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Exploring the Nexus Between Environmental Sustainability Practices and Economic Performance in Local Government Units in Cagayan Valley Region: An Analysis using CMCI Data

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Abstract*: This study explores the nexus between environmental sustainability practices and economic performance in Local Government Units (LGUs) of the Cagayan Valley Region, using data from the Cities and Municipalities Competitiveness Index (CMCI) from 2020 to 2022. The research aims to assess the environmental sustainability initiatives of LGUs and evaluate their economic outcomes, analyzing trends and patterns to uncover potential correlations. Key indicators, including utility costs, gross sales, and business capitalisation, were examined to determine the relationship between sustainability and economic performance. Results reveal a moderate positive correlation between electricity costs, particularly for industrial users, and economic performance, while water costs exhibited weaker associations. The findings suggest that energy management is a significant factor influencing economic outcomes, with energy-efficient practices offering long-term benefits for both economic growth and environmental sustainability. The study provides policy recommendations to enhance ecological and economic performance, including investments in renewable energy, infrastructure improvements, and sustainable resource management. These strategies are crucial for promoting balanced regional development and aligning local objectives with global sustainability goals.

Keywords*: Cagayan Valley Region, Cities and Municipalities Competitiveness Index (CMCI), Economic Performance, Environmental Sustainability, Local Government Units (LGUs)

Abbreviations:
LGUs: Local Government Units
CMCI: Cities and Municipalities Competitiveness Index

I. INTRODUCTION

Environmental sustainability has emerged as one of the most pressing challenges of the 21st century. The increasing recognition of the detrimental effects of environmental degradation, ranging from climate change to biodiversity loss, has driven both global and local actors to prioritise sustainable practices across all sectors of society. As nations grapple with these challenges, the role of Local Government Units (LGUs) in fostering environmental sustainability at the grassroots level has become pivotal. LGUs, being at the frontline of public service, are uniquely positioned to implement policies that promote environmental stewardship while simultaneously driving local economic development. This dual responsibility underscores the importance of integrating sustainability into local governance frameworks [1].

The Cagayan Valley Region, situated in the northeastern part of the Philippines, presents a compelling context for examining the intersection of environmental sustainability and economic performance. Rich in natural resources, including vast agricultural lands, forest reserves, and water systems, the region is not only a financial hub but also an ecological treasure trove. However, like many regions globally, it faces the challenge of balancing economic growth with the preservation of its natural assets. Rapid urbanization, industrialization, and agricultural expansion have placed increasing pressure on the environment, necessitating the implementation of more sustainable practices at the local government level [2].

As the need for sustainability becomes more urgent, understanding the dynamics between environmental practices and economic outcomes is crucial. Local government units (LGUs) in the Cagayan Valley are at the forefront of this endeavour, making critical decisions that impact both the economic vitality of their communities and the health of the region's environment. To support LGUs in this role, robust data and analytical frameworks are needed to provide evidence-based insights into the effectiveness of sustainability initiatives. The Cities and Municipalities Competitiveness Index (CMCI), a tool developed by the National Competitiveness Council, offers a comprehensive framework for assessing the performance of LGUs in terms of economic dynamism, government efficiency, infrastructure, and resiliency [3]. The CMCI dataset serves as a valuable resource for examining how LGUs can simultaneously achieve environmental sustainability and economic competitiveness.

This research aims to explore the intricate nexus between environmental sustainability practices and economic performance in the LGUs of the

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Cagayan Valley Region by leveraging CMCI data from 2020 to 2022. This period encompasses significant developments, including national and global responses to environmental crises, economic shocks, and policy shifts driven by both external factors, such as the COVID-19 pandemic and internal governance reforms. By analyzing how LGUs in the region have navigated these challenges, this study sought to uncover patterns and correlations that can inform more sustainable local governance strategies.

Furthermore, this research is set against the backdrop of a global shift in the understanding of sustainability. The traditional notion of economic development, which focuses primarily on growth metrics such as Gross Domestic Product (GDP), is increasingly being challenged by more holistic frameworks that emphasise the need for long-term ecological sustainability and social well-being. The integration of environmental considerations into economic planning has transitioned from a peripheral concern to a core aspect of policymaking, particularly in light of the Paris Agreement on climate change and the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 [4]. In this context, LGUs in the Cagayan Valley, like those in many regions worldwide, face the challenge of aligning local development objectives with global sustainability commitments.

The Cagayan Valley Region's experience is not isolated but part of a broader global trend where local governments are increasingly expected to act as key drivers of sustainability. However, a gap remains in empirical research that explicitly examines how local sustainability initiatives affect economic outcomes. This study, which focuses on the Cagayan Valley, aims to fill this gap by providing not only a regional perspective but also contributing to the broader discourse on sustainable development in local governance. The findings will have implications not only for the region but also for other local governments that strive to balance the dual objectives of economic growth and environmental sustainability.

A. Statement of Research Problem and Objectives

This research addresses the key question: What is the relationship between environmental sustainability practices and economic performance in the LGUs of the Cagayan Valley Region?

To answer this, the study was guided by the following objectives:

i. To assess the current environmental sustainability practices adopted by the LGUs in the Cagayan Valley Region.

ii. To evaluate the economic performance of these LGUs over the period from 2020 to 2022, identifying trends and patterns.

iii. To analyze the correlation between sustainability practices and economic performance, determining whether there is a statistically significant relationship between the two.

iv. To identify best practices in environmental sustainability that are associated with positive economic outcomes in the region.

v. To propose policy recommendations aimed at enhancing both environmental and economic performance in LGUs.

