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[기본연구] 친환경 교통의 새로운 대안:
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Alternative Eco-friendly Transportation Solutions in the Philippines

: Electric Tricycles with Integrated Transit System in Parañaque City, Philippines

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ABSTRACT

This paper addresses transportation challenges in the Philippines, focusing on the environmental impact of the sector, particularly in Metro Manila and the City of Parañaque. It explores the high emissions from road transportation and the need for sustainable solutions, including electric and hybrid vehicles. The Department of Transportation (DOTr) and local government units play key roles in regulating transportation, with specific emphasis on tricycles. The paper discusses the Parañaque City Emissions Inventory's findings, highlighting the significant potential for emission reductions through green alternatives. It also examines the perspectives of residents, drivers, and operators on transitioning to eco-friendly tricycles, emphasizing the importance of policy formulation and strategic planning in implementing sustainable transportation solutions.

본 논문은 필리핀의 교통 문제를 다루며, 특히 메트로 마닐라와 파라냐케시를 중심으로 교통 부문의 환경적 영향을 조명하고자 한다. 우선, 도로 교통에서 발생하는 높은 온실가스 배출량을 지적하고, 이에 대응하기 위한 전기 및 하이브리드 차량을 포함한 지속 가능한 대안의 필요성을 탐구한다. 이와 관련하여, 필리핀 교통부(DOTr)와 지방 정부가 교통 규제에서 핵심적인 역할을 수행하며, 특히 삼륜차에 대한 정책적 접근을 중점적으로 다룬다.
또한, 파라냐케시의 배출량 조사 결과를 분석하여, 친환경 교통 수단 도입을 통한 배출 감축 가능성을 제시한다. 나아가, 주민·운전자·운영자 등의 인식을 통해 친환경 삼륜차 전환의 사회적 수용성을 살펴보고, 이러한 전환이 성공적으로 이루어지기 위해서는 정책 수립과 전략적 계획이 필수적임을 강조한다.

I Introduction

1.1 Background

The Republic of the Philippines, an archipelago comprising over 7,641 islands, faces with diverse transportation challenges that impact both urban and rural areas. The transportation sector plays a crucial role in connecting communities, fostering economic growth, and ensuring the mobility of goods and people. Public transportation is a lifeline for many constituents of the Philippines, the Filipinos. Jeepneys, buses, tricycles, and trains are among the common modes of public transport in the country.

The transportation sector in the Philippines is intricately linked with environmental concerns, particularly in terms of emissions. As a developing nation with a rapidly growing population, the demand for transportation has surged, resulting in increased carbon emissions. The prevalence of traditional modes of transport, such as outdated jeepneys and tricycles, and inefficient buses, contributes significantly to air pollution. Additionally, traffic congestion in major urban centers worsens the problem, as vehicles spend prolonged periods idling. These significant challenges in transport sector in the country is visibly observed in its capital region, the Metropolitan Manila.

Metropolitan Manila, an urban sprawl characterized by dense population and extensive road networks, contends with chronic traffic congestion. The transport sector emitted an estimated 24.174 $MtCO_2e$ in 2010, making the sector the third largest emitting in the 2010 National Greenhouse Gases Inventory. 21.243 MtCO2e, or about 87.87% of the transport sector total, was caused by road transportation[1].

