

# Exploring the Socio-Economic impacts of various extension services on Public Infrastructures: A Qualitative Assessment

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## Abstract

This study assesses the socio-economic impact of the extension projects conducted by the Civil Engineering Department as part of the "Integrated Engineering Services for Sustainable Agro-Industrial and Infrastructure Development" program from 2016 to 2020. Using a qualitative, multiple-case design, the research focused on facility assessments at two public schools, the construction of a vermicompost facility, and a rainwater harvesting system at a public gymnasium. Key findings demonstrate that the department's technical assistance led to measurable improvements in school infrastructure and safety, resulting in tangible cost savings for the beneficiaries. The findings were used to guide school development plans and secure project funding from the Department of Education. While the rainwater harvesting facility proved beneficial for daily operations, a critical gap in capacity and power resilience was identified for use during large-scale calamities. This study validates the strategic value of targeted university extension services and provides a model for future program enhancement and policy-making.

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## 1. Introduction

### 1.1. Background

Cagayan State University (CSU) is committed to producing globally competent graduates through excellent instruction, innovative and creative research, responsive public service, and productive engagement with industry and the community. As a state-run institution, CSU upholds its mandate to extend academic expertise beyond the classroom, ensuring that knowledge is actively applied to address real-world challenges. This commitment to public service and community engagement remains central to the university's mission, fostering inclusive development and meaningful partnerships across sectors.

In many communities, particularly in developing regions, public infrastructure, such as school buildings and civic centers, faces significant challenges related to structural integrity, safety, and compliance with national standards. Ensuring that these facilities are safe for occupancy is a critical public health and safety concern. The National Building Code of the Philippines (PD 1096) (1977) sets forth rigorous standards for the design,

construction, and maintenance of all buildings to safeguard life, health, property, and the public welfare. However, many older public structures may not meet these modern requirements, necessitating regular professional assessment.

The quality and condition of school facilities have a direct impact on the learning environment. Research has repeatedly demonstrated a strong correlation between adequate school infrastructure and improved student outcomes. A well-maintained and safe school building provides an optimal environment that supports the educational process and allows students to focus on learning without physical discomfort or safety concerns (Michelle Ivory M. Bosio & Elizabeth D. Dioso, 2025). The need for services that are capable of evaluating and improving these situations is therefore vital to community well-being and academic success.

### 1.2. Description of the Extension Program

In response to these community needs, the College of Engineering and Architecture (COEA) launched the "Integrated Engineering Services for Sustainable Agro-Industrial and Infrastructure Development" program, which ran from 2016 to 2020. This is a multidisciplinary extension program involving several departments, including Civil Engineering (CE), Chemical Engineering (ChE), Electronics Engineering (EeE), Computer Engineering (CpE), Electrical Engineering (EE), and Agricultural and Biosystems Engineering (ABE). The program aims to provide expert technical assistance to local government units, non-government organizations, and other partner beneficiaries.

A significant component of this program was the inspection of physical facilities and the provision of technical assistance, which was assigned to the CE Department. The CE department's

structural and safety engineering groups, composed of experienced faculty members and students, were tasked with utilizing their expertise to assess the structural integrity of school buildings and ensure compliance with the National Building Code of the Philippines.

The specific services provided by the CE Department focused on two primary schools in Tuguegarao City: Carig Integrated School (CIS) and Tuguegarao Northeast Central School (TNECS). Services included on-site building assessments and recommendations for necessary repairs or demolition. A separate project involved the management and maintenance of a rainwater harvesting system at the Tuguegarao People's Gymnasium, which is an essential public facility that additionally functions as a primary evacuation center during natural disasters.

### 1.3. Significance

This study is important because it provides a detailed assessment of the socioeconomic impact of the CSU CE Department's extension activities. The study's documentation of the tangible outcomes offers important insights into how academic expertise can be used for community development. The results show the immediate advantages of expert engineering assessments, which extend beyond technical suggestions to include long-term sustainability and economic savings.

Furthermore, the results of this study can be used by the beneficiary institutions, particularly the schools, as a basis for their long-term development plans. The documented findings and recommendations provide a solid, evidence-based foundation for securing future funding from the Department of Education or other external funding agencies. The study also serves as a model for other academic institutions seeking to develop and implement effective extension programs.

### 1.4. Objective

The main objective of this study is to assess the socio-economic impact of the extension services provided by the CSU Civil Engineering Department. To achieve this, a set of specific objectives was established. The first was to determine the impact of the extension services on the safety and adequacy of facilities at the beneficiary institutions. The second was to identify the economic impacts and cost savings for these institutions. The third objective was to evaluate the effectiveness of the training and technical assistance in building the human capacity of the beneficiaries. Finally, the study aimed to identify gaps and challenges that could inform future policy improvements and program enhancement.

