TRAFFIC DENSITY OF SUNAN KUDUS ROAD IN RELATION TO HIGH ACTIVITY LEVELS AT MENARA KUDUS MOSQUE

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ABSTRACT: *Kudus is a hub of Islamic culture, featuring landmarks like the tomb of Sunan Kudus and the Menara Kudus Mosque, making it a key destination for tourism and pilgrimage. This study focuses on Sunan Kudus Road, a vital thoroughfare in Kudus town, heavily used by locals for commuting and connecting to areas like Jepara. The road serves both private vehicles and public transportation, including buses, mini-buses, and angkot (public minivans). It is also the main route for locals and tourists heading to the Menara Kudus Mosque. Additionally, Sunan Kudus Road functions as a parking area for vehicles and a designated lane for motorcycle taxis (ojek), facilitating transportation for pilgrims and tourists. The study examines the road network around Jalan Sunan Kudus, highlighting its role as a central point for various vehicles, resulting in congestion and high density. These findings provide insights into the challenges and opportunities for urban planning and transportation management in Kudus Regency.*

Keywords: *high activity area, Kudus City, Menara Kudus Mosque, traffic density.*

INTRODUCTION

Nestled in the heart of Central Java, Indonesia, Kudus Regency stands as a cultural and historical gem, luring visitors with its rich Islamic heritage, notably the revered tomb of Sunan Kudus and the Menara Kudus Mosque. Amidst this cultural tapestry, Sunan Kudus Road emerges as a vital lifeline, connecting locals to neighboring areas and serving as the main artery leading to the esteemed Menara Kudus Mosque.

This study seeks to unravel the complexities of Sunan Kudus Road's traffic dynamics, with a particular focus on exploring factors contributing to its notable traffic density. Drawing inspiration from urban planning theories, especially Kevin Lynch's influential work "The Image of the City," which delves into the perceptual aspects of urban environments, our goal is to delve into how the design and perception of Sunan Kudus Road influence its traffic patterns.

Applying Lynch's idea of legibility, where the physical layout of a city affects navigation and understanding, we'll assess how Sunan Kudus Road's design impacts traffic flow. By examining the road's legibility, we aim to enhance our understanding of the intricate relationship between urban form and transportation dynamics in Kudus Regency.

Furthermore, this study aligns with Lynch's concept of paths, edges, districts, nodes, and landmarks as pivotal elements in urban design. As we scrutinize Sunan Kudus Road, we'll investigate how these urban design elements contribute to or alleviate traffic density. Through this exploration, we aspire to contribute not only to the local conversation on sustainable urban development but also to the broader theoretical framework of urban planning as articulated in "The Image of the City."

In light of our findings, we propose a redesign of Sunan Kudus Road, transforming it into a one-way thoroughfare and optimizing the area's routes to create a more efficient road network, especially during peak hours. This proactive measure aims to address the observed increase in traffic density and contribute to a smoother and more sustainable urban transportation system in Kudus Regency



Figure 1 Menara Kudus Mosque
Source: Author, Field Survey

LITERATURE REVIEW

Traffic density is how many cars are on a road or in an area. It tells us if the road is crowded or not. High traffic density means lots of cars, which can make driving slower and cause traffic jams. It helps planners figure out how well the roads are working and if changes are needed to make traffic flow better.

High traffic density is a situation where traffic flow is slowed down or even stopped due to the high number of vehicles exceeding the road capacity. Congestion is prevalent in large cities, especially those lacking efficient public transportation or experiencing an imbalance between road demand and population density (Dedy Arif, 1987).

The traffic characteristics according to Clarkson H. Oglesby and R. Gary Hicks (1993) are as follows:

Table 1 Traffic characteristics

Level of Services	Traffic Characteristics	Score
A	Free-flow conditions with high speeds and low traffic volume. Drivers can choose their desired speed without impediments.	0,00 – 0,19
B	In this zone, the flow is stable, and drivers have sufficient freedom to maneuver. Within this stable flow zone, drivers are constrained in choosing their speed.	0,20 - 0,44
C	In this zone, the flow is stable, and drivers are restricted in choosing their speed.	0,45 - 0,69
D	Unstable flow, where almost all drivers are constrained in their speed, and traffic volume is nearly approaching road capacity but still acceptable.	0,70 - 0,84
E	Traffic volume is approaching or at the capacity, resulting in unstable flow and frequent stops.	0,85 - 0,99
F	Forced flow characterized by either very low speeds, significant congestion, or very long queues with numerous obstacles.	1,00+

Source : Clarkson H.Oglesby dan R. Gary Hicks

The Level of Service (LOS) for a road segment, commonly abbreviated as LOS, refers to a comparison made between the traffic volume and the road's capacity. This concept involves the consideration of two contradictory factors: the average speed and the traffic volume. In instances of low traffic volume, vehicles generally maintain a higher average speed, while in situations of high traffic volume, vehicles exhibit a higher average spatial speed. The assessment of the level of service takes into account this dynamic interplay between traffic volume and average speed, providing an evaluation of the overall efficiency and quality of traffic flow on a specific road segment.