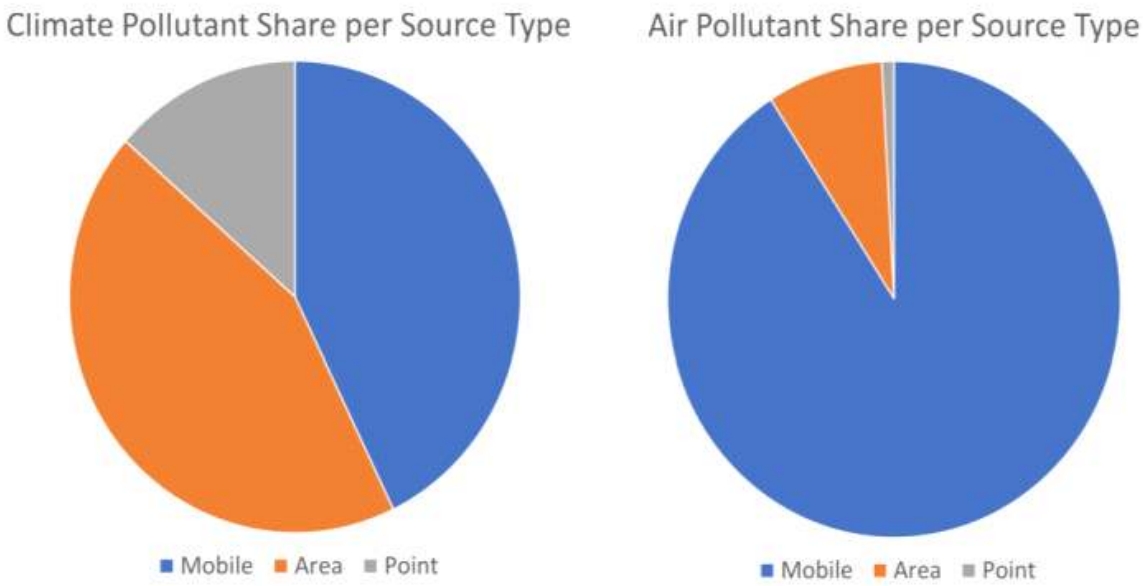
The City of Parañaque, as part of the metropolitan region, shares in the transport sector challenges. Though efforts for improvement are notable in the City, with its initiatives including the introduction of new technologies, and ongoing infrastructure developments to enhance connectivity, the need to look for possible sustainable solutions are still needed.

Addressing the complex transportation issues in the cities of Metro Manila, including the City of Parañaque, requires sustained commitment to sustainable practices, comprehensive urban planning, and the integration of cleaner, more efficient modes of transport to enhance the overall mobility experience for residents. The use of electric and hybrid vehicles as one of the possible sustainable transportation solutions is essential to mitigate the environmental impact of the transportation sector and foster a more sustainable and eco-friendly Philippines.

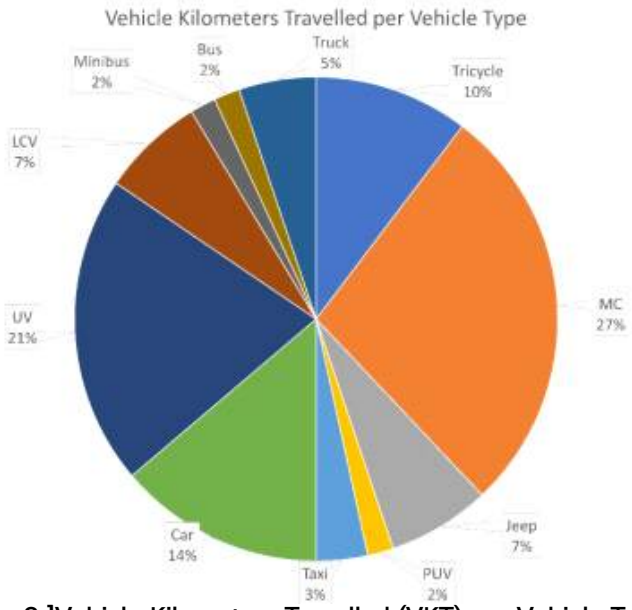
1.2 Problem Statement

A City Emissions Inventory was developed, through the funding of the Department of Environment and Natural Resources which was awarded to Clean Air Asia on 2021, using the available activity data from 2019. Out of the three emission sources, which were classified as Point, Area, and Mobile Sources as shown in the graph below, the Mobile sources has an estimated climate pollutant emissions of 79,136 tons/yr, or about 43% of the total climate pollutants emitted, and estimated air pollutants of 16,463 tons/yr, or about 91% of the total air pollutants emitted.

