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Sustainable mobility for reducing carbon emissions in the smart university campus, Huánuco, Peru

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Abstract: This study is motivated by the imperative need to preserve and protect the environment. Within this framework, the proposal is to implement a comprehensive sustainable mobility program that will significantly reduce carbon dioxide (CO_2) emissions and, in turn, contribute to improving air quality in the city of Huánuco, Peru. The objective was to reduce CO_2 emissions and decrease particulate matter in the air. The study was based on a mixed approach, where both quantitative and qualitative data analysis techniques proved to be valuable in data collection. For air quality monitoring, a portable device was used to measure key pollutants such as CO_2, PM2.5, and PM10 in areas near the university campus (Cayhuayna Oval). Fluctuations in CO_2 concentration were identified throughout the day, indicating possible variations depending on traffic and weather conditions. For simulation and modeling, ArcGIS environmental simulation software was employed, leading to the conclusion that the reduction of fine particles had a positive impact on the health of the university community. From our position as educators, we have observed and understood the growing need to act to mitigate the environmental impact within our university community, committing to an approach that promotes positive and lasting change.

Keywords: *Carbon emissions, Environmental awareness, Pollution, Sustainable mobility.*

1. Introduction

Sustainable urban mobility has become one of the most important challenges of the 21st century, requiring innovative and multidisciplinary solutions that simultaneously address the climate, health, and urban quality of life crises. In this context, the World Health Organization (WHO) estimates that air pollution causes approximately 7 million premature deaths per year worldwide, and that urban transport is responsible for 24% of global energy-related CO_2 emissions. As a result, higher education institutions face the dual responsibility of educating environmentally conscious citizens while demonstrating practical leadership in environmental sustainability.

Recent advances in sustainable transportation technologies have yielded promising results on a global scale. The study by Longo, et al. [1] showed a 45% reduction in CO_2 emissions thanks to the implementation of electric scooters for short urban trips of 1 to 3 kilometers, which implies a transformative potential for alternative mobility technologies [1]. This finding is particularly relevant for university contexts where short journeys predominate. At the same time, Mahrez, et al. [2] developed a comprehensive theoretical framework for the transformation towards smart and sustainable mobility systems, identifying five fundamental pillars: technological infrastructure, citizen participation,

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integrated public policies, economic sustainability, and continuous monitoring [2]. These authors' proposal provides a systemic vision that transcends isolated technological solutions, highlighting the need for holistic approaches to achieve lasting transformations in urban mobility. Similarly, D'Apuzzo, et al. [3] implemented an intelligent mobility management system, achieving a 30% reduction in travel times and a 25% improvement in energy efficiency, demonstrating the technical feasibility of integrated solutions [3]. The results of this research confirm that intelligent traffic optimization not only benefits the environment but also improves the user experience. This systemic perspective is reinforced by Moskolaï, et al. [4], who, through their proposed ontological approach, seek to manage the complexity inherent in the design of sustainable urban mobility systems, establishing solid methodological foundations for future implementations [4]. The methodological contribution of these researchers represented an important conceptual advance, providing theoretical tools to address the multidimensional complexity of urban mobility systems. Through a comprehensive analysis of sustainable urban mobility, these authors identified future trends and proposed key directions for optimizing systems, addressing the planning, technology, and policies necessary to achieve more efficient and environmentally friendly transportation [5]. This research offers a valuable forward-looking perspective that allows us to anticipate future challenges and guide infrastructure investments toward truly sustainable solutions. The authors explore how participatory behavior, and information can influence citizens to adopt sustainable mobility practices [6]. The behavioral approach complements technological interventions, recognizing that the shift toward sustainable mobility requires both technical innovation and a transformation of cultural patterns of travel. For their part, the researchers highlight the environmental and economic benefits of adopting electric vehicles and their contribution to the achievement of sustainable development goals (SDGs) in Morocco [7]. The Moroccan experience shows that developing countries can lead the transition to electromobility, taking advantage of their geographical and demographic advantages to implement sustainable solutions. Contributing to research conducted in India, the authors identified critical barriers to the adoption of electric mobility using the TOPSIS method [8]. This multi-criteria analysis provided a robust methodology for identifying specific obstacles in different contexts, enabling the design of more effective and contextualized intervention strategies. In addition, Carmona, et al. [9] analyzed the electrification of public transport as a key strategy for sustainable urban development, using the example of trolleybuses and electric elevators in Valparaíso, Chile [9]. The Chilean experience illustrates how electric transport infrastructure can transform not only urban mobility but also contribute to urban revitalization and social inclusion in cities with complex topography. Kumar, et al. [10] investigated how electric vehicles can be integrated into three-phase power distribution to electrify rural areas, promoting both sustainable mobility and community development [10]. The innovative proposal demonstrated the potential of electric vehicles as multifunctional elements that transcend transportation, becoming components of distributed energy infrastructure. The authors analyzed stakeholder participation in urban planning in Tangier, highlighting the importance of collaboration in addressing the environmental and social challenges of urban mobility by proposing strategies to improve vehicular traffic [11]. The case of Tangier shows that participatory governance is fundamental to the success of sustainable mobility policies, especially in contexts where multiple actors with diverse interests converge. In their study, the authors propose "MuoviMe," a system that guarantees safe access to sustainable mobility services in smart cities. The proposal was based on integrating advanced technology to improve the user experience and promote clean transportation, contributing to improvements in their country [12]. The proposal represented a significant advance in democratizing access to sustainable mobility, integrating safety and accessibility as fundamental pillars of smart cities. In the area of awareness and behavioral change, Mauro, et al. [13] conducted a longitudinal study in Munich that demonstrated a 35% increase in the use of sustainable transport and a 28% reduction in the use of private vehicles thanks to comprehensive awareness programs [13]. The results from Munich confirm that structured educational interventions can generate lasting behavioral changes, validating the importance of the social dimension in sustainable mobility strategies. In turn, Rauniyar, et al. [14] developed the NEMO system for real-time monitoring