As per the definition provided by Clarkson H. Oglesby and R. Gary Hicks in 1993, congestion on a road segment is identified when the level of service surpasses 0.7 or falls within the classification of level D service. This particular service level is characterized by an array of features, including unstable traffic speeds, drivers constraining their speed, diminished opportunities for overtaking, and traffic volume that is nearly reaching the road capacity yet remains acceptable for the short term. The magnitude of the level of service value serves as an indicator of the severity of traffic congestion on the respective road segment, with higher values signifying more pronounced congestion issues.

As per Miro (2004), the varied and multifaceted activities of urban inhabitants manifest in their daily travel patterns. During specific intervals, such as peak hours, these travel patterns become diverse due to the array of activities taking place. The distinctions in urban residents' activities underline the need for a transportation system offering services with multiple origins and destinations. Miro (2004) classifies the activities of urban residents into:

1. Activities of the population related to space include:
    a. Population Growth
    b. Urbanization
    c. Land use planning and regional development
2. Activities of the population associated with resources (needs) are manifested through economic activities aimed at improving well-being, including:
    a. Production effort
    b. Consumption patterns
    c. Distribution (trade)
3. Activitiees of the population linked to family symbols include:
    a. Family relationship (community)
    b. Education
    c. Health
    d. Religion
    e. Recreation

Ari Putranto (2001) explains that traffic flow can occur due to a process of meeting life needs, involving:

1. Decision-making to undertake a journey
2. Determaining the destionation of journey
3. Selection the mode of transportation for the journey
4. Choosing the route for the journey
5. Choosing the route for the journey
6. Deciding when the journey will take place

Kevin Lynch's book "Image of the City", offers valuable insights into urban navigation. Lynch contends that individuals create mental maps of the city, focusing on key elements like paths, edges, districts, nodes, and landmarks. These elements contribute to the legibility of a city, influencing how people perceive and move within it. Applied to traffic and urban

planning, Lynch's theory suggests that a city's legibility, characterized by clear paths, recognizable landmarks, and well-defined districts, plays a crucial role in efficient wayfinding and traffic management. A city with a clear structure and identifiable features may contribute to smoother traffic flow, while an unclear or disorganized urban layout could lead to navigation challenges and potential traffic-related issues. Integrating Lynch's insights into urban planning facilitates the creation of environments that enhance both the visual experience and practical efficiency for residents and commuters alike.

RESEARCH FRAMEWORK

This research begins with an observation of issues closely related to transportation problems, specifically traffic congestion in Sunan Kudus Road, Kudus City, and the dominant factors associated with the situation of traffic congestion in Sunan Kudus road area. The objectives of this study are a) To identify the level of traffic congestion in Sunan Kudus Road, b) To understand the factors influencing congestion in Sunan Kudus Road, c) To assess whether the land use factors in the research area coply with applicable regulations.

The research methodology involves several stages, including field surveys, identification of land use related to traffic congestion issues in the research area, and an assessment of existing road needs.