II. METHODOLOGY

A. Variables and Measures/Concepts and Indicators

In this study, the primary variables examined are environmental sustainability practices and economic performance in the local government units (LGUs) of the Cagayan Valley Region. These variables are defined and measured using the following concepts and indicators:

Environmental Sustainability Practices. This variable refers to the initiatives, policies, and programs implemented by LGUs aimed at preserving the environment while supporting sustainable development. In this study, sustainability practices were primarily measured using proxy indicators related to utility costs, as direct sustainability measures were not explicitly available in the dataset. The key indicators used to infer sustainability practices were:

i. *Cost of Electricity for Commercial Users:* This represents the cost incurred by businesses in the LGUs for electricity consumption, which serves as a proxy for energy efficiency and infrastructure sustainability in commercial sectors.

ii. *Cost of Electricity for Industrial Users:* This reflects the energy costs associated with industrial operations, indicating the environmental burden and energy consumption patterns in these activities.

iii. *Cost of Water for Commercial Users:* Water consumption and its associated costs offer insight into how effectively commercial sectors manage water resources, a crucial factor in sustainability.

iv. *Cost of Water for Industrial Users:* Like the commercial water costs, this metric highlights the sustainability practices in industrial water usage, an essential resource management indicator for industries.

These indicators serve as proxies for environmental sustainability practices, as they reflect the energy and water resource consumption within the LGUs. Higher costs could suggest either higher consumption (which may indicate environmental stress) or more efficient infrastructure that supports larger economic activities.

Economic Performance. The key indicators used to measure economic performance in this study include the following:

- *Gross Sales of Registered Firms:* This indicator represents the total sales generated by businesses registered in each LGU. It provides a direct measure of economic activity and business productivity within the local government units.

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- *Total Capitalization of New Businesses:* This reflects the total investment in new businesses, indicating the level of economic growth and the attraction of new business ventures. High capitalization values suggest strong business development and investor confidence in the LGU's economy.
- *Number of Approved Business Permits (New and Renewals):* This serves as an indicator of business activity, with more permits signalling a thriving business environment. It reflects both the entry of new businesses and the continuity of existing ones.

The above indicators collectively offer a comprehensive view of the economic performance of the LGUs, focusing on business growth, sales output, and the capacity to attract new investments.

B. Research Design and Methods

This study employs a quantitative research design, utilising a correlational approach, to investigate the relationship between environmental sustainability practices and economic performance. The research used secondary data from the Cities and Municipalities Competitiveness Index (CMCI) covering the years 2020 to 2022. This dataset provides a rich source of information on the competitiveness and environmental performance of LGUs, making it ideal for assessing correlations between sustainability initiatives and economic outcomes.

The data collection involved extracting relevant indicators from the CMCI dataset related to both environmental sustainability and economic performance. These indicators were standardized for consistency and comparability across different LGUs. To complement the quantitative data, qualitative analysis was performed by reviewing the specific sustainability initiatives implemented by high-performing LGUs to identify best practices that contribute to both environmental protection and economic competitiveness.

C. Statistical Tests and Parameters

To analyze the relationship between the two primary variables, environmental sustainability practices and economic performance, several statistical tests were applied:

i. *Descriptive Statistics:* Descriptive statistics, including mean, median, standard deviation, and frequency distributions, were computed for both environmental and economic indicators to summarise the data and provide an overall view of the trends across the LGUs in the region.

ii. *Correlation Analysis:* Pearson correlation coefficients were calculated to assess the strength and direction of the relationships between environmental sustainability practices (as measured by various indicators) and economic performance. A positive correlation would indicate that higher sustainability performance is associated with better financial outcomes.

iii. *Hypothesis Testing:* The study tested the null hypothesis (H0) that there is no significant relationship between environmental sustainability practices and economic performance, against the alternative hypothesis (H1) that such a relationship does exist. A significance level (alpha) of 0.05 was used for all statistical tests. P-values were calculated to determine whether the observed relationships in the data were statistically significant.

The data were processed and analyzed using SPSS Version 17 statistical software, ensuring accuracy in calculations and reporting. The findings from the analyses are discussed in detail in the results section, highlighting the implications of the relationship between sustainability practices and economic outcomes for LGUs in the Cagayan Valley Region.

III. RESULTS AND DISCUSSION

A. Current Environmental Sustainability Practices Adopted by the LGUS in the Cagayan Valley Region

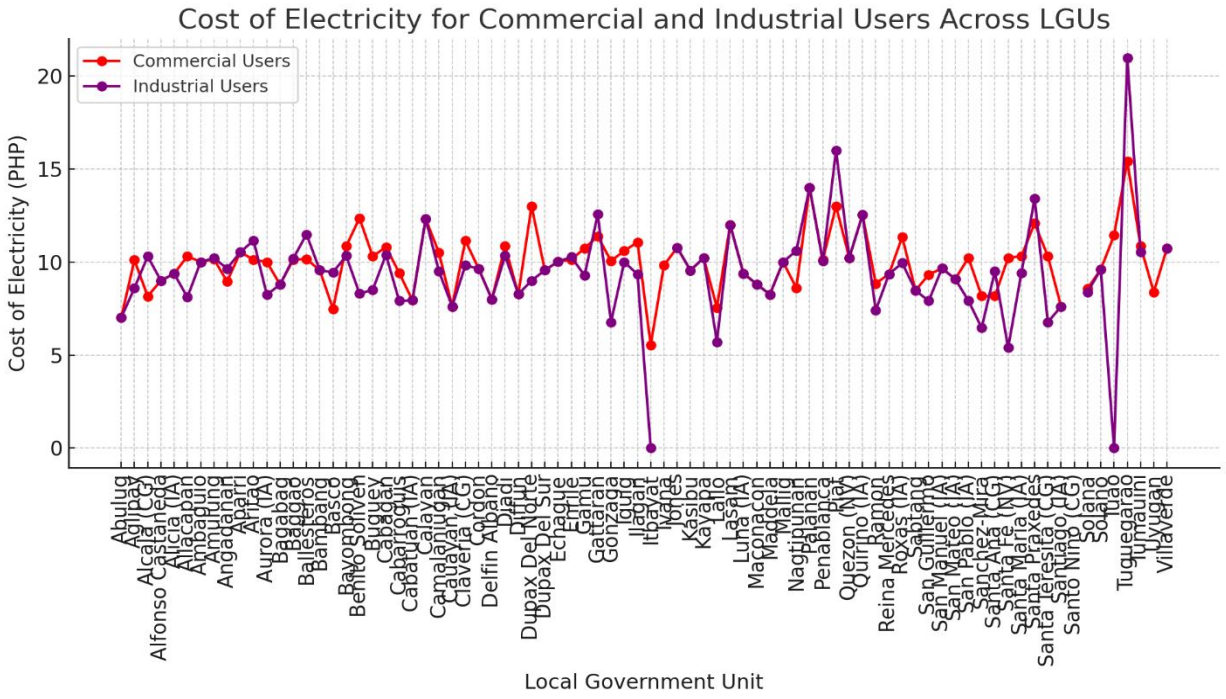
The first research objective is to assess the current environmental sustainability practices adopted by the LGUs in the Cagayan Valley Region. Based on the available data, ecological sustainability practices were inferred through utility costs related to electricity and water consumption for both commercial and industrial users.

