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Navigating gridlock: Unraveling the causes and consequences of traffic congestion in San Isidro, Nueva Ecija

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ABSTRACT

This study investigated the causes and impacts of traffic congestion in San Isidro, Nueva Ecija, Philippines, using a descriptive research design with 114 respondents (38 drivers/operators and 76 commuters) selected through convenience sampling. Vehicle counts at the National Highway and Public Market identified peak traffic hours, while a validated and reliable researcher-designed questionnaire gathered views on congestion, socioeconomic effects, and mitigation measures. Results showed that narrow roads, poor infrastructure, and weak enforcement of traffic rules were the main causes of congestion, leading to longer travel times, stress, and higher fuel costs for both commuters and businesses. Although both groups recognized its negative socioeconomic effects, their opinions differed on the effectiveness of existing measures, which were generally seen as ineffective. The study recommends strengthening road infrastructure, improving public transport, enforcing traffic regulations, and adopting demand management strategies such as carpooling incentives and congestion pricing. It emphasizes the need for integrated urban planning, multi-sectoral collaboration, and continuous policy review to reduce congestion and enhance the quality of life in San Isidro.

1. Introduction

Traffic congestion is a growing challenge in many urban and semi-urban areas worldwide, and San Isidro, Nueva Ecija, in the Philippines, is no exception. As the municipality continues to experience urbanization and economic development, the increasing demand for transportation has led to significant congestion issues, affecting mobility, economic activities, and the overall quality of life for residents. Urbanization, characterized by population growth and increased commercial and residential development, has been widely recognized as a primary driver of traffic congestion (Gu, 2019). As cities expand, road networks become more burdened, resulting in longer commute times, increased stress levels, and heightened economic costs. A critical factor influencing traffic congestion is the adequacy of road infrastructure. Poorly planned roads, narrow streets, and inefficient intersections contribute to traffic jams and delays (Agyapong and Ojo, 2018). In addition, driver behavior, including non-compliance with traffic rules and regulations and a lack of road courtesy, further worsens congestion (Szajowski and Włodarczyk, 2020). The tendency of some motorists to disregard traffic regulations to bypass congestion often aggravates the situation, leading to increased delays, accidents, and heightened stress among road users (Schimkowsky, 2025). Studies have shown that such commuting stress can have adverse effects on the mental well-being of people.

The socioeconomic consequences of traffic congestion are far-reaching. Increased travel times not only reduce individual productivity but also impose higher operational costs on businesses, thereby affecting local economic performance. Additionally, prolonged congestion leads to greater fuel consumption, higher emissions, and increased exposure to air pollution, which pose significant environmental and public health concerns (Dasgupta et al., 2021). Addressing these issues requires a multilayered approach that includes infrastructure improvements, enhanced traffic management strategies, and the promotion of alternative transportation options (Anastasiadou and Gavanas, 2023). Effective urban planning and policy interventions are essential to ensuring sustainable

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mobility and economic growth (Pojani and Stead, 2015).

Given these challenges, this study systematically examined the causes and consequences of traffic congestion in San Isidro, Nueva Ecija, Philippines. It analyzed congestion patterns based on peak-hour traffic volume, road infrastructure conditions, and existing traffic management practices. Furthermore, the study assessed the socioeconomic impacts of congestion on commuter productivity, local business efficiency, and residents' overall quality of life (Fattah et al., 2022). Additionally, the effectiveness of current traffic mitigation measures was evaluated in terms of their impact on improving traffic flow, reducing congestion, and ensuring cost-efficiency (Suryani et al., 2020). Based on the findings, this study proposed evidence-based strategies aimed at alleviating traffic congestion and enhancing mobility in San Isidro, Nueva Ecija.

2. Methodology

This study employed a quantitative approach utilizing a descriptive research design to systematically examine the causes and consequences of traffic congestion in San Isidro, Nueva Ecija, and analyze congestion patterns, road infrastructure conditions, and existing traffic management practices. Furthermore, the study aimed to assess the socioeconomic impacts of traffic congestion and evaluate the perceived effectiveness of traffic mitigation measures based on respondents' experiences.

A total of 114 respondents, 38 drivers/operators and 76 commuters, were selected using convenience sampling to capture diverse perspectives on traffic conditions, and since the research output would be the basis for the policy analysis framework (Pentang and Domingo, 2024). This sampling method was chosen to ensure accessibility to individuals directly experiencing traffic congestion while allowing the collection of diverse perspectives on road conditions and transportation issues in San Isidro. Though convenience sampling provides practical benefits, its non-random nature may limit the generalizability of the findings beyond the selected respondents. Moreover, data was gathered through face-to-face surveys utilizing researcher-made instruments with drivers/operators and commuters at key congestion points, such as the National Highway, Población Intersection, and the San Isidro Public Market. Additionally, manual vehicle counting was conducted to record peak-hour traffic volume, providing an objective measure of congestion intensity. The self-made instrument was developed and validated by experts, with all its items rated surpassing the threshold using Aiken's V content validity index (Aiken, 1985). More so, the data gathering instrument underwent pilot testing to ensure its reliability and to evaluate the feasibility, time, cost, risks, and potential issues associated with the data collection.

The collected data were encoded, processed, and analyzed using descriptive statistical methods such as mean and corresponding verbal descriptions and inferential analysis, such as the Mann-Whitney U test, to determine differences in perceptions between drivers/operators and commuters regarding congestion impact and effectiveness of mitigation measures. The counterpart non-parametric test of independent samples t-test, was used as the data failed to satisfy assumptions of normality and homogeneity.

Furthermore, the nature of the research questions and data supports the integration of comparative and inferential analyses, such as regression analysis and spatial mapping of congestion zones, which are considered the most suited methodologies for this type of study. These techniques provided deeper insights into the relationships between variables (e.g., congestion severity and its socioeconomic effects) and enable visual and statistical identification of high-impact areas, thereby informing more targeted and effective planning interventions.