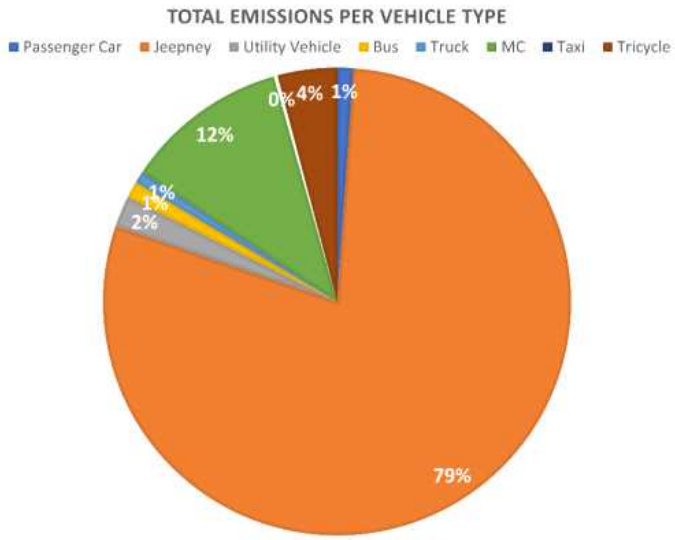
[Fig.1&2.]Share of Emission Sources: Mobile, Area, and Point, to Climate (left)and Air (right) pollutants



Majority of the total road activity in the City is from motorcycles, utility vehicles, and private cars, which is about 27%, 21% and 14% respectively, but most of these vehicles have better gasoline–fueled engines and thus, less pollutants are produced. Though jeepneys share in VKT is relatively low, it has the highest in the mobile emissions since most of these vehicles were invented during the 1950s ever since it was discovered by Sarao Motors[2]. The city's VKT and Total Emission per vehicle type are shown below.



[Fig.3.]Vehicle Kilometers Travelled (VKT) per Vehicle Type



[Fig.4.]Total Mobile Emissions per Vehicle Type

The government of the Philippines, through its Department of Transportation (DOTr), is currently managing the jeepneys emissions through the Public Utility Vehicle Modernization Program (PUVMP)[3]. On the other hand, Tricycles, which is the fourth in terms of road activity and third in the mobile emissions, is under the direct jurisdiction of the local government unit. In this aspect, the City of Parañaque lacks the integrated environmentally sustainable solution for the two and four stroke tricycles operating within the City.

With the increasing concerns about environmental sustainability and the negative impact of traditional combustion engine vehicles, there is a pressing need to explore innovative transportation options that can reduce carbon emissions and promote a cleaner and greener Parañaque City. The

current reliance on conventional tricycles and other motorized modes of transportation in Parañaque contributes significantly to air pollution and traffic congestion, posing health risks and inconveniences to commuters. This paper's purpose is to address the need for alternative eco-friendly transportation solutions in the City of Parañaque.

1.3 Research Objectives

This research paper aims to:

- Evaluate the potential benefits of integrating these tricycles with the existing transportation infrastructure in terms of reduced emissions and improved accessibility;
- Assess the adoptability and acceptability of the alternative eco-friendly electric tricycles with integrated transit system in the City of Parañaque; and
- Propose recommendations and strategies for effectively integrating electric tricycles to improve the overall transit system in Parañaque.

1.4 Scope

This research focuses specifically on the City of Parañaque, Philippines. The study will explore the adoptability of the implementation and integration of alternative eco-friendly electric tricycles (E-Trikes) within the existing transportation infrastructure of the city. This research will tackle electric tricycles as a whole and not delve into various models of e-trikes or examine technical specifications. Environmental Impacts will be assessed through the use of the existing 2022 Emission Inventory, with 2019 baseline data and reflects normal conditions, with the assumption of other emissions sources as constant to compare the change in the mobile source emissions and how it will affect the overall total emissions of the city.

This research will explore the integration of E-Trikes into the existing system of the city, which includes examining routes, pick-up/drop-off points, and the potential synergy with other modes of transportation. Perceptions, acceptance, and concerns of Parañaque residents, tricycle drivers, and operators considering social and economic factors that may influence the success of the integration.

1.5 Hypothesis

The replacement of the two and four-stroke engine tricycles plying within the city with the alternative eco-friendly electric tricycles substantially reduce the city's emissions from mobile sources, and the integration of transit system in this mode of transportation lessen traffic congestion in secondary and tertiary roads and affects the congestion in the primary roads of the city as well.