Table I. Descriptive Statistics Table

	1.1. Gross Sales of Registered Firms	1.2. Total Capitalization of New Businesses	7.1.1. Cost of Electricity Commercial Users	7.1.2. Cost of Electricity Industrial Firms / Customers	7.2.1. Cost of Water Commercial Users	7.2.2. Cost of Water Industrial Firms / Customers
Mean	2,304,064,131.9507	193,293,331.68	9.959039	9.525675	35.83	31.66
Median	419,181,840.0400	26,496,780.00	10.077500	9.510000	25.13	25.00
Mode	199,972,000.00	10,810,000[a]	8.1600[a]	9.0000[a]	0[a]	0
Std. Deviation	5.78491E9	999,525,598.452	1.5700416	2.7812690	49.554	26.862
Range	46,191,002,757.91	14,336,430,420	9.8700	20.9600	390	155
Minimum	10,489.09	112,000	5.5400	.0000	0	0
Maximum	46,191,013,247.00	14,336,542,420	15.4100	20.9600	390	155

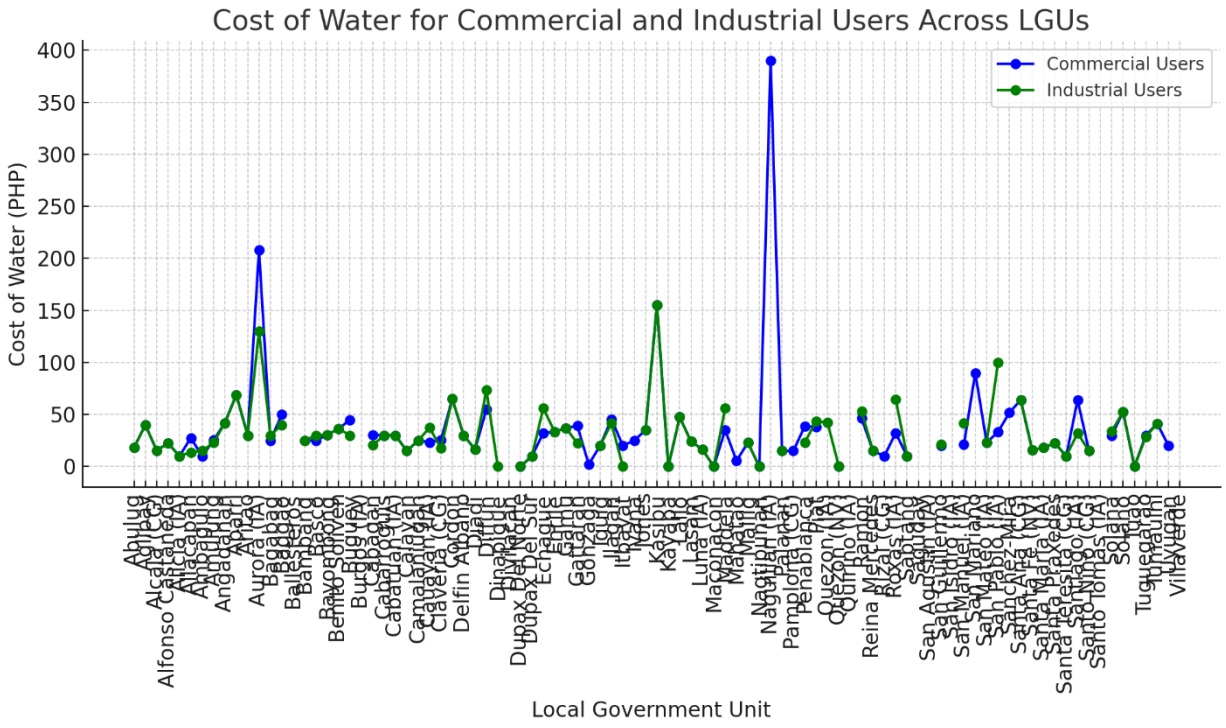
a. Multiple modes exist. The smallest value is shown

Table I summarizes the mean, median, and standard deviation of utility costs, offering a snapshot of sustainability practices across the LGUs. It presents the descriptive statistics for key indicators of economic performance and environmental sustainability across local government units (LGUs) in the Cagayan Valley Region. The table includes data on gross sales of registered firms (1.1), capitalization of new businesses (1.2), and utility costs for electricity (7.1.1, 7.1.2) and water (7.2.1, 7.2.2) for both commercial and industrial users.



[Fig.1: Trend Chart for Electricity Costs]

A chart showing the cost of electricity for both commercial and industrial users across the LGUs. This can illustrate how different LGUs are managing energy consumption, a key aspect of sustainability.



[Fig.2: Trend Chart for Water Costs]

A. Gross Sales of Registered Firms and Capitalization of New Businesses

The mean gross sales of registered firms are approximately PHP 2.3 billion. At the same time, the median is significantly lower at PHP 419.2 million, indicating that the distribution of gross sales is skewed to the right. This is further supported by the high standard deviation of approximately PHP 5.8 billion and an extensive range between the minimum (PHP 10,489.09) and maximum (PHP 46.2 billion). The significant disparity suggests that a small number of LGUs generate much larger revenues compared to others, pointing to economic inequality across the region. This reflects broader patterns of regional economic disparities observed in other studies, where metropolitan areas or highly urbanized LGUs tend to capture a disproportionate share

of economic activity due to better infrastructure, access to markets, and policy advantages [5].

