SHS Survey 2025.

Table 12 District-wise Financing Mode Preference

District	Joint Purchase (%)	Installment Loan (%)	Self-funded (%)	Institutional (%)
Bagerhat	0.00%	100.00%	0.00%	0.00%
Barguna	54.17%	45.83%	0.00%	0.00%
Bhola	0.00%	91.67%	8.33%	0.00%
Brahmanbaria	4.17%	54.17%	41.67%	0.00%
Chapainawabganj	0.00%	93.75%	2.08%	4.17%
Chattogram	0.00%	25.00%	30.56%	44.44%
Cumilla	0.00%	83.33%	16.67%	0.00%
Feni	0.00%	50.00%	50.00%	0.00%
Gaibandha	8.33%	8.33%	0.00%	83.33%
Gazipur	0.00%	83.33%	16.67%	0.00%
Habiganj	0.00%	100.00%	0.00%	0.00%
Jamalpur	0.00%	100.00%	0.00%	0.00%
Khulna	0.00%	91.67%	8.33%	0.00%
Kishoreganj	0.00%	100.00%	0.00%	0.00%
Kurigram	83.33%	8.33%	8.33%	0.00%
Kushtia	0.00%	91.67%	8.33%	0.00%
Moulvibazar	0.00%	100.00%	0.00%	0.00%
Mymensingh	0.00%	83.33%	16.67%	0.00%
Narail	0.00%	100.00%	0.00%	0.00%
Natore	0.00%	75.00%	25.00%	0.00%
Noakhali	0.00%	100.00%	0.00%	0.00%
Patuakhali	25.00%	75.00%	0.00%	0.00%
Pirojpur	20.83%	79.17%	0.00%	0.00%
Rangpur	7.69%	46.15%	0.00%	46.15%
Satkhira	16.67%	83.33%	0.00%	0.00%
Sherpur	0.00%	91.67%	8.33%	0.00%
Sunamganj	0.00%	100.00%	0.00%	0.00%
Tangail	0.00%	83.33%	16.67%	0.00%
Thakurgaon	0.00%	18.18%	9.09%	72.73%
Total	8.13%	73.33%	9.79%	8.75%

Source: CPD-SHS Survey 2025.

For two decades, the Solar Home System was rural Bangladesh's answer to electricity access. Millions of households once relied on it for light, for charging a phone, for keeping a small business running after dark. Today, that answer is fraying. Grid lines have reached villages that once depended entirely on solar, free-panel programmes have reshaped demand, and the systems already installed are ageing without the batteries, repair networks, or service standards needed to keep them running.

This study asks what comes next. Drawing on a nationally representative survey of 480 households across all eight divisions of Bangladesh, spanning programme-supported and market-purchased systems alike, it maps who is still using solar, who has stopped, and why. It finds a sector where fewer than half of installed systems remain functional, where battery failure drives most abandonment, and where satisfaction varies widely depending on which programme installed the panel. Yet it also finds something easy to overlook: households have not given up on solar. Most say they would adopt it again, if it were reliable and affordable.

That tension between eroding confidence and enduring demand is the heart of this report. It sets out a practical path forward, from stronger battery standards and local repair networks to rooftop solar with net metering and financing that meets households where they are. For policymakers, development partners, and anyone invested in Bangladesh's renewable energy transition, this is a close look at what it takes to keep a pioneering programme, and the people who depend on it, from being left behind.



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