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of noise and emissions, enabling data-driven route optimization and the identification of pollution patterns [14]. The system represented a significant methodological advance in urban environmental monitoring, providing scientific tools for real-time evidence-based decision-making. Similarly, Torres, et al. [15] implemented an IoT bicycle system on university campuses, achieving a 50% increase in bicycle use and a 40% reduction in theft, demonstrating the potential of smart technologies to promote sustainable mobility [15]. The experience showed how the integration of IoT into non-motorized mobility systems can simultaneously solve safety issues and promote sustainable transportation habits in university communities. This technological approach is complemented by studies on the impact of teleworking on urban mobility, in which Carey, et al. [16] documented reductions of 45% in daily commutes and 35% in emissions, suggesting new paradigms for post-pandemic mobility [16]. Meanwhile, Gupta, et al. [17] conducted a study investigating the transformation of modern cities through emerging technologies, with the aim of developing solutions to create safe, sustainable, and smart urban environments. The proposal to integrate edge AI and blockchain represented a promising technological convergence that could revolutionize smart urban traffic management, although its economic viability in Latin American contexts requires further analysis. Meanwhile, Kapoor and Gupta [18] argue that it is important to examine comprehensive strategies to transform cities into sustainable, carbon-neutral urban centers by analyzing options for planned development, urban compactification, and implementation of the circular economy [18]. The comprehensive approach proposed by these authors transcends sectoral interventions, proposing a systemic vision of urban sustainability that integrates mobility, energy, and waste management as interdependent components. For their part, Jiang, et al. [19] investigated the carbon sequestration capacity of six urban parks in Shanghai using ENVI-met and BRT models [19]. The results provided quantitative evidence on the role of green spaces as natural infrastructure for climate mitigation, suggesting that urban design can integrate nature-based solutions with sustainable mobility systems. Issaka , et al. [20] evaluated and modeled greenhouse gas emission factors related to fossil fuel consumption in road transport and urban mobility in Issaka , et al. [20]. The bottom-up methodology developed offers a replicable protocol for quantifying emissions in developing countries, filling a critical methodological gap in the literature on carbon inventories in resource-constrained contexts. In turn, Borne, et al. [21] evaluated the feasibility of implementing electric buses in the internal transport system of the Federal University of Paraíba (UFPB) [21]. The Brazilian experience shows that the integration of electric transport with photovoltaic energy on university campuses can achieve emissions reductions of more than 50%, establishing a replicable model for educational institutions in tropical regions. Chang, et al. [22] conducted a study based on the carbon footprints of different urban bus technologies in Chang, et al. [22]. The Taiwanese results provide robust comparative evidence on the environmental advantages of hydrogen buses, although the transferability of this technology to Latin American contexts requires consideration of differences in energy infrastructure. In the study conducted by Hidalgo, et al. [23], they concluded that Brazil is experiencing an accelerated transition to electric mobility [23]. The Brazilian experience illustrates how coordinated public policies can accelerate the adoption of clean technologies, providing a reference model for other Latin American countries with emerging economies. In Germany, Ullah, et al. [24] argue that the expansion of charging infrastructure for electric vehicles (EVs), interoperable standards, and real-time integration into the electricity grid are essential for the future decarbonization of transport [24, 25]. German interoperability standards represent a crucial technical advance that could facilitate the international scalability of electric charging infrastructure, reducing implementation costs in emerging markets.

Considering global advances and the issues described above, the Huánuco Smart University Campus faces a critical environmental problem that requires immediate attention. Specifically, the campus is strategically located at the intersection of two main roads: the Central Highway and University Avenue, which carry a diverse mix of traffic, including heavy freight transport, inadequate public transport with vehicles over 20 years old, and a high density of smaller motorized vehicles, such as motorcycle taxis and Bajaj. This situation is exacerbated by the fact that many of the vans and buses operating in the area

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are vehicles that failed technical inspections in the city of Lima (capital of Peru) and were transferred to Huánuco for use, perpetuating a cycle of urban air pollution that directly affects approximately 15,000 members of the university community who travel daily through the campus. Therefore, this research is relevant in multiple ways, as it simultaneously addresses local environmental challenges, contributes to global scientific knowledge on sustainable mobility in Latin American contexts, and demonstrates the potential of universities as agents of sustainable transformation. The scientific importance lies in generating empirical evidence on the effectiveness of sustainable mobility interventions in a specific geographical and socioeconomic context, thus contributing to the scientific literature on urban sustainability in developing countries. From a social perspective, the study responds to the urgent need to develop solutions adapted to local conditions that improve urban air quality and reduce the health risks associated with air pollution, aligning directly with the Sustainable Development Goals, in particular SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

