Assessing Facility Needs for Rural School Infrastructure: A Case Study of Maruso Elementary School, Rizal, Palawan

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ABSTRACT

Rural infrastructure development in the Philippines is frequently constrained by high costs and transport dependence, resulting in inadequate facilities at public schools. This study assesses the facility deficits of Maruso Elementary School in Rizal, Palawan, and establishes engineering priorities that civil engineering can address. The study also aims to identify the most urgent facility needs, assess the local availability of specific bamboo varieties, and measure the level of community acceptance and awareness regarding bamboo–based construction. A descriptive feasibility study was conducted using surveys distributed to 72 respondents within the school and local community, mainly focusing on quantifying infrastructure dissatisfaction. The study identified the Comfort Room as the highest priority facility (89.04%), followed by the Waiting Shed (10.96%). A majority of respondents (56%) reported inadequacy in existing comfort rooms and shelters, indicating a need for additional infrastructure. Resource assessment showed that bamboo is widely available, with 94.44% of participants noting its presence in the area. Taken together, these results indicate that context–appropriate, low–cost engineering interventions using locally sourced bamboo can feasibly address the school's most pressing facility needs while building local capacity and reducing reliance on distant suppliers. However, there is a growing concern around 48% regarding the maintenance of bamboo and 33% for its degradability. Suggesting that treated bamboo is essential to improve resistance to biological decay while maintaining structural integrity. Furthermore, strategically reconfiguring the bamboo–concrete interface through mechanical interlocking maximizes the structural efficiency and economic viability of these bio–composite materials. In addition, we suggest exploring the integration of sustainable building materials in these expansions: constructions of school classrooms and waiting sheds, as it is needed and suggested by the respondents, as well as evaluating the feasibility of using bamboo as reinforcement in low–load structures.

Keywords: Bamboo construction, facility needs assessment, rural school infrastructure, community acceptance, geographically isolated and disadvantaged areas (GIDA)

INTRODUCTION

The Philippine educational system faces a persistent infrastructure crisis. National projections estimate a shortage of 58,000 to 81,000 classrooms by 2040, with many regions already recording student–to–classroom ratios well above the national standard (Abrigo et al. 2025). In some urban areas, more than 90% of elementary students are taught in classes of 50 or more, a situation that reflects both the scale and urgency of the problem. These national trends are magnified in Geographically Isolated and Disadvantaged Areas (GIDAs) such as Rizal, Palawan, where remote geography and elevated transport costs make conventional construction largely impractical, leaving schools like Maruso Elementary unable to maintain even basic sanitary and shelter facilities.

Several interrelated problems compound the infrastructure shortfall. First, the national target for annual classroom construction has fallen sharply, from 91,000 units in 2016 to 12,445 in 2024, widening the gap between need and delivery (Marcelo, 2024). Second, budgetary and implementation failures persist: classroom construction completion rates have consistently remained below 85% since 2016, largely due to funding shortfalls (Manatlao, 2024). Third, logistical and economic barriers disproportionately affect remote island communities, where inflation and the high cost of transporting conventional materials, steel and concrete, make standard construction approaches increasingly unsustainable (Ticke, 2025).

Despite these well–documented challenges, localized assessments that explore alternative, cost–effective construction methods for remote schools remain scarce. There is an underexplored opportunity to leverage locally available, sustainable materials, particularly bamboo as viable alternatives for low–load school infrastructure in GIDAs. The specific gap this study addresses is the absence of a comprehensive facility needs assessment for Maruso Elementary School that simultaneously documents infrastructure priorities and evaluates the technical and social feasibility of using local bamboo for targeted construction interventions.

The general objective of this study is to assess the facility needs of Maruso Elementary School in Rizal, Palawan, and to translate those needs into practical, locally feasible solutions. Specifically, the study aims to: (1) identify and prioritize the most urgent infrastructure requirements of the school and the surrounding community; (2) assess the local availability and species diversity of bamboo; and (3) evaluate community acceptance of bamboo as a construction material, with attention to perceived cost–effectiveness, usability, and maintenance concerns.

METHODS

Descriptive Analysis

This study employed a descriptive research design to assess the facility needs of Maruso Elementary School and the feasibility of using locally sourced bamboo as a construction material. Descriptive research was deemed appropriate as the study aimed to systematically document existing conditions, quantify respondent perceptions, and characterize available local resources without experimental manipulation (Creswell, 2014).

