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EFFECT OF LAND UER ON PROVINCIAL ROAD PERFORMANCE THE CITY OF PALU

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ABSTRACT

Land use that is not integrated with the transportation system has a significant impact on the performance of roads in the province. Trade and service activities such as shopping centers, restaurants, workshops, and educational and religious facilities that are not supported by supporting infrastructure such as pedestrians or road shoulders, cause disruption to traffic flow. This study aims to analyze fluctuations in traffic volume and the impact of land use on road performance, using the Indonesian road capacity guidelines (PKJI) 2023 approach. The results showed that Jl. I GustiNgurah Rai experienced the highest traffic fluctuation at the end of the month at 3750 kend/hour, Jl. Sis Aljufri at the beginning of the month amounted to 3492 kend / hour, and Jl. Towua in the middle of the month amounted to 4621 kend / hour. The highest degree of saturation is found on Jl. Towua (0.69,69-0.78), while the lowest on Jl. Sis Aljufri (0.25–0.27). The highest free flow speed is recorded on Jl. Sis Aljufri (57.94,94 km / h), while the highest level of Service (LOS B) is also located on this road. Instead, Jl. Towua shows the lowest level of service with LOS D. The findings underscore the need for land-use realignment and improvements in supporting infrastructure to improve overall road performance.

KEYWORDS: *Land Use, Traffic Volume, Road Performance, CLA 2023, Degree of Saturation, Servant Level*

Article History

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INTRODUCTION: PREDECESSORAN

Provincial roads are an important infrastructure that serves as a transportation infrastructure that connects various areas within a province. The performance of provincial roads largely determines the efficiency and affectivity of transportation in the region. However, in recent years there have been various problems that arise along with the rapid economic development resulting in increased potential that causes the movement of people and goods.

This area has different location roads namely Jalan Sis Aljufri, Jalan I Gusti Ngurah Rai, and Jalan Touwa. It causes movement from one place to another, not only local movement but also movement between regions. The rapid development of the city of Palu makes people who pass through the road to the city center. Although it has the same road function, but the type of SIS Aljufri road, I Gusti Ngurah Rai Road, and Touwa Road are different. Dimana Jalan Sis Aljufri 4/2 TT, Jalan I Gusti Ngurah Rai 2/2 TT, danJalan Touwa 2/2 TT. These conditions can result in different road performance values and Road service levels.

Land use has a close relationship with transportation, this is because land use both in the present and in the future is an input to transportation planning designed to serve people, companies, and other institutions in other words land use makes the desire to move (Kaiser *etal.,* 1995).

RESEARCH METHODS

Research Location

The location of this study is located on the road I GustiNgurah Rai, Sis Aljufri, and Touwa, a road whose land use is mixed use in the form of land use trade and services, settlements, undeveloped land and plantations. Trade and service areas are more dominant along the roads of the specified location as seen in the picture below.