## 2. Methodology

### 2.1 Research Design

A multiple-case qualitative design was adopted, treating each site—the facility inspections at Carig Integrated School (CIS) and Tuguegarao Northeast Central School (TNECS), the vermicompost facility, and the rainwater-harvesting system at the People's Gymnasium—as a bounded case. This approach enables an in-depth exploration of CSU-CE's extension impacts within distinct contexts. The qualitative framework allowed for the capture of diverse experiences and perceptions of the beneficiaries, providing rich data that quantitative methods alone would not be able to provide. This design was particularly suitable for understanding the complex social and economic outcomes of the program.

### 2.2 Data Collection Procedure

Data collection relied on a combination of methods to ensure a comprehensive and triangulated understanding of the program's impact. Semi-structured interviews were conducted one-on-one with twelve key beneficiaries, including school administrators and facilities coordinators from CIS and TNECS, as well as the caretaker of the People's Gymnasium. These interviews were designed to explore their perceptions of safety, usability, cost avoidance, and any maintenance challenges encountered. On-site inspections were also performed at both schools during the Brigada Eskwela, where the conditions of gutters, ceilings, drainage systems, and the presence of fire safety signage were carefully documented. Concurrently, the condition of the tank, pump, and piping at the gymnasium was also documented. To further validate the findings, a thorough document review was conducted, including assessment reports, PICE memos, proposals, CSU-CE maintenance logs, and caretaker usage records for the rainwater harvesting facility.

### 2.3 Analysis

All transcripts, feedback forms, field notes, and documents underwent a rigorous thematic analysis. Two researchers independently coded the data using four predetermined themes: safety adequacy, operational usability, economic benefit, and knowledge transfer. This independent coding process was critical for ensuring the robustness and credibility of the findings. The researchers then met to reconcile any differences in their coding through discussion, ensuring a consensus-based approach to the final analysis. This systematic process allowed for the identification of key patterns and insights from the qualitative data and for connecting them directly to the program's objectives.

## 3. Results and Discussion

### 3.1. Impact on School Infrastructure and Safety

The extension services helped improve the safety and condition of school facilities. Structural assessments at Carig Integrated School (CIS) and Tuguegarao Northeast Central School (TNECS) identified a range of critical deficiencies. The gutters were missing or not working properly, which caused water damage and erosion. Many ceilings were broken and could collapse. Drainage systems were poor, which led to standing water and possible pest problems. The schools also lacked safety signs and did not meet fire safety standards. These issues were considered major risks to public safety.

These assessments were not merely technical exercises but were essential in safeguarding the learning environment for students. School infrastructure plays a direct role in shaping students' physical comfort, sense of security, and ability to focus in class. When facilities are unsafe or poorly maintained, students may experience stress, distraction, or even health risks, all of which can hinder academic engagement. Inadequate school infrastructure contributes to physical discomfort and limits the overall learning experience, though its direct impact on academic performance may vary (Bosio & Dioso, 2025). On the other hand, students in schools with adequate and well-maintained facilities report feeling more engaged and satisfied, which supports motivation and a positive learning environment (Jaminal, 2019).

The provided recommendations led to direct interventions that improved the physical environment for students and staff. At

CIS, five obsolete buildings were demolished and replaced, removing a substantial safety hazard. Additionally, a major repair project on buildings SM1 and SM2, costing PhP950,000, restored these spaces to a safe and functional state. Similarly, TNECS used the provided assessment report as a basis for securing funding from the Department of Education (DepEd) Region 2, which was then utilized to add new comfort rooms and improve the school's drainage system. The table below summarizes the key findings and outcomes for each school.

Table 3.1. *Infrastructure and Safety Impacts on Beneficiary Schools*

| Institution                                 | Identified Issues                                                                             | Interventions/ Outcomes                                                                                                                          |
|---------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Carig Integrated School (CIS)               | Missing gutters, damaged ceilings, poor drainage, inadequate fire safety, obsolete buildings. | Five (5) buildings demolished and replaced; SM1 and SM2 repaired; safety signage installed; recommendations included in School Improvement Plan. |
| Tuguegarao Northeast Central School (TNECS) | Lack of comfort rooms, dilapidated ceilings, poor drainage, no site development plan.         | DepEd Region 2 funding secured for new comfort rooms and drainage improvements; recommendations included in School Improvement Plan.             |

## 3.2. Economic Impacts and Cost Savings

The extension program generated measurable economic benefits for the beneficiary institutions by providing pro bono technical services. At CIS and TNECS, the CE Department conducted facility inspections and prepared technical reports at no cost. Based on prevailing consultancy rates from firms such as Engineering and Development Corporation of the Philippines (EDCOP) and the Department of Public Works and Highways' (DPWH) standard terms for school infrastructure evaluations, the estimated avoided cost for facility inspections ranges from PhP30,000 to PhP60,000 per site (DPWH, 2016; EDCOP, n.d.). The estimated one-time savings for both schools is conservatively placed at PhP60,000. This relief allowed school administrators to redirect limited funds toward instructional materials and minor infrastructure improvements.

