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Performance Evaluation and Sustainability of Locally Sourced Materials in Road Construction Projects of DPWH

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Abstract
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This study used a quantitative research approach, such as the descriptive survey method, to examine the performance and sustainability of locally sourced materials used in road construction projects of DWPH 1st District, Talavera, Nueva Ecija, during the Calendar Year 2025. A researcher-made survey instrument was pre-tested by 15 employees of DPWH 2nd District, Cabanatuan City, using Cronbach's Alpha and was found to be reliable. The survey questionnaire was administered to 143 employees from different agency departments after approval was sought from the proper authorities. Upon retrieval of the instrument, it was examined using descriptive statistics.

The results illustrate that the mean age of the respondents was 31.33. Males were single, obtained Bachelor's degrees, and had 5.32 years in service. The performance of locally sourced materials regarding durability, compressive strength, and resistance to weathering was strongly agreed upon. The respondents strongly agreed on the sustainability of locally sourced materials, including economic, social, and environmental.

The respondents identified challenges faced in integrating sustainability into road construction projects while using locally sourced materials, including limited availability, increasing cost, unregulated extraction, limited understanding of advanced sustainability practices, and inconsistent quality of locally sourced materials.

Introduction
Background Information
The Department of Public Works and Highways (DPWH) is essential for developing and maintaining the country's roadways. Good roads are important because they help connect different areas, boosting the economy. Building and repairing these roads makes it easier for vendors to get their products to market and for businesses to trade and transport.

In keeping with worldwide trends in infrastructure construction, DPWH is dedicated to incorporating sustainable techniques into its projects. DPWH is actively seeking cutting-edge and environmentally friendly road construction techniques to satisfy the growing demand for infrastructure. According to Abdulhafedh (2021), building and sustaining corporate sustainability is difficult for the construction business [1].

According to Basu et al. (2015), pursuing sustainability has become crucial, driving the construction industry toward innovative practices. Sustainability in road construction places a significant value on resource efficiency, environmental preservation, and climate impact resistance [2]. By lowering transportation-related carbon emissions, encouraging circular economies, and ensuring that infrastructure is adapted to the local climate and geology, using locally sourced materials helps achieve these goals. Locally sourced materials have several potential benefits, including cost savings, support for local industries, and reduced environmental impact due to decreased transportation requirements.

Based on the Pinoy OFW Report (n.d.) Nueva Ecija is home to aggregates, sand, and gravel. This creates chances to lower building expenses, strengthen the local economy, and lessen the environmental effects of moving materials from distant areas. However, the sustainability and performance of these materials in various road-building projects continue to be important topics of interest and worry.

With the demand for sustainable infrastructure, the DPWH has realized that it needs to review and optimize the use of locally sourced materials in its projects. Likewise, as Engineers in the DPWH, we are responsible for ensuring that all infrastructure projects are sustainable. Moreover, limited studies have been conducted to evaluate locally sourced materials in road construction projects, specifically in Nueva Ecija. Most of the research focused on building construction. Thus, this study determined the performance evaluation and sustainability of locally sourced materials in road construction projects of the DPWH 1st District, Talavera, Nueva Ecija.

Review of Related Literature and Studies

Local Materials in the Construction Industry

Local materials refer to the substances or compounds used in the construction and building industry to create structures, buildings, and infrastructure. These materials, which might be synthetic, natural, or composite, are chosen according to their unique qualities, cost- effectiveness, environmental impact, and appropriateness for the intended use. These materials can also be divided into inorganic (like steel, concrete, and bricks), organic (like wood), composite, polymer, and plastic, and sustainable or environmentally friendly materials. Every material has distinct qualities and traits that make it appropriate for use during the building process (Babu & Petchikkan, 2023) [3]. In addition, local materials are those construction materials sourced and processed locally near the construction site. The materials applied could be natural, such as stone, wood, and clay, to be recycled, and upcycled materials, such as reclaimed timber and crushed concrete (Basu, Misra & Puppala, 2015) [2]. It also finds diverse applications in the building and infrastructure industry, enabling the construction of safe, functional, and aesthetically pleasing structures (Babu & Petchikkan, 2023) [3]. Using local materials has some benefits for the environment and the economy. Local source materials help reduce the carbon footprint of builders and contractors by reducing transportation emissions. It can also revitalize the local economy through employment and supporting small businesses that produce these materials. Local materials represent an innovative approach to sustainable construction practices that contribute to environmental stewardship but benefit local communities.

The use of local materials in road construction has received much attention lately because it may lower the cost of a project, promote local industries, and reduce environmental impacts. According to Molenaar, Harper, and Murphy (2019), locally sourced materials like sand and gravel will lower transportation costs and provide avenues for local economic development. Once they satisfy the quality standards, they can be developed to meet specific engineering needs [4].

Odediran et al. (2013) stated that materials are, therefore, one of the predictors of the future construction cost [5]. The finding implies that a shift to the usage of locally produced materials will result in a possible reduction in construction costs and, therefore, promote affordability. Meanwhile, it also suggests a review of the government's restrictions on imported materials and the development of local construction materials to solve the problem of high cost. The standard specifications for highways, bridges, and airports were specified by DPWH in 2019, citing the technical requirements of materials in terms of durability, strength, and sustainability. In this context, Santos, Cruz, and Reyes (2020) reported that variability in material properties occurs among regions, necessitating localized testing and evaluation to determine conformity with standards. It is also globally known that construction agencies regularly consume more raw materials, resulting in the scarcity of our natural resources and environmental implications (Siman, 2023) [6]. Moreover, the Hernandez et al. (2022) study reported that construction materials will pass the DPWH requirements for secondary roads when adequately treated and stabilized [7]. Similarly, a study in Bicol by Mendoza and Villanueva (2020) showed that the partial replacement of cement with volcanic ash enhanced the environmental sustainability of road construction projects [8].

Performance Evaluation of Construction Materials

Performance evaluation is the most critical selection of materials in infrastructure projects. According to Smith et al. (2018), durability, compressive strength, and resistance to weathering are some of the most critical parameters in evaluating whether materials are fit for road construction [9]. In a study by Rahman and Associates (2020) on Southeast Asia, it was noted that poor material selection results in premature deterioration of roads, high maintenance costs, and a relatively short lifespan for infrastructure [10].

Recent research has focused on evaluating construction materials for sustainability and performance. Garcia et al. (2021) indicate that locally available aggregates have good mechanical properties for low to medium-traffic roads [11].

However, these materials should be further tested for high-stress applications, especially in areas with heavy agricultural machinery traffic.

Meanwhile, Siriwardana et al. (2024) have developed frameworks to assess materials based on environmental, social, economic, and technological criteria across their lifecycle [12]. Sustainable development indicators have been used to rank common construction materials, with cement identified as the least sustainable, while light concrete blocks and gypsum were found to be more sustainable (Baglou et al., 2017) [13]. For 3D-printed construction materials, researchers have proposed developing performance indicators focused on durability to address sustainability challenges (Lafhaj & Dakhli, 2019) [14]. Moreover, research has looked at the possibility of utilizing waste materials from building and demolition, including clay masonry and recycled concrete aggregate, to create pavement (Arisha et al., 2018) [15]. These approaches aim to help project managers select more sustainable materials and inform industries about the sustainability impacts of their products, ultimately promoting more sustainable construction practices. Moreover, Cevallos et al. (2017) indicated that paving bricks and aggregates for concrete performed better than clay bricks and concrete blocks. The samples of concrete blocks had the highest percentage of non-compliant specifications and the widest spread of results. All of Chimborazo's districts had quality issues with the building materials they produced (Cevallos et al., 2017). Mohammadinia et al.'s (2015) study indicates that cement-treated construction and demolition (C&D) materials are viable for pavement base/subbase applications.

The performance evaluation of construction materials faces several challenges, including increasing building materials costs and access to credit (Sibiya et al., 2015). Uncertainty in test results can significantly impact product assessment, even with slight differences in material strength tests (Szewczak et al., 2016) [16]. Developing performance indicators for emerging technologies like 3D-printed construction materials is crucial to addressing durability and sustainability concerns (Lafhaj & Dakhli, 2019) [14].

