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ILLUMINATING SOCIAL CHANGE: IMPACT ANALYSIS OF THE EFFECTIVENESS AND SUSTAINABILITY OF THE SOLAR STREETLIGHTING PROJECT IN BRGY. ABULALAS AND BRGY. CARILLO, HAGONOY, BULACAN

ILUMINANDO A MUDANÇA SOCIAL: ANÁLISE DO IMPACTO DA EFICÁCIA E SUSTENTABILIDADE DO PROJETO DE ILUMINAÇÃO PÚBLICA SOLAR NOS BAIRROS DE ABULALAS E CARILLO, EM HAGONOY, BULACAN

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Abstract
More than an infrastructure improvement, adequate public lighting serves as a catalyst for safety, community cohesion, and social change. This study evaluated the impact of the Solar Streetlighting Project installed on the Brgy. Abulalas–Carillo Bridge in Hagonoy, Bulacan, initiated by the College of Industrial Technology, Bulacan State University. Designed to address inadequate illumination in a high-risk area, the project aimed to promote community safety, social interaction, and overall quality of life. The project impact was assessed across four dimensions, namely technological, cost-efficiency, sustainability, and socio-economic benefits using a descriptive research design. Data were collected from the perspectives of thirty-one (31) recipients through survey questionnaires. Statistical analyses indicate favorable perceptions among neighborhood members, demonstrating that the project successfully addressed lighting problems, optimized resource utilization, and enhanced nighttime mobility, safety, and community engagement. Overall, the project demonstrated significant contributions to community welfare and social cohesion, establishing the potential of university-led extension programs as catalysts

Resumo
Mais do que uma melhoria de infraestrutura, a iluminação pública adequada atua como um catalisador para a segurança, a coesão comunitária e a transformação social. Este estudo avaliou o impacto do Projeto de Iluminação Pública Solar instalado na ponte Brgy. Abulalas–Carillo, em Hagonoy, Bulacan, iniciado pela Faculdade de Tecnologia Industrial da Universidade Estadual de Bulacan. Concebido para resolver a iluminação inadequada em uma área de alto risco, o projeto teve como objetivo promover a segurança da comunidade, a interação social e a qualidade de vida em geral. O impacto do projeto foi avaliado em quatro dimensões, a saber: tecnológica, custo-benefício, sustentabilidade e benefícios socioeconômicos, utilizando um desenho de pesquisa descritivo. Os dados foram coletados a partir das perspectivas de trinta e um (31) beneficiários por meio de questionários de pesquisa. As análises estatísticas indicam percepções favoráveis entre os moradores do bairro, demonstrando que o projeto resolveu com sucesso os problemas de iluminação, otimizou a utilização de recursos e melhorou a mobilidade noturna, a segurança e o envolvimento da comunidade. De modo geral, o projeto demonstrou contribuições significativas

for local development and transformative social change.

Keywords: Community Extension. Effectiveness. Impact Assessment. Solar Streetlights. Sustainability.

para o bem-estar da comunidade e a coesão social, estabelecendo o potencial dos programas de extensão liderados por universidades como catalisadores do desenvolvimento local e da mudança social transformadora.

Palavras-chave: *Extensão Comunitária. Eficácia. Avaliação de Impacto. Postes de Iluminação Solar. Sustentabilidade.*

1 INTRODUCTION

Renewable energy has been increasingly recognized as a critical solution to deal with the dual challenges of meeting the world's growing electricity demand and mitigating environmental degradation (Dol et al., 2024). Renewable energy provides a long-term and cost-effective alternative to traditional power sources in rural and isolated places where grid connections are not available or are not reliable. For communities with limited financial resources, these technologies eliminate recurring electricity costs and foster energy independence (Boxwell, 2014). Among various renewable sources, solar power has gained prominence due to its relatively low installation cost, ease of deployment, and potential to provide clean, inexhaustible energy (Jones-Albertus et al., 2018).

Solar energy derives its power from the sun, which is the world's largest and most reliable natural energy source. While the sun emits approximately 7,000 times more energy than global human consumption, only a small fraction is harnessed for electricity generation (Centre for Climate and Energy Solutions [C2ES], 2011). Solar panels, which convert sunlight into electrical energy through PV cells, represent a non-polluting and sustainable energy solution, especially as the depletion of fossil fuels and the volatility of energy markets intensify the need for alternatives (Boxwell, 2014). Global solar photovoltaic (PV) capacity increased over 25-fold between 2009 and 2019, driven by government incentives and supportive policies (Crago, 2021).

Recognizing the strategic importance of renewable energy, the Philippine government has enacted several policies to promote its development and adoption. The National Electrification Administration Act (RA 6038), the Electric Power Industry

Reform Act of 2001, and the National Electrification Administrative Reform Act of 2013 collectively aim to expand energy access in underserved communities. Furthermore, the Renewable Energy Act of 2008 seeks to reduce dependence on imported fossil fuels, accelerate the commercialization of renewable technologies, and ensure a balance between economic growth and environmental protection.