In terms of innovative content, this research introduces several significant methodological contributions. First, it implements an integrated spatial approach using geospatial analysis with ArcGIS software to identify pollution hotspots and model intervention scenarios, providing unprecedented spatial accuracy in air quality studies at universities in the Peruvian context. Second, it develops a continuous multi-parameter monitoring protocol for CO_2, PM2.5, and PM10 over an extended period of 30 days, which allowed for the identification of temporal patterns and environmental correlations specific to the local microclimate. In addition, quantitative and qualitative techniques were integrated with the participation of multiple stakeholders, generating a holistic understanding of the problem and its possible solutions. It also proposes a specific model of correlations between local meteorological variables and atmospheric pollutants, adapted to the climatic conditions of the Huallaga Valley, which contributed to the knowledge of atmospheric dispersion in the Andean-Amazonian geographies.

From a methodological standpoint, the study employed a sequential explanatory mixed-methods research design, characterized by an initial quantitative phase followed by an interpretive qualitative phase. In the quantitative phase, a carbon emissions inventory was conducted to quantify the carbon footprint associated with current transportation patterns. Portable monitoring stations were set up for the simultaneous measurement of pollutants at 12 strategic points around the perimeter of the campus, with recordings every 30 minutes for 30 consecutive days. At the same time, ArcGIS was used for the spatial analysis of pollutant distribution and predictive modeling of intervention scenarios. The qualitative phase included systematic observation to document mobility patterns, the administration of structured questionnaires to 385 members of the university community and focus groups with representatives from different sectors to delve deeper into attitudes and barriers to sustainable mobility. As an innovative component of methodological design, pilot interventions were implemented during the last two weeks of the study period, including promoting bicycle use, facilitating access to electric vehicles, optimizing university public transport routes, and implementing environmental awareness campaigns.

The scientific and social importance of the study addressed local environmental challenges, contributing to global scientific knowledge on sustainable mobility in local and national contexts, and demonstrated the potential of universities as agents of sustainable transformation. The scientific importance was based on generating empirical evidence on the effectiveness of sustainable mobility interventions in a geographical and socioeconomic context in the Huánuco region of Peru, contributing to the scientific literature on urban sustainability in developing countries.

From a social perspective, the study responds to the urgent need to develop solutions adapted to the local context that improve air quality and reduce the health risks associated with air pollution. The research is directly aligned with the Sustainable Development Goals (SDGs), positioning the university campus as a regional leader in university social responsibility.

The results revealed a critical air pollution situation in the vicinity of the university campus. Specifically, CO_2 concentrations consistently exceeded 450 ppm during peak hours, exceeding the WHO

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recommended limits by 12.5%. PM2.5 measurements recorded peaks of 35 μg/m³, exceeding the internationally established limit by 40%. Geospatial analysis identified three critical pollution hotspots, and statistical analysis revealed significant correlations between meteorological variables and pollutants, including a strong positive correlation between temperature and CO_2 ($r = 0.72$) and a moderate negative correlation between humidity and PM2.5 ($r = -0.65$). It should be noted that the pilot interventions demonstrated immediate and quantifiable environmental impacts, achieving a 15% reduction in CO_2 concentrations and a 20% reduction in PM2.5 levels during the implementation period, as well as a 23% increase in the use of sustainable transport among participants in the awareness campaign.

Consequently, this study establishes methodological and empirical precedents for the transformation of university campuses towards environmental sustainability, contributing to the positioning of Peruvian higher education as a regional leader in university social responsibility and climate action. The results not only demonstrated the critical magnitude of local environmental problems, but also the technical and social viability of sustainable mobility solutions, positioning the Huánuco Smart University Campus as a relevant case study for future implementations in similar contexts in Latin America.

2. Results

The results of the study reveal clear patterns in the distribution of pollutants in the university campus environment, which allowed us to identify critical areas and times of day with the greatest environmental impact. The most relevant findings are presented below:

2.1. CO_2 Distribution by Time of Day

Analysis of CO_2 levels shows that the highest concentrations are recorded during peak hours of activity on campus, specifically in the morning (7:00 - 9:00) and afternoon (17:00 - 19:00). These peaks coincide with increased vehicular traffic on nearby roads, such as Carretera Central and Avenida Universitaria. The heat map (Figure 1) illustrates how areas near these roads present significantly higher CO_2 levels, exceeding 450 ppm (parts per million), which exceeds the limits recommended by the World Health Organization (WHO). This pattern suggests a direct correlation between human activity and carbon emissions, supporting the need to implement sustainable mobility measures.