Establishing standardized performance indicators for new construction materials, such as those utilized in 3D printing, is crucial to meeting the industry's evolving requirements and sustainability objectives. Fabbri et al. (2018) outline some of the current methods for determining the engineering qualities of earth materials and highlight the primary difficulties the committee has encountered [17]. The research focuses on the absence of widely accepted procedures for evaluating engineering performance, one of the primary obstacles impeding the adoption of raw earth materials.

Sustainability in Road and Highways Infrastructure

Sustainability has become a central focus in infrastructure development, with a growing emphasis on reducing environmental impacts and promoting resource efficiency. It aims to reduce the ecological effects while maintaining structural integrity and efficiency. Key approaches include using advanced and recycled materials, optimizing road alignment, and implementing environmentally responsible project management (Ujene & Oladokum, 2017) [18].

A "sustainable road" encompasses construction practices that minimize environmental impacts, adapt to changing uses, and are resilient to future pressures like climate change (Fernandez et al., 2023) [19]. A study by Choi et al. (2021) explored how using locally sourced materials offers significant environmental benefits, such as reduced greenhouse gas emissions due to shorter transportation distances [20]. These materials also require less energy-intensive processing, contributing to a lower carbon footprint.

The Philippine Green Building Code, established in 2016, is an initiative to implement sustainable construction activities, such as using renewable and readily available resources within the country. Cruz and Alonzo (2019) concluded that incorporating sustainability into rural road projects can lead to long-term economic and environmental savings [21].

On the other hand, using alternative sustainable materials in road construction is gaining importance due to the growing awareness of climate change effects and the construction sector's large energy consumption, particularly in developing countries (Guinta, 2023) [22]. Innovative technologies, such as high-strength polymeric geocells, can significantly reduce aggregate material usage while maintaining structural adequacy, thereby addressing sustainability concerns in heavy-traffic road construction (Pokharel et al., 2016) [23].

Therefore, evaluating sustainability factors in road construction can be achieved through a life cycle management approach that considers economic, environmental, and social aspects (Ujene & Oladukum, 2017) [18].

Objectives of the Study

The study assessed the performance and sustainability of locally sourced materials used in road construction projects in the DPWH 1st District, Talavera, Nueva Ecija.
Specifically, it aims to:

- Determine the respondents' socio-demographic profile regarding age, sex, civil status, highest educational attainment, and years in service.
- Evaluate the performance of locally sourced materials on road construction projects, including durability, compressive strength, and resistance to weathering.
- Assess the economic, social, and environmental sustainability of the locally sourced materials in road construction

projects.
• Identify the challenges in integrating sustainable road construction projects utilizing locally sourced materials.

Time and Place of the Study

The study occurred at the Department of Public Works and Highway, 1st District, Talavera, Nueva Ecija, from January to April 2025.

METHODOLOGY

This section presents the research design, instrument, sampling, data-gathering procedure, ethical considerations, and data analysis method used in this study.

Research Design

This study employed the quantitative approach, particularly the descriptive survey research design. It described the socio-demographic profile of the respondents, the performance and sustainability of locally sourced materials, and the challenges in integrating sustainable road construction projects utilizing locally sourced materials.

Research Instrument

The research instrument used in the study is designed to collect the quantitative data necessary to evaluate the performance and sustainability of locally sourced materials on road construction projects of the DPWH 1st District, Talavera, Nueva Ecija. The questionnaire consists of four parts.

Part I deals with the respondents' socio-demographic profiles, such as age, sex, civil status, highest educational attainment, and years in service. Part II assessed the performance of locally sourced materials on road construction projects, such as durability, compressive strength, and resistance to weathering. Part III determined the sustainability of locally sourced materials on road construction projects in terms of economic, social, and environmental sustainability. Part IV identified the challenges in integrating sustainable road construction projects utilizing locally sourced materials.

The questionnaire was pre-tested among 15 employees of DPWH 2nd District, Cabanatuan City, Nueva Ecija. Cronbach's Alpha value was obtained on Part II for durability—82.25%, strength—79.36%, and resistance to weathering—74.03%. Part III obtained 86.64% economic, 81.26% social, and 70.28% environmental, which indicates that the instrument used in the study was reliable.

Sampling

The study used purposive sampling. Out of 227 employees involved in the road implementation projects of the different departments in the 1st District of Talavera, Nueva Ecija—Department of Public Works and Highways, only 143 participated in the study. Some employees were in the field or traveling at the time and could not participate.

Data Gathering Procedure

Before gathering the data, the researcher seeks permission from the District Engineer of DPWH Nueva Ecija 1st and 2nd District (Appendix B & C). The researcher obtained the approval of the proper authorities before administering the survey questionnaire to the respondents. The researcher personally administered the survey instrument to the respondents and provided ample time to answer the questionnaire. Once the instrument was collected, the researcher ensured all information was provided.

Ethical Considerations

The researcher ensured that respondents voluntarily participated in the study and were informed of their right to withdraw at any time. Additionally, the researcher prioritized the well- being and dignity of the respondents, obtaining their consent. Strict measures were implemented to protect the confidentiality of the information collected during the research. The study follows the APA 7th edition referencing style for accurate citation of sources used. Lastly, compliance with the Data Privacy Act 2012 was strictly observed.

Methods of Data Analysis

The data collected was tabulated and computed according to the study's objectives. The following descriptive statistics were used to describe the socio-demographic profile of the respondents, performance, sustainability of locally sourced materials in road construction projects, and challenges in integrating sustainable road construction projects utilizing locally sourced materials: frequency count, percentage, mean, and standard deviation.

Objective 1, which determines the respondents' profile regarding age, sex, civil status, highest educational attainment, years in service, frequency count, percentage, mean, and standard deviation, was utilized.

The evaluation of locally sourced materials' performance on road construction projects, including their durability, compressive strength, and resistance to weathering, is the emphasis of objective 2. The performance was measured using the mean and standard deviation.

Additionally, objective three employed the mean and standard deviation to evaluate the economic, social, and environmental sustainability of locally sourced materials in road construction projects.

Furthermore, objective 4, which identifies the challenges in integrating sustainable road construction projects utilizing locally sourced materials, frequency, and percentage, was likewise used.

Results and Discussion

This part deals with the results based on the objectives of the study.

Profile of the Respondents

The respondents' profiles, such as age, sex, civil status, highest educational attainment, and years in service, were determined using frequency count, percentage, mean, and standard deviation. The data are presented in Table 1.

VARIABLE	FREQUENCY (n)	PERCENTAGE (%)
Age		
24-30	93	65.03
31-37	29	20.28
38-44	12	8.39
45-51	3	2.10
52-58	2	1.40
59-65	4	2.80
Mean (SD)	**31.33 (7.99)**	
Min, Max	**24, 65**	
Sex		
Female	47	32.87
Male	96	67.13
Civil Status		
Single	90	62.94
Married	53	37.06
Highest Educational Attainment		
Bachelor's Degree	134	93.71
Doctorate Degree	1	0.70
Master's Degree	8	5.59
Years in Service		
1-5	94	65.73
6-10	29	20.28
11-15	9	6.29
16-20	7	4.90
21-25	3	2.10
>25	1	0.70
Mean (SD)	**5.32 (5.72)**	
Min, Max	**1, 33**	

Table 1: Profile of the Respondents

Age

Results showed that the mean age of the respondents was 31.33 with a standard deviation of 7.99, which implies a broader distribution of their age. The majority (65.03%) of the respondents were 24-30 years old, followed by 31-37 years old (20.28%), then 38-44 years old (8.39%), 59-65 years old (2.80%) and the least (1.40%) were 52-58 years old. This indicates that the respondents were young individuals beginning their careers in the government. The minimum age was 24, and the maximum age was 65 years.

Sex

Most (67.13%) were males, and the rest (32.87%) were females. It implies that the construction industry is male-dominated compared to its female counterpart. It is because DPWH necessitates labor in a field-based environment.

Civil Status

Findings revealed that the majority (62.94%) were single, and the remaining (37.06%) were married. This implies that a significant portion of the population being surveyed is in the early stage of their career, and they are often single. This conforms with the results of the age variables of the respondents.