Slovin's Formula

In this study, Slovin's formula was utilized to determine the appropriate sample size from the total population of 72 respondents in Sitio Maruso. By applying Slovin's formula, the study ensured that the chosen sample size would balance accuracy with efficiency, minimizing sampling error while still reflecting the views of the community. With a margin of error set at 5%, the computation is as follows:

Where:

n=Sample Size

N=Population Size

e=Margin of error

$$n = \frac{N}{1 + Ne^2}$$

$$n = \frac{72}{1 + 72(0.05)^2}$$

$n = 61.017 \approx 62 < 72$, thus 72 is considered

Given the small and clearly bounded population of 72 individuals, a total enumeration (census) approach was adopted. All accessible and eligible members of the population were invited to participate, ensuring complete coverage of available data sources within the community.

Data Analysis

Quantitative data were analyzed using descriptive statistics, including frequency counts and percentages. Responses related to facility adequacy, bamboo availability, and community acceptance were tabulated and presented through figures and tables. All data were processed using Microsoft Excel.

RESULTS

Demographic Profile

Figure 1 shows the age distribution of respondents, where the majority fall within the 25–34 years (45.83%) and 35–44 years (41.67%) age groups. Only a small portion belongs to the 18–24 years (5.56%) and 45–54 years (5.56%) categories, while 1.39% are aged 55–64, and none are 65 or older. This indicates that most respondents are in their prime working and parenting years, which is significant because these age groups are directly engaged in supporting their children's education and are most likely to be concerned about school infrastructure needs.

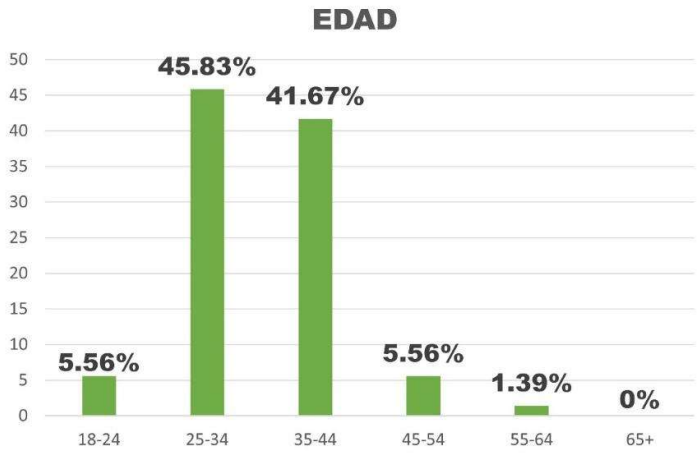

Figure 1. Age of respondents.

Figure 2 presents the gender distribution, showing that 61% of respondents were female, while 39% were male.

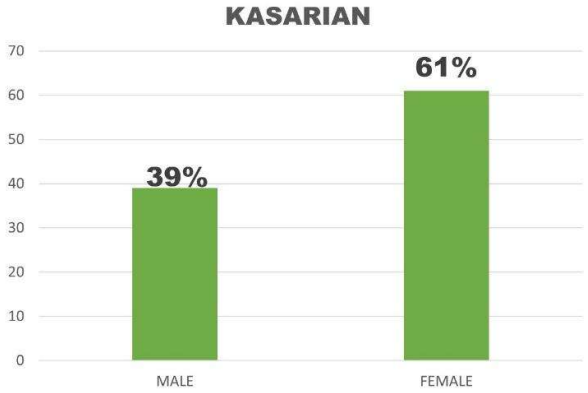

Figure 2. Gender of the respondents.

Figure 3 illustrates the monthly income levels of respondents, revealing that 75% earn between ₱0–5,000, which highlights the community's economic vulnerability. Meanwhile, 16.67% earn between ₱5,001–10,000, and only 1.39% each fall into the ₱10,001–15,000 and above ₱15,000 categories. Additionally, 4% did not disclose their income. This data underscores the financial limitations of the community, suggesting that residents may struggle to contribute to infrastructure projects without external support. It also emphasizes the importance of cost–effective and sustainable building solutions for schools in the area.

Figure 3. Monthly income of the respondents.