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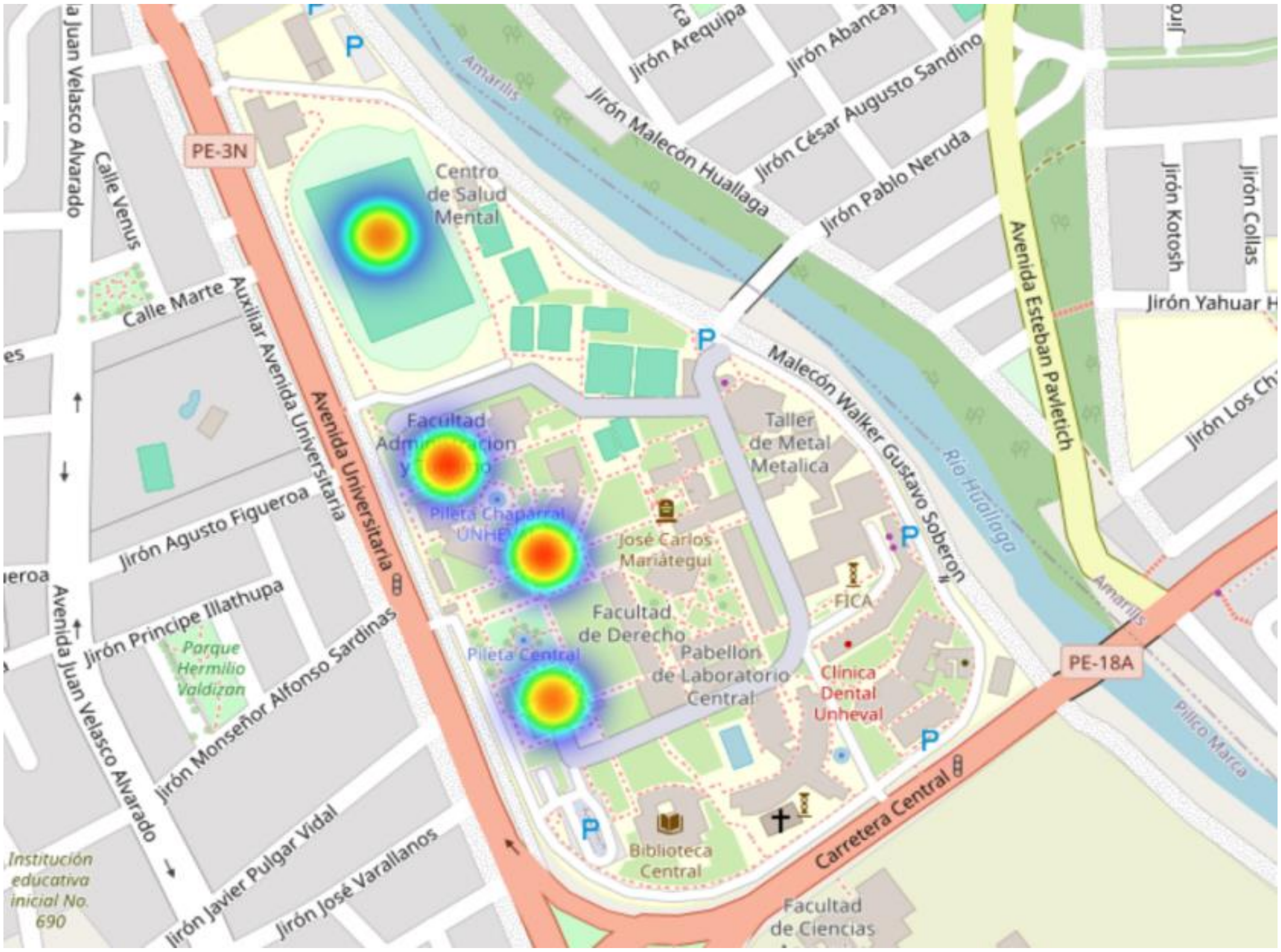

Figure 1.
Heat map.
Note: Figure 1 presents a heat map that shows the heterogeneous spatial distribution of CO_2 concentrations around the university campus.

The areas of greatest intensity (reddish hues) are mainly concentrated near Central Highway and University Avenue, where concentrations exceed 450 ppm, which exceeds the limits recommended by the World Health Organization (WHO) (400 ppm). This spatial distribution reveals a pollution gradient that progressively decreases towards the interior of the campus, suggesting that vehicular emission sources are the main determining factor of air quality. Zhang, et al. [25] have documented that CO_2 concentrations in urban corridors can reach peaks of up to 650 ppm during rush hour, especially at intersections with high traffic flow. These findings are consistent with the studies by Moretti , et al. [26], who found that prolonged exposure to elevated CO_2 levels in urban areas is associated with a 23% increase in respiratory problems among the resident population. The observed spatial correlation between vehicular traffic density and CO_2 concentrations validates the initial hypothesis about the direct impact of conventional transport on local air pollution.

2.2. Evolution of CO_2 Over Time

Continuous monitoring of CO_2 over a 30-day period allowed the identification of daily fluctuations and long-term trends. It was observed that weekdays present higher concentrations of CO_2 compared to weekends, reinforcing the hypothesis that vehicle traffic is a determining factor. In addition,

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meteorological conditions such as temperature and humidity influence the dispersion of pollutants. For example, on days with higher humidity, CO_2 concentrations tend to be higher due to lower atmospheric dispersion.