Research demonstrates the transformative potential of solar-powered electricity, especially in overcoming energy access difficulties in rural and off-grid regions of the Philippines. Break-even distance analysis indicates that solar photovoltaic (PV) systems are more cost-effective for remote communities. However, power line extension is still more cost-effective when servicing several neighboring communities (Napao et al., 2017). In South and Southeast Asia, the use of solar home systems (SHS) has achieved notable success through government-supported schemes (Dellosa & Barocca, 2021). In the Philippines, switching from diesel-based generation to solar PV–battery–diesel hybrid systems in island grids might cut electricity prices by about 20% and make energy more reliable (Ocon & Bertheau, 2019). Despite national laws like the Renewable electricity Act of 2008, implementation challenges continue to persist. For example, in rural areas like Lanao del Norte, consistent electricity supply remains to be a challenge (Orain, 2025). To achieve sustainable rural electrification in line with the Philippine Energy Plan, it is essential to surmount technical and financial obstacles.

The municipality of Hagonoy in the Province of Bulacan exemplifies the challenges and opportunities connected with rural electricity. The Brgy. Abulalas-Carillo Bridge, a critical link between two barangays and a daily commuter route for residents and students of Bulacan State University's Hagonoy Campus, was previously unlit at night, causing substantial safety risks and contributing to petty crime. In 2016, Bulacan State University's College of Industrial Technology (CIT) launched a solar-powered streetlighting expansion project to address these challenges while raising awareness and adoption of renewable energy. Custom-designed lamp posts were installed on the bridge's vertical clearance arches to provide maximum illumination and safety.

While anecdotal accounts indicate improvements in community safety and evening mobility, there is no comprehensive, evidence-based assessment of the project's long-term performance and sustainability. Existing work on solar streetlighting frequently focuses on technical feasibility or short-term outcomes, with little research on long-term

benefits in small-community settings in the Philippines. This gap points to the need to assess not only the project's technological and economic performance but also its socio-economic benefits and capacity for sustained operation. Thus, this study aims to assess the impact of the BSU-CIT Solar Streetlighting System in Barangays Abulalas and Carillo through the following objectives:

1. To measure the project's level of effectiveness in terms of cost-efficiency and socio-economic contributions to community quality of life.
2. To evaluate the project's sustainability in meeting residents' streetlighting needs, particularly from a technological perspective.
3. To identify necessary modifications to further improve the effectiveness and long-term sustainability of the extension project.

2 REVIEW OF RELATED LITERATURE

2.1 Safety, mobility, and public health improvements

Adequate streetlighting is widely recognized as a public safety intervention that extends beyond its functional role of illumination. Empirical evidence demonstrates that the installation of well-designed streetlights reduces crime, deters antisocial behavior, and decreases the risk of road accidents, particularly in high-risk or poorly lit areas (Li & Makumbe, 2017; Welsh et al., 2022). The improvement in visibility facilitates safer pedestrian and vehicular mobility, enabling residents to engage in economic and social activities during nighttime hours. In rural or peri-urban communities, such interventions directly influence public health by reducing accidents and enabling access to emergency services after dark (SolarLighting, 2023). These safety and mobility benefits are particularly significant in bridging communities where transportation routes serve as critical lifelines for trade, education, and healthcare access.

2.2 Socio-economic and community well-being impacts

Solar streetlighting is increasingly recognized as a catalyst for socio-economic growth, particularly in rural and indigenous communities in the Philippines. Beyond

lowering energy costs, it allows for longer business hours, promotes night markets, and encourages communal meetings that build social cohesion (Salac et al., 2024). According to research, solar street lights (SSLs) improve public safety, lengthen work and leisure hours, and stimulate dynamic community activities (Albina et al., 2025; Maroma & Maroma, 2019). Their adoption has also been associated to lower family expenses and enhanced nighttime visibility, with users reporting high levels of satisfaction (Albina et al., 2025). SSLs are becoming more dependable and cost-effective as solar-powered LED technology advances and essential component prices fall (Ciriminna et al., 2017). The integration of solar power systems on small Philippine islands has expanded service hours, reduced costs, and promoted environmental sustainability (Bertheau, 2020). Nonetheless, obstacles remain, such as high initial installation costs and discrepancies in electricity usage patterns between income groups (Albina et al., 2025; Bertheau, 2020).

2.3 Technological design, efficiency, and environmental sustainability

The effectiveness of solar streetlighting projects is frequently dependent on the quality of their design and the suitability of their technical requirements for local conditions. Pratama et al. (2023) found that strategic system sizing, battery optimization, and LED selection dramatically improved lighting quality while lowering greenhouse gas emissions in rural Indonesian villages. However, technical success can also be attributed on the contextual adaptation; systems that fail to consider environmental conditions, local maintenance capability, and community demands frequently fail prematurely. These findings highlight the importance of socially and environmentally relevant designs in solar streetlighting, in addition to superior technology (Abdullah et al., 2024).

Community perception is critical in deciding the long-term viability of solar streetlighting schemes. According to Liu et al. (2022), visual comfort, brightness homogeneity, and optimum color temperature are critical for community approval. Residents who believe lighting is insufficient or too harsh may underuse illuminated areas, decreasing the intended benefits for safety and community interaction. This stresses the need of user-centered design approaches in public infrastructure projects, where technical efficiency must be balanced against end-user experiences.