Types of Structures

Table 1 shows the types of structures present in Sitio Maruso, with four light structures made of wood, bamboo, and other local materials, two mixed structures combining local materials with concrete, and three concrete structures reinforced with steel. The prevalence of light structures indicates reliance on inexpensive, locally available resources, while the presence of mixed and concrete structures demonstrates attempts to achieve durability despite limited resources. This finding supports the study's recommendation to integrate bamboo with concrete, as such hybrid construction could balance affordability, sustainability, and structural strength for school facilities.

Table 1. Numbers and Types of Structures

Types of Structures	No.
Light	4
Mixed	2
Concrete	3

Facility needs

Figure 4 reveals a notable insufficiency in the availability of school facilities, particularly comfort rooms and waiting sheds. More than half of the respondents (56%) expressed that the current number of these facilities is inadequate to meet the needs of both students and teachers. In contrast, only a small proportion (15%) believed that the existing facilities are sufficient, while nearly a third (29%) remained uncertain.

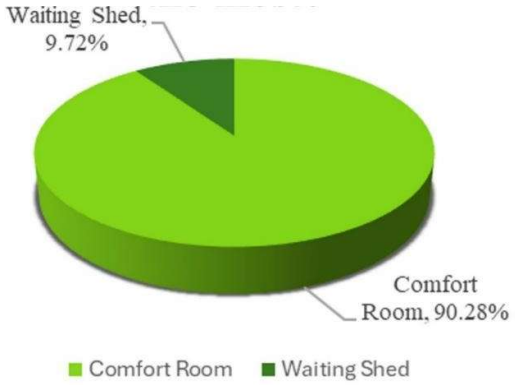

Figure 4. Facility needs.

Bamboo Availability

According to Figure 5, bamboo is not only abundant but also diverse in species within the study area. With 94.44% of respondents confirming its accessibility, bamboo emerges as a highly sustainable and locally sourced material that can be readily integrated into construction projects. The distribution of bamboo species further enriches its potential applications. Patong, identified by 40.23% of respondents, is the most common type, followed by Kawayan tinik (24.71%), Tiring (18.97%), Buho (13.79%), and Bayog (2.30%).

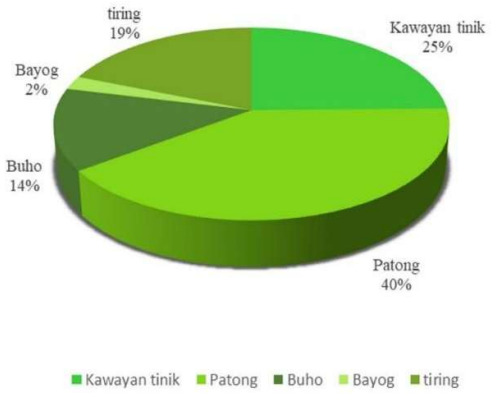

Figure 5. Bamboo Availability.

Community Acceptance

Based on Figure 6, community acceptance of bamboo use in school construction was overwhelmingly positive, with 100% of respondents supporting its application for comfort rooms and waiting sheds. Additionally, 86.11% of the community acknowledged bamboo's potential as a primary building material, and 80.56% had prior experience with bamboo structures.

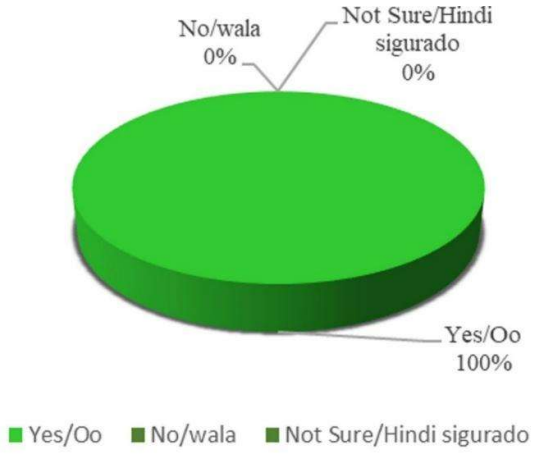

Figure 6. Community Acceptance.