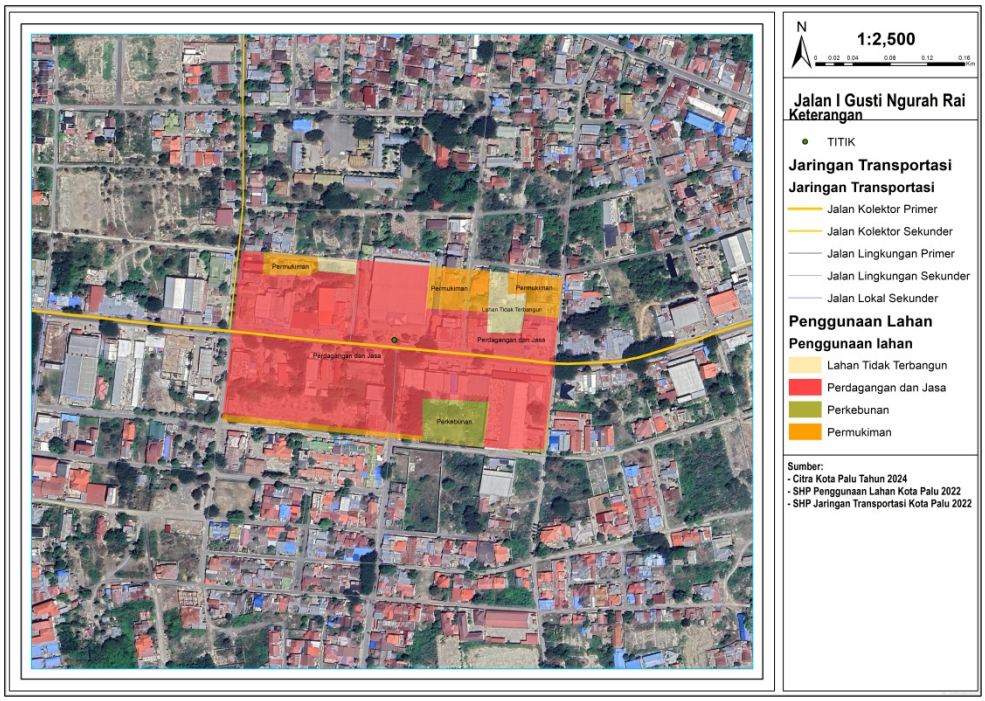

Figure 1: Location Penelitian Jl. I Gusti Ngurah Rai

From Figure 1.it can be seen that Jl. I GustiNgurah Rai is 2.43 km long. with the percentage of land use taken as far as 200 m left and right in 5 years trakhir can be seen in Table 1.

Chart 1: Percentage of Land Use. I Gusti Ngurah Rai

Land use	Percentage/%		
	2020	2021	2022
Undeveloped Land	15.25	15.25	4.16
Trade and Services	66.25	66.25	79.35
Plantation	4.46	4.46	5.08
Settlement	14.02	14.02	11.4
Total	100		

Source: *Palu City Transportation Network 2022*

Land use on these three roads has a variety of land use, which can attract a lot of traffic vehicles generally trade and services with the highest percentage.

DATA RETRIEVAL TECHNIQUES

The Data needed in this study are primary data and secondary data. Primary Data obtained directly through field surveys, while secondary data obtained by collecting from Related Agencies and previous studies.

Data Retrieval Time

Survey conducted simultaneously at each location is carried out during the period of the beginning of the month, mid-month, and end of the month. With a range of execution time for 16 hours / day. With this time will be obtained data on traffic Volume fluctuations to determine changes in the ups and downs of traffic Volume at a predetermined hour in the area of trade and services.

Direct Observation

The survey team consists of 2 people to monitor the traffic Volume directly, 2 people to measure the average speed, and to record the activitiesof the side hustle and bustle. There are 4 people in each location. It can be done using a note sheet/form that has been provided or a simple electronic device such as a calculator or timer.

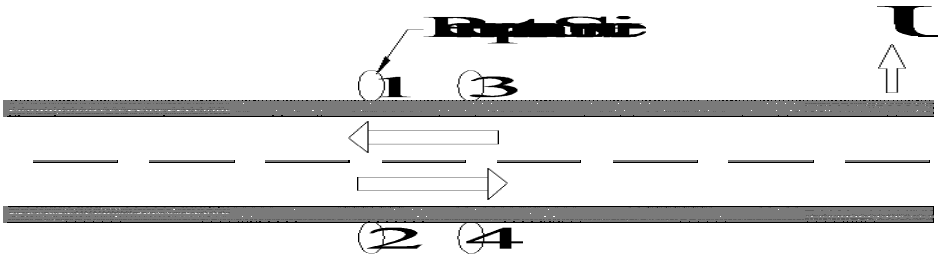

Figure 2: Survey Placement Sketch Description.

Description

1. monitoring right - of-way traffic
2. monitoring traffic in the left lane of the road
3. retrieves average speed data and side drag data
4. Retrieves average speed data and side drag data

RESULTS AND DISTINCTIONS

Data Processing

Traffic volume survey data for 16 hours in (kend/hour) will be converted into units of passenger cars per hour (smp / hour) after the results are multiplied by the passenger car equivalence factor (EMP).There are overall results of traffic volume data at peak hours can be seen in Table 3.