II Literature Review

2.1 Overview of the Electric Tricycles and as Mode of Transportation

Various kinds of road-based public transportation vehicles are seen in Southeast Asian emerging countries. For example, Vietnam is home to motorcycle taxis known as "motos," whereas Thailand has "tuktuks," Indonesia has "bajajs," and Thailand has "motos." Tricycles and public utility jeepneys are highly common in the Philippines[4]. Tricycle, motorized and non-motorized, is a three wheeled vehicle which is the primary mode of transportation of intra-city transportation. For passengers, public transit serves numerous needs. As long as it offers affordable, effective, and safe transportation, it improves the standard of living in societies[5].

An electric tricycle, also known as an E-trike, is similar in configuration to a tricycle in the Philippines. It is a three-wheeled vehicle that can carry multiple passengers, depending on the motor engine's capacity and body design. A sidecar that is mounted to the side of a motorcycle to carry passengers is a common design seen in the Philippines; an e-trike runs on electricity, whereas the latter is powered by gas. Its body structure is akin to that of a "jeepney," and its components include handlebars, consoles, side mirrors, and windshields. With regard to the following variables—awareness and availability, safety and security, convenience and cost, and enjoyment—the researchers employed Van Acker's Routine Mode Choice of Decision. Accessibility enables travelers to examine the various facets of the adoption of E-trikes, or electric tricycles, as a public transportation system that supplants motorized tricycles in urban areas, and awareness, which dictates that individuals must be cognizant of the mode and possess it as a means of transportation to a destination[6].

2.2 Benefits of Eco-friendly Electric Tricycles

Balaria et al. discuss the benefits of e-trikes as an alternative sustainable transport solutions. E-trikes have a customizable design and may accommodate up to ten passengers, including the driver. Carbon dioxide is reduced using an electronic tricycle. In the long run, it also lessens reliance on oil, prevents excessive fuel use, and eventually boosts employment prospects and tricycle drivers' pay.

Since electric tricycles have electrically powered brushless direct current motor, it produces zero carbon emissions during operation. This makes electric tricycles an environmentally friendly option compared to gasoline-powered motors. The solar PV system on the roof of the tricycle charges the battery bank by converting the solar energy from sunlight into electricity. The solar panels, also known as photovoltaic cells, absorb the sunlight and generate a direct current (DC) electrical output. This DC

power is then used to charge the battery bank of the tricycle. The solar charge controller regulates the charging process to ensure that the battery is charged efficiently and safely. This allows the tricycle to replenish its power supply while in motion, making it more sustainable and reducing the need for frequent battery replacements. Additionally, the tricycle features a regenerative braking system. When the brakes are applied, the motor acts as a generator and converts the kinetic energy of the tricycle into electrical energy, which is then stored in the battery. This feature helps to extend the range of the tricycle and improve overall energy efficiency. The regenerative braking system helps to increase the range of the tricycle by capturing and storing energy that would have been wasted. This allows the tricycle to travel longer distances on a single charge. By recovering energy during braking, the tricycle reduces the need for frequent recharging from external sources. This leads to cost savings in terms of electricity consumption and maintenance. Overall, electric tricycle provides a sustainable and affordable solution for commercial passenger transportation, particularly in developing countries Commercializing the electric tricycle can create job opportunities and contribute to economic growt h[7].

2.3 Introduction and Potential Benefits of Integrated Transit System

As cities struggle with the effects of rapid urbanization particularly the increasing traffic congestion and environmental concerns, the adoption and upgrading of public transportation systems has become critical. The introduction of transit systems inflict a number of benefits upon urban environments, examining how they not only reduce traffic congestion but also contribute considerably to environmental sustainability. Urban areas, with their growing populations and rising automotive ownership, are frequently caught in the grip of traffic congestion. However, transportation systems provide a dynamic solution to this problem. These systems provide residents with a more rapid and more dependable mode of transit by serving as a viable alternative to private vehicles. As more people use public transportation, total traffic volume on highways drops, resulting in better traffic flow, shorter travel times, and less congestion–related stress.