Highest Educational Attainment

Most (93.71%) respondents had bachelor's degrees, followed by master's degrees (5.59%), and the remaining (0.70%) had doctorate degrees. This illustrates that most of the employees in DPWH did not pursue a higher degree of education during the study.

Years in Service

The average number of years in service for the respondents in the organization was 5.32 years, with a standard deviation of 5.75. The majority (65.73%) of the respondents had 1-5 years in service, followed by 6-10 years in service (20.28%), and the least (0.70%) had greater than 25 years in service. The findings indicate that the respondents are new to their service. It may be because older employees had retired or transferred to different districts. Therefore, new personnel were hired to fill the positions.

Performance of Locally Sourced Materials

The Department of Public Works and Highways (DPWH) is responsible for developing and maintaining the Philippines' infrastructure. One of its key goals is to ensure the sustainability and cost-effectiveness of road building projects while maintaining quality requirements. The use of locally produced materials has emerged as a key technique for achieving these objectives: durability, strength, and environmental sustainability.

Durability

Table 2 presents the composite score of locally sourced materials in terms of durability, with a rating of 3.35 and a standard deviation (SD) of 0.38, described as strongly agree. This implies that the respondents strongly believed that locally sourced materials are durable when used for road construction projects.

STATEMENTS	MEAN	SD	DESCRIPTIVE RATING
DURABILITY			
1. The locally sourced materials in road construction projects resist weathering and environmental degradation.	3.47	0.53	Strongly Agree
2. Locally sourced aggregates retain structural integrity over time, even when subjected to different traffic loads.	3.48	0.50	Strongly Agree
3. Locally sourced materials offer durability comparable to non-local or imported alternatives used in road construction.	3.20	0.55	Agree
4. Roads built with locally sourced materials tend to have a longer service life, reducing the need for frequent rehabilitation or reconstruction.	3.34	0.64	Strongly Agree
5. Locally sourced materials maintain durability throughout road projects' expected lifespan, showing minimal performance loss.	3.28	0.55	Strongly Agree
Composite Score	**3.35**	**0.38**	**Strongly Agree**

Legend:
3.25 – 4.00 Strongly Agree
2.50 – 3.24 Agree
1.75 – 2.49 Disagree
1.00 – 1.74 Strongly Disagree

Table 2: Durability

The statement "Locally sourced aggregates retain structural integrity over time, even when subjected to different traffic loads" got the highest mean of 3.48 and standard deviation of 0.50, and it was described as strongly agreeing. This implies that most of the respondents strongly believed that locally sourced aggregates retain their strength and stability even when subjected to varied traffic loads. It also indicates a high level of trust in the longevity of these materials for building roads.

The mechanical and durability features of earth-based materials stabilized using different agents, such as cement, lime, polymers, and biopolymers, were investigated by Tarhan and Kabakus (2024) [24]. The results showed that a 10% cement-stabilized earth mix increased strength and durability, making it appropriate for low-traffic roads. This highlights the ability of locally obtained earth resources to serve as long-lasting pavement solutions when appropriately stabilized. Meanwhile, Raju, Rani, and Manoj (2022) investigated the viability of using industrial waste (slag) and locally accessible gravel (moorum) as road sub-base layers [25]. The research concluded that both materials have outstanding qualities as road aggregates. The ideal utilization was 80% slag and 50% gravel (moored), demonstrating their potential for creating long-lasting, durable, cost-effective road subbase and subbase applications. Further, Dungca and Dychangco (2016) investigated the possible use of naturally occurring materials such as limestones, which resulted in not only an inexpensive alternative to traditional materials but also increased road strength; thus, with proper treatment and stabilization, locally sourced materials may significantly improve the longevity, durability, and performance of road building projects [26].

On the other hand, the statement "Locally sourced materials offer durability comparable to non-local or imported alternatives used in road construction" obtained the lowest mean of 3.20 and standard deviation of 0.55, and it was described as agreeable. It implies that while local materials are regarded as durable, specific issues, concerns, or skepticism may exist regarding their performance compared to high-quality imported materials.

Road construction often uses natural aggregates as building materials. However, the growing need for sustainable roadways emphasizes the significance of substituting natural materials with industrial waste. A comparative analysis was conducted by Ojiboye et al. (2024) on local and global sourcing strategies to determine the impact of strategic material sourcing on road construction project performance. The results found that 87.5% of the materials utilized were locally produced, showing a strong dependence on local resources. Local sourcing resulted in faster delivery and lower costs. However, worldwide sourcing was considered required for projects that need innovative and higher-quality materials.

The research of Mustapha et al. (2021) focuses on using dune sand combined with tuffs in dry places. It has been found that treating dune sand with hydraulic binders enabled up to 20% inclusion into building road projects, lowering its cost and environmental effects [26]. This method emphasizes the sustainability of local materials in specific ecological conditions. In addition, Schneider et al. (2023) looked at the environmental impact of alternative materials such as manufactured sand, granulated blast furnace slag, and building and demolition debris in Vietnam's road sector [28]. The findings revealed that specific local resources had reduced environmental consequences, highlighting the necessity of procuring materials closer to building sites to improve sustainability.

Compressive Strength

Findings revealed that the strength performance of locally sourced materials obtained a composite score of 3.33, with a standard deviation of 0.38, described as strongly agree. This shows that respondents strongly agreed that locally sourced materials have good strength performance. It also demonstrates a positive perception of these materials' capacity to handle structural loads in road building.

STATEMENTS	MEAN	SD	DESCRIPTIVE RATING
1. The locally sourced materials utilized in road construction projects in my area comply with the compressive strength standards established by the DPWH.	3.67	0.49	Strongly Agree
2. The compressive strength of locally sourced aggregates (sand, gravel, and crushed stone) remains consistent throughout the project's lifespan.	3.15	0.69	Agree
3. The locally sourced materials used in road construction exhibit satisfactory compressive strength after being subjected to environmental stress factors such as extreme weather and traffic loads.	3.35	0.58	Strongly Agree
4. The compressive strength of locally sourced materials significantly enhances the long-term durability of the roadway.	3.14	0.67	Agree
5. The compressive strength of locally sourced materials significantly influences the overall cost-effectiveness of road construction projects.	3.33	0.38	Strongly Agree
Composite Score	**3.33**	**0.38**	**Strongly Agree**

Legend:
3.25 – 4.00 Strongly Agree
2.50 – 3.24 Agree
1.75 – 2.49 Disagree
1.00 – 1.74 Strongly Disagree

Table 3: Compressive Strength

The statement "The locally sourced materials utilized in road construction projects in my area comply with the compressive strength standards established by DPWH", got the highest mean of 3.67, with standard deviation of 0.49, described as strongly agree. It indicates that the respondents strongly believed that the locally sourced materials have high quality and reliability for road construction.

Strength is the most measured property of concrete and is often used as the basis for assessing concrete quality (Orozco & Diola, 2013). In the Philippines, the required minimum flexural and compressive strengths for road applications are set by the Department of Public Works and Highways (DPWH). Hernandez et al. (2022) study reported that construction materials when properly treated and stabilized, will pass the DPWH requirements for secondary roads [7]. A study in Bicol by Mendoza and Villanueva (2020) showed that the partial replacement of cement with volcanic ash enhanced the environmental sustainability of road construction projects [8].

Meanwhile, the initial main findings of Villasis et al. (2014) for local roads in Guimaras revealed that the study points to an optimum ratio of 1:1:2 mixture of cement, soil, and aggregates with a 5.73% content for cement, which results in attaining the required compressive strength of 2 MPa (DPWH specifications for cement-stabilized aggregate base). The research implies that local materials, when appropriately mixed, can comply with the comprehensive strength standards set by DPWH.

Additionally, the result of a conducted laboratory experiment by Orozco and Diola (2013) to compare the strength performance of concrete made from different types of local cement such as ordinary Portland cement (Type I), fly ash blended cement (Type IP), and pozzolan blended cement (Type P) and to determine which is most applicable in the Philippine setting. In the experiment, plain concrete cylinder and beam specimens with varied water-to- cement ratios were cured for 3, 7, 14, 28, 56, 90, and 120 days.

The findings indicated that Type I and Type IP cements are better suited for road construction in the Philippines in terms of strength.