The technical reports also played an important role in securing external funding. At CIS, the recommendations were used to justify a PhP950,000 allocation from the Department of Education for the repair of SM1 and SM2 buildings. This outcome reflects findings from studies, which show that university-community partnerships provide the technical expertise, documentation, and institutional credibility needed to support infrastructure planning and unlock government funding (Mores et al., 2019; Oana, 2022).

Economic benefits extended to the local government unit through the rainwater harvesting system installed at the People's Gymnasium. The facility supports daily maintenance activities such as cleaning and sanitation, especially during water supply interruptions. Philippine studies confirm that rainwater harvesting systems can reduce dependence on municipal water, lower utility costs, and improve operational continuity in public facilities (Juele & Lapong, 2024; Lumbea et al., 2023). Based on the caretaker's usage estimates and the local water rate of PhP15 per cubic meter, the system yields a projected annual savings of PhP14,796. These savings are particularly valuable in disaster-prone areas like Tuguegarao, where evacuation centers must maintain hygiene standards despite utility disruptions.

Table 3.2. *Estimated Economic Impacts and Cost Savings*

| Project Activity              | Beneficiary        | Estimated Savings (PhP) | Impact Type              |
|-------------------------------|--------------------|-------------------------|--------------------------|
| Facility Inspection Report    | CIS and TNECS      | 60,000 (One-time)       | Avoided Consultancy Fees |
| Rainwater Harvesting Facility | People's Gymnasium | 14,796 (annual)         | Reduced Utility Costs    |

Overall, the combination of avoided consultancy fees and utility savings emphasizes the financial value of CSU-CE's extension services. These impacts affirm the role of academic institutions in fostering cost-effective, community-based engineering solutions, as demonstrated by Philippine studies showing that university-led extension programs can reduce costs and improve service delivery for local communities (Magnaye & Ylagan, 2021).

## 3.3. Impact on Training and Human Capacity

The extension services demonstrated a strong impact on human capacity, primarily through the construction and turnover of a rainwater harvesting facility and the construction of a vermicompost facility. In 2016, as part of the rainwater harvesting project at the People's Gymnasium, the CE Department, in collaboration with the EcE and EE departments, provided training to beneficiaries. This training included an orientation on the project, the provision of safety features, a project launching to demonstrate functionality, training on proper operation and maintenance, and a turnover ceremony.

The training evaluation for this project was rated as "outstanding" on multiple fronts, with participants noting that the topics were relevant to their concerns, provided new insights, gave them new skills to improve efficiency, and were relevant to the needs of the community. This feedback validates the effectiveness of the CE department's hands-on approach to knowledge transfer.

Similarly, the construction and turnover of the vermicompost facility at CIS demonstrated a direct impact on the beneficiary. While other departments conducted seminars on various topics, the CE department's role was in the actual construction and turning over of the facility. Construction of the vermicompost bins was completed on October 2019, followed by the installation of a shed-type roofing on July 2020. The principal of CIS gave the CE department's work an "outstanding" rating across all measured criteria, including service relevance, technical advice, knowledge transfer, clarity of instructions, and timeliness. This qualitative feedback serves as a testament to the direct, tangible impact of the CE projects on community development.

## 3.4. Gaps and Challenges for Policy Improvement

The final objective of the study was to identify the gaps and challenges for future program improvements. While the rainwater harvesting system at the People's Gymnasium proved effective for daily maintenance, on-site observations confirmed a significant limitation. The 1800L capacity of the system is insufficient to meet the 7500 L/day demand during large-scale emergency evacuations. This critical gap in capacity limits the facility's effectiveness during the very events it is intended to support.

Furthermore, the system's dependence on an inadequate solar

power system leaves its operations vulnerable to power outages, which are a common occurrence during typhoons and other natural disasters in the region. Studies on small-scale harvesting systems emphasize the need for robust off-grid power solutions and expanded storage to ensure an uninterrupted supply and resilience during disasters. These challenges show the need of revising the policy to include a more durable and sustainable infrastructure plan so that the facility can fulfill its role as a reliable evacuation center.

In the case of the site inspections at Carig Integrated School and Tuguegarao Northeast Central School, a key challenge lies in the sustainability of the intervention. While the one-time assessments provided crucial data and justified funding, they do not account for the long-term deterioration of facilities due to wear and tear, environmental factors, or insufficient maintenance. A follow-up mechanism for continuous monitoring and a structured partnership to assist with the implementation of a long-term maintenance plan were not part of the initial program design. This gap suggests that for maximum impact, extension services should move beyond a one-time intervention to a sustained engagement model.