Similarly, the capitalization of new businesses shows a mean value of approximately PHP 193.3 million, with a median of PHP 26.5 million. The high standard deviation of approximately PHP 1 billion suggests that certain LGUs attract substantially higher investments, while others struggle to garner significant business capitalization. This uneven business growth can be linked to factors such as the availability of infrastructure, access to markets, and LGU-level economic policies. Studies have shown that regions with better infrastructure and more conducive business environments attract higher levels of investment (Melo, Graham, & Noland, 2013). High capital inflow into specific LGUs may drive further development, but may also result in the marginalization of smaller LGUs that lack the same infrastructural advantages [6].

B. Costs of Electricity and Water for Commercial and Industrial Users

As reflected in Table 1, the cost of electricity for commercial users shows a mean of PHP 9.96, which is close to the median of PHP 10.08, indicating a relatively even distribution. The cost for industrial users follows a similar pattern, with a mean of PHP 9.53 and a median of PHP 9.51. The minimal variation in electricity costs suggests a consistent pricing structure across LGUs. However, some outliers are present, as indicated by the standard deviation of 1.57 for commercial users and 2.78 for industrial users. Literature highlights that consistent energy pricing, particularly in developing regions, is essential for ensuring a stable environment for business operations, particularly for small and medium enterprises (SMEs) [7].

Interestingly, the range of electricity costs for industrial users is significant (0 to PHP 20.96), indicating that certain LGUs may offer subsidies or have differential pricing policies aimed at attracting industrial development. Regions with lower energy costs tend to have a competitive advantage in attracting manufacturing industries, which are typically energy-intensive [8]. This variation in energy costs can influence regional competitiveness, particularly in industrial sectors.

The cost of water for commercial users (mean = PHP 35.83, median = PHP 25.13) and industrial users (mean = PHP 31.66, median = PHP 25.00) shows more significant variability compared to electricity costs, with standard deviations of 49.55 and 26.86, respectively. This considerable variation can be attributed to differing levels of water resource availability, infrastructure, and management practices across LGUs. The range of water costs, from zero to as high as PHP 390 for commercial users, highlights that some LGUs have abundant and affordable water resources. In contrast, others face significant constraints that lead to higher costs. Studies have shown that water scarcity and inefficient resource management can significantly affect local industries, particularly in agriculture and manufacturing [9]. Addressing these discrepancies through investment in water infrastructure and sustainable management practices will be crucial for fostering long-term growth.

The findings from this table reveal several important implications.

i. *Economic Disparities*: The wide disparity in gross sales and business capitalization points to significant economic inequalities among LGUs. This suggests the need for more balanced regional development strategies that focus on levelling the playing field for smaller LGUs, particularly in terms of infrastructure investment and policy support to attract business investments [5].
ii. *Energy Costs and Industrial Competitiveness*: Consistent electricity costs across the region suggest that energy is not a significant barrier to business growth for most LGUs. However, the considerable outliers indicate that certain LGUs with higher costs may face challenges in attracting industries that rely heavily on electricity. Policy interventions, such as energy subsidies or investments in renewable energy sources, could help enhance competitiveness in these regions [7].
iii. *Water Resource Management:* The considerable variation in water costs indicates that some LGUs are better positioned to support water-intensive industries. In contrast, others may face sustainability challenges due to water scarcity or infrastructure limitations. Addressing these disparities through investment in water infrastructure and sustainable management practices will be crucial for fostering long-term growth [9].
iv. *Sustainability and Economic Growth*: The variability in utility costs, particularly for water, reflects broader concerns about sustainability. Local governments with high utility costs may struggle to maintain economic growth while managing their environmental resources. This highlights the need for sustainable practices that balance economic development with ecological stewardship [8].

The descriptive statistics provide valuable insights into the economic performance and sustainability practices of LGUs in the Cagayan Valley Region. While certain LGUs show strong financial performance, others face significant challenges, particularly in attracting business investment and managing resource costs. Moving forward, policy interventions aimed at reducing economic disparities, improving resource management, and promoting sustainability will be critical to ensuring balanced regional growth.

C. Economic Performance of the LGUs Over the Period From 2020 to 2022

To evaluate the economic performance of the LGUs in the Cagayan Valley Region, two primary indicators were assessed: gross sales of registered firms and capitalization of new businesses. These indicators offer insight into overall economic activity and the LGUs' ability to attract investments from 2020 to 2022.

i. *Gross Sales of Registered Firms*: The mean gross sales across all LGUs were PHP 2.3 billion, with a high degree of variability, as shown by the standard deviation of PHP 5.78 billion. This significant variability suggests that a few LGUs dominate the economic landscape, while others generate much lower revenues. The minimum gross sales value was as low as PHP 10,489, while the maximum reached PHP 46.19 billion. The