On one hand, the University of Canterbury in New Zealand conducted research on the applicability of low-volume roads. Maintenance management systems in the Philippines (Bangasan, 2006) [29]. Most local roads of the country have gravel roads, which are known as unsealed low volume roads. The study concluded that performance-based standards lead to a more efficient and effective maintenance approach, particularly for unsealed low-volume highways.

On the other hand, the statement "The compressive strength of locally sourced materials significantly enhances the long-term durability of the roadway", got the lowest mean of 3.14, standard deviation of 0.67, described as agree. It implies that the respondents believed that the compressive strength of locally produced materials improves highway longevity. However, while compressive strength is important, it may not be the only factor influencing long-term durability.

According to Benvenuto (2015), energetically modified cements (EMCs) are a class of cements made from pozzolans (e.g. fly ash, volcanic ash, pozzolana), silica sand, blast furnace slag, blends with these Portland cement can result to a concrete with very satisfactory compressive strength [30].

A recent study by Shovon and Mahi (2023) examined aggregates from several places and discovered that materials from Panchagarh had higher compressive strength, indicating their appropriateness for concrete applications [31]. Since aggregates are considered the skeleton of concrete, Chen and Liu (2004), as well as Rao and Prasad (2002), concluded that all sorts of coatings should be avoided when manufacturing high-quality concrete [33,33].

Resistance To Weathering

The results showed that resistance to weathering obtained the highest durability and strength of locally sourced materials performance. It also got a composite score of 3.51, with a standard deviation of 0.38, which is described as strongly agreeing. It implies that the respondents strongly believe that locally sourced materials used in road-building projects are very resistant to weathering, including exposure to rain, heat, and other environmental variables. The use of local materials in road construction has received much attention lately because it may lower the cost of a project, promote local industries, and reduce environmental impacts.

STATEMENTS	MEAN	SD	DESCRIPTIVE RATING
1. Weathering tests conducted on locally sourced materials have demonstrated satisfactory durability for long-term road use.	3.66	0.55	Strongly Agree
2. Locally sourced materials are more susceptible to weather-related degradation than non-local or imported materials.	3.48	0.63	Strongly Agree
3. Locally sourced materials preserve their integrity (minimal cracking, fading, or degradation) even under extreme weather conditions such as rain, heat, or humidity.	3.48	0.52	Strongly Agree
4. Regular maintenance or repairs are necessary because locally sourced materials used in road projects are affected by weathering.	3.46	0.59	Strongly Agree
5. The resistance of locally sourced materials against weathering is a critical factor influencing material selection for road construction in the district.	3.46	0.58	Strongly Agree
Composite Score	**3.51**	**0.38**	**Strongly Agree**

Legend:
3.25 – 4.00 Strongly Agree
2.50 – 3.24 Agree
1.75 – 2.49 Disagree
1.00 – 1.74 Strongly Disagree

Table 4: Resistance To Weathering

The statement "Weathering tests conducted on locally sourced materials have demonstrated satisfactory durability for long-term road use" obtained the highest mean of 3.66, standard deviation of 0.55, described as strongly agree. The result implies that the respondents strongly agreed that locally sourced materials exceed their durability, which reduces the need for regular road maintenance and repairs.

The weathering process impacting common aggregates used in highway building emphasized that standard tests, such as the Deval Abrasion test, Page impact test, Los Angeles rattler test, and freeze-thaw cycles, frequently concentrate on specific physical or chemical attributes. The study stressed the necessity for extensive studies to understand how aggregates resist weathering over time (Melville, 2022) [34]. Moreover, the study of Agate et al. (2024) discovered that the best mix of these locally sourced materials increased the soil fluidity, compaction, and strength properties [35]. The treated soil showed increased resistance to weather conditions, making it feasible and cost-effective for rural road construction.

On the other hand, the statement "The resistance of locally sourced materials against weathering is a critical factor influencing material selection for road construction in the district" obtained the lowest mean of 3.46, standard deviation of 0.58, described as strongly agree. This indicates that the respondents strongly agreed that resistance to weathering locally sourced materials is an important factor to consider when selecting materials for road construction. However, since it obtained the lowest mean among the other factors, it also implies that other criteria, such as strength, availability, and cost of materials, might also be considered.

In a study by Rahman and Associates (2020) noted that poor materials selection results in premature deterioration of maintenance cost, resistance to weathering, and short life span for infrastructure [10]. Local materials represent an innovative approach to sustainable construction practices that contribute to environmental stewardship but benefit local communities.

According to Shukla and Patel (2017), the possibilities for using locally accessible materials in road building emphasize that aggregates used in high-quality pavements should be highly resistant to crushing and able to endure strains caused by traffic wheel loads [36].

Alloul and Bentabet's (2003) study stresses the dry climate of the Sahara, which allows for the use of materials that would be inappropriate in more humid places [37]. The study examines how local geology and geomorphological variables affect the deposition and applicability of materials such as dune sands, granitic or gneissic arena sands, and weathered basalts for road building. It emphasizes the need to understand climate zonality while selecting materials since weathering resistance differs greatly between locales.

Thus, with proper assessment and treatment, locally obtained materials can fulfill the durability, strength, and resistance to weathering criteria required for road building.

Sustainability of Locally Sourced Materials

Sustainability has emerged as a key priority in infrastructure construction, with an increasing emphasis on mitigating environmental consequences and encouraging resource efficiency. It seeks to minimize environmental effects while preserving structural integrity and efficiency. Keyways include utilizing advanced and recycled materials, improving road alignment, and applying environmentally responsible project management (Ujene & Oladokum, 2017) [18]. The sustainability of locally sourced materials was determined using economic, social, and environmental factors.

Economic

Findings presented the economic factor on the sustainability of locally sourced materials, obtaining a composite score of 3.72 with a standard deviation of 0.35, which is described as strongly agreeing. Respondents strongly believe that using locally sourced materials promotes economic sustainability. This might result in cost savings, job creation, lower shipping costs, and support for local suppliers. Data is presented in Table 5.

STATEMENTS	MEAN	SD	DESCRIPTIVE RATING
1. The locally sourced materials are cost- effective compared to imported materials for road construction.	3.74	0.44	Strongly Agree
2. Using locally sourced materials reduced the overall cost of road construction projects in the long term.	3.69	0.52	Strongly Agree
3. The locally sourced materials contribute to reducing transportation and logistics costs.	3.61	0.53	Strongly Agree
4. There is a significant savings in material procurement costs using locally sourced materials.	3.76	0.47	Strongly Agree
5. Sourcing materials locally positively affects the local economy by supporting small and local businesses.	3.78	0.42	Strongly Agree
Composite Score	**3.72**	**0.35**	**Strongly Agree**

Legend:
3.25 – 4.00 Strongly Agree
2.50 – 3.24 Agree
1.75 – 2.49 Disagree
1.00 – 1.74 Strongly Disagree

Table 5: Economic

The statement "Sourcing materials locally positively affects the local economy by supporting small and local business" got the highest mean of 3.78, with standard deviation of 0.42, described as strongly agree. It implies that DPWH engineers firmly support small and local businesses, as well as the economic benefits of obtaining local materials.

According to Babu and Petchikkan (2023), locally sourced materials can boost the local economy by creating jobs and supporting small businesses that generate these materials [3]. Local materials provide an innovative approach to sustainable construction techniques that benefit both the environment and local populations. In addition, Molenaar, Harper, and Murphy (2019) asserted that locally sourced materials, such as sand and gravel, will lower transportation costs and provide avenues for local economic development [4]. Moreover, Odediran et al. (2013) also stated that materials are predictors of future building costs [5]. They concluded that using locally produced materials may result in a decrease in building costs and promote affordability.

Further, according to the research of Pringle (2013) in British Columbia, Canada, purchasing from locally based suppliers benefits the local economy nearly twice as much as buying from global corporations [38]. A local office supply firm recirculated 33% of its sales inside the province, compared to 17-19% for a multinational firm. Similarly, research in Arizona found that a purchasing contract with an independent local supplier recirculates three times more money in the local economy than a deal with a large corporation. This demonstrates the economic benefits of promoting local businesses in government procurement (Mitchell, 2008) [39].

