

Renewable Energy for Long-Term Growth and Development: Bangladesh Perspective

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Abstract

Beneficiaries prefer renewable energy-based systems over grid-connected electricity. The cost of energy is viewed as the most influential factor while choosing renewable energy systems. Beneficiaries chose to stay linked with renewable energy systems even when they received grid-connected electricity at a lower tariff.

Net-metering and feed-in tariff mechanisms, as well as tax cuts and subsidies for renewable energy projects, could be the catalyst for fostering greater uptake of renewables in the electricity generation mix.

Key Messages

- Beneficiaries prefer renewable energy-based systems over grid-connected electricity.
- Cost of energy is viewed as the most influential factor while choosing renewable energy systems.
- Beneficiaries chose to stay linked with renewable energy systems even when they received grid connected electricity in a lower tariff.
- Net-metering and feed-in tariff mechanisms, as well as tax cuts and subsidies for renewable energy projects could be the catalyst for fostering greater uptake of renewables in the electricity generation mix.

Introduction

Bangladesh, the eighth-most populous country in the world, is situated in the world's largest river delta, the Ganges-Brahmaputra-Meghna Delta, with an area of approximately 150,000 km². It is also one of the countries most vulnerable to the adverse effects of climate change. Although Bangladesh is not a significant emitter of Greenhouse Gases (GHG), it has submitted its updated Nationally Determined Contributions (NDC) in August 2021, where enhanced economy-wide emission reduction targets have been committed: 6.73% from business-as-usual (BAU) (27.56 MtCO₂e) by 2030 in the unconditional scenario and 15.12% from BAU (61.9 MtCO₂e) by 2030 in the conditional scenario [1].

Renewable Energy Targets Of Bangladesh In Various Policy Documents

The Bangladesh Power System Master Plan-2016 states that 10% of the total installed capacity has to come from renewable energy sources by 2041 [2]. The Eighth Five-Year Plan, which goes up to 2025, describes adding 2,362 MW from renewable energy resources into the overall electricity generation stream. In the updated NDC, Bangladesh committed to implement renewable energy projects with a cumulative capacity of 5,026 MW by 2030 (including unconditional and conditional contributions).

Solar Energy In Bangladesh

Bangladesh enjoys moderate levels of solar radiation on a daily basis (Global Horizontal Irradiance » 4.5 kWh/m²). It boasts the world's largest off-grid solar home initiative, which has provided electricity to 20 million people, primarily living in remote and rural Bangladesh [3]. The country's solar energy-based project typologies are primarily dominated by off-grid Solar Home Systems (SHS), with 6.02 million installations generating 263 MW of electricity. Other solar-based renewable energy generation comes from solar parks (130 MW), rooftop solar (64 MW), solar irrigation pumps (44 MW), solar streetlights (17 MW), and solar mini-grids (5 MW) [4]. The Government of Bangladesh is ramping up its implementation of large-scale grid-tied solar photovoltaic (PV) projects; as of January 2021, a total of 21 large-scale solar independent power producer (IPP) projects have been taken up with an installed capacity of 980 MW (including Power Purchase Agreement (PPA) signed and Letter of Intent (LOI) issued) [5].

Policy Brief Background

Electrification in remote areas using renewable energy technologies is a complicated and multi-dimensional challenge. Variables that must be taken into account span economic, social, technical, environmental, and political issues. Multi-criteria decision analysis has identified that economic, technical, social, and environmental criteria are the most vital criteria in planning renewable energy-based systems for electrifying remote areas [6]. Thus, considering the remote Bangladesh context, this policy brief has aimed to evaluate the perception of renewable energy technologies using the economic, technical, and social criteria – specifically for solar energy technology – from the beneficiary point of view.

Methodology

A field survey was conducted among 218 beneficiaries in seven districts (Barisal, Dhaka, Dinajpur, Thakurgaon, Manikganj, Sirajganj, and Shariatpur) of Bangladesh, covering private households, commercial businesses, and rural farmings. The demographics of the survey are presented in **Table 1**. The beneficiaries of three types of solar-based technologies were chosen: SHSs, solar mini-grids, and solar irrigation pumps. All SHS and solar mini-grid beneficiaries had various amounts of lighting, cooling (only fan), and phone-charging loads. Only 53 have televisions, 3 have computers, and 97 have refrigerators at their premises. The beneficiaries of solar irrigation projects use underground water using the submersible multistage centrifugal motor pumps powered by solar PV systems. These were used to diesel-run pumps before switching to the solar PV-based irrigation system.