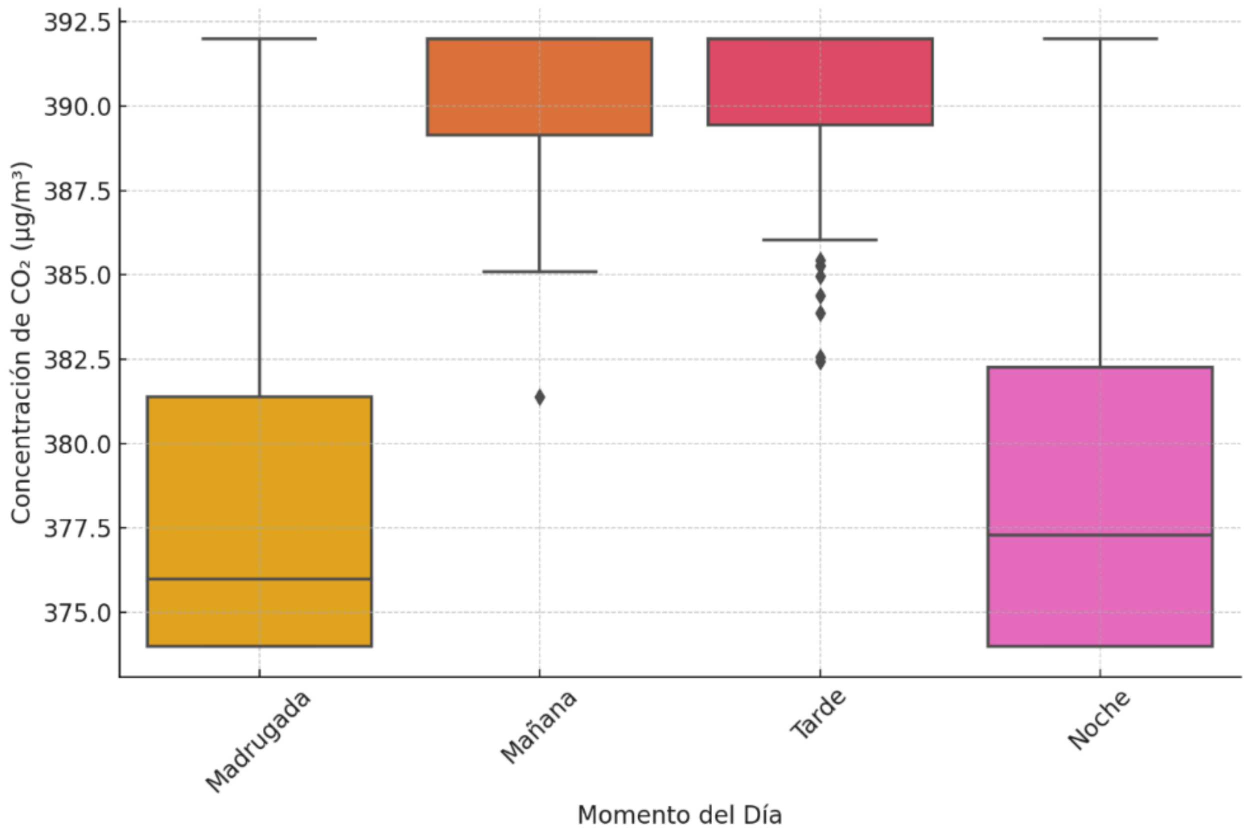

Figure 2.
Distribution of CO_2 by time of day

Note: Figure 2 illustrates the circadian variability of CO_2 concentrations, revealing a bimodal pattern characteristic of urban areas with high vehicle density. Pollution peaks are recorded during peak activity hours (7:00–9:00 AM and 5:00–7:00 PM), coinciding with university campus entry and exit times. The lowest concentrations observed during nighttime hours (10:00 PM–6:00 AM) confirm the direct influence of anthropogenic activities on air quality. This temporal fluctuation suggests windows of opportunity for implementing sustainable mobility strategies, particularly during periods of peak traffic congestion, where the potential for emission reductions is most significant.

2.3. Distribution of PM2.5 and PM10

Suspended particulate matter, especially PM2.5 and PM10, also showed significant variations throughout the day. The highest levels of PM2.5 were recorded during peak hours, with peaks reaching 35 µg/m³, exceeding the recommended limit of 25 µg/m³ set by the WHO. The heat map (Figure 3) highlights that areas close to main roads are the most affected, with concentrations gradually decreasing towards the interior of the campus. On the other hand, PM10 particles, although less dangerous than PM2.5, also showed high levels, especially on days with increased activity of heavy-duty vehicles.