The detrimental impact of excessive private automobile usage is apparent, with severe concerns about air pollution, greenhouse gas emissions, and noise pollution. Transit systems are emerging as environmentally friendly options, reducing the environmental effect of individual travel. Electric buses, trains, and other environmentally friendly means of public transportation cut carbon emissions dramatically, contributing to cleaner air and a better urban environment. Cities may actively engage in the global effort to battle climate change and promote a more sustainable future by encouraging the use of public transportation. Compared to individual vehicles, transit systems are intrinsically more energy–efficient because they can carry a higher number of people while using less energy per passenger. This effectiveness encourages the preservation of priceless resources while simultaneously lowering the demand for fossil fuels. Furthermore, the incorporation of renewable energy sources and energy–efficient vehicles, together with other improvements in transportation technology, enhance the favorable environmental impact of these systems even further.

In the journal article titled "Urban Mobility Modeling to Reduce Traffic Congestion in Surabaya", Suryani et al. presents results from system dynamics models, showing how strategic implementations like Mass Rapid Transit (MRT) and Bus Rapid Transit (BRT) development can significantly improve urban mobility. The authors' findings indicate that reducing public transport delays and enhancing modal split in favor of public transportation can effectively decrease traffic congestion. The study underscores the importance of adopting comprehensive and integrated urban transportation strategies to address congestion challenges in Surabaya[8].

On the other hand, the effectiveness of public transportation systems in reducing urban congestion and pollution in the United States (US) is examined in detail in the paper "Congestion, Pollution, and Benefit-to-Cost Ratios of US Public Transit Systems"[9]. Using information from eighteen cities, Harford assesses the costs and advantages of public transportation, emphasizing its ability to lessen traffic jams and enhance air quality. The results point to a complicated picture in which certain transit systems play a major role in reducing traffic and pollution, while other systems have a less noticeable impact. This suggests that public transportation effectiveness varies greatly throughout urban locations.

An extensive analysis of research on the effects of public transportation spending on air quality and traffic congestion can be found in the paper "Public Transit Investment and Sustainable Transportation". In order to comprehend the connection between transit investments and sustainable urban transportation, a critical analysis of empirical literature is conducted[10]. In the context of urban transportation planning and environmental sustainability, the analysis underscores the difficulty in gauging the impact of transit investments and stresses the significance of taking regional variations, policy consequences, and both short- and long-term equilibria into account.

The transformative power of transit systems extends beyond mere mobility solutions. These systems play a pivotal role in alleviating traffic congestion, curbing environmental degradation, and shaping sustainable urban environments. As cities embrace the paradigm shift toward comprehensive and integrated transit solutions, they pave the way for a future where mobility is synonymous with environmental responsibility and societal well-being.

III Methodology

Regulatory and Policy Analysis will be done in this paper to examine the existing regulations and policies related transportation in the City of Parañaque. Legal barriers for the identroduction of electric tricycles and integrated transit. Existing literature on electric tricycles and integrated transit systems in urban setting will be reviewed and case studies on similar initiatives in other cities will be examined to understand the challenges, successes, and best practices.

The researcher used environmental impact assessment to analyze potential environmental benefits of transitioning to electric tricycles which includes reductions in air pollution and carbon emissions using the available data collected from local offices. Potential pilot area for implementation will be developed for the introduction of electric tricycles and identification of routes and possible pick-up / drop-off points. Factors such as population density, traffic patterns, and existing public transportation infrastructure will be considered for the site selection.

To further analyze the acceptability and adoptability of the transition of electric tricycles, key stakeholders is identified and engaged. The researcher formulated survey questionnaire to gauge public perceptions and acceptance of electric tricycles and integrated transit.

Ⅳ Results and Data Analysis

4.1 Regulatory and Policy Analysis

The Department of Transportation (DOTr) is the primary government agency responsible for the formulation and implementation of policies, plans, and programs for the development of a reliable and efficient transportation system in the country. One of their mandates is the enforcement of Land Transportation and Traffic Code (Republic Act No. 4136), a comprehensive law that governs various aspects of land transportation, including traffic rules, vehicle registration, and driver's licensing. The Local Government Code of 1991 identified local government units (LGUs) to directly regulate tricycles. While tricycles are primarily regulated at the local level, there are national guidelines that LGUs follow to ensure uniformity and compliance with broader transportation goals.