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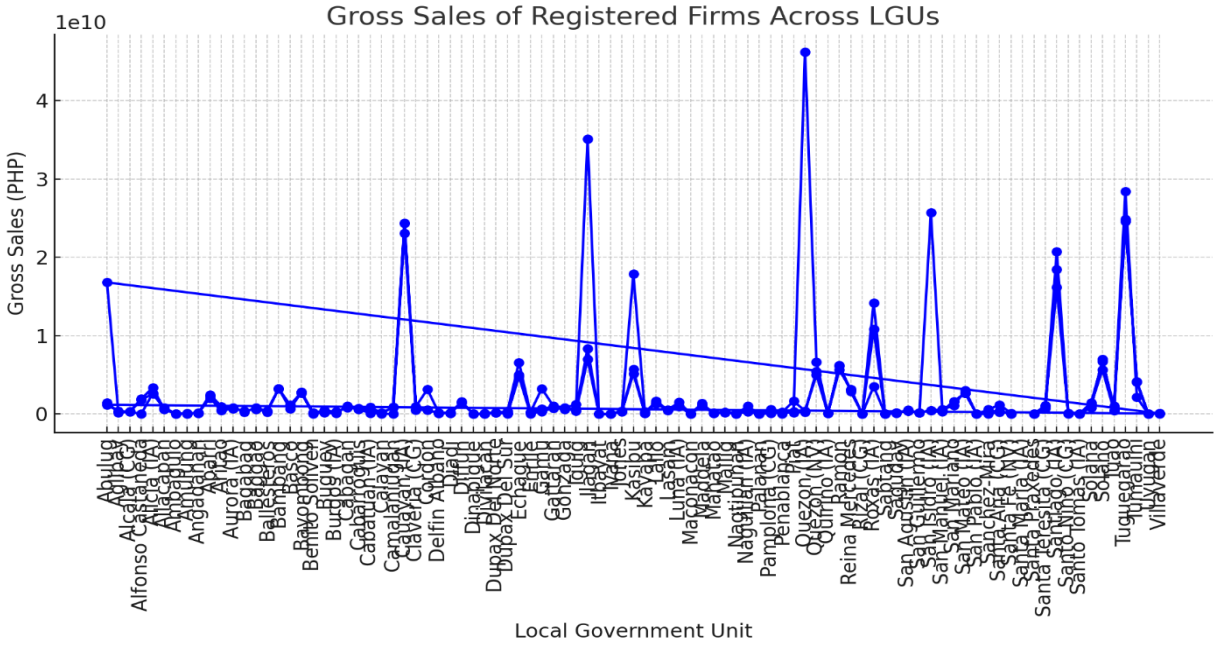
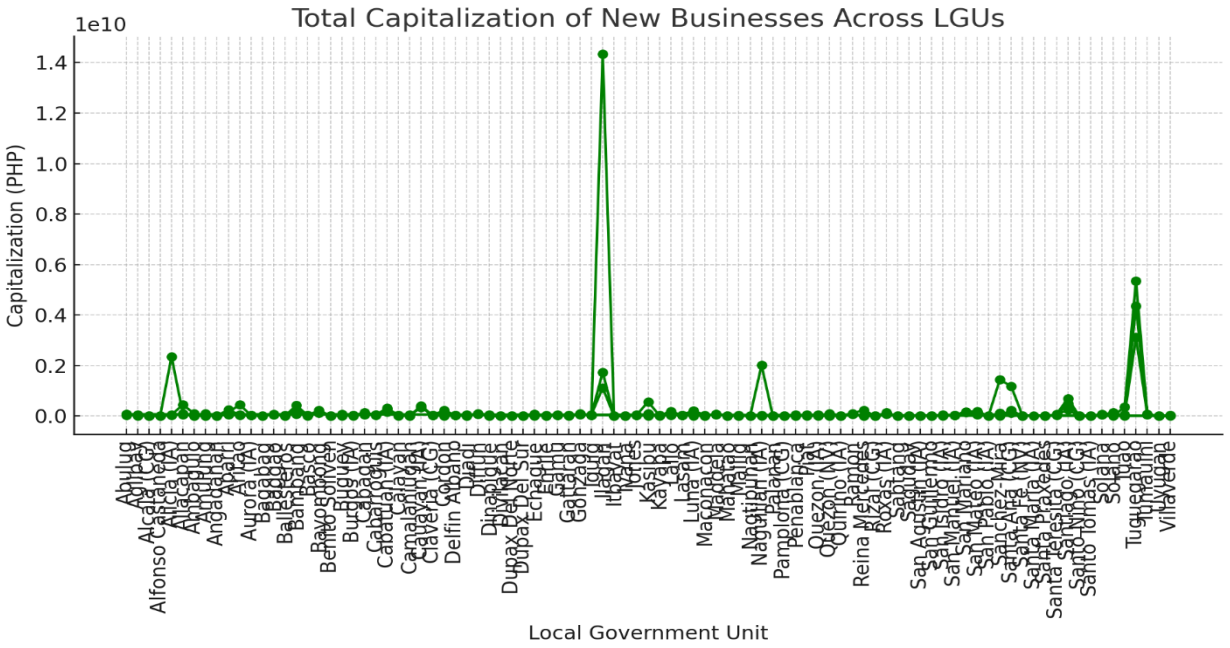
median gross sales were PHP 419.2 million, indicating that more than half of the LGUs generate less than this amount in annual sales. This underscores the economic disparities among LGUs in the region, where a few large cities or municipalities drive most of the financial activity. The range of gross sales (PHP 46.19 billion) suggests that some LGUs possess far more economic power and influence, possibly due to better infrastructure, market access, and business-friendly policies.

ii. *Capitalization of New Businesses*: The mean capitalization of new businesses was PHP 193.3 million, with a median value of PHP 26.5 million. Like gross sales, the variation in capitalization was significant, as shown by the standard deviation of PHP 999.5 million. The minimum capitalization value was PHP 112,000, while the maximum reached PHP 14.34 billion. This vast range reflects that while some LGUs successfully attracted large-scale investments, many LGUs struggled to attract significant capital. The median being far lower than the mean suggests that a small number of LGUs experienced much higher investments, while most received relatively more minor capital inflows.

D. Trend and Pattern Identification



[Fig.3: Gross Sales Trend Chart Across LGUs in Region 2]



[Fig.4: Capitalization of New Businesses Trend Chart Across LGUs in Region 2]

Figures 3 and 4 show the trend chart of gross sales and capitalisation of new businesses across LGUs, providing a visual representation of the economic disparities and concentration of wealth in a few LGUs.

i. *Economic Concentration*: The data indicates that economic activity and investments are concentrated in a few high-performing LGUs. These LGUs are likely more urbanized or have more favorable conditions for business development, such as better infrastructure, access to markets, and supportive local policies. These findings are consistent with the literature on regional economic development, where more developed regions attract disproportionate amounts of investment, leading to unequal economic growth [5].

ii. *Disparities in Business Growth*: The significant variation between the minimum and maximum values of both gross sales and business capitalization highlights the challenges faced by less developed LGUs in attracting business and investment. These LGUs may lack the necessary infrastructure, market access, or policy frameworks to foster growth, thereby contributing to regional inequalities. Research suggests that addressing these challenges requires targeted policies to improve infrastructure and local governance [10].

