

EVALUATION OF THE LEVEL OF STREET LIGHTING ON THE SAFETY ROAD USERS: CASE STUDY OF THE KERTAJATI – KADIPATEN ROAD

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ABSTRACT

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At night, road lighting is very important for a driver. Apart from reducing the number of traffic accidents, good street lighting can also reduce the level of street crime that can occur. As time goes by, human activities are not limited by time. Many people choose to be active day and night to pursue efficiency and effectiveness of time. Apart from playing an important role in various social activities, street lighting is also very important for the sustainability of the traffic system. In this case, the case that occurred on the Kertajati – Kadipaten road was that there was no adequate street lighting. This reduces visibility and also the driver's safety level at night. This research aims to evaluate the location of the Kadipaten – Kertajati road, which does not yet have a good street lighting system, and see the impact on motorists. This research was located on the Kertajati – Kadipaten highway, more precisely on the Babakan Anyar village highway, Kadipaten – Monjot Bridge. The research method used in this research is a qualitative method with perception analysis. The parameters used are the respondents' perception of the importance and satisfaction with street lighting on this road, using a scale of 1 to 5 from not important to very important and not satisfied to very satisfied. Data was processed using the Importance Performance Analysis (IPA) method. Data collected from 40 respondents was divided based on age, gender, and vehicle used when crossing the Kertajati – Kadipaten road. From the results of the questionnaire, the majority of gender who travel the Kertajati – Kadipaten road are women. The age range of the majority who cross the Kadipaten – Kertajati road is ≤ 20 years, while those who rarely cross this road are > 60 years. Meanwhile, the most widely used vehicle is a motorbike.

1. Introduction

At night, road lighting is very important for a driver. Apart from reducing the number of traffic accidents, good street lighting can also reduce the level of street crime that can occur. We find evidence that communities assigned more lighting experienced a sizable reduction in nighttime outdoor index crimes [1]. Increasing driver safety from traffic accidents and street crime can be done by improving the quality of good and orderly roads. One thing that needs to be improved is street lighting, both on highways and public roads that are usually crossed by some groups.

As time goes by, human activities are not limited by time. Many people choose to be active day and night to pursue time efficiency and effectiveness. For some people, evening is the most productive time to carry out various important daily activities, whether for running a business, work, recreation, or other

social activities. In the era of rapidly transforming cities with high population density, several researchers have demonstrated the significance of nighttime lighting design for urban sustainability and enhancing social well-being in the city. [2] Therefore, outdoor lighting is very important for the sustainability of today's life.

Apart from playing an important role in various social activities, street lighting is also very important for the sustainability of the traffic system. Street lighting is a right for all road users which must be fulfilled by local governments according to their needs. Of course, with correct installation and according to standards, also with quality lighting. Several aspects to be considered in the design process were lighting quality, used material, energy source, and the installation type. [3]. Not only on urban roads but also on roads that connect various areas. One example is the Kertajati – Kadipaten road, which does not meet good lighting standards.

In this case, the case that occurred on the Kertajati – Kadipaten road was that there was no adequate street lighting. This reduces visibility and also the driver's safety level at night. This greatly affects the transportation system and drivers. In general, governments can reduce road crash severities by intervening in road users' behavior or improving road conditions [4]. It is hoped that having lighting on the roads can reduce the number of accidents and crimes.

This research aims to evaluate the location of the Kadipaten – Kertajati road, which does not yet have a good street lighting system, and see the impact on motorists.

2. Literature Review

2.1 Traffic

Traffic is defined as the movement of vehicles and people in road traffic space. This means that traffic includes several components, namely humans, vehicles and the road itself. These components have an important role in realizing a balanced traffic system. The rapid growth of motor vehicles highly accelerates the imbalance between the infrastructure's service capacity and the traffic requirements in transportation, especially in urban transit [5]. Because of this interrelated relationship, it is important to keep each component organized.

The most frequent traffic problems are accidents. As mentioned above, the most frequent accidents are caused by a lack of balance between traffic components. Likewise, the increase in congestion due to the addition of new vehicles is exceptionally subject to the type of vehicle, the level of volume, the composition of traffic flow, the width of the highway, etc. [6]. A smooth traffic system symbolizes the fulfillment of all its components. Good lighting is also an example of a road component that is very important for the sustainability of the traffic system.