In the local level, the City of Parañaque has the City Tricycle Regulatory Office, the agency responsible for overseeing tricycle operations within the jurisdiction. Tricycle routes, within secondary and tertiary roads, and fare structures were established to ensure organized and regulated transportation services. In spite of the regulations and policies in national and local level, program for efficiency and environmental sustainability in tricycles is lacking.

4.2 Environmental Impact Assessment

As part of the Department of Environment and Natural Resources Environmental Management Bureau of the National Capital Region's (DENR-EMB NCR) mandate and support to cities that are part of the NCR Airshed, Clean Air Asia was tasked to develop the Parañaque City Emissions Inventory (EI) under RFQ No. 260-2020. The Parañaque City EI identified sources of air pollutants, including criteria air pollutants, GHGs, and short-lived climate pollutants (SLCPs) and their share in the overall emissions within the city. Results of the EI are helpful for policymakers and stakeholders in prioritizing actions to achieve emission reduction targets. The study results also gives insights on health and environmental impacts of air pollution in the city. The EI also lays the foundation for longer-term clean air action planning for the city, which would set out clear and targeted measures and mechanisms to sustain air quality management action.

An EI is a listing of emission sources and the amount of air pollutants that are discharged or potentially discharged into a specific geographical area (such as a city) over a given period of time. Emissions are calculated as product of emission factor (EF) and activity data. The basic formula used in an emissions inventory is:

$$EMISSION = Emission\ Factor * Activity\ Data \quad (1)$$

[Table 1.]Summary table of Emissions per pollutants per source in the City of Parañaque (2019 Data)

	Air pollutant (tons/yr)					Climate pollutants (tons/yr)				
	PM10	PM2.5	SO2	NOx	CO	NMVOC	BC	CH4	N2O	CO2
Mobile	272.79	272.79	64.44	2439.23	13414	3157.67	242.04	145.95	3.79	75587
Area-Commercial	910.91	91.09	0.02	0.11	0.47	2180.72	0.01	6833.39	0.16	196.62
Area-Residential	19.02	13.18	7.73	37.98	420.58	2035.42	6.19	1989.30	2.19	67454
Point	6.03	6.03	56.06	71.44	17.41	6.51	1.15	1.01	0.20	24990
TOTAL	1208.8	383.09	128.25	2548.76	13852	7380.32	249.39	2136.30	6.34	168228

Using the 2019 baseline data and the percent share of tricycle in the total mobile sources emission, estimated reduction for the complete transition of conventional tricycles, about 4,198 units, to electric tricycles was computed.

[Table 2.]Total number of tricycle units plying in the city and terminals in the city (Source: City Tricycle Regulatory Office)

Total No. of Tricycle Units	Total No. of Terminals
4,198	133

[Table 3.]Mobile Emissions (tons/yr) of Air and Climate Pollutants with and without emissions from tricycles

POLLUTANTS	MOBILE	TOTAL	MOBILE (w/o TRICYCLES Emission)	TOTAL (w/o TRICYCLES Emission)	REDUCED EMISSIONS	% REDUCTION
Air Pollutants (tons/yr)						
PM10	272.79	1,208.75	261.88	1,197.84	10.91	0.90%
PM2.5	272.79	383.09	261.88	372.18	10.91	2.85%
SO2	64.44	128.25	61.86	125.67	2.58	2.01%
NOX	2,439.23	2,548.76	2,341.66	2,451.19	97.57	3.83%
CO	13,414.00	13,852.46	12,877.44	13,315.90	536.56	3.87%
Subtotal	16,463.25	18,121.31	15,804.72	17,462.78	**658.53**	**3.63%**
Climate Pollutants (tons/yr)						
NMVOC	3,157.67	7,380.32	3,031.36	7,254.01	126.31	1.71%
BC	242.04	249.39	232.36	239.71	9.68	3.88%
CH4	145.95	8,969.65	140.11	8,963.81	5.84	0.07%
N2O	3.79	6.34	3.64	6.19	0.15	2.39%
CO2	75,587.00	168,227.62	72,563.52	165,204.14	3,023.48	1.80%
Subtotal	79,136.45	184,833.32	75,970.99	181,667.86	**3,165.46**	**1.71%**
TOTAL	95,599.70	202,954.63	91,775.71	199,130.64	**3,823.99**	**1.88%**

Using the 2019 data of the Emissions Inventory, the City can reduce about 658.53 tons/yr of air pollutant (3.63%) and 3,165.46 tons/yr of climate pollutants (1.71%). Changing to green alternatives has a great impact on the environment, particularly on the emissions of pollutants, and to the public health as well.