iii. *Potential for Growth in Underdeveloped LGUs:* The presence of relatively low gross sales and capitalization values in many LGUs also indicates untapped potential. With the right investments in infrastructure, policies promoting ease of doing business, and access to financing, these LGUs could potentially increase their economic output over time. Studies have shown that improving business environments in lagging regions can significantly boost economic growth [6].

iv. *Policy Interventions*: The significant economic disparities among LGUs suggest the need for targeted interventions to support underdeveloped LGUs. Policies aimed at improving infrastructure, reducing barriers to entry for businesses, and enhancing the business climate could help promote more equitable growth across the region.

v. *Investment Strategies*: Local governments that have successfully attracted significant capital can serve as models for other local governments. Sharing best practices in terms of policies and infrastructure investments could help spread economic growth more evenly across the region.

vi. *Future Economic Growth*: The potential for economic growth in underdeveloped LGUs is significant. With strategic investments and policy support, these LGUs could increase their contribution to the regional economy, leading to more balanced development.

E. Correlation Between Sustainability Practices and Economic Performance

To address the third research objective, the relationship between environmental sustainability practices, measured through utility costs, and economic performance, measured by gross sales and capitalization of new businesses, was analyzed using Pearson correlation analysis.

Table II. Pearson Correlation Between Environmental Sustainability Practices and Economic Performance

		1.1. Gross Sales of Registered Firms	1.2. Total Capitalization of NEW Businesses	7.1.1. Cost of Electricity Commercial Users	7.1.2. Cost of Electricity Industrial Firms/Customers	7.2.1. Cost of Water Commercial Users	7.2.2. Cost of Water Industrial Firms/Customers
1.1. Gross Sales of Registered Firms	Pearson Correlation	1.00	0.53**	0.08	0.20	0.03	0.14
	Sig. (2-tailed)		.000	.444	.066	.776	.226
	N	275	274	88	85	80	73
1.2. Total Capitalization of NEW Businesses	Pearson Correlation	0.53**	1.00	0.29**	0.34**	0.01	0.04
	Sig. (2-tailed)	.000		.007	.002	.903	.721
	N	274	275	87	84	79	72
7.1.1. Cost of Electricity Commercial Users	Pearson Correlation	0.08	0.29**	1.00	0.63**	0.07	-0.08
	Sig. (2-tailed)	.444	.007		.000	.516	.510
	N	88	87	90	86	81	73
7.1.2. Cost of Electricity Industrial Firms/Customers	Pearson Correlation	0.20	0.34**	0.63**	1.00	0.03	0.04
	Sig. (2-tailed)	0.07	0.00	0.00		0.83	0.72
	N	85	84	86	87	77	74
7.2.1. Cost of Water Commercial Users	Pearson Correlation	0.03	0.01	0.07	0.03	1.00	0.87**
	Sig. (2-tailed)	.776	.903	.516	.826		.000
	N	80	79	81	77	82	73
7.2.2. Cost of Water Industrial Firms/Customers	Pearson Correlation	0.14	0.04	-0.08	0.04	0.87**	1.00
	Sig. (2-tailed)	.226	.721	.510	.718	.000	
	N	73	72	73	74	73	75

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation between gross sales and electricity costs for commercial users was weakly positive, with a correlation coefficient of 0.08. The relationship with industrial electricity costs was slightly stronger, with a coefficient of 0.20. These findings suggest that higher energy costs, particularly for industrial users, are moderately correlated with improved economic performance in terms of gross sales. This result aligns with research suggesting that energy-intensive industries contribute significantly to regional economic output [7]. Industrial regions often show increased energy consumption due to the presence of manufacturing and other high-energy sectors, which in turn drive higher economic activity [8]. However, the correlation between gross sales and water costs for both commercial and industrial users was weak, with coefficients of 0.03 and 0.14, respectively. This suggests that water costs are not a significant determinant of the gross sales of registered firms in these LGUs, a conclusion that is consistent with findings showing that energy costs tend to have a more direct impact on industrial activity than water costs [5].

In terms of the total capitalization of new businesses, the correlation with electricity costs
For commercial users, the coefficient was moderate, at

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0.29, and the relationship with industrial electricity costs was stronger, at 0.34. This indicates that LGUs with higher electricity costs, particularly for industrial users, are more likely to attract significant new business investments. High energy consumption in these LGUs may be indicative of robust industrial and commercial activities that contribute to business growth. Studies show that regions with high energy costs can still attract investment if they offer other business-friendly conditions, such as favourable infrastructure and policy environments [6]. On the other hand, the correlation between capitalization and water costs for both commercial and industrial users was weak, with coefficients of 0.01 and 0.04, respectively. This suggests that water costs are less important in determining new business investments compared to electricity costs, which are more critical for energy-dependent industries [10].

The findings suggest that electricity costs, particularly for industrial users, have a stronger correlation with economic performance compared to water costs. This is likely because electricity is a more critical resource for manufacturing and industrial processes, which contribute significantly to economic output. The positive correlations between electricity costs and both gross sales and capitalization suggest that LGUs with higher economic activity tend to have greater energy demands, consistent with research showing that economic growth is often accompanied by increased energy consumption [7]. In contrast, the weak correlation between water costs and economic performance indicates that water pricing is not a major driver of economic growth in these LGUs. This could be because many businesses, particularly those in non-industrial sectors, are less dependent on water resources, or because water is relatively abundant in the region and does not constrain economic activity. Research on the role of natural resource costs in economic growth has similarly found that water costs often have a less direct impact on regional competitiveness compared to energy costs [9].

Although the correlations reveal some positive relationships, the strength of these correlations is generally weak to moderate. This suggests that while electricity costs may influence economic performance, other factors, such as infrastructure, market access, governance, and policy, likely play a larger role in driving economic outcomes. As Rodríguez-Pose [5] suggests that addressing regional economic disparities requires a multifaceted approach, where energy management is just one of many components that contribute to growth.