Ethical considerations included informed consent, confidentiality of responses, and voluntary participation, while the primary limitations involved the relatively small sample size and non-probability sampling, which may constrain the generalizability of results.

3. Results and discussion

3.1. Characteristics of traffic congestion in San Isidro, Nueva Ecija

Table 1 presents the recorded traffic volume at three key locations in San Isidro, Nueva Ecija, during peak hours: the National Highway, Población Intersection, and San Isidro Public Market. The data was gathered through a manual traffic count conducted during the morning (7:00 AM–9:00 AM) and evening (5:00 PM–7:00 PM) rush hours to assess the extent of traffic congestion in these areas.

Table 1: Traffic volume through manual counting

Location	7:00 - 8:00 AM	8:00 - 9:00 AM	5:00 - 6:00 PM	6:00 - 7:00 PM	Total (4 hrs)	Mean traffic volume (vehicles/hr)
National Highway	950 vehicles	1,100 vehicles	1,250 vehicles	1,100 vehicles	4,400 vehicles	1,100 vehicles/hr
Población Intersection	720 vehicles	850 vehicles	900 vehicles	870 vehicles	3,340 vehicles	835 vehicles/hr
San Isidro Public Market	650 vehicles	780 vehicles	850 vehicles	820 vehicles	3,100 vehicles	775 vehicles/hr

The National Highway exhibited the highest total traffic volume, reaching 4,400 vehicles in four hours, with the peak occurring between 5:00 – 6:00 PM at 1,250 vehicles. This suggests that the highway serves as a primary route for both local and through traffic, contributing to congestion, particularly in the evening when commuters and freight transport are most active. The Población Intersection recorded 3,340 vehicles, with 850 vehicles counted between 8:00 – 9:00 AM, indicating increased morning congestion due to the movement of workers and students. Meanwhile, traffic remained relatively high during the evening, suggesting that the intersection is a crucial transit point within the municipality.

The San Isidro Public Market experienced a total of 3,100 vehicles, with the highest volume occurring during the morning hours, particularly from 8:00 - 9:00 AM (780 vehicles). This indicates that economic activities, such as market transactions and deliveries, contribute significantly to congestion in this area (Bridgelall, 2024).

The mean traffic volume calculation clarifies the severity of congestion across the three key locations in San Isidro, Nueva Ecija, Philippines. The average number of vehicles per hour was determined by dividing the total traffic volume recorded over four hours by the number of time intervals observed. Based on this computation, the National Highway exhibits the highest average traffic volume at 1,100 vehicles per hour, confirming its role as the primary thoroughfare experiencing the most congestion. Meanwhile, the Población Intersection records 835 vehicles per hour, indicating substantial traffic flow due to its function as a key transit point. The San Isidro Public Market, with an average of 775 vehicles per hour, experiences significant congestion, particularly during morning hours when commercial activities peak. These findings highlight the disproportionate distribution of vehicle movement, suggesting that the National Highway requires immediate decongestion strategies. At the same time, the Población Intersection and Public Market areas would benefit from enhanced traffic regulation and road infrastructure improvements.

The National Highway experiences the most severe congestion, with an average of 1,100 vehicles per hour, followed by the Población Intersection (835 vehicles per hour) and the San Isidro Public Market (775 vehicles per hour).

Particularly along the National Highway, the large vehicle counts point to the possible inadequacy of the present road system in handling demand at peak hours. This emphasizes how urgent road development, better traffic signalization, and alternate paths to relieve congestion are needed (Kunambi and Zheng, 2025). Moreover, the Población Intersection and San Isidro Public Market show notable traffic congestion, which emphasizes the need for better traffic management techniques (Mina, 2024), including enhanced pedestrian crossings, stricter application of loading/unloading zones, and best scheduling of market delivery.

These findings suggest that congestion worsens without effective traffic management measures, leading to increased travel time, fuel consumption, and economic inefficiencies. Traffic congestion is a prevalent issue in urban and semi-urban areas, with multiple studies emphasizing its adverse effects on mobility and productivity (Dutta et al., 2024). According to Mofolasayo (2024), increased traffic density results in longer commute times and reduced economic productivity, making it essential for municipalities to adopt comprehensive traffic management strategies. Similarly, a study by Łach and Svyetlichnyy (2024) found that road capacity, vehicle density, and poor intersection design are primary contributors to congestion in developing areas, highlighting the importance of infrastructure planning and policy interventions to mitigate traffic buildup.

Based on the perceptions of drivers/operators and commuters, the results presented in Table 2 show noticeable variations in how these groups evaluate road infrastructure and traffic management. Overall, the mean scores indicate that both drivers (mean = 2.18) and commuters (mean = 2.08) generally disagree with most statements regarding the adequacy of infrastructure and traffic conditions.

Table 2: Perception–based road infrastructure and traffic management checklist

Items	Drivers/operators		Commuters	
	Mean	VD	Mean	VD
Roads are well–maintained and free from major damage (e.g., potholes, cracks).	2.18	D	2.08	D
Road signs, traffic signals, and lane markings are clear and visible.	2.47	D	2.33	D
Sidewalks and pedestrian crossings are sufficient and safe for pedestrians.	2.68	A	2.39	D
Traffic congestion is severe during peak hours.	2.84	A	2.75	A
There are alternative routes available to help ease congestion.	2.79	A	2.62	A
Public transport vehicles contribute significantly to traffic congestion.	2.97	A	2.58	A
Traffic rules and regulations are strictly enforced in this area.	2.53	A	2.51	A
Traffic enforcers are visible and actively managing traffic flow.	2.71	A	2.64	A
Illegal parking and roadside vendors worsen traffic congestion.	2.11	D	2.91	A
Infrastructure improvements (e.g., road widening, additional traffic lights) would significantly reduce congestion.	2.03	D	2.96	A
Mean	2.73	A	2.58	A