Percent reduction is expected to be higher than the aforementioned estimated percentages since only the reduction from the change of vehicle type has been taken into consideration, and the effect on other vehicles due to reduced idle time from improving congestion has not been accounted.

4.3 Integration of E-Trikes in existing transport system and Potential Pilot Area Implementation

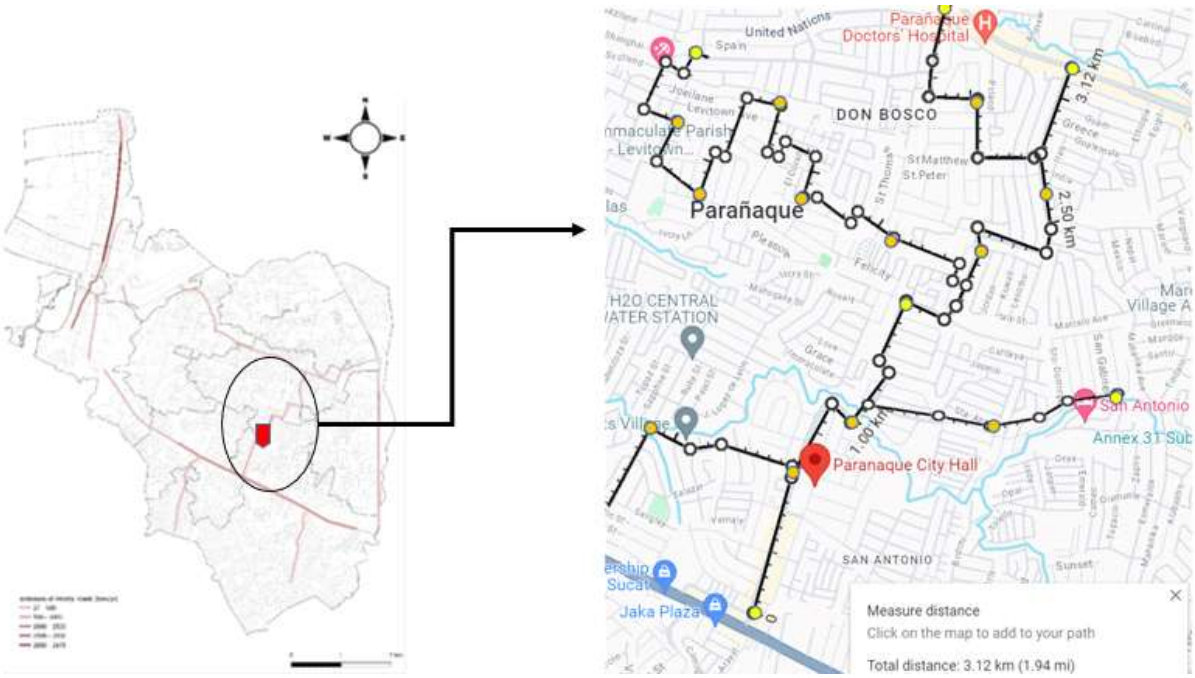
In this research, SAVTODA is the chosen tricycle association with 90 tricycle units and 7 terminals operating along San Antonio Ave. of Brgy San Antonio – area is chosen since the cityhall of the City is located along the avenue. Terminals are identified as the possible charging stations.