The results suggest that LGUs with higher energy demands, particularly in industrial sectors, tend to experience better economic performance. As such, energy management should be a key focus for LGUs looking to support sustainable growth. LGUs could benefit from investing in energy-efficient technologies and infrastructure to balance economic development with environmental sustainability (Wang et al., 2020). While water costs showed weaker correlations with financial performance, LGUs should not neglect sustainable water management. Ensuring the long-term availability of water resources is crucial for industries that are dependent on water, such as agriculture and food processing. According to Aeschbach-Hertig and Gleeson [9], managing water resources sustainably can help prevent future supply constraints that might hinder economic growth. The moderate relationship between electricity costs and business capitalization underscores the importance of policy and infrastructure investments in attracting new businesses. While energy costs are essential, LGUs should also focus on improving their overall business environments, as research shows that regions with better infrastructure and governance attract higher levels of investment [10].

F. Best Practices in Environmental Sustainability that are Associated with Positive Economic Outcomes in the Region

Identifying best practices in environmental sustainability that correlate with positive economic outcomes requires analysing how different LGUs in the Cagayan Valley Region manage their energy and water resources, and their financial performance. The data suggests that LGUs with higher gross sales and greater business capitalization often experience higher utility costs, particularly for electricity, which indicates a higher demand for energy resources. Therefore, one of the most effective practices these LGUs can implement is to focus on energy efficiency and sustainable energy management.

LGUs with strong economic performance, such as Tuguegarao and Cauayan, show a correlation between high energy costs and robust industrial and commercial activities. However, rather than simply absorbing the costs of increased energy demand, these LGUs should invest in renewable energy sources and technologies that reduce energy consumption per unit of output. Studies suggest that regions that prioritize energy efficiency and develop renewable energy infrastructures, such as solar or wind power, can lower operational costs over time and attract more sustainable business investments [7]. This shift to renewable energy also helps mitigate the environmental impact of economic growth, reducing carbon emissions and contributing to national and regional climate goals.

Another best practice identified in the data relates to infrastructure development. LGUs that demonstrate strong economic growth tend to have better-developed infrastructure, particularly in energy and water resource management. For example, these LGUs are likely to have reliable power grids, modern water distribution systems, and policies in place that encourage the sustainable use of these resources. Research shows that infrastructure investment is a critical factor in attracting new businesses, as businesses depend on reliable access to resources such as electricity and water for their operations [10]. To improve economic outcomes, other LGUs in the region could adopt similar infrastructure development strategies to support both sustainability and economic growth.

The role of public policy is also critical in aligning sustainability practices with economic growth. Local governments that implement policies encouraging sustainable business practices, such as offering incentives for companies that adopt green technologies or providing subsidies for energy-efficient upgrades, are more likely to reap long-term economic benefits. For instance, some local governments may benefit from implementing policies that promote the installation of

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energy-efficient lighting, HVAC systems, and industrial machinery, all of which can reduce energy consumption while maintaining or even boosting productivity. Policies that streamline regulatory processes for businesses investing in green infrastructure can also attract more companies to adopt sustainable practices [5].

Water resource management is another area where best practices can drive both sustainability and economic growth. Although the correlation between water costs and financial performance is weaker than that of electricity, LGUs that ensure efficient and sustainable water management stand to benefit in the long term. Industries that rely heavily on water, such as agriculture and food processing, may face significant challenges if water resources are not adequately managed. Aeschbach-Hertig and Gleeson [9] argue that sustainable water management is crucial for regions that want to ensure the long-term availability of water resources, particularly in the face of climate change and increasing demand. Best practices in this area include investing in technologies that reduce water waste, implementing water recycling programs, and upgrading infrastructure to minimize water loss through leaks and inefficient distribution systems.

The integration of sustainability practices into economic planning is another best practice. LGUs that integrate environmental considerations into their economic development plans tend to create more resilient and adaptable economies. For example, by considering the environmental impact of industrial growth and ensuring that resource use remains within sustainable limits, LGUs can avoid the depletion of critical resources while still promoting economic activity. This approach aligns with the concept of "green growth," which emphasizes the importance of balancing economic growth with environmental sustainability [6]. Local governments that adopt this holistic approach to planning are better positioned to attract investments from businesses that prioritise sustainability, particularly as global markets increasingly value environmental responsibility.

The best practices in environmental sustainability that are associated with positive economic outcomes in the Cagayan Valley Region include investments in energy efficiency and renewable energy, infrastructure development, supportive public policies, sustainable water resource management, and the integration of environmental sustainability into economic planning. Local governments that implement these practices are more likely to experience long-term economic growth while minimising their environmental impact, thereby contributing to the region's overall sustainability and financial resilience.

G. Proposed Policy Recommendations Aimed at Enhancing Both Environmental and Economic Performance in LGUs

Based on the analysis of environmental sustainability practices and economic performance among local government units (LGUs) in the Cagayan Valley Region, several key policy recommendations can be made. These recommendations aim to enhance both environmental and economic outcomes in the region, focusing on striking a balance between economic growth and sustainability to ensure long-term prosperity and resource resilience.

One of the primary areas that the policy should target is energy efficiency and the adoption of renewable energy. The correlation analysis shows that LGUs with higher electricity costs, particularly for industrial users, also tend to have better economic outcomes. This indicates that energy-intensive industries play a key role in driving economic growth. However, relying solely on high energy consumption to fuel growth is unsustainable in the long run, particularly given the global shift toward more sustainable business practices. To mitigate this, LGUs should implement policies that incentivize businesses to adopt energy-efficient technologies. For example, tax credits or subsidies could be offered to companies that install energy-efficient lighting, heating, ventilation, and air conditioning systems, or upgrade their machinery to reduce energy consumption. Research has shown that improving energy efficiency can lead to substantial cost savings while also reducing environmental impact, making it a win-win strategy for both businesses and governments [7].