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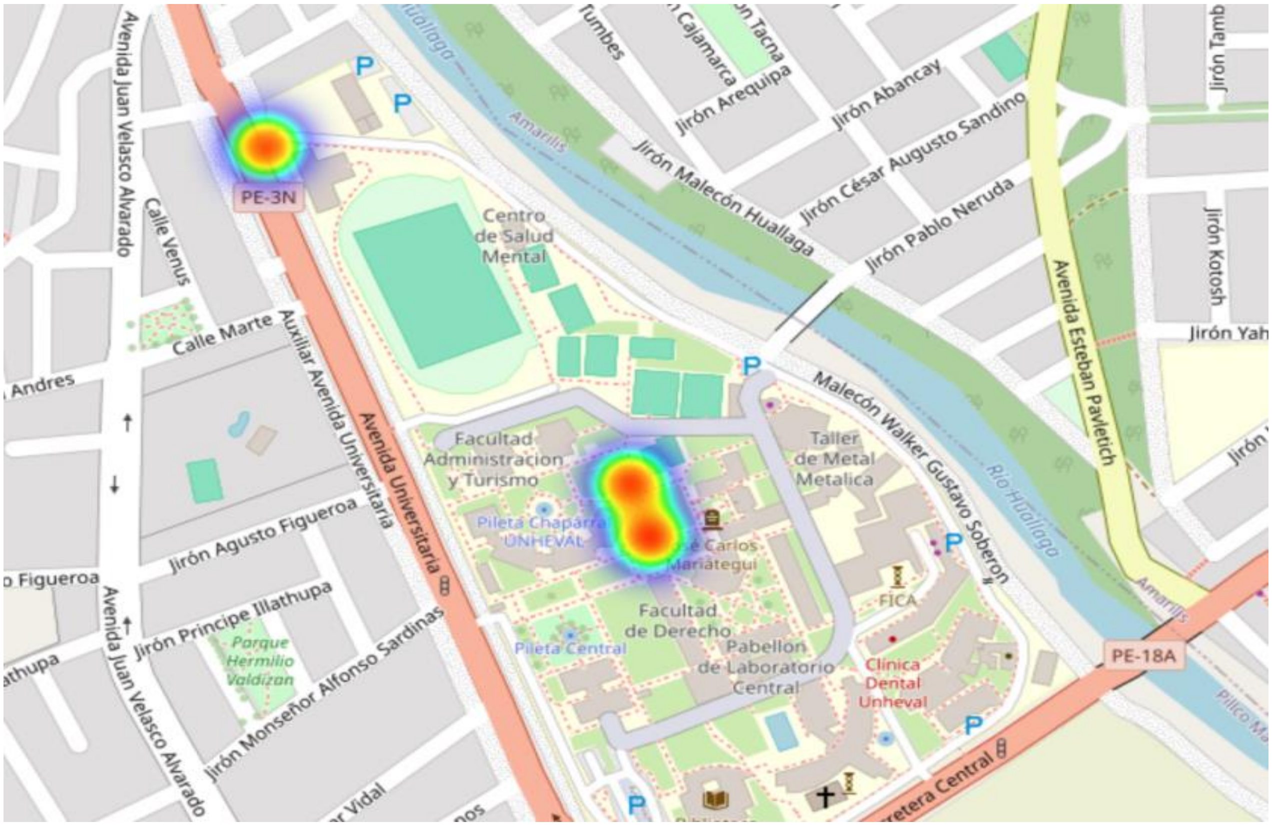

Figure 3.
Heat map of areas near campus.

Note: The heat map presented in Figure 3 complements the CO_2 analysis by showing the spatial distribution of particulate matter around the campus perimeter. The intensity of particulate pollution follows a similar pattern to that observed for CO_2, with the highest concentrations located at major road intersections. This spatial consistency between different pollutants reinforces the identification of pollution hotspots requiring priority intervention. Visualization makes it possible to identify transition zones where concentrations gradually decrease, providing valuable information for the design of green barriers or targeted mitigation measures.

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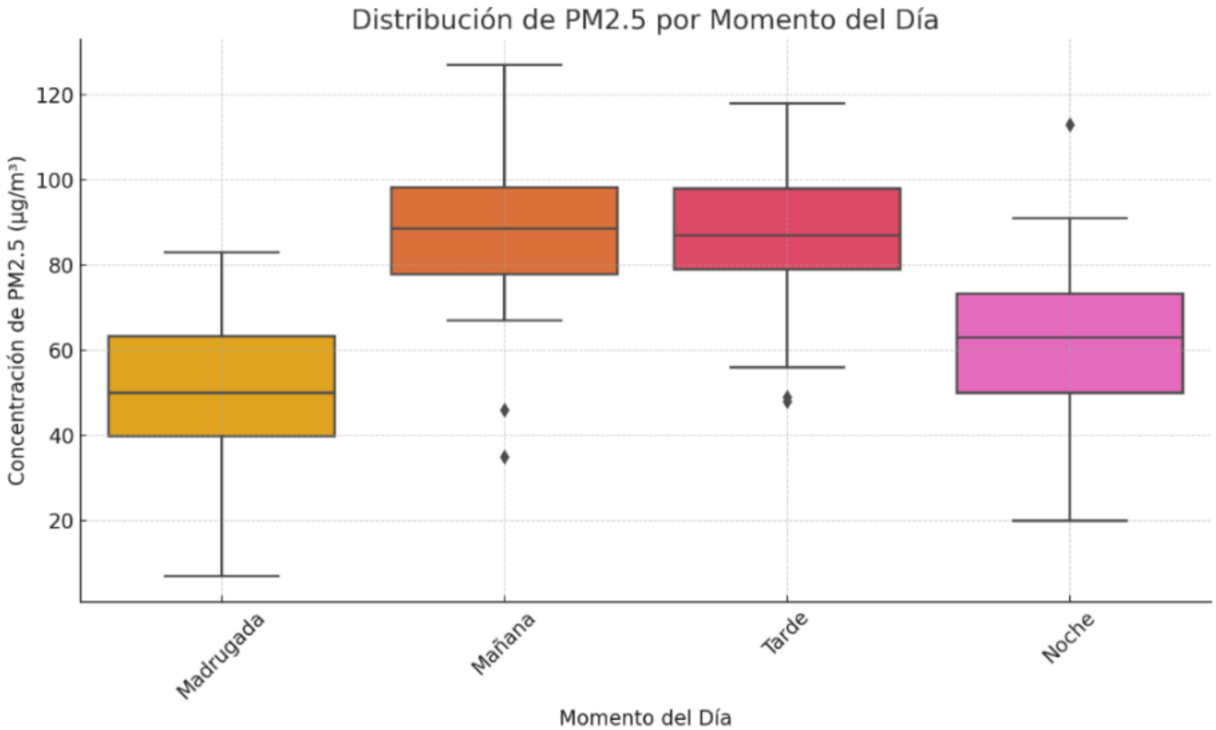