There are various ways to optimize the traffic system, including traffic management. Traffic management aims to increase the efficiency of traffic movement by minimizing the level of disruption and congestion. In addition, traffic management is also a means of realizing security and safety on the roads and health for the general public. Many traffic management strategies are designed for other purposes, e.g., speed limits are often designed for safety or congestion reasons; new road constructions are often designed to meet increasing travel demand [7].

2.2 Road User Safety

Road safety is a significant issue worldwide [8]. Safety can be defined as a situation of being physically and mentally safe so that there is no risk of danger that can occur. This safety is the result of actions that

reduce the risk of death, accidents, or damage that can occur to objects and people. In this case, traffic safety means efforts to reduce these various risks. Safety is a condition that must always be maintained in the road traffic system. Road safety is a major global health issue since large proportions of unintentional injuries are caused by traffic-related crashes [9].

Safety in the traffic system is also greatly influenced by the road users themselves. Several forms of road user behavior have been highlighted as increasing the risk of collisions, resulting in casualties [10]. Demand that road users are mature in age, mentality, and personality to create a safe transportation system. A person's driving skills also influence the level of safety on the road; this is necessary so that the driver can determine the appropriate action when signs of an accident occur. Traffic accidents are something that every road user wants to avoid, but sometimes, these traffic accidents occur suddenly because of poor road infrastructure or due to negligence of the road users [11]. To improve road safety, insight is needed into preventable causes of road accidents [12].

Road conditions also greatly influence traffic safety. The risk of accidents may increase according to certain road conditions. For slushy road surfaces, the corresponding risk for fatal accidents was fivefold [13]. For example, roads in rainy conditions are more at risk of causing accidents than roads in dry conditions. Then, roads that do not meet standards also have a higher risk of accidents, one of which is roads that do not have good lighting.

2.3 Road Lighting

A lighting system is a system consisting of various electrical components that are interconnected and function to provide lighting or certain signs. In this case, the lighting in the traffic system functions to support the activities of road users, both pedestrians and drivers. Apart from that, good lighting can also minimize crime at night. One of the assumed benefits of road lighting in subsidiary roads is a crime reduction [14].

The main purpose of street lighting in the traffic system is so that road users, drivers and pedestrians, can carry out their activities safely and comfortably at night. The need for street lighting emerged with public safety and maritime requirements at night [15]. Using street lights has been proven to reduce the risk of accidents. The reason is that street lights came to increase the level of contrast between objects and the road surface. So that road users can see various objects clearly, which can ultimately improve road safety.

Road lighting is part of the road infrastructure, which is largely responsible for ensuring road safety [16]. Due to its importance, the traffic lighting system must be installed properly. One of the things that must be considered when designing traffic lights is the place where lighting is needed and the quality of the lights that will be installed. When planning to install traffic lights, one must also pay attention to the quality of visibility for road users. Good lighting will produce clarity and comfort for the eyes at night.

3. Method

Broadly, research refers to the activity performed by people trained to obtain knowledge through systematic procedures [17]. The method used in this research is a qualitative method with perception analysis. This research usually answers several questions that cannot be resolved using quantitative methods. Qualitative designs are needed to discover reasons for observed patterns, especially the

invisible or surprising ones [18]. This research data contains road users' perceptions about how high lighting affects the safety and security of road users.