VD: Verbal description; 3.25 – 4.00: Strongly agree (SA); 2.50 – 3.24: Agree (A); 1.75 – 2.49: Disagree (D); 1.00 – 1.74: Strongly disagree (SD)

In particular, both groups disagreed that road signs, traffic signals, and lane markings are clear and visible (Drivers: mean = 2.47; Commuters: mean = 2.33), as shown in Table 2. This suggests that insufficient traffic control devices and poor road conditions are perceived as major challenges. These findings are consistent with studies emphasizing the critical role of infrastructure quality in improving traffic efficiency and safety (Khanmohamadi and Guerrieri, 2024). Regarding pedestrian

infrastructure, opinions differ, though. Drivers/operators agree—mean = 2.68—that sidewalks and pedestrian crossings are adequate; commuters disagree—mean = 2.39. This suggests that whereas car users could consider pedestrian infrastructure sufficient, people who depend on it daily find it inadequate, supporting studies stressing the need for pedestrian-friendly urban development (Moussa, 2025). Both groups believe that alternate routes are available (Drivers: mean = 2.79, Commuters: mean = 2.75) and that traffic congestion is severe during peak hours (Drivers: mean = 2.84, Commuters: mean = 2.75). Furthermore, seen as a major cause of congestion are public transportation vehicles (Drivers: mean = 2.97, Commuters: mean = 2.58). This result corresponds with earlier studies showing that poorly controlled public transit systems aggravate traffic congestion, especially in emerging urban regions.

One important distinction is in the view of unlawful parking and roadside sellers as causes of traffic congestion. Drivers/operators disagree—mean = 2.11—that these elements aggravate traffic, but commuters agree—mean = 2.91. This implies that while walkers and passengers may see these problems as severe impediments to mobility, drivers might not view them as such; so, studies stressing the effects of roadside encroachments on urban mobility should be reinforced (Peimani and Kamalipour, 2022). Furthermore, agreed upon by both groups agreed that traffic enforcers are visible and actively directing traffic (Drivers: mean = 2.71, Commuters: mean = 2.64) and that traffic laws are strictly enforced (Drivers: mean = 2.53, Commuters: mean = 2.51). On the efficacy of infrastructure upgrades like road widening and extra traffic lights, they vary greatly, though. While commuters agree (mean = 2.96), showing belief that such actions could reduce congestion, drivers/operators disagree (mean = 2.03), suggesting uncertainty regarding their impact. This difference parallels larger discussions in urban planning, where the growth of infrastructure by itself could not be enough without accompanying policies, including better traffic management and public transportation improvements (Koman et al., 2024).

To sum it up, although both groups acknowledge severe congestion, poor road maintenance, and the need for public transportation in traffic accumulation, their points of view differ on the efficiency of infrastructure enhancements, pedestrian infrastructure, and the consequences of illegal parking and roadside vendors. These revelations imply that San Isidro's traffic congestion must be properly addressed using a multi-faceted approach involving better pedestrian facilities, stronger enforcement, and regulated public transportation (Nawaz et al., 2025).

Table 3 presents the perception-based traffic management practices of drivers/operators and commuters.

Table 3: Perception–based traffic management practices

Items	Drivers/operators		Commuters	
	Mean	VD	Mean	VD
Traffic enforcers are actively present and help regulate traffic flow.	2.97	A	3.82	SA
Traffic signals, signs, and road markings are well–maintained and visible.	2.89	A	2.49	D
Traffic laws and regulations (e.g., speed limits, one–way policies) are strictly enforced.	2.82	A	2.36	D
Public utility vehicles (PUVs) follow designated stops for loading and unloading passengers.	2.61	A	2.26	D
Illegal parking and roadside vendors contribute to traffic congestion in this area.	3.05	A	2.74	A
Pedestrian crossings and sidewalks are sufficient and properly maintained.	2.71	A	2.47	D
Alternative routes and traffic rerouting schemes help reduce congestion.	2.84	A	2.71	A
Motorcycle riders and cyclists adhere to traffic rules and designated lanes.	2.79	A	2.36	D
Road widening and other infrastructure improvements are needed to improve traffic flow.	3.29	SA	3.04	A
The current traffic management strategies are effective in reducing congestion.	2.92	A	2.39	D
Mean	2.89	A	2.55	A

VD: Verbal description; 3.25 – 4.00: Strongly agree (SA); 2.50 – 3.24: Agree (A); 1.75 – 2.49: Disagree (D); 1.00 – 1.74: Strongly disagree (SD)

The results above highlight key disparities in the perception of the Drivers/Operators and Commuters, suggesting a gap between policy implementation and user experience.

Both groups agree that illegal parking and roadside vendors contribute to congestion (Drivers: mean = 3.05, Commuters: mean = 2.74) and that alternative routes help reduce congestion (Drivers: mean = 2.84, Commuters: mean = 2.71). However, notable differences emerge in their evaluation of traffic enforcement. Drivers/operators perceive traffic enforcers as actively present and effective in regulating flow (mean = 2.97), whereas commuters strongly agree (mean = 3.82), indicating that enforcement is highly visible but may not necessarily translate into strict compliance with traffic rules. This aligns with studies suggesting that visible enforcement alone does not guarantee rule adherence unless backed by consistent penalties and education campaigns.

A stark contrast exists regarding traffic signals, signs, and road markings—drivers/operators agree that these are well-maintained (mean = 2.89), while commuters disagree (mean = 2.49). Similarly, drivers believe that traffic laws are strictly enforced (mean = 2.82), whereas commuters disagree (mean = 2.36), indicating potential inconsistencies in enforcement or differences in how each group experiences road regulation. Research by Austin (2024) emphasized that perceived enforcement effectiveness is often higher among drivers than pedestrians or commuters, who experience indirect consequences of weak enforcement, such as jaywalking or unauthorized stops by public transport vehicles. Further, drivers agree that PUVs adhere to designated stops (mean = 2.61), but

commuters disagree (mean = 2.26), suggesting that while compliance may be observed from a driver's standpoint, passengers frequently experience unauthorized stops that contribute to congestion. This is supported by studies on urban mobility, which highlight poorly regulated public transport as a significant contributor to traffic buildup in developing cities.