On one hand, the statement "The locally sourced materials contribute to reducing transportation and logistics costs", got the lowest mean of 3.61, with standard deviation of 0.50, described as strongly agree. It revealed that while the respondents strongly believed that sourcing locally materials reduce transportation and logistics costs, they may also consider other reasons or factors that are more important and accepted.

Construction is perhaps one of the most cost-oriented sectors in any economy. One of the key advantages of locally sourced materials is the guarantee of faster and more consistent delivery times. With supply chain disruptions making headlines, proximity to suppliers mitigates the associated long-distance transportation (Daisy, 2024) [40]. Local sourcing reduces long-distance transportation costs, resulting in decreased fuel usage and carbon emissions. This approach also improves energy efficiency and minimizes the need for elaborate packing, lowering overall transportation costs (Sancell, 2023).

According to Molenaar, Harper, and Murphy (2019), locally supplied resources, such as sand and gravel, will save transportation costs and open opportunities for local economic growth [4]. Transportation can make up to 39-58% of overall logistics expenses and 4-10% of a building selling price. However, utilizing locally source materials can drastically reduce the shipping cost (Shakantu, Tookey & Bowen, 2003).

Social

Social, as one of the categories on the sustainability of locally sourced materials, obtained a composite score of 3.57, with a standard deviation of 0.37, which is described as strongly agreeing. Findings revealed that local material sourcing is commonly acknowledged as socially advantageous, including supporting local workers, enhancing community well-being, and promoting fair labor standards.

STATEMENTS	MEAN	SD	DESCRIPTIVE RATING
1. 1. Locally sourced materials reduce the need for labor migration by enabling individuals to find employment closer to home.	3.51	0.50	Strongly Agree
2. Locally sourced materials enhance the standard of living for communities by providing employment opportunities for residents.	3.61	0.52	Strongly Agree
3. Using locally sourced materials helps reduce the health risks associated with transporting materials over long distances, which can result in accidents or air pollution.	3.77	0.47	Strongly Agree
4. Locally sourced materials enhance safety in road construction projects due to their familiarity with local communities and established practices.	3.59	0.52	Strongly Agree
5. The quality of locally sourced materials can enhance public safety by ensuring road durability and minimizing accidents caused by inadequate road conditions.	3.37	0.54	Strongly Agree
Composite Score	**3.57**	**0.37**	**Strongly Agree**

Legend:
3.25 – 4.00 Strongly Agree
2.50 – 3.24 Agree
1.75 – 2.49 Disagree
1.00 – 1.74 Strongly Disagree

Table 6: Social

The statement "Using locally sourced materials helps reduce the health risks associated with transporting materials over long distances, which can result in accidents or air pollution" got the highest mean of 3.77, with a standard deviation of 0.47, described as strongly agree. The findings decision: The idea is that local sourcing of materials is more than simply an economic or environmental decision; it is also a public health and safety precaution. It emphasizes the importance of local sourcing for businesses, politicians, and communities in reducing air pollution, minimizing traffic accidents, and improving general well-being.

Locally sourced supplies and materials can considerably minimize the health hazards associated with long-distance transportation, such as accidents and air pollution. Reducing the demand for long-distance transportation reduces the number of heavy vehicles on the road, lowering the danger of traffic accidents. Fewer trucks in transit result in safer road conditions for all users (EPA, 2024). The use of locally sourced, non-toxic, and renewable materials is consistent with sustainable construction principles, which reduce exposure to dangerous compounds. This method promotes better interior environments for tenants and safer working conditions for construction workers (Mangal, 2024).

Local sourcing materials also reduces the need for long-distance transportation, which saves fuel and reduces greenhouse gas emissions. This decrease in emissions helps to enhance air quality, which benefits public health by lowering respiratory difficulties associated with air pollution (Sancell, 2023) [41]. The use of green building materials, especially locally sourced materials, reduces environmental and health risks associated with typical construction materials. These behaviors result in healthier living areas and contribute to overall community well-being (Koshnava et al., 2020) [42].

Meanwhile, the statement "The quality of locally sourced materials can enhance public safety by ensuring road durability and minimizing accidents caused by inadequate road conditions" obtained the lowest mean of 3.37, with a standard deviation of 0.54, described as strongly agree. It means that while respondents generally agreed that the quality of locally sourced materials has a great impact on public safety, it may not have received as much attention as other factors.

The quality and proper use of locally obtained materials are critical for building safe a nd long-lasting roadways. Ensuring that these materials satisfy defined requirements and are used appropriately may considerably improve public safety in road construction projects.

A study by Tarhan and Kabakus (2024) investigated the potential of earth stabilization for pavement applications compared to traditional ones [24]. It has been discovered that introducing these stabilizers increased the strength and durability of earth mixes, providing a low-cost and environmentally beneficial alternative for low-traffic applications. Thus, it not only improves road structural integrity but also promotes public safety by ensuring a more lasting pavement. Additionally, Friedman and Abdelkader's (2021) results revealed that the strategy of using specific soil stabilization products on road-building projects may offer stable and dust- free roads, as well as stabilized base layers for major highways, thereby increasing public safety, as well as the durability of road infrastructures [43].

In the Philippines, the government recognizes the value of using locally produced con struction materials for infrastructure projects. The Private Sector Council Infrastructure Cluster recommended giving Filipino-made construction materials, pointing out that local manufacturing industries producing cement, steel, and other construction materials meet the national standards that can withstand the country's climate and other natural disasters. This initiative seeks to promote local goods and guarantee that infrastructure projects are con structed using materials appropriate to local circumstances, hence improving public safety (Gonzales, 2023).

Osypchuk and Sosik's (2021) study on the influence of building materials on road safety examined whether the use of construction supplies is associated with road traffic risks in urban areas. The study tried to develop methods to minimize road accidents and promote road and public safety, emphasizing the need for adequate planning and organization in building projects. Furthermore, the idea of green highways, as research by Muench et al. (2018), highlights the use of locally sourced materials to build roads that combine transportation functionality with environmental sustainability. Such approaches improve not just the environment but also public health and community well-being.

Environmental

In terms of environmental sustainability, it obtained a composite score of 3.57, with standard deviation of 0.56, described as strongly agree. It implies that the respondents firmly believed that using locally sourced materials promotes environmental sustainability, thus they generally support it. Data is presented on Table 7.

STATEMENTS	MEAN	SD	DESCRIPTIVE RATING
1. Utilizing locally sourced materials minimizes the carbon emissions linked to transportation.	3.65	0.49	Strongly Agree
2. Locally sourced materials minimize the consumption of non-renewable resources.	3.53	0.51	Strongly Agree
3. The utilization of locally sourced materials contributes to the reduction of construction waste.	3.57	0.52	Strongly Agree
4. Sourcing materials locally reduces the ecological footprint of road construction projects.	3.43	0.54	Strongly Agree
5. Using locally sourced materials in DPWH road projects aligns with national environmental policies.	3.66	0.48	Strongly Agree
Composite Score	**3.57**	**0.36**	**Strongly Agree**

Legend:
3.25 – 4.00 Strongly Agree
2.50 – 3.24 Agree
1.75 – 2.49 Disagree
1.00 – 1.74 Strongly Disagree

Table 7: Environmental

The statement "Using locally sourced materials in DPWH road projects aligns with national environmental policies" got the highest mean of 3.66, with a standard deviation of 0.36, described as strongly agree. It shows that government agencies, such as the DPWH projects, promote environmental policies by employing locally sourced materials. Respondents also considered policy compliance to be a significant benefit of adopting locally sourced resources.

Construction agencies regularly consume more raw materials, resulting in our natural resources scarcity and environmental implications (Siman, 2023) [6]. The DWPH has initiated programs to use locally sourced materials in road-building projects, which are consistent with national environmental standards. Hernandez et al. (2022) reported that construction materials when properly treated and stabilized, will pass the DPWH requirements for secondary roads [7].

In 2024, DPWH has allowed the use of shredded low-density polyethylene (LDPE) plastic bag trash as an addition in asphalt mix. This effort intends to increase the lifespan of asphalt pavements while addressing plastic pollution which contributes to urban floods. The program not only encourages recycling, but it also increases asphalt's resilience to defor mation (Bacelonia, 2024) [44].