A questionnaire was designed to assess key issues that fall under three primary criteria: economic, technical, and social. An Analytical Hierarchy Process (AHP)-based Multi-Criteria Decision Analysis (MCDA) mechanism has been utilized to study the insights of the grid-connected and renewable energy systems that electrify their premises or provide energy for farming the lands [7]. MCDA is a process that can combine all the diverse viewpoints to propose a comprehensive solution. There are various MCDA methods that can solve energy-related problems, which deal with multiple objectives associated with multiple numbers of resources [7]. AHP is one such method for organizing and analysing complex

decisions, using math and psychology. AHP provides a rational framework for a needed decision by quantifying its criteria and alternative options and relating those elements to the overall goal [8].

All the beneficiaries were asked to score the given criteria and sub-criteria, using the Saaty scale [9]. Using the Saaty scale (1 to 9), a user can express the intensity of importance of one criterion/parameter over the other (pairwise comparison). For example, a user can express ‘extreme importance’ intensity using 9 and ‘equal importance’ using 1, while 3 represents ‘moderate importance’, 5 represents ‘strong importance’, and 7 represents ‘very strong importance’. The pairwise comparison is the cornerstone of AHP, as it allows the decision-maker to temporarily focus on only two alternatives or criteria at a time. To calculate priorities, the individual preference is expressed on a verbal scale and then converted to the numerical value using the Saaty scale.

Table 1: Survey Demographic

Category	Male	Female
Households	106	58
Commercial Businesses	44	0
Solar Irrigation Pump Users	10	0
Total	160	58

Key Findings

- The economic criteria are found to be the most essential criteria, having the highest weightage in the evaluation of the perception of beneficiaries who use solar PV-based systems and also get support from the grid-connected systems (available or unavailable). This illustrates the significance of economic evaluation of a system during all the phases, which includes system planning, design, and finally evaluating the beneficiary satisfaction level. **Figure 1(a)** presents the weight of the three criteria deployed in this study.
- The analysis revealed that the most significant parameter to influence perception is the “cost of energy” (COE) (falling within the economic criteria). Within the social arena, the “inconvenience of the systems” is the most weighted sub-criterion, whilst amongst the technical sub-criteria, the “ease of technical maintenance” has been judged to be the most important. **Figures 1(b), (c), and (d)** portray the weights of the sub-criteria that fall under economic, technical, and social criteria, respectively. The higher the value, the more important that criterion is.
- The study reveals that the beneficiaries from all three solar PV-based technologies are pleased with the electrification scheme at their premises. Even though some regions have recently received electricity from the national grid, the survey discovered that beneficiaries chose to stay linked with

solar PV systems due to various long-term benefits, which includes reliability, backup during power outages, convenience of maintenance, long-term cost, and health benefits, etc. The study found that beneficiaries prefer renewable energy-based (i.e., solar PV-based) systems over grid-connected ones. A 65% preference for renewable energy-based systems against a 35% preference for grid-connected systems has been computed to quantify the overall findings. The total scores are shown in **Figure 2**, demonstrating a preference for the renewable energy-based system.

- While querying the impact on livelihood due to sudden electricity shutdown or unavailability of electricity for a long time, 93% of the household beneficiaries said it moderately hampers their lives. This is true for 75% of the commercial beneficiaries.
- Around 60% of the SHSs and solar mini-grids customers informed that they would prefer the consistency of power supply over a cheaper but unreliable option.
- At least 90% of all consumers were aware of the environmental advantages of renewable energy-based systems. As a result, they are prepared to pay a little more to accommodate solar PV systems in their premises.