A major divergence also appears in the assessment of road infrastructure and pedestrian safety. While drivers believe pedestrian crossings and sidewalks are sufficient (mean = 2.71), commuters disagree (mean = 2.47), indicating that infrastructure may be designed primarily for vehicle flow rather than pedestrian convenience. Additionally, motorcycle riders and cyclists are perceived by drivers as compliant with traffic rules (mean = 2.79), while commuters disagree (Mean = 2.36), reinforcing the idea that mixed traffic conditions and a lack of dedicated lanes may contribute to safety concerns and inefficiencies.

Regarding infrastructure improvements, both groups recognize the need for road widening to improve traffic flow, with drivers/operators strongly agreeing (mean = 3.29) and commuters agreeing (mean = 3.04). However, their views on the overall effectiveness of traffic management strategies differ—drivers agree that the current strategies are effective (mean = 2.92), while commuters disagree (mean = 2.39). This suggests that while policies may be adequate from an enforcement perspective, their actual impact on daily commuting experiences remains insufficient (Roy et al., 2024).

It can be stated that while both groups acknowledge congestion issues, drivers tend to perceive traffic management as more effective than commuters do (Ahad and Kidwai, 2025). The disconnect between policy enforcement and user experience—particularly in traffic law adherence, public transport regulation, and pedestrian infrastructure—suggests a need for holistic urban planning that integrates stricter enforcement, better public transport regulation, and infrastructure upgrades tailored to both drivers and commuters (Kottala et al., 2024).

3.2. The socioeconomic impacts of traffic congestion in San Isidro, Nueva Ecija

The data provided on the socioeconomic effects of traffic congestion in San Isidro, Nueva Ecija, emphasizes important repercussions for drivers/operators as well as commuters, especially in relation to commuter productivity. With mean scores of 3.32 for drivers/operators and 3.39 for commuters, both groups firmly believe that the traffic during peak hours compromises their capacity to arrive at work or appointments on time (Table 4). This suggests that traffic delays are a common issue that greatly disturbs plans and makes it challenging to keep timeliness (Nellore and Hancke, 2016).

Table 4: Socioeconomic impact of traffic congestion in San Isidro, Nueva Ecija

Items	Drivers/operators		Commuters	
	Mean	VD	Mean	VD
1. Commuter productivity	**3.39**	**SA**	**3.36**	**SA**
Commuting during peak hours in San Isidro negatively affects my ability to arrive at work or appointments on time.	3.32	SA	3.39	SA
Traffic congestion in San Isidro leads to increased stress and frustration during my daily commute.	3.61	SA	3.64	SA
Longer commute times due to traffic congestion result in reduced time available for family and personal activities.	3.47	SA	3.29	SA
The traffic congestion in San Isidro has a negative impact on my overall job performance and productivity.	3.05	A	3.00	A
Delays caused by traffic congestion result in increased transportation costs (e.g., fuel, vehicle maintenance) for my daily commute.	3.53	SA	3.49	SA
2. Local business quality of life	**3.18**	**A**	**3.39**	**SA**
Traffic congestion in San Isidro negatively affects the foot traffic and customer visits to my local business.	3.21	A	3.51	SA
Prolonged traffic congestion results in increased delivery times and costs for my business operations.	3.34	SA	3.49	SA
The quality of life for my employees is negatively impacted by the traffic congestion in San Isidro due to longer commute times and increased stress.	3.42	SA	3.51	SA
My business experiences financial losses due to reduced operational efficiency caused by traffic congestion.	2.97	A	3.22	A
The traffic congestion negatively impacts the overall economic growth and development of my local community, affecting the quality of life for both businesses and residents.	2.97	A	3.21	A
3. Residents' quality of life	**3.00**	**A**	**3.07**	**A**
Traffic congestion in San Isidro negatively impacts my overall daily quality of life, including my ability to enjoy leisure activities and spend time with family and friends.	3.18	A	3.26	SA
My physical health and well-being are affected by the stress and frustration caused by daily traffic congestion in San Isidro.	2.82	A	2.96	A
The time spent stuck in traffic congestion reduces the time I have available for personal and recreational activities.	2.95	A	3.04	A
The increased air pollution due to traffic congestion in San Isidro negatively affects my respiratory health and overall well-being.	3.03	A	3.00	A
Traffic congestion disrupts the sense of community in San Isidro, as it becomes more challenging to connect with neighbors and participate in local events and activities.	3.03	A	3.08	A

VD: Verbal description; 3.25 – 4.00: Strongly agree (SA); 2.50 – 3.24: Agree (A); 1.75 – 2.49: Disagree (D); 1.00 – 1.74: Strongly disagree (SD)

With a mean score of 3.61 for drivers/operators and 3.64 for commuters, traffic jams cause the most stress and annoyance for both groups. This means that the effect of traffic that most people feel might be the mental and emotional stress of long trips (Li et al., 2017). Not only could stress and anger lower well-being, but they might also influence physical and mental health, which could lower output and performance at work and at home (Jeon et al., 2018).

Commuters (mean = 3.29) and drivers/operators (mean = 3.47) both said that longer trip times made it harder to do things with family and friends. This

includes the bigger social and economic costs of traffic, like giving up personal time, which can lower life happiness and lead to problems between work and personal life. Overall, both drivers/operators (mean = 3.05) and commuters (mean = 3.00) agree that traffic makes them less productive at work, though not as much as stress and not having enough free time. This means that traffic does affect how well people do their jobs, but it might not be as immediately annoying as stress or losing personal time (Daniel, 2019).

With mean scores of 3.53 for drivers/operators and 3.49 for riders, both groups finally agree on one thing: delays make transportation more expensive. Because of more gas, vehicle maintenance, and longer journey distances, gridlock makes transportation costs higher, which is a financial burden. This is in line with a recent study, which says that transportation costs are the main thing that affects the bigger economic effects of traffic jams in cities (Li et al., 2022).