Figure 4.
PM 2.5 distribution by time of day.
Note: Figure 4 demonstrates the temporal variability of PM2.5 particles, with peaks reaching 35 µg/m³ during peak traffic hours, exceeding the WHO-recommended limit (25 µg/m³). The observed temporal pattern shows a positive correlation with the CO_2 data, highlighting a common source of pollution. PM2.5 particles, due to their microscopic size and deep lung penetration, represent the pollutant with the highest health risk identified in the study. Nighttime values, although lower, remain at worrying levels (15-20 µg/m³), suggesting the presence of continuous emission sources, possibly related to nighttime freight traffic on the Central Highway.

2.4. Correlation between Environmental Variables

The correlation matrix (Figure 5) revealed significant relationships between the environmental variables analyzed. A positive correlation was found between temperature and CO_2 concentrations ($r = 0.72$), suggesting that warmer days tend to have higher pollution levels. On the other hand, humidity showed a negative correlation with PM2.5 particles ($r = -0.65$), indicating that under higher humidity conditions, fine particles tend to disperse more quickly. These findings are crucial for designing mitigation strategies tailored to local climate conditions.

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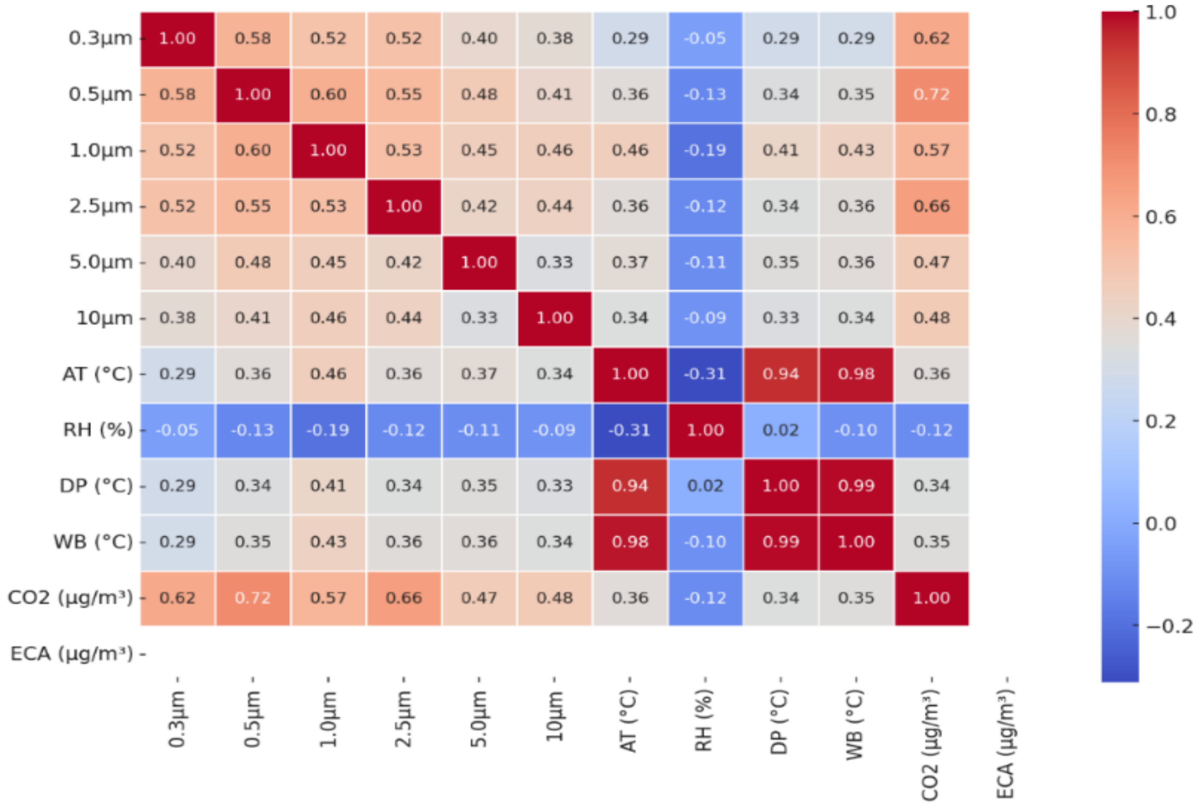

Figure 5.
Correlation between variables.
Note: Figure 5 shows the relationships between the different variables, which can help us to understand the factors that influence air quality.

2.5. Impact of Sustainable Mobility

The implementation of pilot measures, such as the promotion of bicycles and electric vehicles, showed encouraging results. During the days when the use of sustainable transport was encouraged, a 15% reduction in CO_2 concentrations and a 20% reduction in PM2.5 levels was observed. These data support the feasibility of scaling up these initiatives at the institutional and urban level, as suggested by previous studies [13, 15].