2.4 Role of universities in community extension projects

University extension programs provide an important link between academic competence and community needs, promoting social transformation and knowledge democratization (Santana et al., 2025). In the Philippines, state universities and colleges (SUCs) are required to provide extension services that benefit local development, frequently addressing infrastructural gaps, livelihood enhancement, and capacity building (Koudroglou & Leonoras, 2019). As a relevant extension project, solar streetlighting efforts performed by academic institutions demonstrate how higher education can leverage technical know-how, engineering experience, and student participation to address important community challenges.

3 METHODOLOGY

3.1 Research design

This study used a descriptive research approach, which is often used to explain the features of a phenomena and evaluate the current state of a program or intervention (Creswell & Creswell, 2018; Babbie, 2020). The design entailed identifying key elements at various stages of the study, such as inputs like environmental impact considerations, project documentation, and stakeholder agreements; processes like survey administration, validation, and statistical analysis; and outputs like impact assessment findings and recommendations. This organized approach allowed for a thorough evaluation of the solar streetlighting project's efficacy and contributions to community welfare.

3.2 Research locale and respondents

The study was carried out in Barangays Abulalas and Carillo, Hagonoy, Bulacan, where a solar streetlighting system was constructed in 2016 as part of the Bulacan State University-College of Industrial Technology (BSU-CIT) community extension program. The renovation was carried out along the Abulalas-Carillo Bridge, which serves as a main thoroughfare for BSU Hagonoy Campus residents and students. Figure 1 shows the

installation and operation of the solar lighting system in Abulalas and Carillo Bridge, including (a) solar panel unit, (b) installation, (c) final testing, and (d) nighttime monitoring.

Respondents consisted of 31 residents from the two barangays, selected purposively as direct beneficiaries of the project. Participants were categorized into three groups: working, non-working, and student residents. This stratification enabled the analysis of differences in perception and satisfaction across demographic categories.

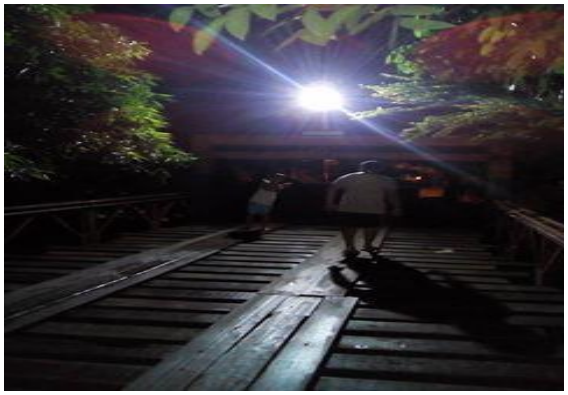
Figure 1

Installation and operation of the solar lighting system in Abulalas and Carillo Bridge: (a) solar panel unit, (b) installation, (c) final testing, and (d) nighttime monitoring.

(a) Solar panel unit (80 W / 26 A) capable of charging the battery even in mildly sunny conditions

(b) Installation of the solar lighting system on both sides of the bridges

(c) Final testing and fastening of installed units to concrete posts



(d) Nighttime monitoring showing fully functional and well-illuminated bridge.

3.3 Research instruments

The primary data collection instrument was a structured survey questionnaire developed and validated to assess the perceived impact of the solar streetlighting project across four key dimensions: technological, cost-efficiency, socio-economic, and sustainability. The technological aspect measured perceptions of design quality, functionality, and potential for further development. Cost-efficiency focused on resource utilization, budget adequacy, and willingness to contribute to maintenance. The socio-economic dimension examined perceptions of safety, mobility, community interaction, and economic activities, while the sustainability dimension assessed long-term viability, maintenance, and continued benefits. Each indicator consisted of multiple items rated on a four-point Likert scale (4 = Strongly Agree to 1 = Strongly Disagree), allowing for the quantification of agreement levels. To ensure clarity and accessibility for respondents, the questionnaire was prepared in Filipino. Prior to administration, the instrument underwent expert validation to confirm content relevance, clarity, and appropriateness for the target community (Taherdoost, 2016).

3.4 Data gathering procedures

A organized, multi-step method was used to collect data, ensuring accuracy, reliability, and ethical compliance. During the pre-data collecting phase, authorization was obtained from barangay officials and the BSU-CIT administration, and the research instrument was validated by subject matter experts to verify it was appropriate for the target population. During the data collection phase, the questionnaire was administered in person to encourage high response rates and provide immediate clarification of any respondent questions. In addition, unstructured interviews were conducted with chosen participants to gain deeper insights and corroborate the quantitative survey results. The post-data gathering process included combining and encoding survey replies, as well as transcribing interview material for later thematic analysis. Throughout the process, ethical considerations were scrupulously followed. Respondents were informed of the study's objectives, ensured of confidentially, and reminded that they might withdraw from participation at any time without consequence (Babbie, 2020).