Chart 3: Results of Data Processing Traffic Volume at Peak Hours

Location	Survey Time			Peak Hours	Total Peak Hour	
	Beginning of Month	Middle of Month	End of month		Kend /Jam	Smp / jam
Jl. I GustiNgurah Rai	✓			07.00 - 08.00	3329	1358
		✓		16.30 -17.30	2886	1237
			✓	07.00 - 08.00	3750	1588
Jl. Sis Aljufri	✓			06.45 - 07.45	3492	1215
		✓		06.45 - 07.45	3377	1271
			✓	12.30 - 13.30	2527	1126
Jl. Towua	✓			06.45 - 07.45	4275	1620
		✓		06.45 - 07.45	4621	1778
			✓	06.45 - 07.45	4252	1575

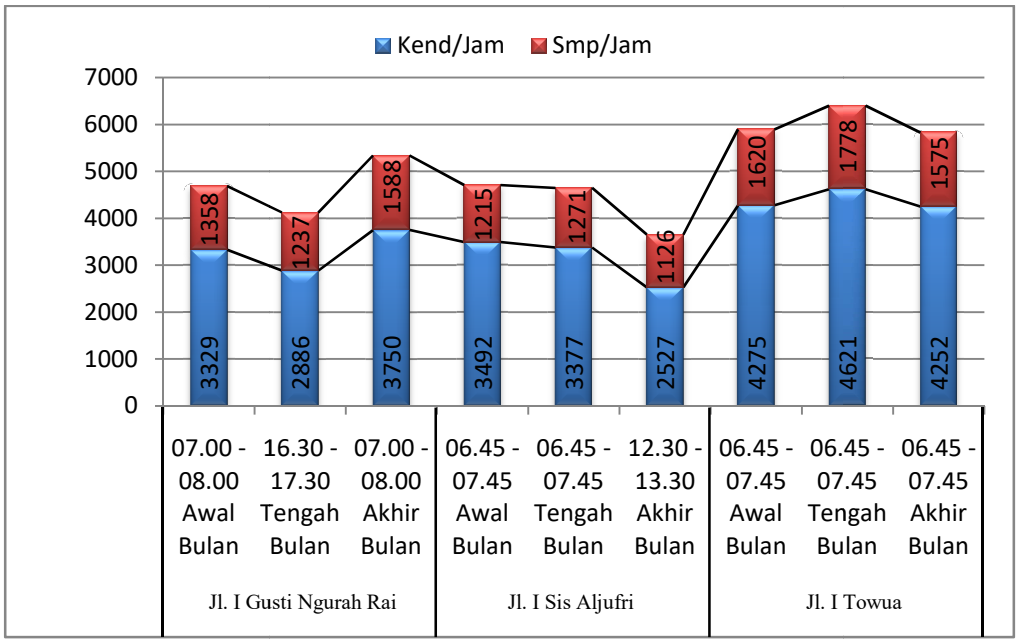

Figure 2: Graph Of Traffic Volume At Peak Hours

Overall, the comparison of these three roads shows that the level and stability of traffic volume is strongly influenced by the intensity and continuity of land trade and services functions**.** Therefore, the comparison of traffic volume and land use characteristics can be seen in Table 4.

Chart 4: Comparison of Traffic Volume and Land Use Characteristics

Road	Section Beginning of Month (Kend/HR)	Middle of Month (Kend/HR)	End of Month (Kend/HR)	Fluctuation Pattern	Of Land Use Character
Jl. I GustiNgurah Rai	3.329	2.886	3.750	down → up	trade and services with periodic activities
Jl. Sis Aljufri	3.492	3.377	2.527	Down → Down	trade and services with decreasing intensity
Jl. Towua	4,275	4,621	4,252	Up → Down Light	trade and services with steady activity

Side Obstacle Data

Side obstacles observed include pedestrian activity, stopped vehicles, vehicles in and out, as well as slow vehicles can be seen in Table 5.