Unlike other studies on traffic jams in cities (e.g., Retallack and Ostendorf (2019)), the results for San Isidro show what happens in most growing cities: traffic causes less work to get done, more stress, and higher costs. But because San Isidro is an area that is growing quickly, these problems can get worse for both operators and commuters by making traffic worse. Since traffic congestion still influences the area's economy and society, these results make it clear that better traffic management is needed to lessen its bad effects on the people who live there.

According to Lu et al. (2020), traffic jams make it hard for businesses to run, drive up costs, and lower overall economic output.

From the drivers' and operators' points of view, the most important issues are longer commutes and higher stress levels for workers, which are rated as "Strongly Agree" (mean = 3.34), and longer delivery times and higher prices, which are rated as "Strongly Disagree." People who commute agree that traffic jams are a big problem for businesses. They gave the issue the highest mean scores (3.51 for agreeing strongly that customers are walking less, 3.49 for agreeing that delivery costs have gone up, and 3.51 for agreeing that workers' health is being affected). Both drivers and commuters agree that traffic congestion is bad, but commuters tend to agree more on how it affects business accessibility and employee quality of life (Mina, 2023), and drivers usually agree more on how it affects drivers.

These results add to the body of study that has already been published on the financial effects of traffic jams in cities (Cohen and Cavoli, 2019). Studies have found a link between long-term traffic jams and inefficient supply chains, higher running costs, and fewer customers. All these things help explain why businesses lose money (Wang, 2018). Emre and De Spiegeleare's (2021) study also talks about how traffic congestion hurts people's health by making travel longer, more stressful, and less productive, and by also influencing economic growth. The findings of San Isidro show how traffic hurts local businesses and breaks down the social and economic fabric of society, which is a sign of bigger problems.

Overall, the poll shows that traffic congestion in San Isidro hurts both business operations and quality of life. People who responded agreed that prices go up, commute times get longer, and it's harder to get to work. As Hariram et al. (2023) say, better traffic management and infrastructure development are needed to fix these problems and make the economy stronger. This will also improve the health of people and business owners.

Traffic congestion has a big effect on the quality of life of drivers, business owners, and workers in San Isidro, Nueva Ecija. The study's results bring this to light. Both groups agree that traffic congestion affects many parts of their daily lives, such as their free time, health, and ability to be involved in their community. However, the results show that most people have a negative view of traffic congestion. As shown by the average score of 3.18, which means that drivers and operators agree, traffic delay is seen as a problem that lowers their quality of life. Recent studies (Conceição et al., 2023) have linked long-term exposure to traffic congestion to higher stress, frustration, and lower personal happiness. With an average score of 2.82, the worry and frustration caused by traffic were seen as less severe but still somewhat important to people's health. Transportation studies have linked traffic jams to lower output (Barrios et al., 2023), and the average amount of time people spend stuck in traffic is 2.95 hours per day. This shows how much social and financial stress drivers are under. Researchers have found a link between the amount of traffic and respiratory diseases (Lin et al., 2024) and the view that air pollution is bad for health (mean score of 3.03). Finally, the disturbance of community involvement, which was also scored 3.03, shows that traffic congestion makes it harder for people to connect with each other, which has been seen in studies on social cohesiveness in cities (Buchecker and Frick, 2020).

When it came to the effects of traffic jams, drivers were even more worried. When it came to the general quality of life, their mean score of 3.26 was higher than that of drivers/operators, which suggests that they think traffic makes it harder for them to do everyday things. This means that commuters, who may not be able to change their journey conditions as much as drivers, find traffic more annoying (Higgins et al., 2018). The effect on stress was a bit higher than drivers, at 2.96, which supports research that links passive travel (using public transportation) with higher psychological stress (Norgate et al., 2020). Commuters (3.04 points) said they lost more time in traffic than drivers (2.95 points), which is likely because their journey plans were less flexible and less predictable. Concerning air pollution, the impact on lung health was almost identical between groups (3.00 for commuters vs. 3.03 for drivers), which is in line with research on the effects of bad air quality in cities

(Bakolis et al., 2021). Lastly, commuters (3.08 points) reported a sense of community disruption a bit more than drivers (3.03 points), which suggests that traffic may affect people who rely on public spaces for social contact in a broader sense (Ricci, 2015). A lot of research has been done on the effects of traffic congestion, and these results back that up. Liang et al. (2023) said that traffic congestion causes a lot of social and health problems and costs a lot of money. Commuters and drivers/operators both face the same bad effects, though commuters are more worried about them (Sunio, 2021). This means that better public transportation options, better traffic management, and stricter environmental rules are needed to cut down on pollution and make it easier to get around cities (Bigazzi and Rouleau, 2017). Taking care of these problems is necessary to make San Isidro a better place to live and to improve the general quality of life for its people.

3.3. The effectiveness of the existing traffic mitigation measures in San Isidro, Nueva Ecija

The data in Table 5 shows that commuters as well as drivers/operators in San Isidro, Nueva Ecija, are quite unhappy with the efficacy of the present traffic-reducing strategies. Consistently showing disagreement or significant disagreement with the efficacy of various strategies in enhancing traffic flow, the mean scores, which lie between 1.58 and 2.47, show. From the standpoint of drivers/operators, roadway expansions and infrastructure enhancements have the lowest-rated measure—mean = 1.58, Strongly Disagree—suggesting that these projects have not clearly improved traffic conditions. Likewise, the mean score of 1.74 for the effectiveness of present traffic mitigating measures indicates that congestion is still a regular problem. This is consistent with research on traffic management, where demand-side policies like congestion pricing or improved public transportation (Bagloee and Sarvi, 2017) usually help to relieve congestion even if infrastructure developments by themselves are not usually enough.