3.5 Data analysis

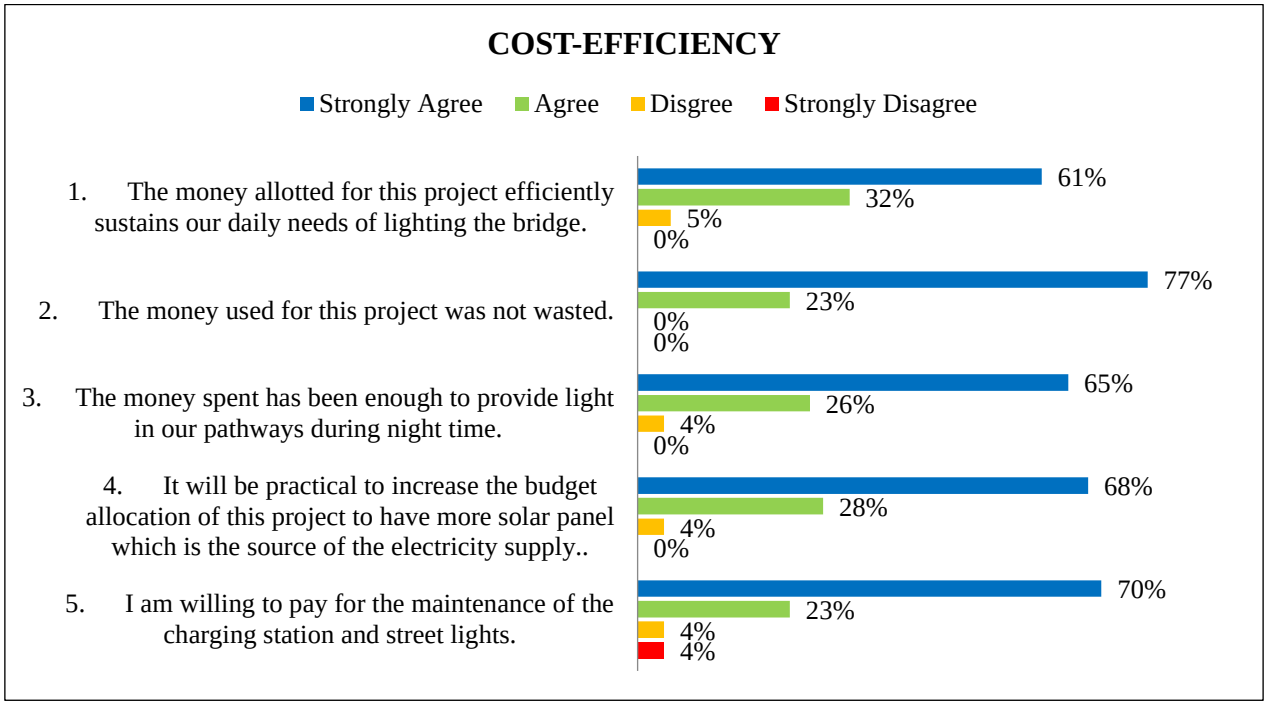
Quantitative data from the surveys were analyzed using weighted mean to determine the overall level of agreement for each indicator. Percentages were calculated to represent the proportion of respondents who chose each response category, giving a more complete picture of the distribution of opinions. This method turned ordinal Likert-scale replies into numerical and proportional values that could be easily interpreted (Boone & Boone, 2012). Graphs and charts were used to convey the data with greater clarity.

4 RESULTS AND DISCUSSION

This section presents and interprets the findings of the study on the impact of the Solar Streetlighting Project installed on the Abulalas–Carillo Bridge in Hagonoy, Bulacan. The results are organized according to the four assessed dimensions, technological, cost-efficiency, socio-economic, and sustainability, based on the weighted mean and percentage distribution of responses. The discussion integrates relevant literature to contextualize the findings, highlighting how the project addressed the community's needs, contributed to safety and quality of life, and demonstrated potential for long-term viability.

Figure 2

Percentage distribution of respondents' perceptions on the cost-efficiency of the Solar Streetlighting Project in Brgy. Abulalas and Carillo, Hagonoy, Bulacan.