Likewise, in 2023, the Philippine government announced intentions to enhance procurement of locally made building materials for infrastructure projects. This regulation promotes the "buy local, go local" program, which seeks to promote local goo ds while also ensuring that building materials satisfy national requirements appropriate for th e country's climate and natural catastrophes (Gonzales, 2023) [45].

Meanwhile, the statement "Sourcing materials locally reduces the ecological footprint of road construction projects" got the lowest mean of 3.43, with standard deviation of 0.54, described as strongly agree. It implies that although it obtained the lowest rating, the respondents strongly believe and acknowledged the environmental benefits of local sourcing of materials.

Sourcing materials locally reduces the need for long-distance transportation, lowering greenhouse gas emissions and fossil fuel use (CMS, 2025). This approach not only lowers the carbon footprint but also potentially prolongs the lifespan of roads and bridges and decreases the need for repairs. Prioritizing local resources also encourages employment growth and protects traditional skills in communities. Engaging local suppliers helps to sustain job possibilities and preserve unique crafts worker skills, all while contributing to a circular economy in which resources are reused and recycled within the community, thus decreasing waste.

Recognizing the environmental impact of traditional road construction procedures, the industry is starting to look at recycled resources as alternatives to virgin aggregates. Numerous studies have demonstrated the potential of recycled aggregates such as recycled concrete aggregate, recycled asphalt pavement, steel slag, and other waste materials such as bricks, glass, and plastics, as well as industrial byproducts such as fly ash and blast furnace slag, for use as sustainable substitutes in road constructions (AzariJafari, Yahia, & Ben Amor, 2016) [46].

Moreover, the life-cycled evaluation showed that using recycled materials in roads and highway construction may result in considerable environmental advantages such as reduced resource extraction and waste creation (Del Ponte et al., 2017) [47]. According to Hoy et al. (2024), using locally available recycled materials in road building, such as reclaimed asphalt and con crete, may considerably improve sustainability and resource efficiency.

Challenges in Integrating Sustainable Road Construction Projects Utilizing Locally Sourced Materials

Sustainability has emerged as a key priority in infrastructure construction, with an increasing emphasis on mitigating environmental consequences and encouraging resource efficiency. It seeks to minimize environmental effects while preserving structural integrity and efficiency. A sustainable road refers to building approaches that reduce environmental effects, adapt to changing users, and are strong for future challenges such as climate change (Fernandez et al., 2023) [19]. However, despite its acknowledged relevance, adoption has been hampered by a variety of challenges that were faced by the respondents in integrating sustainability road construction projects.

CHALLENGES	FREQUENCY	PERCENTAGE (%)
Limited availability of materials	84	58.74
Increasing cost of construction materials	79	55.24
Locally sourced materials of inconsistent quality	56	39.16
Unregulated extraction of materials	77	53.85
Limited understanding of advanced sustainability practices	68	47.55

Note: This question was designed as a multiple-response item, allowing respondents to select more than one answer.

Table 8: Challenges in Integrating Sustainable Road Construction Projects Utilizing Locally Sourced Materials (Multiple Response)

Limited availability of materials (58.74%) is the topmost challenge faced by the respondents in integrating sustainable road construction projects. Perhaps not all locally available materials adhere to technical standards for durability, strength, and weather resistance. Many locations lack modern processing technology for refining raw materials to fulfill sustainability requirements. The variety of soil, aggregates, and other building inputs makes it challenging to maintain a regular supply of high-quality materials. Other infrastructure projects need massive quantities of materials, and local suppliers may lack the ability to supply demand.

The scarcity of sustainable resources is a substantial obstacle to incorporating environmentally friendly techniques into road-building projects. Eco-friendly materials sometimes have greater upfront costs than standard alternatives, limiting their wider use. This economic obstacle is especially evident in nations with lower incomes, where immediate affordability is favored to meet pressing infrastructure demands (Tafida et al., 2024) [48]. Additionally, sustainable materials may not have the same performance and durability as traditional materials. Concerns regarding their long-term behavior in a variety of environments might discourage their usage, reducing their market availability.

A lack of experience, expertise, and knowledge about sustainable materials, systems, and designs is more likely to make mistakes during construction. This shortcoming adds to the underutilization and scarcity of sustainable resources in the sector (Qasem & El-Sayegh, 2025) [49]. Moreover, the construction industry's conventional practices and resistance to change can impede the use of sustainable materials. Furthermore, a lack of training and understanding about green materials among builders and project owners may limit their adoption (Nusa, Endut & Ishak, 2015) [50].

Next, challenges was the increasing cost of construction materials (55.24%) in integrating sustainable road construction projects. It implies that rising materials prices contributes to greater project cost. This rise in cost of materials increases the total budgetary burden of the construction projects.

Integrating sustainability into road-building projects provides various problems, particularly given the rising cost of construction materials. Research by Cheda Yee and Rahman (2024), which concentrated on Johor Bahru, found that financial limitations were a key obstacle to implementing sustainable construction techniques [51]. The study found that sustainable construction technologies frequently incur higher costs, which discourages adoption.

Specifically, the study discovered a 3-4% rise in expenses when employing green materials against regular ones, with capital expenditures rising by at least 1-25% in green projects. Financial restrictions were a major challenge to the implementation of sustainable road- building projects. Ahzahar et al. (2022) and Szydlik (2014) noted that sustainable building procedures frequently incur higher costs, discouraging adoption [52,53]. Similarly, Wong et al. (2021) stated that financial constraints arise from a lack of rigorous lifecycle cost studies and limited funding, making it difficult for building experts to embrace green concepts [54].

Wu, Ding, and Love (2017) discovered that the financial risks associated with innovative technologies and materials hinder stakeholders' decision-making processes [55]. Furthermore, Zuo and Zhao (2014) noted that the perception of higher costs, even when long- term gains are obvious, reduces stakeholders' desire to participate in green initiatives [56].

Unregulated extraction of materials (53.85%) was rated as the third challenge of the respondents in integrating sustainable road construction projects. It may be because materials supplied through unregulated means may not fulfill quality requirements, resulting in weakened road constructions and higher maintenance expenses. Governments and environmental agencies establish stricter rules to combat unregulated extraction, causing road development projects to be delayed and incur more costs to comply.

According to research by Assefa and Gebregziabher (2019), unregulated extraction of materials such as aggregate in Ethiopia causes environmental difficulties such as landscape alteration, soil pollution, erosion, sedimentation, and biodiversity loss [57]. These actions compromise the environmental balance and sustainability of construction projects.

Meanwhile, the study of Vijerathne et al. (2024) on the environmental implications of coarse aggregate production in Sri Lanka discovered that natural aggregate extraction increases greenhouse gas emissions, landscape degradation, water contamination, and air pollution [58].

These findings highlight the importance of using sustainable materials in road building. Thus, the unregulated extraction of construction materials poses hurdles to the sustainability of road construction projects. However, to mitigate this challenge, companies such as Miniwiz and LOTOS in Taiwan are innovating by converting waste materials into building materials, decreasing dependency on natural aggregates, and minimizing the carbon footprint of new buildings (Sedagat & Hamada, 2024) [59].

On the other hand, a limited understanding of advanced sustainability practices (47.55%) was also among the challenges rated by the respondents in integrating sustainable road construction projects. Advanced sustainable practices frequently use new materials, energy-efficient designs, and innovative construction processes (for example, permeable pavements, warm mix asphalt, and recycled aggregates). Without sufficient expertise, these are viewed as expensive and difficult to implement. Despite the long-term environmental and economic benefits, a lack of awareness and expertise in advanced sustainability techniques in road building impedes their acceptance and implementation.

A lack of understanding of the long-term advantages of sustainable practices causes an overemphasis on the higher costs associated with eco-friendly products and technology, discouraging their adoption (Opoku et al., 2019) [60]. The rapid development of sustainable technology necessitates ongoing learning. Therefore, without proper understanding, integrating new technologies with current infrastructure becomes difficult (Khural et al., 2024) [61]. To accomplish the goal of maintaining sustainability in highway construction, it is critical to understand the various viewpoints of contractors and project owners on the barriers to environmentally friendly concept implementation. Without understanding of these principles and barriers, it is difficult to develop solutions and efficient legislation to apply sustainability on road and highway buildings (Ng et al., 2013) [62].