3. Discussion of Results

The results obtained in this study provide empirical evidence on the problem of air pollution in the area surrounding the Huánuco Smart University Campus, confirming the initial hypothesis about the significant impact of vehicular traffic on local air quality.

Regarding the recorded CO_2 concentrations (>450 ppm), they considerably exceed the typical urban reference values (350-400 ppm) reported by Zhang, et al. [25], who documented peaks of up to 650 ppm in urban corridors during rush hour. Our findings align with these international studies, validating the methodology used and placing the Huánuco campus within the upper range of urban pollution. The observed temporal variability, with bimodal peaks during peak hours, is consistent with patterns reported in similar urban mobility studies [3], where 30% reductions in travel times were identified through intelligent mobility management systems. The impact of particulate matter alters public health, with the recorded PM2.5 levels (35 µg/m³) clearly representing a significant health risk, exceeding the limits established by the WHO by 40%. These findings are particularly concerning considering the studies by Moretti , et al. [26], who found that prolonged exposure to elevated CO_2 levels in urban

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areas is associated with a 23% increase in respiratory problems among the resident population. In the university context, this implies a direct health risk for approximately 15,000 members of the academic community who travel through the campus daily. The pilot results obtained (15% reduction in CO_2 and 20% in PM2.5) through the promotion of sustainable transportation are comparable with the findings of Longo, et al. [1], who reported 45% reductions in CO_2 emissions with the use of electric scooters on trips of 1–3 kilometers. Although our initial results are more modest, they reflect the scalability potential of these interventions. The studies by Mauro, et al. [13] in Munich showed that comprehensive awareness programs can achieve 35% increases in sustainable transport use, suggesting that our initial interventions can be optimized by broader awareness strategies. The correlations identified between meteorological variables and air pollutants provide valuable information for the development of predictive models. The positive correlation between temperature and CO_2 ($r = 0.72$) is consistent with the scientific literature on atmospheric dispersion in tropical climates, where thermal inversions can intensify the accumulation of pollutants. The negative correlation between humidity and PM2.5 ($r = -0.65$) suggests that the higher relative humidity conditions characteristic of Huánuco's climate may act as a natural mitigating factor. This study presents limitations inherent to its exploratory nature, including the relatively short monitoring period (30 days) and the spatial coverage limited to the immediate vicinity of the campus. Longitudinal studies, such as the NEMO system developed by Rauniyar, et al. [14] for real-time noise and emissions monitoring, suggest the need to implement permanent monitoring systems that allow for seasonal and long-term analyses. Furthermore, assessing the impact of socioeconomic variables and mobility patterns specific to the university population requires further research. The results obtained have direct implications for the development of public policies for sustainable urban mobility in Huánuco. The identification of pollution hotspots provides specific spatial information for the implementation of targeted measures, while the temporal patterns identified suggest windows of opportunity for traffic management interventions. The documented correlation between meteorological factors and air quality can inform the development of early warning systems and environmental contingency protocols.

4. Conclusions

At the conclusion of this study, it is concluded that:

- This study constitutes the first comprehensive characterization of air quality around the university's Smart University Campus in Huánuco, providing robust scientific evidence on the problem of air pollution and the potential for sustainable mobility strategies as a viable solution.
- The results demonstrate that CO_2 and particulate matter concentrations around the campus significantly exceed international air quality standards, with CO_2 levels above 450 ppm and PM2.5 levels of up to 35 $\mu g/m^3$ during peak hours. This situation represents a documented health risk for the approximately 15,000 members of the university community who travel through these areas daily.
- The pilot implementation of sustainable mobility measures demonstrated reductions of 15% in CO_2 emissions and 20% in PM2.5 concentrations, validating the hypothesis about the effectiveness of these interventions and their potential for scalability at the institutional and urban levels. These preliminary results establish a quantitative baseline for future impact assessments and justify investment in sustainable transport infrastructure.
- It was proposed to implement permanent monitoring stations to assess the long-term impact of sustainable mobility strategies.

5. Future Projections

The results of this study lay the groundwork for longitudinal research assessing the seasonal impact of the implemented measures and their long-term sustainability. The collaboration established with local authorities during the development of this project provides a solid institutional framework

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for the expansion of these initiatives to the municipal urban level, positioning the university as a regional leader in environmental sustainability and university social responsibility.

This study represents a significant contribution to scientific knowledge on sustainable mobility in Latin American university contexts, providing empirical evidence that supports the technical and environmental viability of sustainable transportation strategies as an effective tool for mitigating urban air pollution.

6. Recommendations

The findings position the Huánuco Smart University Campus as a relevant case study for the implementation of environmental sustainability strategies in higher education institutions in Latin America. The proposed implementation of permanent monitoring stations will establish a continuous surveillance system that will allow for the long-term assessment of the impact of sustainable mobility policies and their contribution to the Sustainable Development Goals (SDGs 3, 11, and 13).

The immediate implementation of a comprehensive sustainable mobility program is recommended, including: (1) development of non-motorized transportation infrastructure (bike lanes, secure bicycle parking); (2) promotion of electric vehicle use through institutional incentives; (3) optimization of university public transportation routes; and (4) implementation of environmental awareness campaigns aimed at the academic community.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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