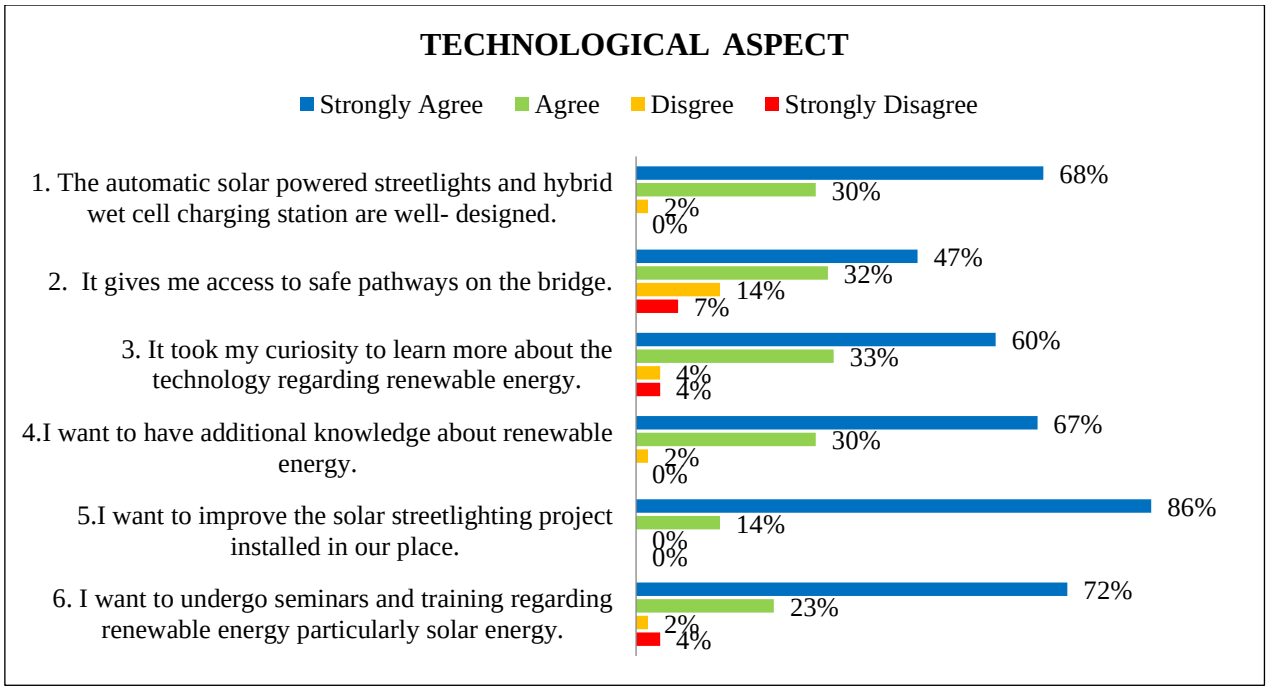


The results in Figure 2 indicate that the community perceives the solar streetlighting project as highly cost-efficient, with an overall mean rating of 3.60 (Agree). Across the five indicators, weighted means ranged from 3.49 to 3.77, all falling within the "Agree" range, reflecting consistently positive community sentiment. A significant majority (77% strongly agree, 23% agree; M = 3.77) affirmed that *"The money used for this project was not wasted."* This reflects strong beneficiary satisfaction with the allocation of resources, suggesting that the project delivered tangible value relative to its cost. Such satisfaction is a crucial determinant of public trust in community-based renewable energy initiatives (Bosu et al., 2017). Similarly, 70% strongly agreed and 23% agreed (M = 3.60) with being willing to contribute financially for the maintenance of the charging station and streetlights. This high willingness-to-pay indicates strong community ownership and a readiness to sustain the project over time, which is an essential factor in ensuring the operational longevity of renewable energy systems (Bhandari et al., 2020).

Respondents also expressed strong support (68% strongly agree, 28% agree; M = 3.65) for increasing the budget allocation to install additional solar panels. This reflects a recognition of the potential benefits of expanding the system's coverage and capacity, which can enhance service reliability and address future demand (Kothapalli, 2024). While the majority (65% strongly agree, 26% agree; M = 3.49) agreed that the funds spent have been adequate to provide nighttime pathway lighting, this item received slightly lower agreement than others. This may point to perceptions of uneven lighting coverage or insufficient brightness in some areas. Such observations align with findings by Chaurey and Kandpal (2010), who noted that technical limitations, such as lighting intensity and coverage, can influence community perceptions of cost-effectiveness in solar streetlighting programs. Overall, the data suggest that the project was not only financially well-managed but also valued by the community for the benefits it provides. The combination of prudent resource use, high beneficiary satisfaction, and willingness to invest further underscores the project's cost-effectiveness and potential for sustainable expansion.

Figure 3

Percentage distribution of respondents' perceptions on the technological aspect of the Solar Streetlighting Project in Brgy. Abulalas and Carillo, Hagonoy, Bulacan.