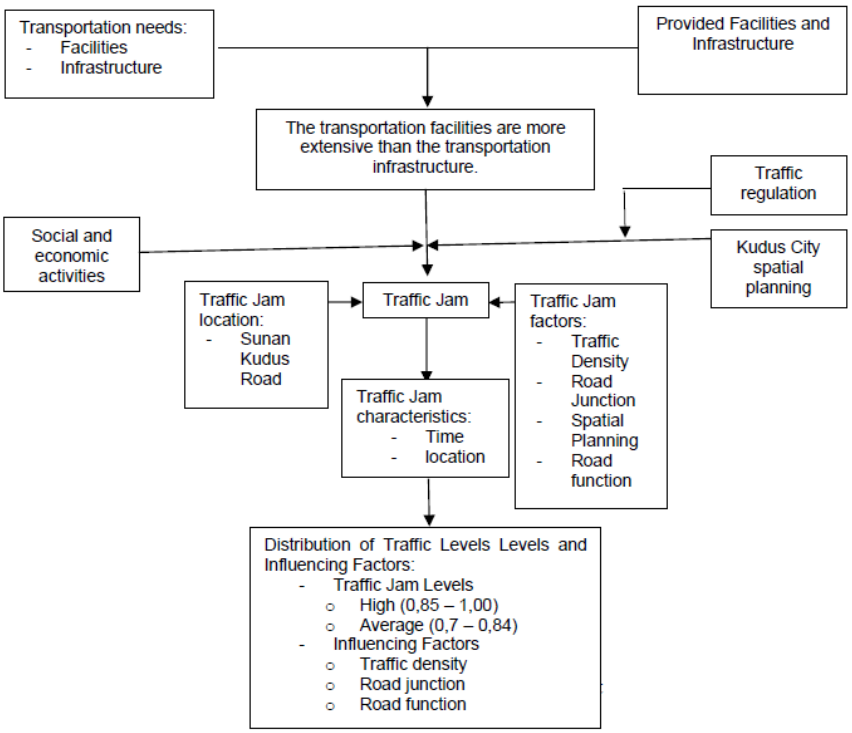


Figure 2 Research Framework
Source: Author

RESEARCH METHOD

This study uses a qualitative method and using Kevin Lynch theory from the books "The Images of The City". The primary data is taken from the survey and observation on the 16th-17th of September and 9th of November. While the secondary data is taken through a literature review.

The first survey conducted involved the selection of the observation area, specifically the Sunan Kudus road area with a radius distance of 200 meters from the intersection of Sunan Kudus Road (the main observation point) between Menara Road and Kyai Telingsing Road towards the east and west. It was followed by observations on the connecting roads that

lead to Sunan Kudus Road. The last step involved observing the time and road density at the main point of observation.



Figure 3 Sunan Kudus Road & Observation Area
Source: Google Maps (2023)

In 16th - 17th September and 9th of November we do survey to Masjid Kudus, Kudus City. Collecting the data which are site condition, vehicle behavior, parking area, and access to Sunan Kudus Road



Figure 4 Sunan Kudus Road Condition and Traffic Density.
Source: Author, Field Survey

This survey was carried out to achieve the research objectives. Through the observations, several factors were identified as contributors to traffic density, consequently leading to congestion.

RESULT AND DISCUSSIONS

From the conducted observations, several factors contributing to the congestion on Sunan Kudus Road were identified:

1. Numerous connecting roads leading to Sunan Kudus Road, resulting in a high influx of vehicles. Various types of vehicles enter Sunan Kudus Road, including private vehicles such as cars and motorcycles, as well as public transportation like minibusses, motorcycle taxis (gojek), buses, and trucks. This factor has a significant impact due to the dimensions of public transport vehicles, such as minibusses, buses, and trucks, which occupy a considerable road space.

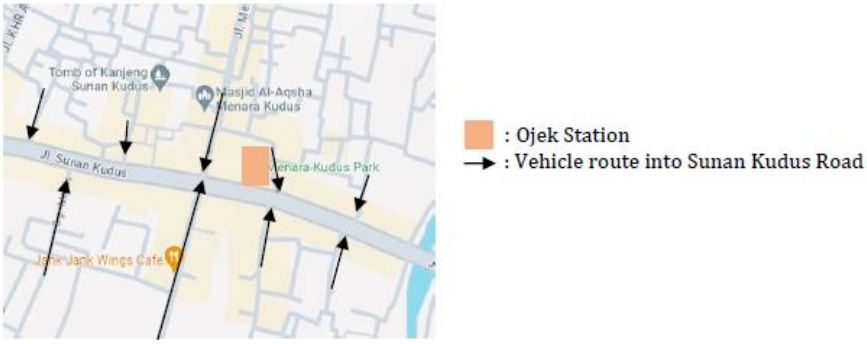


Figure 5 Connecting roads leading to Sunan Kudus Road
Source: Author, Field Survey

2. Increasing visitors during specific hours, namely from 9-11 am, 1-4 pm, and 6-9 pm.



Figure 6 Masjid Menara Kudus visitors in peak hours
Source: Author, Field Survey

3. Abundance of parked vehicles on the road, narrowing the space and making it insufficient for the high volume of passing vehicles.



Figure 7 Sunan Kudus Road side used as parking area.
Source: Author, Field Survey

4. Sunan Kudus Road serves as a two-way route from the east and from the west. Although there are regulations prohibiting four-wheeled vehicles from heading west, when the number of visitors to the Menara Kudus Mosque increases, this road becomes highly ineffective as a two-way route.