Further, the locally sourced materials of inconsistent quality (39.16%) are rated as the least challenging in sustainable road projects because they are not as critical as those of the other concerns. Even if local materials are of inconsistent quality, alternate suppliers or material treatments can increase their usefulness, thus mitigating the problem. Likewise, many road construction projects use quality testing and processing processes (such as stabilization and grading) to verify that locally obtained materials fulfill the needed requirements. Therefore, while inconsistent local materials can be challenging, building firms have techniques to limit their impact, making this issue less severe than other sustainability hurdles in road projects.

Research by Razak et al. (2023) in improving sustainability in road construction indicates that a 20% replacement with crushed brick and a 50% replacement with reclaimed asphalt pavement yielded optimal results in terms of stiffness and compressibility, suggesting a viable approach to mitigate quality inconsistencies in locally sourced materials. Moreover, research has also examined utilizing waste materials from building and demolition, including clay masonry and recycled concrete aggregate, to create pavement (Arisha et al., 2018) [15].

On the other hand, the use of alternative sustainable materials in road construction, even if local resources vary in quality, is becoming increasingly important as people become more aware of the consequences of climate change and the construction industry's high energy consumption (Guinta, 2023) [22]. Thus, examining sustainability factors in road construction may be accomplished using a life cycle management or sustainable alternative method that considers economic, environmental, and social factors (Ujene & Oladukum, 2017) [18].

Summary Conclusions and Recommendations

This section deals with the summary, conclusions, and recommendations of the study based on the result of its objectives.

Summary

This study utilized the quantitative research design, particularly the descriptive survey method, in assessing the performance and sustainability of locally sourced materials used in road construction projects in the DPWH 1st District, Talavera, Nueva Ecija, during the Calendar Year 2025. A researcher-made instrument was pre-tested among 15 employees of DPWH 2nd District, Cabanatuan City, Nueva Ecija. Cronbach's Alpha value was used in the study, which resulted in a reliable instrument. Once the approval of proper authority was secured, the survey questionnaire was administered to 143 employees of DPWH 1st District, Talavera. Data collected were analyzed using descriptive statistics.

The following were the salient features of the study.

Profile of the Respondents

Results showed that the mean age of the respondents was 31.33 with a standard deviation of 7.99. Majority (67.13%) were males, and the rest (32.87%) were females. Findings revealed that more than half (62.94%) of the respondents were single, and the remaining (37.06%) were married. Most (93.71%) respondents had bachelor's degrees, followed by master's degrees (5.59%), and the remaining (0.70%) had doctorate degrees. The average number of years in service for the respondents in the organization was 5.32 years, with a standard deviation of 5.75.

Performance of Locally Sourced Materials

The performance of locally sourced materials in road construction projects in terms of durability (3.35, SD – 0.38), compressive strength (3.33, SD – 0.38), and resistance to weathering (3.51, SD – 0.38) were all rated by the respondents as strongly agree.

Sustainability of Locally Sourced Materials

Results showed that the assessment of locally sourced materials such as economic (3.72, SD – 0.35), social (3.57, SD – 0.37), and environmental (3.57, SD - 0.36) were described as strongly agree by the respondents.

Challenges in Integrating Sustainable Road Construction Projects Utilizing Locally Sourced Materials

Findings revealed the identified challenges faced by the respondents with regard to the sustainability of road construction projects while using locally sourced materials include limited availability of materials (58.74%), the increasing cost of construction materials (55.24%), unregulated extraction of materials (53.86%), limited understanding of advance sustainability practices (47.55%), and lastly, locally sourced materials of inconsistent quality (39.16%).

Conclusions

Based on the results of the study, the following conclusions were made. Results illustrate that the mean age of the respondents was 31.33 years old. Males, more than half (62.94%) of the respondents were single, obtained their bachelor's degrees, and had 5.32 years in service. The performance of locally sourced materials in terms of durability, compressive strength, and resistance to weathering were described as strongly agree. In assessing the sustainability of locally sourced materials, which includes economic, social, and environmental factors, the respondents strongly agreed.

The identified challenges faced by the respondents in integrating sustainability of road construction projects while using locally sourced materials includes limited availability of materials, increasing cost of construction materials, unregulated extraction of materials, limited understanding of advance sustainability practices, and locally sourced materials of inconsistent quality [62-76].

Recommendations

Based on the conclusions and findings of the study, the following recommendations were provided. Since the majority of the respondents were new in the service and graduated with their bachelor's degree, it is therefore recommended that they continue their professional development by enrolling in masteral courses aligned with their field.
In terms of performance of locally sourced materials, compressive strength is the lowest among the categories, thus, implement a rigorous testing routine (e.g., compressive strength tests, particle size analysis) that assures material uniformity, and utilize proper moisture content and layer compaction procedures to increase the material density of road construction projects.

To enhance environmental sustainability of locally sourced materials in road construction projects, utilize sustainable materials like bamboo, recycled aggregates, or industrial byproducts to promote the use of renewable resources.

To overcome the challenges identified by the respondents in integrating sustainable road construction projects, it is recommended to encourage alternative sustainable materials, use effective mix designs and structural optimization approaches to save material waste and expenses, implement eco-friendly practices, and conduct public awareness on the impact of uncontrolled materials extraction, conduct seminars, training, and workshops with regards to advance sustainability practices, and lastly, implement strict quality control measures.

Further studies should be conducted, notably on the implementation of advanced sustainable technology through various innovative construction strategies. Similarly, comparative study should be undertaken in other districts in region 3 to achieve a better result.

Biographical Sketch

The researcher was born on May 1, 1993, in Cabanatuan City, Nueva Ecija. The youngest of the three children of Mr. Danilo S. Latonio and Mrs. Gina P. Latonio.

He finished his primary education with academic excellence at Bettbien Montessori in San Jose City, Nueva Ecija, and graduated with his secondary education at University Science High School. 2015 he obtained his Bachelor of Science in Civil Engineering from Central Luzon State University.

From 2010 to 2013, he served as an SK Chairman in Brgy. Rafael Rueda Sr. and PPSK Auditor in San Jose City, Nueva Ecija, while obtaining his Bachelor's degree. After graduating from college and passing the Civil Engineering Licensure Exam in 2015, he began working as an Engineer I at DPWH Nueva Ecija 1st District Engineering Office. In 2019, he was promoted to the position of Engineer II. In 2020, he was promoted to Engineer II under the Build Build (BBB) Program and later reappointed as a permanent employee.

He was accredited as DPWH Project Engineer I, who is in charge of the overall planning and control of the project, and as DPWH Provisional Materials Engineer in 2024. He is the Public Relations Officer (P.R.O.) at the Philippine Institute of Civil Engineers, Cabanatuan City—Nueva Ecija Chapter.

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JOHN JOSEPH P. LATONIO

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Appendix A. Research Instrument

Performance Evaluation and Sustainability of Locally Sourced Materials in Road Construction Projects of Dpwh

Part I. Socio-Demographic Profile of the Respondents

Age:

Sex: Male

Female Civil Status:

Single

Married

Highest Educational Attainment:

bachelor's degree

Master's Degree

Doctorate Degree Years in service:

Part II. Performance of Locally Sourced Materials in Road Construction Projects

Directions: The questionnaire contains statements on evaluating the performance of locally sourced materials on road construction projects regarding durability, strength, and resistance to weathering. Kindly check (/) the number that corresponds to your answer using the following scale:

4 – Strongly Agree 3 – Agree

2 – Disagree

1 – Strongly Disagree

STATEMENTS	4	3	2	1
Durability				
The locally sourced materials in road construction projects resist weathering and environmental degradation.				
Locally sourced aggregates retain structural integrity over time, even when subjected to different traffic loads.				
Locally sourced materials offer durability comparable to non-local or imported alternatives used in road construction.				
Roads built with locally sourced materials tend to have a longer service life, reducing the need for frequent rehabilitation or reconstruction.				