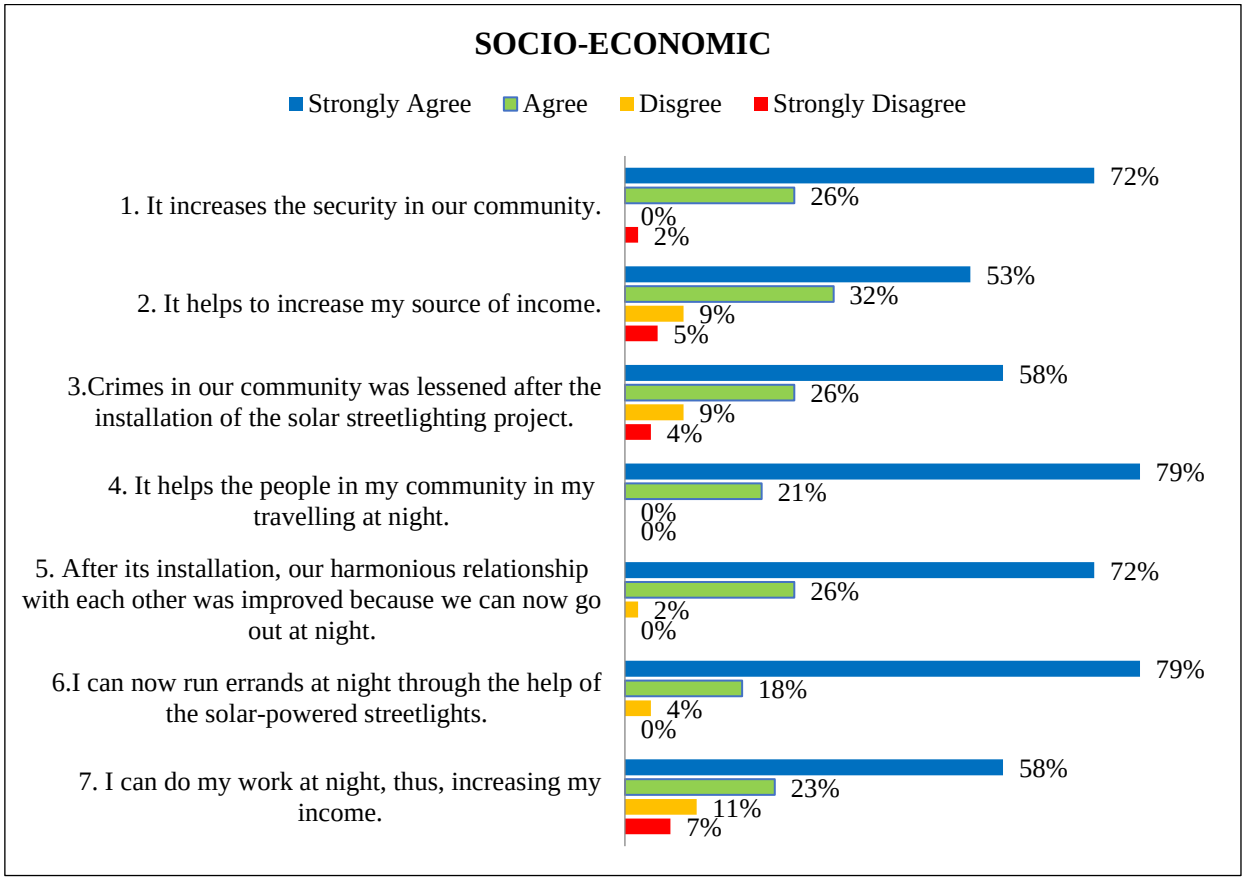


As shown in Figure 3, the community perceives the solar streetlighting project as technologically sound. The highest-rated statement, *"I want to improve the solar streetlighting project installed in our place"*, earned a mean score of 3.86, with 86% strongly agreeing and 14% agreeing. This highlights strong community engagement and a proactive stance toward system enhancement, a key driver for long-term viability. Interest in capacity-building was also evident, as 72% strongly agreed and 23% agreed that they wanted to undergo seminars and training in renewable energy, particularly solar power (mean = 3.63). Satisfaction with the design of the automatic solar-powered streetlights was also high (mean = 3.57), reflecting positive perceptions of technical quality and aesthetics, which are factors that influence user acceptance (Chaurey & Kandpal, 2010). However, the item on providing safe pathways scored lowest (mean = 3.19), suggesting that some users still experience safety concerns, possibly due to light placement, brightness, or environmental factors.

Overall, the integration of financial prudence, strong community ownership, and generally favorable technical assessments underscores the project's effectiveness. The data reveal that the solar streetlighting system not only meets practical needs but also stimulates interest in renewable energy education and long-term participation in sustaining and improving the system. Targeted improvements, such as optimizing light placement and increasing coverage, could further enhance both perceived cost-effectiveness and technological reliability.

Figure 4

Percentage distribution of respondents' perceptions on the socio-economic aspect of the Solar Streetlighting Project in Brgy. Abulalas and Carillo, Hagonoy, Bulacan.



As reflected on Figure 4, the socio-economic dimension of the solar streetlighting project obtained a favorable overall mean score of 3.54, signifying that respondents generally agree the project has delivered positive effects on community safety, mobility, and social interactions. Among the indicators, the highest-rated statements were *"It helps the people in my community in my travelling at night"* (M = 3.79) and *"I can now run errands at night through the help of the solar-powered streetlights"* (M = 3.75). Both items recorded 79% "Strongly Agree" and over 18% "Agree," reflecting the system's role in enhancing mobility and enabling both social and economic activities during nighttime. This aligns with Cravioto (2020) who emphasized that rural electrification projects allow communities to extend productive and leisure activities into evening hours, thereby improving quality of life. Safety-related indicators also received strong agreement. The statement *"It increases the security of our community"* achieved a mean of 3.68, with

72% strongly agreeing, while *"Crimes in our community were lessened after the installation of the solar streetlighting project"* garnered a mean of 3.32. These findings resonate with Chalfin et al., (2019), who demonstrated that adequate public illumination significantly reduces criminal activity in urban settings.

Additionally, social cohesion impacts were evident as well. The item *"After its installation, our harmonious relationship with each other was improved because we can now go out at night"* received a mean of 3.70, indicating that better lighting facilitates community gatherings and informal interactions. This supports Bosu et al., (2017)'s conclusion that rural electrification fosters social capital by increasing opportunities for engagement. However, income-related indicators reflected more moderate gains. The statements *"It helps to increase my source of income"* (M = 3.28) and *"I can do my work at night, thus, increasing my income"* (M = 3.28) had lower means, suggesting that while the project may provide the opportunity to work at night, actual economic benefits may take longer to manifest.

Figure 5

Percentage distribution of respondents' perceptions on the sustainability aspect of the Solar Streetlighting Project in Brgy. Abulalas and Carillo, Hagonoy, Bulacan.