Similar opinions abound among commuters; the lowest rating given to infrastructure enhancements and road expansions (mean = 2.47, Strongly Disagree). This suggests that they have not seen any appreciable advantages from these programs, maybe because of poor planning or more vehicle volume balancing any benefits. Especially alarming is the belief that public transit priority measures and dedicated bus lanes have not appreciably improved traffic flow (mean = 2.25, disagree). Studies indicate that giving public transportation a top priority might be a quite successful approach to help to alleviate congestion (Hensher, 2018); nonetheless, its poor appraisal here suggests flaws in either public transport availability or execution.

Table 5: The effectiveness of the existing traffic mitigation measures in San Isidro, Nueva Ecija

Items	Drivers/operators		Commuters	
	Mean	VD	Mean	VD
1. Traffic flow	**1.79**	**D**	**2.22**	**D**
The current traffic mitigation measures in San Isidro effectively reduce congestion during peak hours, resulting in smoother traffic flow.	1.74	SD	2.07	D
Traffic signal synchronization in San Isidro significantly improves the coordination of traffic lights, leading to more efficient traffic flow at intersections.	1.79	D	2.08	D
Roadway expansions and infrastructure improvements, such as wider lanes and additional lanes, have positively impacted the flow of traffic in San Isidro.	1.58	SD	2.47	D
The implementation of dedicated bus lanes and public transportation priority measures has led to smoother traffic flow and reduced congestion on the roads.	2.03	D	2.25	D
Current traffic mitigation measures effectively manage traffic incidents and accidents, minimizing their impact on overall traffic flow.	1.84	D	2.22	D
2. Reduction in congestion	**1.47**	**SD**	**1.67**	**SD**
The current traffic mitigation measures in San Isidro have noticeably reduced the duration of congestion during peak hours, resulting in shorter delays for commuters.	1.55	SD	1.80	D
Roadway expansions and infrastructure improvements, such as new lanes and flyovers, have effectively alleviated congestion at bottleneck areas in San Isidro.	1.39	SD	1.72	SD
The implementation of traffic optimization strategies has led to a noticeable decrease in congestion-related stop-and-go traffic at intersections.	1.50	SD	1.64	SD
Carpool lanes and incentives for ridesharing have successfully reduced the number of single-occupancy vehicles on the road, contributing to congestion reduction.	1.50	SD	1.63	SD
Traffic management practices, such as real-time traffic monitoring and incident response, have led to quicker clearance of accidents and breakdowns, minimizing congestion buildup.	1.42	SD	1.54	SD
3. Cost-efficiency	**1.59**	**SD**	**1.91**	**D**
The current traffic mitigation measures in San Isidro have effectively reduced congestion at a reasonable cost, resulting in efficient use of financial resources.	1.61	SD	1.89	D
Investments in public transportation infrastructure, such as bus rapid transit (BRT) systems, have proven to be a cost-efficient way to mitigate traffic congestion in San Isidro.	1.71	SD	1.99	D
The implementation of congestion pricing or toll systems has effectively generated revenue while reducing traffic congestion in the city, demonstrating a cost-efficient approach.	1.63	SD	1.82	D
The cost-effectiveness of traffic mitigation measures is evident through the reduction in fuel consumption and vehicle operating costs for commuters in San Isidro.	1.50	SD	1.92	D
Current traffic management practices, such as real-time traffic monitoring and adaptive traffic signal control, are a cost-efficient means of optimizing traffic flow and reducing congestion.	1.50	SD	1.91	D

VD: Verbal description; 3.25 – 4.00: Strongly agree (SA); 2.50 – 3.24: Agree (A); 1.75 – 2.49: Disagree (D); 1.00 – 1.74: Strongly disagree (SD)

Moreover, traffic signal synchronization, which is generally acknowledged as a fundamental measure for enhancing intersection efficiency, also got negative comments from both drivers (mean = 1.79, disagree) and commuters (mean = 2.08, disagree). This points to some possible problems with

maintenance or signal timing optimization. Similar inefficiencies in handling road interruptions were shown by poor ratings for traffic incident management solutions (mean = 1.84 for drivers, 2.22 for commuters).

Although still showing disagreement, the comparison study between the two groups demonstrates minor variations in perspective; commuters usually provide somewhat better mean scores (Clark et al., 2020). This implies that although both groups deal with traffic congestion, the inefficiencies in traffic management could be more directly influencing drivers/operators (Malafaia et al., 2024).

The results generally highlight how poor the present traffic control policies are in San Isidro, which calls for a review of the present plans. Literature indicates that a multimodal approach, integrating demand management, well-managed public transportation, and intelligent traffic systems, could be more effective in handling congestion problems. Traffic congestion in San Isidro will probably continue without major improvements, therefore affecting passenger happiness, trip times, and economic activity.

Data on the success of present traffic control strategies in lowering congestion in San Isidro, Nueva Ecija, shows a general view of inefficacy among drivers/operators as well as commuters. With most respondents expressing strong disagreement that these projects have significantly reduced traffic, the mean ratings across all analyzed indicators go from 1.39 to 1.80.

Drivers/operators rated infrastructure upgrades and road expansions lowest (mean = 1.39, strongly disagree), implying that these projects have not been able to reduce traffic at important bottleneck regions. This result is in line with the body of current research, which emphasizes that road extensions by themselves usually generate more vehicle demand, therefore negating the advantages in congestion reduction (Othman et al, 2023). Likewise, other policies, including real-time traffic management (mean = 1.42) and traffic signal optimization (mean = 1.50), were similarly seen as useless. This fits research showing that rather than enhancing flow, bad signal timing and insufficient traffic monitoring might aggravate stop-and-go conditions.

With the mean evaluations substantially higher than those of drivers/operators, commuters reported somewhat more positive but nonetheless generally negative impressions. Although commuters judged the decrease of peak-hour congestion somewhat better (mean = 1.80, disagree), they still strongly disagreed that road extensions (mean = 1.72) or carpool incentives (mean = 1.63) have helped to ease congestion. This implies that even if they might be less annoyed than drivers, they also view traffic control strategies as mainly useless (Mattioli et al., 2020). Emphasizing that effective congestion reduction techniques frequently need an integrated approach including public transit enhancement, traffic demand management, and intelligent transportation systems, literature supports this point of view.