Recommendations

Based on the consumer judgement and the subsequent analysis of user perception of renewable energy beneficiaries in remote Bangladesh, the following recommendations can be made:

- **Beneficiaries in rural Bangladesh are in favour of renewable energy-based systems for electrification over the grid-connected option.** Therefore, the Government should make scaling up large-scale renewable energy projects a priority, as well as boosting grid-connected renewable generating capacity and strengthening the transmission and distribution network capacity.
- **Economic criteria, specifically the cost of energy, are viewed as the most influential factor by beneficiaries of solar PV systems.** The Government and regulators should take measures to reduce the energy price for renewable energy systems to make them more attractive to the users. Implementing high feed-in tariffs (to take advantage of the net-metering system), tax reductions, and reallocating subsidies from conventional energy generation to renewable energy facilities could be critical in assisting current efforts.
- **Beneficiaries prioritize a consistent power supply over cheaper (but unreliable) options.** The Government should focus on providing a quality power supply with high-quality standardized equipment.
- The aim of financing renewable energy projects should be to **shift away from the mindset of high-profit margins and towards the ultimate goal of fuel diversification** in order to achieve the UN Sustainable Development Goals.

Declarations

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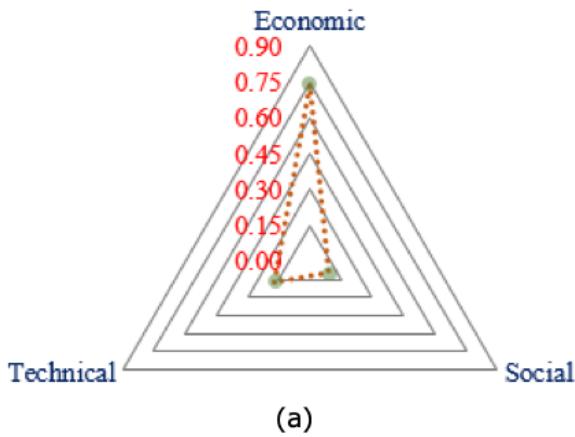
Competing Interests

The authors declare no competing interests.

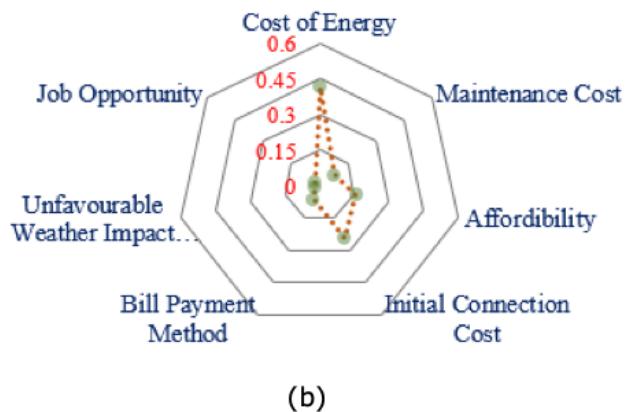
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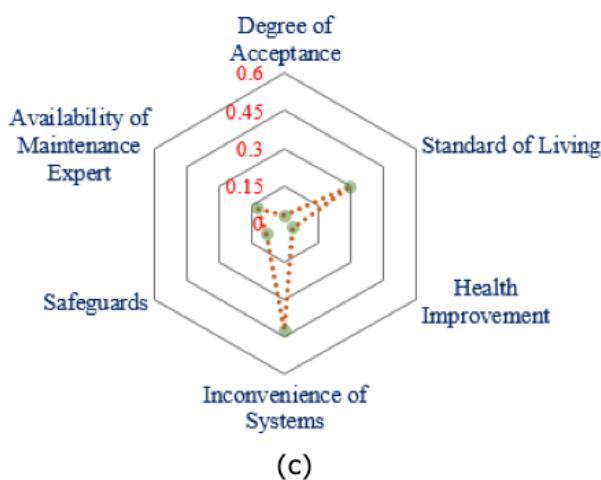
Figures



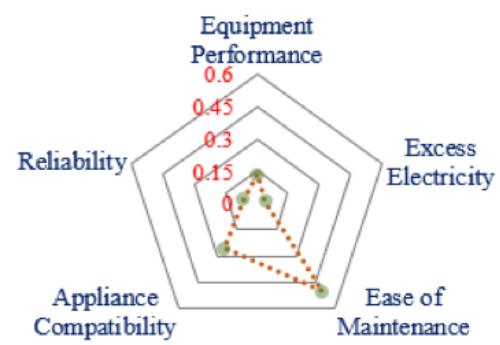
(a)



(b)



(c)