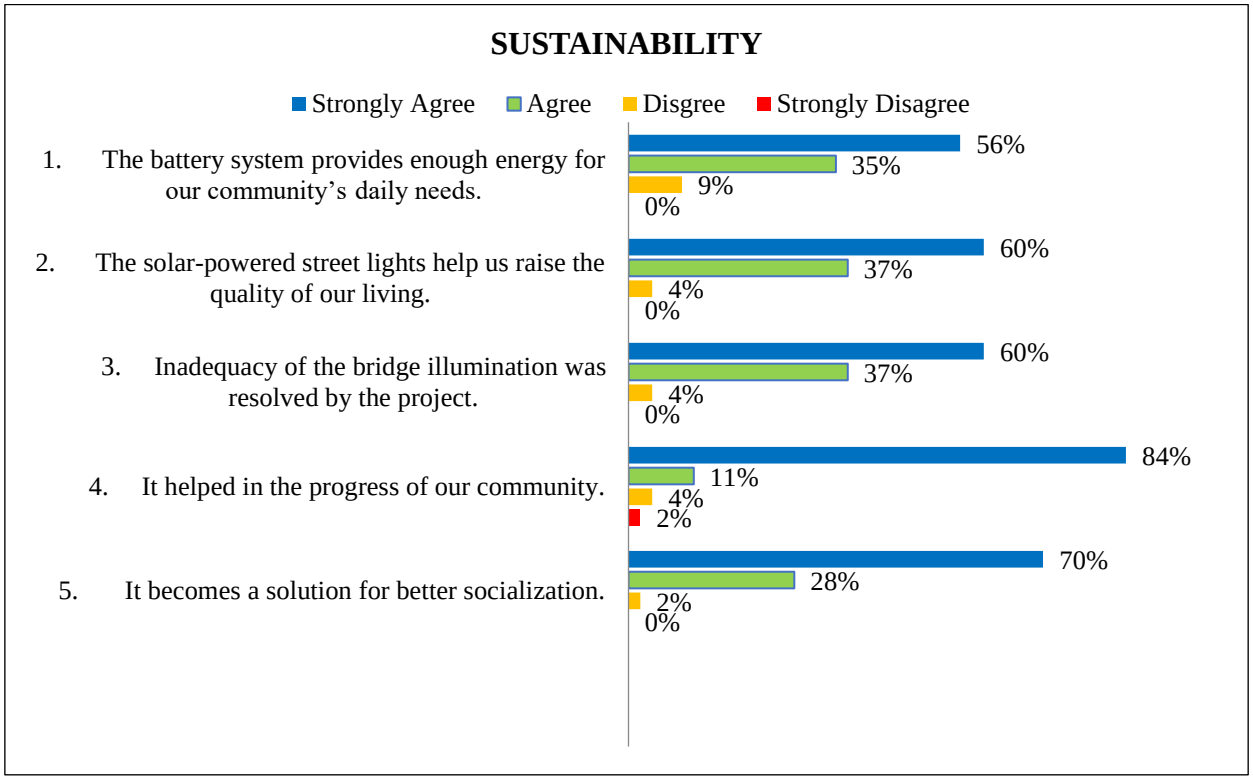


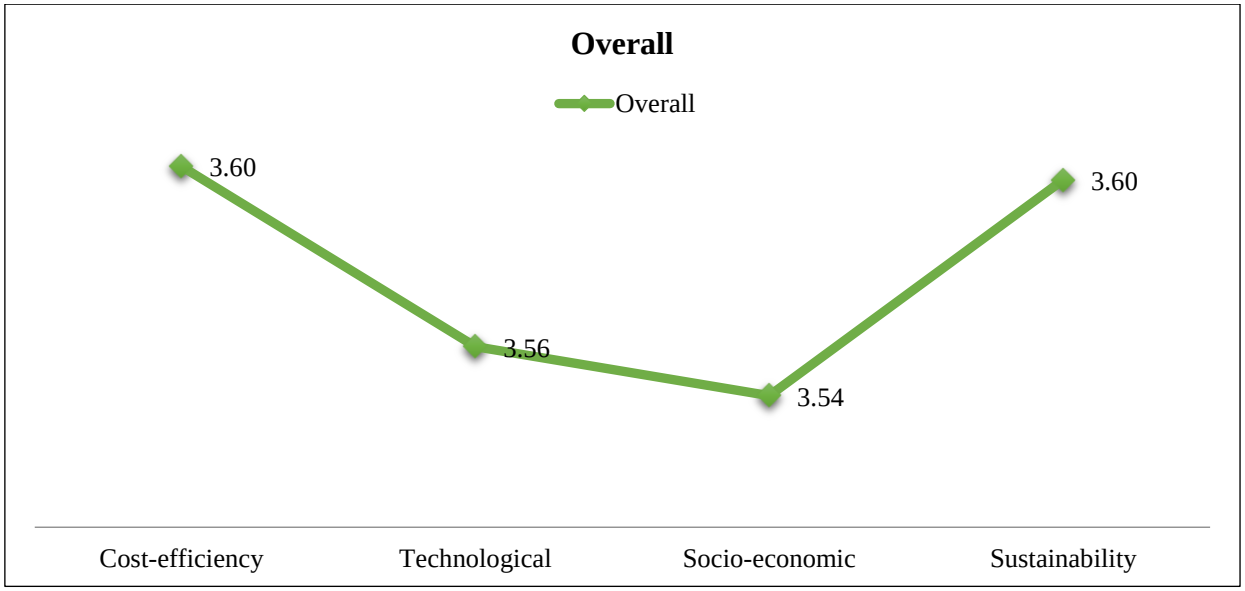
Figure 5 presents the respondents' perceptions of the sustainability aspect of the Solar Streetlighting Project, with mean scores ranging from 3.47 to 3.70, indicating a high level of agreement across all indicators. The statement *"The battery system provides enough energy for our community's daily needs"* obtained a mean score of 3.47, with 56% *strongly agree* and 35% *agree*. This reflects the project's capacity to deliver reliable and continuous service without dependence on conventional power sources, suggesting that the renewable energy component effectively supports local energy requirements while reducing operational costs and environmental impact. Meanwhile, the perception that *"The solar-powered streetlights help us raise the quality of our living"* received a mean score of 3.56, with 60% *strongly agree* and 37% *agree*. This aligns with existing literature noting that sustainable public lighting enhances safety, productivity, and well-being in communities (Pardo-Bosch et al., 2022). Similarly, the statement *"Inadequacy of the bridge illumination was resolved by the project"* garnered a mean score of 3.56, affirming the project's success in addressing its primary objective. The high agreement