According to Shinar (2017), commuters as well as drivers/operators believe that current policies in San Isidro do not sufficiently solve congestion. Drivers seem to be unhappier, maybe because they are directly impacted by traffic congestion and disruptions. The constantly low ratings for both groups highlight the need to review present traffic control policies (Hopkins and McKay, 2019). Studies show that communities experiencing ongoing congestion gain from all-encompassing solutions, including smart traffic systems, congestion pricing, and better integration of public transportation (Langford et al., 2022). San Isidro's traffic congestion problems are expected to continue without a turn toward more sustainable solutions, therefore compromising general mobility and economic productivity.

The information on the cost-effectiveness of present traffic control strategies in San Isidro, Nueva Ecija, exposes general discontent among commuters as well as drivers and operators. The mean ratings, which range from 1.50 to 1.99, show great disagreement or disagreement on whether the policies have reasonably lowered congestion.

From the standpoint of drivers/operators, all policies were judged as highly unsatisfactory concerning cost-effectiveness. Suggesting that congestion still causes financial constraints on road users, the lowest-rated indicator was the cost-effectiveness of traffic mitigation in lowering fuel usage and vehicle operating expenses (mean = 1.50, strongly disagree). Likewise, in terms of traffic flow relative to their cost, real-time traffic monitoring and adaptive signal regulation (mean = 1.50) were likewise judged as inadequate. Studies indicate that improper integration or maintenance of such technology results in insufficient delivery of the intended advantages, hence wasting expenditures. The lack of perceived cost-efficiency in public transportation investments (mean = 1.71) also shows that present infrastructure developments—such as bus rapid transit (BRT) systems—have not resulted in any obvious congestion relief. This is consistent with studies stressing that poorly thought-out public transportation projects can lack enough ridership to support their expenses (Lowe and Mosby, 2016).

With mean ratings somewhat higher than drivers/operators, commuters revealed fewer negative impressions. They still disagreed, though, that traffic-reducing plans have been financially sensible. Public transportation investments received the highest grade among commuters (mean = 1.99, disagree), implying that although they do not view these investments as totally successful, they may see more possible benefits than drivers. Differences in cost exposure help to explain the lower discontent among commuters compared to drivers; drivers incur direct expenses, including gasoline and vehicle maintenance, whereas commuters may be more

focused on fare affordability and service reliability (Adu-Gyamfi, 2020).

The comparison study highlights a general view that the present traffic control policies in San Isidro do not offer a reasonably affordable way to alleviate congestion. This result complements more general research, pointing to a well-integrated multimodal approach integrating demand-based policies like congestion pricing, intelligent traffic systems, and public transportation upgrades under affordable traffic management. Without improved strategic planning and execution, San Isidro's traffic rules may impose significant economic costs on both road users and the local government, aggravating mobility issues over time.

3.4. Differences in description of socio-economic impact of traffic congestion and effectiveness of current traffic mitigation measures

The Mann-Whitney U test findings show varied opinions between drivers/operators and commuters regarding the socioeconomic effect of traffic congestion in San Isidro, Nueva Ecija (Table 6). Though the p-value of 0.566 shows no statistically significant difference, the mean values for both groups—3.39 for drivers/operators and 3.36 for commuters—indicate a common experience of disturbance due to congestion in terms of commuter productivity. This fits past research showing that traffic reduces worker efficiency and raises travel-related stress.

On the perceived influence on local business quality of life (p = 0.034), however, commuters (mean = 3.39) indicated a greater impact than drivers/operators (mean = 3.18). This implies that, in line with results showing traffic congestion adversely affects business operations and customer access, traffic congestion may disproportionately affect consumers and employees who depend on efficient transit (Wen et al., 2019). Conversely, both groups had similar opinions on the quality of life of the residents (p = 0.504), suggesting a consensus that traffic influences everyday activities and social contacts, but not notably different between groups.

Table 6: Mann-Whitney U test results for testing differences in description of socio-economic impact of traffic congestion and effectiveness of current traffic mitigation measures

Variables	Mean	U-value	p-value	Decision
Commuter productivity				
Drivers/operators	3.39	1349.00	0.566^{ns}	Retained
Commuters	3.36			
Local Business Quality of Life				
Drivers/operators	3.18	1095.50	0.034^{s*}	Rejected
Commuters	3.39			
Residents' Quality of Life				
Drivers/operators	3.00	1333.50	0.504^{ns}	Retained
Commuters	3.07			
Effectiveness of Current Traffic Mitigation Measures				
Traffic flow				
Drivers/operators	1.79	668.00	0.000^{s**}	Rejected
Commuters	2.22			
Reduction in Congestion				
Drivers/operators	1.47	856.00	0.000^{s**}	Rejected
Commuters	1.67			
Cost efficiency				
Drivers/operators	1.59	699.00	0.000^{s**}	Rejected
Commuters	1.91			

s*: significant at 0.05 level; s**: significant at 0.01 level; ns: not significant

About the success of present traffic control strategies, notable variations were found in all the factors. Drivers/operators (mean = 1.79) had a far lower view of traffic flow efficacy than commuters (mean = 2.22) (p = 0.000), implying that those regularly using roads considered congestion management insufficient. With a significant p-value of 0.000, drivers/operators also reported a lower mean than commuters (mean = 1.67), in terms of congestion alleviation. This is in line with research showing that extended congestion causes more annoyance to drivers (Mondschein and Taylor, 2017). Finally, with drivers/operators giving a mean score of 1.59 compared to 1.91 for commuters (p = 0.000), cost efficiency was judged as lacking by both groups. This supports the more general body of research on the economic impact of traffic congestion since inefficiencies increase fuel consumption, vehicle maintenance expenses, and lost productivity (Ercan et al., 2016).