Sunan Kudus Road is a key street for the local community, used for various activities and daily travel. Its central location in Kudus makes it an important path for people heading to the town square. Moreover, as it connects to the main road from Kudus to Jepara, it serves as a main entry point for vehicles coming from Jepara. Ensuring smooth traffic flow on

Sunan Kudus Road is crucial given its significant role in daily commuting and transportation.

Based on the survey and observations, it has been identified that the traffic density on Sunan Kudus Road is notably high, leading to frequent congestion, particularly in the vicinity of the Masjid Menara Kudus intersection that has a high activity such as pedestrian crossing, vehicle entrance into Sunan Kudus Road, and near the Ojek drop and pickup station. It can be said that Sunan Kudus Road has a E & F Level of Service in terms of Traffic Characteristics according to Clarkson H.Oglesby dan R. Gary Hicks, it can be proven from the high rate of the density in Sunan Kudus Road from the photos or the data that has be collected.

Table 2 Traffic Characteristics for Sunan Kudus Road

Level of Services	Traffic Characteristics	Score
E	Traffic volume is approaching or at the capacity, resulting in unstable flow and frequent stops.	0,85 - 0,99
F	Forced flow characterized by either very low speeds, significant congestion, or very long queues with numerous obstacles.	1,00+

Source: Author (according to **Tabel 2**)

RECOMMENDATION AND CONCLUSION

As a recommended solution, a proposed alteration involves reorganizing the flow or direction of Sunan Kudus Road and its surrounding streets. Transforming Sunan Kudus Road into a one-way street heading east (towards Alun-Alun Kudus) could alleviate congestion in the Masjid Sunan Kudus area. By eliminating the flow of vehicles from east to west, Sunan Kudus Road would have increased width, and traffic would be directed in a singular westward direction.

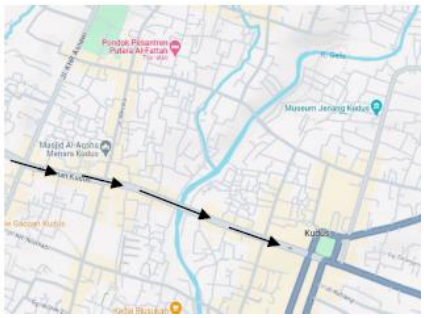


Figure 8 Recommendation flow changes
Source: Author

Streets, as vehicles entering and exiting would follow the same direction. Additionally, it would simplify pedestrian crossings, as they would only need to focus on one direction—vehicles coming from the west to the east.Drawing inspiration from a case study in Yogyakarta, where Mayor Suryotomo Street was originally a two-way road from north to south, similar to Sunan Kudus Road, and served as a parking area, causing road narrowing. In 2018, the Yogyakarta government transformed Mayor Suryotomo Street into a one-way road from south to north. This change had a significant impact, eliminating congestion on the street. This case study illustrates that altering a road from two-way to one-way can have positive effects on a street central to community activities, reducing congestion caused by roadside parking and facilitating pedestrian movement.



Figure 9 St. Mayor Suryotomo before and after
Source: https://jogya.com (2021) & Google Lens

In conclusion, the findings from the survey and discussion underscore the pressing issue of high traffic density leading to frequent congestion on Sunan Kudus Road, particularly around the Masjid Menara Kudus intersection. The observed factors contributing to this congestion include the influx of vehicles from various connecting roads, heightened visitor numbers during specific time intervals, the challenge posed by parked vehicles along the road, and the bidirectional flow of Sunan Kudus Road. These factors collectively create a complex traffic scenario that warrants careful consideration and strategic interventions to enhance the efficiency of this vital urban thoroughfare.

As a potential solution, the recommendation to transform Sunan Kudus Road into a one-way street heading east demonstrates promise in mitigating congestion. Drawing inspiration from successful cases such as the transformation of Mayor Suryotomo Street in Yogyakarta, this proposed alteration aims to improve traffic flow, reduce the challenges posed by parked vehicles, and enhance pedestrian safety. By aligning with the principles of urban planning, especially Kevin Lynch's emphasis on the legibility and organization of urban spaces, this recommendation strives to create a more navigable and efficient transportation infrastructure in Kudus Regency. It is imperative that these proposed changes undergo further evaluation and collaboration with relevant stakeholders to ensure their feasibility and effectiveness in addressing the identified traffic challenges on Sunan Kudus Road.

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