In addition to promoting energy efficiency, LGUs should also focus on expanding the use of renewable energy sources. While the current reliance on conventional electricity generation supports economic activity, transitioning to renewable energy such as solar, wind, or hydropower can further strengthen LGUs' energy security and reduce their environmental footprint. Policies that encourage investment in renewable energy infrastructure, such as solar panels on industrial buildings or small-scale wind farms, can help LGUs meet their energy needs sustainably. This transition is critical, especially as many global industries are increasingly demanding sustainable energy sources to meet their environmental goals [8]. LGUs that invest in renewable energy will not only reduce their greenhouse gas emissions but also position themselves as attractive locations for environmentally conscious businesses.

Infrastructure investment is another key area where policy interventions can support both environmental sustainability and economic growth. The data suggests that LGUs with better-developed infrastructure, particularly in energy and water resource management, are more successful in attracting businesses and driving economic growth. Therefore, LGUs should prioritize investments in modernizing their infrastructure, including upgrading energy grids and water distribution systems. These upgrades not only improve efficiency but also ensure reliable access to resources, which is crucial for businesses. For example, infrastructure improvements that reduce energy losses or prevent water leakage can lead to more efficient resource use, thereby lowering operational costs for both the government and businesses. Studies show that regions with better infrastructure are more competitive and can attract higher levels of investment [10].

Another critical policy recommendation is the implementation of sustainable water management practices. Although water costs were found to have a weaker correlation with economic performance compared to electricity, the long-term sustainability of water resources remains critical, particularly for industries that rely heavily on water, such as agriculture and manufacturing. LGUs should invest in technologies that improve water efficiency and reduce waste. This could include

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the installation of smart water meters that enable real-time monitoring of water usage, the development of water recycling systems in industrial areas, and the upgrading of water infrastructure to minimise leaks and losses. Policies that encourage businesses to adopt water-saving practices can also be effective in reducing overall water consumption. According to Aeschbach-Hertig and Gleeson [9], sustainable water management is crucial for ensuring that industries have reliable access to water resources, particularly in regions where water scarcity may become a challenge due to climate change.

LGUs should also implement policies that support green business practices and promote a circular economy. A circular economy focuses on reducing waste and reusing materials to create a more sustainable economic model. LGUs can incentivize businesses to reduce their environmental impact by providing grants or tax incentives for companies that adopt eco-friendly practices such as waste reduction, recycling, and sustainable sourcing of materials. These policies can be particularly effective in attracting industries that prioritise sustainability, helping local governments establish themselves as leaders in the green economy. Rodríguez-Pose [5] suggests that regions that implement forward-looking environmental policies often experience long-term economic benefits, as businesses increasingly seek to align with global environmental standards.

Lastly, LGUs should prioritise capacity building and public awareness initiatives that promote sustainability among both businesses and citizens. Policies that encourage the public to adopt more sustainable behaviours, such as reducing energy consumption, recycling, and using water efficiently, can complement the broader goals of enhancing sustainability at the local level. LGUs can run public campaigns to raise awareness about energy and water conservation, offer workshops to educate businesses on sustainable practices, and establish partnerships with educational institutions to foster a culture of environmental stewardship. Building the capacity of local government officials and staff to implement and manage sustainability policies is also essential. Studies show that well-trained government personnel are key to the successful implementation of sustainability programs [6].

The key policy recommendations for LGUs in the Cagayan Valley Region include promoting energy efficiency and renewable energy adoption, investing in infrastructure, implementing sustainable water management practices, supporting green business practices, and building capacity for sustainability. By adopting these policies, LGUs can enhance both their environmental and economic performance, ensuring long-term prosperity while minimizing their environmental impact.

IV. CONCLUSION

This study explored the relationship between environmental sustainability practices and economic performance among local government units (LGUs) in the Cagayan Valley Region from 2020 to 2022. The results indicated that electricity costs, particularly for industrial users, had a moderate positive correlation with both gross sales and capitalization of new businesses, suggesting that LGUs with higher economic activity tend to have greater energy demands. In contrast, the correlation between water costs and financial performance was weak, indicating that water pricing does not significantly affect economic outcomes in most LGUs.

While the relationship between sustainability practices and economic performance was established, the results suggest that electricity costs alone do not fully explain the economic disparities among LGUs. Other factors, such as infrastructure quality, governance, market access, and policy environment, likely play a larger role in shaping economic growth. The study also identified best practices in environmental sustainability, such as energy efficiency and infrastructure development, that are associated with positive financial outcomes. These practices provide valuable insights for LGUs looking to balance economic growth with sustainability.

The study contributes to the literature by highlighting the significance of resource management, particularly energy, in driving regional economic growth. It also underscores the importance of adopting a holistic approach to sustainability that considers the environmental, financial, and social dimensions of development. Future research should investigate the impact of other sustainability factors, such as waste management and carbon emissions, on economic performance.

RECOMMENDATIONS

Based on the findings, several recommendations can be made to enhance both environmental and economic performance in LGUs:

1. LGUs should prioritize energy efficiency measures, particularly in industrial sectors, to reduce operational costs and minimize environmental impacts. Policies that incentivise businesses to adopt energy-efficient technologies, such as renewable energy sources, energy-efficient lighting, and energy-saving machinery, will help improve sustainability while supporting economic growth.
2. The study revealed that LGUs with higher energy consumption tend to have better economic outcomes. To sustain this growth while reducing environmental impact, LGUs should invest in renewable energy infrastructure, such as solar or wind power. This will not only reduce dependence on non-renewable energy sources but also position LGUs as attractive locations for environmentally conscious businesses.
3. Although water costs were not strongly correlated with economic performance, LGUs should still adopt sustainable water management practices to ensure long-term water availability. Investing in water-saving technologies, reducing waste, and upgrading water infrastructure will help LGUs support industries that rely heavily on water, such as agriculture and manufacturing.
4. Infrastructure plays a key role in both sustainability and economic growth. LGUs should continue to invest in modernizing their energy and water distribution systems to improve efficiency and reliability. Infrastructure upgrades can reduce resource waste and lower

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operational costs for businesses, making LGUs more competitive in attracting investments.

5. LGUs should create an enabling environment for green businesses by offering incentives for companies that adopt sustainable practices such as recycling, waste reduction, and renewable energy adoption. Supporting a circular economy model can help LGUs reduce environmental degradation while fostering economic innovation and growth.

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