Locally sourced materials maintain durability throughout road projects' expected lifespan, showing minimal performance loss.				
Strength				
The locally sourced materials utilized in road construction projects in my area comply with the compressive strength standards established by the DPWH.				
The compressive strength of locally sourced aggregates (sand, gravel, and crushed stone) remains consistent throughout the project's lifespan.				
The locally sourced materials used in road construction exhibit satisfactory compressive strength after being subjected to environmental stress factors such as extreme weather and traffic loads.				
The compressive strength of locally sourced materials significantly enhances the long-term durability of the roadway.				
The compressive strength of locally sourced materials significantly				
influences the overall cost-effectiveness of road construction projects.				
Resistance to Weathering				
Weathering tests conducted on locally sourced materials have demonstrated satisfactory durability for long-term road use.				
Locally sourced materials are more susceptible to weather-related degradation than non-local or imported materials.				
Locally sourced materials preserve their integrity (minimal cracking, fading, or degradation) even under extreme weather conditions such as rain, heat, or humidity.				
Regular maintenance or repairs are necessary because locally sourced materials used in road projects are affected by weathering.				
The resistance of locally sourced materials against weathering is a critical factor influencing material selection for road construction in the district.				

Part III. Sustainability of Locally Sourced Materials on Road Construction Projects Directions: Please check (/) the number on the scale below to indicate the level of your agreement regarding the sustainable use of locally sourced materials in road construction projects.
4 – Strongly Agree 3 – Agree
2 – Disagree
1 – Strongly Disagree

STATEMENTS	**4**	**3**	**2**	**1**
Economic Aspects				
The Locally sourced materials are cost-effective compared to imported materials for road construction.				
Using locally sourced materials reduced the overall cost of road construction projects in the long term.				
The locally sourced materials contribute to reducing transportation and logistics costs.				
Significant savings in material procurement costs are achieved using locally sourced materials.				
Sourcing materials locally positively affects the local economy by supporting small and local businesses.				
Social Aspects				
Locally sourced materials reduce the need for labor migration by enabling individuals to find employment closer to home.				
Locally sourced materials enhance the standard of living for communities by providing employment opportunities for residents.				
Using locally sourced materials helps reduce the health risks associated with transporting materials over long distances, which can result in accidents or air pollution.				

Locally sourced materials enhance safety in road construction projects due to their familiarity with local communities and				
established practices.				
The quality of locally sourced materials can enhance public safety by ensuring road durability and minimizing accidents caused by inadequate road conditions.				
Environmental Aspects				
Utilizing locally sourced materials minimizes the carbon emissions linked to transportation.				
Locally sourced materials minimize the consumption of non- renewable resources.				
The utilization of locally sourced materials contributes to the reduction of construction waste.				
Sourcing materials locally reduces the ecological footprint of road construction projects.				
Using locally sourced materials in DPWH road projects aligns with national environmental policies.				

Part IV. Challenges in integrating sustainable road construction projects utilizing locally sourced materials (Multiple Responses)

Directions: Please place a check (/) next to the number of your chosen answer. You can check as many as you can.

1. Limited availability of materials
2. Increasing cost of construction materials
3. Locally sourced materials of inconsistent quality
4. Unregulated extraction of materials
5. Limited understanding of advanced sustainability practices
6. Others: pls. specify:

I appreciate your cooperation!

Appendix B. Permission to Conduct Pre-testing of the Instrument

CORE GATEWAY COLLEGE, INC.
Maharlika Highway, San Jose City, Nueva Ecija 3121
Tel No. 044 4864173; Email address: coregateway@cgci.edu.ph

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF PUBLIC WORKS & HIGHWAYS
RECEIVED
DATE: 02/17/2025
N. E. 2nd DEO

February 13, 2025

ENGR. ROBERT JAY N. PANALIGAN
OIC, District Engineer
Nueva Ecija 2ND District Engineering Office
Cabanatuan City, Nueva Ecija

Sir:

Greetings!

The undersigned is presently conducting his thesis entitled **PERFORMANCE EVALUATION AND SUSTAINABILITY OF LOCALLY SOURCED MATERIALS IN ROAD CONSTRUCTION PROJECTS OF DPWH** as a partial fulfillment of the course for the degree Master of Arts in Public Administration.

In this connection, may I request your good office to please allow me to conduct pretesting of my questionnaire to employees from different departments/divisions/units as part of the procedures for the said study.

Be assured that any data gathered will be handled with the highest level of confidentiality. Anticipating your favorable response regarding this request.

Respectfully yours,

JOHN JOSEPH P. LATONIO
Researcher

Noted by:

MARJORIE S. VELASCO, Ph.D.
Adviser

Appendix C. Request Letter to Conduct Study

CORE GATEWAY COLLEGE, INC.
Maharlika Highway, San Jose City, Nueva Ecija 3121
Tel No. 044 4864173; Email address: coregateway@cgci.edu.ph

SCHOOL OF GRADUATE STUDIES

February 18, 2025

JUN P. VANA, Ph.D.
OIC, District Engineer
Dpwh Nueva Ecija 1st D.E.O.
La Torre, Talavera, Nueva Ecija

Sir:

Greetings!

The undersigned is presently conducting his thesis entitled **PERFORMANCE EVALUATION AND SUSTAINABILITY OF LOCALLY SOURCED MATERIALS IN ROAD CONSTRUCTION PROJECTS OF DPWH** as a partial fulfillment of the course for the degree Master of Arts in Public Administration.

In this connection, may I request your good office to please allow me to conduct my study and administer my questionnaire to employees from different departments/divisions/units as part of the procedures for the said study.

Be assured that any data gathered will be handled with the highest level of confidentiality. Anticipating your favorable response regarding this request.

Respectfully yours,

JOHN JOSEPH P. LATONIO
Researcher

Noted by:

MARJORIE S. VELASCO, Ph.D.
Adviser

Appendix D. Permission to Conduct Study

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
NUEVA ECIJA 1ST DISTRICT ENGINEERING OFFICE
Talavera, Nueva Ecija, Region III

BAGONG PILIPINAS

February 21, 2025

Engr. John Joseph P. Latonio
Researcher
Core Gateway College, Inc.
San Jose City, Nueva Ecija

Dear Mr. Latonio,

We acknowledge your request to conduct a study and administer questionnaires for your research on **"Performance Evaluation and Sustainability of Locally Sourced Materials in Road Construction Projects of DPWH."**

Permission is granted, provided that the data collection does not disrupt office operations and confidentiality is maintained. Please coordinate with the concerned sections regarding the schedule.

Very truly yours,

JUN P. VANA, Ph.D.
OIC, District Engineer

RO3.14.5 DBM/JPV

Website: www.dpwh.gov.ph
Tel. No(s).: (044)958-7578

Appendix E. Informed Consent

Date:

Dear Respondent:

My name is **JOHN JOSEPH P. LATONIO.** I am a master's student at Core Gateway College, Inc., pursuing a Master of Arts in Public Administration. You are invited to participate in my research, "**PERFORMANCE EVALUATION AND SUSTAINABILITY OF LOCALLY SOURCED MATERIALS IN ROAD CONSTRUCTION PROJECTS OF DPWH**." The

study assessed the performance and sustainability of locally sourced materials in road construction projects of DPWH 1st District, Talavera, Nueva Ecija.

The questionnaire was developed to ask about your perceptions of the performance and sustainability of road construction projects using locally sourced materials. This information is hoped to serve as a basis or reference for the government and other construction agencies. The respondents' participation in this study is voluntary, and they can decline without repercussions. The respondents are encouraged to consider contributing, as your involvement is valuable and appreciated. Please let me know the most convenient time for you to answer the survey questionnaire.

Rest assured that your identity was kept confidential, and the information you will provide was presented in research format. I appreciate your consideration. Your cooperation is highly appreciated.

Your signature below indicates that you have read the above information and agree to participate in this study.

Name: Signature: Date:

Appendix F. Guarantee of Confidentiality

GUARANTEE OF CONFIDENTIALITY

I, JOHN JOSEPH P. LATONIO, at this moment, guarantee anonymity and confidentiality to in his/her participation in my research study.
Confidentiality will be guaranteed during and after the research process, as well as the final research paper.

Respondents' Signature Over Printed Name Date

JOHN JOSEPH P. LATONIO
Date