DISCUSSIONS

Socioeconomic Context and Its Implications

The demographic data establish a clear socioeconomic backdrop for this study. The majority of respondents are working–age adults (25–44 years) with monthly household incomes below ₱5,000, a profile consistent with rural GIDAs in Palawan. This economic reality directly shapes the feasibility calculus for any proposed intervention: construction solutions must be affordable, locally executable, and low in maintenance cost. The National Center for Education Statistics (2023) notes that in comparable rural settings, parental engagement in school infrastructure advocacy is strongest among working–age households, whose children's educational welfare is most immediately at stake. The low–income profile of Sitio Maruso corroborates findings from Bundi et al. (2024), who found that communities with limited financial resources in the Philippines demonstrate a strong preference for locally available materials over conventional construction inputs.

Facility Needs

The finding that 56% of respondents perceive existing comfort rooms and waiting sheds as inadequate is not merely a local observation, it reflects a well–documented national and global deficit in school WASH infrastructure. Sharma et al. (2024) established a direct link between inadequate sanitation facilities and elevated student absenteeism, particularly among female students. Freeman et al. (2012) similarly found that improvements in school sanitation were associated with reduced gastrointestinal illness and better attendance in developing–country contexts. The present study's results reinforce these findings and add to a growing body of evidence calling for targeted WASH infrastructure investment in GIDAs.

The identification of the Comfort Room as the top–priority facility by 89.04% of respondents carries practical significance: it indicates that community members prioritize dignity and hygiene above other infrastructure amenities. The 29% who were uncertain about facility adequacy may reflect a normalization of substandard conditions, rather than genuine satisfaction, a finding that merits further qualitative investigation in future research.

Bamboo as a Construction Resource

The near–universal availability of bamboo (94.44%) and the identification of five distinct species represent a significant material resource. Each species has distinct mechanical properties relevant to construction suitability. Nugroho et al. (2023) documented that bamboo exhibits a favorable strength–to–weight ratio, with variation across species, age, and growing conditions. This reinforces the need for species–specific structural testing before committing to a construction standard, a recommendation that this study identifies as a priority for subsequent research. The proximity of bamboo supply to the construction site eliminates the transportation cost barrier that undermines conventional material use in remote communities (Adebowale and Agumba 2025; Escamilla and Habert 2024).

Community Acceptance and Its Role in Implementation Success

The full community support for bamboo use in school construction strengthens the practical groundwork for its implementation. Bundi et al. (2024) demonstrated through life cycle assessment that cement bamboo frame technology garnered strong social acceptance in Philippine social housing programs precisely in contexts where communities had prior exposure to the material, a pattern consistent with the 80.56% of respondents in this study who reported prior experience with bamboo structures. Silvana et al. (2016) similarly found that cultural familiarity with bamboo, rooted in vernacular Philippine architecture, contributes to baseline confidence in its constructive applications.

However, the study also surfaces important cautions. Nearly half of respondents (48%) expressed concern about bamboo maintenance, and a third (33%) cited degradability. These concerns are technically grounded: untreated bamboo is susceptible to fungal decay, insect infestation, and moisture–induced deterioration (Nugroho et al. 2023). Effective implementation therefore, requires not only the construction of bamboo facilities but also a complementary community education component on proper treatment methods, including heat treatment, borax–boric acid treatment, or other established preservation techniques.

FUNDING

There were no funding agencies in the public, commercial, or not–for–profit sectors in conducting this study.

GENERATIVE AI STATEMENT

Claude ai (Sonnet 4.6) by anthropic was used to generate image for visualization of the bamboo + concrete beam, bamboo + concrete column and bamboo + concrete footing at figure 7.

ETHICAL CONSIDERATION

This study adhered to the ethical principles of voluntary participation, informed consent, and confidentiality. Before data collection, all participants were briefed on the study's purpose, scope, and the nature of their involvement. Participation was entirely voluntary, and respondents were granted the right to withdraw at any stage without consequence.

To ensure participant privacy, all collected data were anonymized during analysis and reporting; no personally identifiable information (PII) is associated with the responses. The raw data are kept secure and accessible only to the research team. Furthermore, the researchers conducted the study with due respect for the cultural norms and practices of the Maruso community, ensuring that data gathering did not disrupt school operations or community activities. Finally, the researchers declare complete academic objectivity, with no conflicts of interest or external funding influencing the study's design, execution, or findings.

DECLARATION OF COMPETING INTEREST

The authors declare that there is no competing interests to any authors.

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