Chart 5: Data Side Barriers on Three Time Periods Jl. I GustiNgurah Rai

Observation	Peak Hour	Activity Side Street			
		Pedestrian Pedestrian	Vehicle Stop / Park	Vehicle In and Out	Of Vehicle Late
Start of Month	06.45 - 07.45	22	40	984	56
Middle of the Month	16.30 - 17.30	129	96	935	53
End of Month	07.00 - 08.00	109	97	1081	53

From table 5, it can be seen that the most dominant type of side barriers are vehicles in and out, with the highest number recorded at the end of the month as many as 1081 events, followed by the beginning of the month as many as 984 events, and the middle of the month as many as 935 events. This shows that the activity in and out of the vehicle from / to the roadside area is a major factor in the disruption of traffic flow at the study site.

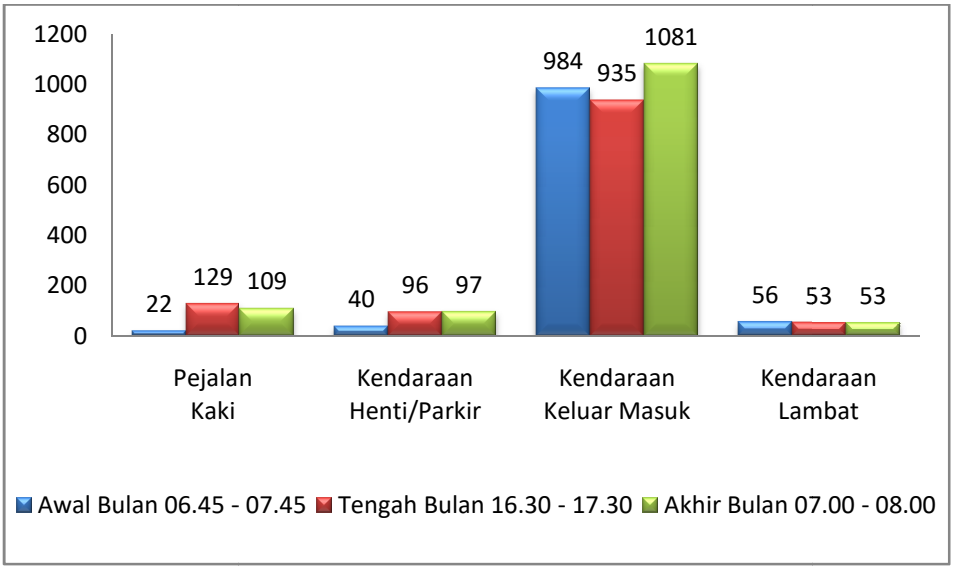

Figure 3: Side Resistance Chart on Three Time Period Jl. I GustiNgurah Rai.

Vehicle Speed Data

Vehicle speed Data is a measurement of the speed of vehicles passing through each road section along 200 m research sites to measure the speed of each type of vehicle motorcycles (SM),passenger cars (MP), medium vehicles (KS) large buses (BB),and large trucks (TB).Vehicle speed Data obtained will be processed to produce an average speed that represents the real conditions of traffic flow in the field.berikut can be seen in Table 6. HasiL processed the average speed of the vehicle.

Chart 6: HasiL Processed Vehicle Average Speed

Location	Survey time			Average Speed (SM)	Average Speed (MP)	Average Speed (KS)	Average Speed (BB)	Average Speed (TB)
	Beginning of Month	Middle of Month	End of Month					
Jl .IgustiNgurah Rai	✓			36.57	24.88	18.63	17.31	16.65
		✓		27.31	24.01	20.64	18.09	17.81
			✓	28.84	26.82	20.57	0.00	0.00
Jl. Sis Aljufri	✓			36.66	28.79	28.99	0.00	0.00
		✓		35.08	29.22	19.19	21.07	19.43
			✓	34.03	27.26	21.14	0.00	0.00
Jl. Towua	✓			34.76	29.15	21.61	18.07	18.16
		✓		32.66	31.21	23.35	0.00	18.21
			✓	37.24	33.74	30.02	0.00	0.00

The results of this average speed calculation will later be compared with the standards set out in the Indonesian road capacity guidelines (PKJI 2023).