For the vermicompost facility, despite receiving outstanding feedback on construction, the long-term viability of the project depends on the sustained commitment of the beneficiaries. While the CE department completed its role, challenges may arise from the need for a continuous supply of composting materials, proper management of the worms, and the motivation of school staff to integrate the facility into their daily activities. These gaps point to the need for a structured post-turnover support system, including refresher workshops and material sourcing guidance, to ensure that the initial investment and effort lead to a lasting community asset.

## 4. Conclusion and Recommendation

### 4.1. Conclusion

Based on the findings, the extension services rendered by the CSU CE Department had a significant positive impact on the beneficiaries, thereby fulfilling the main objective of the study. The findings from the inspections and technical assistance provided a concrete basis for the schools to secure funding from the Department of Education.

The recommendations led to the demolition of unsafe buildings, the repair of existing structures, and the installation of safety provisions. The services also resulted in substantial economic savings for both the schools and the local government. The program serves as a valuable model for how university departments can leverage their expertise for community development.

### 4.2. Recommendation

To further enhance the program and expand its scope, the following recommendations are made based on the results of the study:

1. Regular structural and safety assessments of public schools should be continually provided to ensure ongoing compliance with national building codes and to prevent potential hazards.
2. The existing solar power system for the rainwater harvesting facility should be upgraded to ensure a continuous water supply, especially during power interruptions caused by calamities.
3. Additional water tanks should be installed at the People's

Gymnasium to increase its capacity and ensure it can adequately support the needs of evacuees during emergencies.

4. Training programs for school personnel should be maintained and expanded. This will empower beneficiaries to independently manage their facilities and reduce their reliance on external consultants.
5. Partnership agreements with local government units and the Department of Education should be formalized to create a structured framework for long-term and sustainable extension services. This ensures consistent delivery of engineering expertise to the community.
6. A public awareness campaign should be developed and implemented to inform local communities about the importance of building integrity and safety standards, empowering them to become active participants in maintaining safe public spaces.

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## Conflict of Interest:

The authors declare that there is no conflict of interest regarding the publication of this article.

## References

- DPWH, Department of Public Works and Highways. (2016). *New Schedule of Fees and Other Charges of the revised IRR of the National Building Code of the Philippines (PD 1096)*. NBCDO Memorandum Circular No. 03. [1]
- EDCOP, Engineering and Development Corporation of the Philippines. (n.d.). *Services - EDCOP*. <https://edcop.ph/services/>
- Jaminal, B. (2019). The Impact of School Facilities to the Teaching-Learning Environment. *SMCC Higher Education Research Journal*, 6(1). <https://doi.org/10.18868/sherj6j.06.010119.06>
- Juele, I., & Lapong, E. (2024). Rainwater Harvesting Systems (RWHs): The Multi-Level Perspective towards Sustainability Transition. *Journal of Interdisciplinary Perspectives*, 2(8). <https://doi.org/10.69569/jip.2024.0268>
- Lumbera, M. P., Cruz, M. L. F., & Junio, J. M. (2023). *Issues, challenges, and strategies for the implementation of roof-based rainwater harvesting systems in the Philippines*. 030035. <https://doi.org/10.1063/5.0147972>
- Magnaye, R. P., & Ylagan, A. P. (2021). Effectiveness and Impact of Community Extension Program of One Philippine Higher Education Institution as Basis for Sustainability. *Asia Pacific Journal of Academic Research in Business Administration*, 7(1), 7–16.
- Michelle Ivory M. Bosio, & Elizabeth D. Dioso. (2025). Impact of School Facilities on Student Performance: A Descriptive-

Correlational Study. *EPRA International Journal of Environmental Economics, Commerce and Educational Management*, 25–32.  
<https://doi.org/10.36713/epra23607>

Mores, L. S., Lee, J., & Bae, W. (2019). University-Community Partnerships: A Local Planning Co-Production Study on Calabarzon, Philippines. *Sustainability*, 11(7), 1850.  
<https://doi.org/10.3390/su11071850>

National Building Code of the Philippines, Presidential Decree No. 1096,. (1977).  
<https://www.dpwh.gov.ph/DPWH/files/nbc/PD.pdf>

Oana, J. (2022). *The Urban and the Urbane: The City of Manila and its Universities A Framework for City-University Partnerships*.  
[https://www.academia.edu/83043938/The\\_Urban\\_and\\_the\\_Urbane\\_The\\_City\\_of\\_Manila\\_and\\_its\\_Universities\\_A\\_Framework\\_for\\_City\\_University\\_Partnerships](https://www.academia.edu/83043938/The_Urban_and_the_Urbane_The_City_of_Manila_and_its_Universities_A_Framework_for_City_University_Partnerships)