(d)

Figure 1

Weights of each of the three criteria (a), and their sub-criteria shown in (b) for economic, (c) for social, and (d) for technical

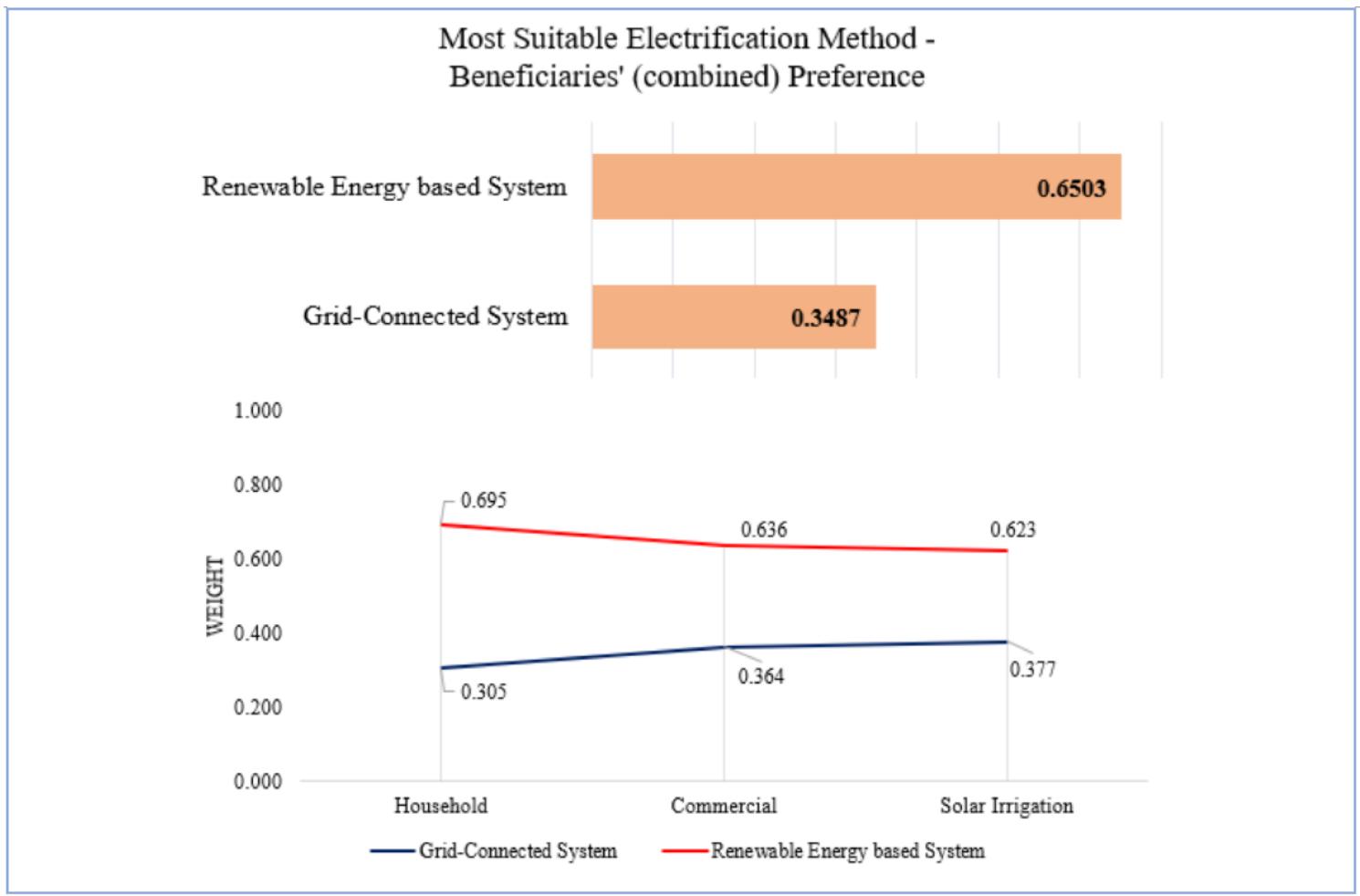


Figure 2

Most suitable electrification method – beneficiaries' perception

Supplementary Files

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- [Onlinefloatimage1.png](#)