ROAD PERFORMANCE ANALYSIS

Road performance analysis was carried out using the Indonesian road capacity guidelines (PKJI 2023), on urban roads where on three main roads, namely Jl. I GustiNgurah Rai, Jl. Sis Aljufri, and Jl. Touwa, which is a provincial road. So that the capacity value of these three roads can be seen in Table 7.

Chart 7: Rated Capacity of Three Roads

Lokasi	*Co*	*FCLJ*	*FCPA*	*FCHS*	*FCUK*	*C*
Jl .IgustiNgurah Rai	2800	1.25	1.00	0.85	0.90	2677.50
Jl. Sis Aljufri	6800	0.92	1.00	0.85	0.90	4785.84
Jl. Towua	2800	1.25	1.00	0.72	0.90	2268.00

From Table 7. seen the capacity of each research site is different to determine the value of the degree of saturation (Dj), by dividing the volume of traffic at peak hours with road capacity.The results of the calculation of the degree of saturation (Dj), on each of the three roads can be seen in Table 8.

Chart 8: The Result of Calculating the Degree of Saturation on Three Roads

Location	Survey Time			Peak Hour	Volume Junior High School / hour	Capacity C (Junior High School/hour)	Saturation Degree (Dj)
	Beginning of Month	Middle of Month	End of Month				
Jl .IgustiNgurah Rai	✓			07.00 - 08.00	1358	2677.5	0.51
		✓		16.30 - 17.30	1237	2677.5	0.46
			✓	07.00 - 08.00	1588	2677.5	0.59
Jl. Sis Aljufri	✓			06.45 - 07.45	1215	4785.8	0.25
		✓		06.45 - 07.45	1271	4785.8	0.27
			✓	12.00 - 13.00	1126	4785.8	0.24
Jl. Towua	✓			06.45 - 07.45	1620	2268.0	0.71
		✓		06.45 - 07.45	1778	2268.0	0.78
			✓	06.45 - 07.45	1575	2268.0	0.69

From the calculation of the degree of saturation (Dj) obtained the highest Dj value of 0.78 on Jl. Touwa middle of the month it is that the closer the value of 1 in Dj, the greater the negative influence on the capacity of the road. The lowest Dj is 0.24 on Jl. Sis Aljufri end of the month, it is that the capacity on the road is still effective and able to serve the vehicle well.

Chart 9: Free Flow Velocity in Three Jaln Segments

Lokasi	Kecepatan Arus Bebas Dasar V_{BD} (Km/Jam)	LebarJalur V_{BL} (Km/Jam)	Hambatan Samping F_{VBHS}	Ukuran Kota F_{VBUK}	Kecepatan Arus Bebas$_{MP}$ V_{BMP}
Jl .IgustiNgurah Rai	44	4	0.85	0.93	47.06
Jl. Sis Aljufri	61	- 4	0.85	0.93	57.94
Jl. Towua	44	4	0.72	0.93	46.59

It Seems That the Service

In the PKJI 2023 standard (Indonesian road capacity guidelines), the level of road service is determined based on the range of saturation degree values (Dj) as follows:

Chart 10: Service Level in Three Roads

Location	Time Survey	Degree of Saturation (DJ)	Service Level (LOS)
Jl. I GustiNgurah Rai	Beginning of Month	0.51	C
	Middle of Month	0.46	C
	End of Month	0.59	C
Jl. Sis Aljufri	Beginning of Month	0.27	B
	Middle of Month	0.24	B
	End of Month	0.29	B
Jl. Touwa	Beginning of Month	0.60	C
	Middle of Month	0.78	D
	End of Month	0.69	C

The Relationship of Road Performance and Land Use

Road performance is an important indicator in assessing how well a road section can accommodate the flow of traffic passing on it. One of the main factors affecting road performance is the use of land around the area**,** especially areas with trade and service functions**.**

Relationship of Service Level and Land Use

The level of road service or level of Service (LOS) is an important indicator in assessing the traffic performance of a road section. LOS is determined based on the degree of saturation value (Dj), which is the ratio of traffic volume to road capacity. In the context of trade and service areas, traffic activity tends to be higher due to the constant intensity of movement of people and goods.