[Fig. 5.]Potential Pilot Area for Implementation – Target Tricycle Association, Number of Units and Terminals

TRICYCLE ASSOCIATION	BARANGAY	TRICYCLE UNITS	TERMINAL
21.SAVTODA	SAN ANTONIO	90	1.San Vicente Street corner San Antonio Ave. SAV- I, San Antonio 2. Aguinaldo Street, Malacañang Village across Mini Stop Convenience Store, San Antonio 3. San Crispin Street corner Hernandez Avenue, San Antonio Valley 3, San Antonio 4. Hernandez Avenue corner San Pascual Street, San Antonio Valley 8, San Antonio 5. San Antonio Valley I corner Sta. Lucia Street, beside 7 - 11Convenience Store across Parañaque City Hall, San Antonio 6. Hernandez Avenue corner Valley 9, San Antonio 7. San Pablo Street corner Sta. Lucia Street near San Antonio Barangay Hall, San Antonio

Distance of 500 meters between proposed tricycle stops – the walkable distance in Metro Manila is at 251 meters[11]. Using the google maps, proposed route and stop- overs were pre-identified and subject for the review and approval of the agency responsible for the routing.

[Fig. 6.]Potential Pilot Area for Implementation – Routes and Stop-overs using Google Maps



4.4 Perceptions and acceptance of electric tricycles and integrated transit

Survey questionnaire was formulated using Likert Scale (Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree) to identify the perceptions, acceptance, and concerns of nearby residents, tricycle drivers, and operators, considering social and economic factors that may influence the success of the integration. Actual survey was not done due to limited time for the conduct of survey but sample questionnaire was finalized and questions are as follows:

SAMPLE QUESTIONNAIRE:

Demographic Information:
Please provide the following demographic information for statistical purposes.
Age: _____
Gender: Male / Female / Other
Occupation: _____
Residence: _____

1. General Opinion
a. The introduction of Electric Tricycles with an Integrated Transit System is a positive step towards a more sustainable city transportation system.
b. I believe that eco-friendly transportation solutions are important for addressing environmental concerns in Parañaque.
c. I am open to using Electric Tricycles with an Integrated Transit System as a mode of transportation.

2. Environmental Impact:
a. Electric Tricycles produce fewer emissions compared to traditional tricycles using fossil fuels.
b. The implementation of an Integrated Transit System will reduce traffic congestion and contribute to a cleaner environment.
c. I believe that promoting eco-friendly transportation options is crucial for reducing air pollution in Parañaque.

3. Convenience and Accessibility:
a. Electric Tricycles with an Integrated Transit System will provide convenient and accessible transportation options for residents.
b. The charging infrastructure for Electric Tricycles is likely to be easily accessible in different parts of the city.
c. The integration of this transportation system will improve overall accessibility to different parts of Parañaque.

4. Economic and Social Impact:
a. The implementation of Electric Tricycles will positively impact the local economy by creating job opportunities.
b. The Integrated Transit System will enhance social connectivity and community engagement.
c. I believe that investing in eco-friendly transportation will contribute to the long-term economic development of Parañaque.

5. Potential Concerns:
a. I am concerned about the reliability and maintenance of Electric Tricycles.
b. The cost of implementing an Integrated Transit System may be a potential drawback for the community.
c. I worry about the availability of charging stations for Electric Tricycles in the city.

6. Future Considerations:
a. I believe that the city should invest more in alternative eco-friendly transportation solutions in the future.
b. The government should prioritize policies and incentives to encourage the adoption of Electric Tricycles.
c. I am optimistic that the integration of Electric Tricycles will lead to a more sustainable and livable city.

Statistical analysis of the result of the survey is expected to be done to determine the possible acceptability / adoptability, and barriers to implementation as well.

V Conclusion

The research showed the need to further understand the effects, advantages and disadvantages as regard this change in the mode of public transportation system. Before the implementation of any transportation alternatives, policies shall be formulated and in place since policies are the backbone of any urban issues solutions in the future, together with strategic planning. The replacement of the two and four-stroke engine tricycles plying within the city with the alternative eco-friendly electric tricycles may reduce at least 2% of the city's overall emissions. The integration of transit system in this mode of transportation may lessen traffic congestion in secondary and tertiary roads through strategic identification of routes, pick-up and drop-off points that may eventually affect the congestion in the primary roads as well. It is recommended to conduct traffic simulation to calculate the exact or estimate effect on the city's congestion situation. Perceptions, acceptance, and concerns of the residents, tricycle drivers and operators should be taken into consideration since they have a crucial role on the success and/or barrier on the implementation.

VI Acknowledgments

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