levels (60% *strongly agree*, 37% *agree*) underscore that the intervention effectively eliminated lighting-related hazards in the area.

Moreover, the highest mean score of 3.70 was recorded for *"It helped in the progress of our community"*, with 84% *strongly agree* and 11% *agree*. This suggests that respondents strongly associate the project with tangible community development outcomes. Finally, the statement *"It becomes a solution for better socialization"* received a mean score of 3.68, supported by 70% *strongly agree* and 28% *agree*. Overall, the consistently high mean scores confirm that the Solar Streetlighting Project is not only technically and economically viable but also socially transformative, fostering safety, cohesion, and improved quality of life in Brgy. Abulalas and Carillo.

Figure 6

Overall mean scores of respondents' perceptions on the four dimensions of the Solar Streetlighting Project—cost-efficiency, technological, socio-economic, and sustainability—in Brgy. Abulalas and Carillo, Hagonoy, Bulacan.



As summarized in Figure 6, the overall mean scores for the four dimensions ranged narrowly from 3.54 to 3.60, signifying a consistently positive perception of the solar streetlighting project. Cost-efficiency and sustainability tied for the highest mean score (3.60), reflecting recognition of both financial prudence and the project's long-term value. The slightly lower score in the socio-economic dimension suggests the need to

complement infrastructure with targeted livelihood interventions to maximize economic benefits. The technological score (3.56) points to the importance of continuous system upgrades and local capacity building.

These results reinforce the notion that solar streetlighting is a viable rural development strategy, offering immediate gains in safety, mobility, and community cohesion, while laying the groundwork for future economic improvements. To sustain and enhance these benefits, stakeholders should adopt a holistic improvement strategy, combining technical refinements, proactive maintenance, and socio-economic support programs, to ensure that the project remains impactful over time.

5 CONCLUSIONS

In 2016, the Solar Streetlighting System was installed between Barangays Abulalas and Carillo in Hagonoy, Bulacan, to illuminate the connecting bridge and nearby paths. The Bulacan State University-College of Industrial Technology Extension Unit and the partner local government units collaborated on this effort, which aimed to address the area's long-standing issue of inadequate public illumination. The impact study results demonstrate that the initiative attained its key objectives. It provided adequate and consistent illumination to the population, improving safety, mobility, and quality of life. The solar lamps helped students to study at night and people to conduct evening activities more effectively. Furthermore, improved lighting strengthened community bonds since members felt safer and more likely to interact after dark. The fundamental issue of insufficient illumination, particularly near the bridge, was successfully addressed, and the money allocation was used properly to maximize community benefits. Overall, the findings show that the Solar Streetlighting Project had a favorable, long-term impact. It addressed both functional needs (safety and accessibility) and social benefits (increased community cooperation). By utilizing renewable energy, the project not only fulfilled urgent needs but also established the foundation for long-term environmental and economic sustainability. These results highlight the value of community-based, renewable energy solutions as catalysts for local development and improved quality of life.

6 RECOMMENDATIONS

Based on the impact analysis findings, it is proposed that the solar streetlights' design be improved further by including a manual override switch and using larger, energy-efficient LED lights to optimize lighting while minimizing power consumption. A complete operating handbook with detailed troubleshooting directions should be created and disseminated so that residents can quickly address minor technological issues. The project's coverage could be enhanced by installing more solar streetlights to illuminate other underlit locations in the town. Regular training and capacity-building exercises should be carried out to improve residents' technical abilities in operating, maintaining, and repairing the system, hence promoting its longevity. Furthermore, skilled workers should be employed to check and maintain streetlights, assuring constant performance and extending their operational life. These approaches will not only improve the project's technical efficiency, but will also encourage community ownership and ensure that the benefits of the solar streetlighting system are sustained in the long run.

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