- Jl. I GustiNgurah Rai, the degree of saturation values ranged from 0.46-0.59during the observation period, with a continuous level of service at LOS C.LOS C shows that traffic conditions are still stable even though drivers are beginning to feel restrictions in freedom of movement. The road is dominated by trade and service activities with a fairly high activity, but still within the tolerance limit of road capacity. This indicates that the land use and traffic system on this corridor is relatively balanced.

- Jl. Sis Aljufri showed the best performance with a Dj value between 0.24-0.29 and LOS B throughout the survey. LOS B reflects traffic conditions that are still very comfortable and smooth. This can be attributed to Good Land Use Management in trade and service areas along Jl. Sis Aljufri, so that the intensity of economic activity does not burden the transportation system significantly. This section also has a larger road capacity or a more organized traffic circulation system.
- Jl. Touwa showed the highest saturation level with Dj value reaching 0.78 in the middle of the month, and LOS decreased from C to D. LOS D indicates unstable traffic conditions, with very limited vehicle movement space. This indicates that the use of land along Jl. Touwa is very congested by uncontrolled trade and service activities, such as the presence of parking vehicles on the road, high access in and out of stores. This decrease in service levels reflects the need for more serious spatial and traffic interventions.

CONCLUSION

Based on the analysis of traffic volume survey data in three locations, namely Jl. I GustiNgurah Rai, Jl. Sis Aljufri, and Jl. Touwa, obtained an overview of the level of fluctuations in road performance based on the Indonesian road capacity guidance method (PKJI 2023).

- Jl. I GustiNgurah Rai at the beginning of the month recorded a traffic volume of 1358 smp/hour, but entering the middle of the month there was a decrease to 1237 smp/hour, and interestingly at the end of the month the traffic volume increased to 1588 smp / hour, even surpassing the initial data of the month. This shows an increase in the economy that triggers an increase in vehicle intensity and community activities. Which directly impacts the load or capacity of the road.
- Jl. Sis Aljufri showed a pattern of fluctuations at the beginning of the month was recorded at 1215 smp/hour, but the middle of the month was recorded at 1271 smp/hour, and interestingly at the end of the month decreased significantly to 1126 smp / hour. Indicates a change in the pattern of economic cycles that occur such as the decline in economic activity dipenghujang month and vehicle mobility, especially in the area of trade and services that are sensitive to changes in time and community activities.
- Jl. Touwa at the beginning of the month, traffic volume was recorded at 1620 smp/hour, reflecting the high intensity of mobility related to goods distribution activities and community movements at the beginning of the operational period. Interestingly, in the middle of the month there was an increase in traffic volume to 1778 smp / hour, which indicates the peak of mobility activity in the second week. This increase is associated with increased trade transactions, Logistics delivery, and interregional mobility. Nevertheless, at the end of the month the traffic volume decreased again to 1575 smp/hour. This decrease is relatively small compared to the data at the beginning of the month, so overall, Jl. Touwa shows a higher level of traffic stabilitytinggicompared to other roads.

ADVICE

Based on the results of the analysis and conclusions that have been obtained, here are some suggestions that can be considered to improve the performance of road sections:

Good Land Use Management

The arrangement of trade and service areas is needed to be more integrated with the transportation system, such as the establishment of activity zones, restrictions on certain operating hours, and the provision of adequate parking areas.

Side Drag Reduction

Side barriers such as illegal parking, street vendors ' activities, and getting in and out of vehicles from shophouses or shops need to be controlled to maintain the speed of traffic flow and reduce the degree of saturation.

Improved Road Infrastructure

For sections with low LOS such as Jl. Touwa, it is necessary to consider increasing the capacity of roads or widening sidewalks and entrances so as not to interfere with the flow of vehicles.

Traffic rules enforcement and Engineering

Strict traffic regulations are needed as well as the application of traffic engineering such as setting the direction of one-way roads, Prohibition of stopping, and the addition of signs at rush hour.

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