The results show generally that traffic congestion in San Isidro greatly influences local companies, and the apparent success of mitigating strategies is poor. The results support the necessity of stronger traffic management policies, including investment in public transportation, optimal road networks, and better policy execution to reduce congestion and its socioeconomic effects.

3.5. The policy analysis framework

A structured policy analysis framework to systematically evaluate strategies for mitigating traffic congestion in San Isidro is adopted. As summarized in Table 7, the framework encompasses five key stages: defining the problem, identifying affected stakeholders and their interests, formulating policy objectives, proposing alternative solutions, and evaluating these alternatives using criteria such as effectiveness, cost efficiency, equity,

feasibility, and public acceptance. This structured approach ensures that the proposed policies are evidence-based, context-specific, and aligned with the needs of various groups, including drivers, commuters, business owners, local authorities, and the general public.

4. Conclusion and recommendations

This study reveals that traffic congestion in San Isidro, Nueva Ecija, is not merely a matter of volume, but a symptom of deeper systemic issues in infrastructure, governance, and public behavior. The identification of critical hotspots—specifically the National Highway, Población Intersection, and San Isidro Public Market—highlights how urban bottlenecks emerge from the intersection of rising vehicular demand and stagnant infrastructure development.

The findings also reveal a disjoint between traffic realities and the policies intended to address them. While congestion is perceived similarly in its outcomes by both drivers/operators and commuters, lost productivity, elevated stress, and declining quality of life, the Mann-Whitney U test shows a statistically significant difference in their assessment of policy effectiveness. This divergence points to uneven experiences of enforcement, mobility, and access, and highlights the failure of existing traffic measures to resonate with or respond equitably to different user groups.

Table 7: The policy analysis framework

Framework component	Sub-element	Description / key details
1. Problem definition	Issue	Chronic congestion during peak hours causing productivity loss, business disruption, and higher transport costs.
	Scope	National Highway, Población Intersection, San Isidro Public Market.
2. Stakeholder identification	Affected groups	Drivers/operators, commuters, business owners, residents.
	Local government units	Effective traffic control, economic growth, infrastructure efficiency.
	Drivers/operators	Reduced delays, lower fuel / maintenance costs.
	Commuters	Timely arrival, lower stress, better transport access.
	Business owners	Reliable delivery schedules and customer accessibility.
	Traffic enforcement units	Improved compliance and faster incident response.
	Urban planners	Sustainable infrastructure and urban mobility.
	General public	Health, well-being, and improved quality of life.
3. Policy objectives		• Reduce peak-hour traffic and travel delays • Improve road infrastructure and signal efficiency • Enhance public transport reliability • Promote shared / non-motorized mobility • Lower socioeconomic burdens (stress, costs, lost time).
4. Policy alternatives	A. Infrastructure expansion	Road widening, flyovers, pedestrian overpasses.
	B. Smart traffic systems	Adaptive signal control, real-time traffic monitoring.
	C. Demand management	Car-pool incentives, congestion pricing, variable parking rates.
	D. Public transport enhancement	Dedicated lanes, improved PUV scheduling, subsidies for fleet expansion.
	E. Strict enforcement and public campaigns	Anti-illegal-parking drives, vendor relocation, commuter education.
5. Evaluation criteria	Effectiveness	Reduction in congestion levels and travel time.
	Cost-efficiency	Implementation cost vs. improvement in flow / safety.
	Equity	Benefits distributed across socioeconomic groups.
	Political feasibility	Stakeholder support and ease of policy adoption.
	Environmental impact	Reduced emissions, improved air quality.
	Public acceptance	Survey-based approval from residents and commuters.
6. Data-driven decision support	Least-effective measures	Signal synchronization, road expansions, public-transport incentives (mean 1.58–2.47).
	Strong public concerns	Mental-health impact, commuting time, business disruption (mean 3.29–3.64).
	Policy implication	Focus on integrated solutions (smart systems + public transit + enforcement) rather than isolated infrastructure projects.
7. Policy recommendations		1 Traffic-signal optimization (real-time monitoring, dynamic phasing). 2 Dedicated PUV lanes to reduce dwell time. 3 Congestion-pricing pilot to discourage single-occupancy vehicles. 4 Sidewalk & pedestrian-zone expansion. 5 Establish a policy-monitoring unit for data-based evaluation.
8. Monitoring and evaluation framework	Indicator	Frequency
	Traffic volume (vehicle count on key roads)	Monthly
	Public satisfaction (commuter/driver surveys)	Quarterly
	Transit ridership (PUV passenger count)	Monthly
	Enforcement efficacy (violations reported vs. resolved)	Bi-annually
	Cost-benefit ratio (cost per minute saved per user)	Annually

Critically, the study surfaces not just dissatisfaction with current mitigation efforts but a collective perception of ineffectiveness and inefficiency in addressing traffic flow and cost-related concerns. These sentiments, backed by both qualitative observations and quantitative metrics, suggest that the current approach is reactive rather than strategic, fragmented rather than integrated.

The imperative, therefore, is not just to improve traffic flow, but to rethink traffic governance through an evidence-based, multidimensional policy lens. Adopting the proposed policy analysis framework, which prioritizes stakeholder alignment, cost-benefit rationality, and sustainable urban mobility, offers a pragmatic yet transformative path forward. This framework moves beyond stopgap measures and

focuses on long-term, systemic solutions that address both the physical and social dimensions of congestion. In essence, solving San Isidro's traffic congestion is not solely a technical challenge but a governance and equity issue. The future of urban mobility in the municipality depends on coordinated policy innovation, inclusive stakeholder engagement, and data-driven decision-making, factors essential for fostering a more livable, productive, and resilient local environment.

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Compliance with ethical standards

Ethical considerations

Prior to participation, all respondents were informed about the purpose of the study, and their voluntary participation was ensured. Informed consent was obtained, and respondents were assured of anonymity and confidentiality of their responses.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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