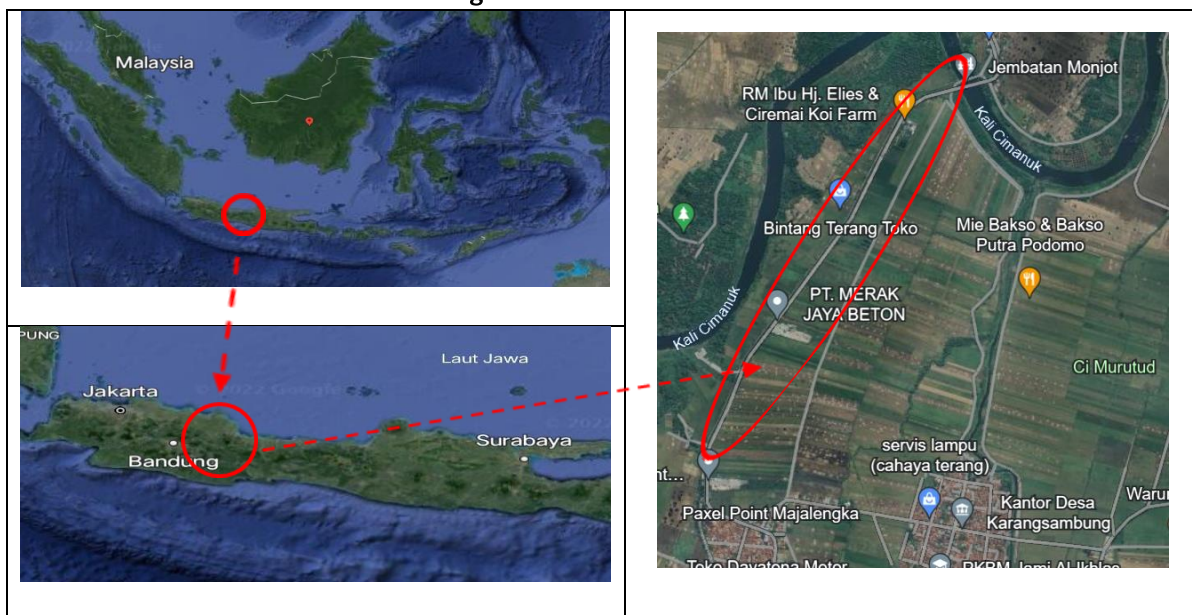
This research uses road user perception variables to evaluate the lack of lighting on the Kertajati – Kadipaten road. Primary data comes from a questionnaire filled out by 40 respondents who use the Kertajati – Kadipaten road. The parameters used are the respondents' perception of the importance and satisfaction with street lighting on this road, using a scale of 1 to 5 from not important to very important and not satisfied to very satisfied. Data was processed using the Importance Performance Analysis (IPA) method. Importance Performance Analysis (IPA) will identify the important factors of performance and produce the priority scale that will be used by the organization to meet customer satisfaction [19].

Importance Performance Analysis (IPA) usually uses a four quadrant method

- a. Quadrant I, the factors found in this quadrant have a high level of importance but are not in accordance with the performance of the user so as to allocate resources to improve performance as expected.
- b. Quadrant II, the factors found in this quadrant have a high level of importance accompanied by a high level of performance and in accordance with the expectations of the user so that the achievement should be maintained.
- c. Quadrant III, the factor found in this quadrant, has a low level of importance accompanied by a level of performance not too prioritized with relatively low expectations, thus providing too little benefit to the user's perception.
- d. Quadrant IV, the factor contained in this quadrant has a low level of importance accompanied by an excessively high degree of performance, so the university must allocate this quadrant resource to other quadrants requiring improved performance [20]

This research was located on the Kertajati – Kadipaten highway, more precisely on the Babakan Anyar village highway, Kadipaten – Monjot Bridge. The research location is in the picture.

Figure 1. Research location



4. Result and Discussion

4.1 Respondent’s Information

Data was collected from 40 respondents based on age, gender, and vehicle used when crossing the Kertajati – Kadipaten road. From the results of the questionnaire, the majority of gender who travel the Kertajati – Kadipaten road are women. The age range of the majority who cross the Kadipaten – Kertajati road is ≤ 20 years, while those who rarely cross this road are > 60 years. Meanwhile, the most widely used vehicle is a motorbike.

Table 1. Respondent’s information

Variable	Category	Frequency	Percent
Gender	Male	18	45%
	Female	22	55%
Age	≤20	21	53%
	21 - 30	11	28%
	31 - 40	2	5%
	41 - 50	3	8%
	51 - 60	2	5%
	> 60	1	3%
Vehicles Used	Car	13	33%
	Motorcycle	27	68%

4.2 The Importance and Performance Level of Road Lighting

From the questionnaire results, the lighting variable for safety from crime (4.85) received the highest importance value but also obtained the lowest satisfaction value (2.15). Meanwhile, what received the lowest importance value was lighting for activities other than those related to traffic (4.55).

Table 2. The importance and performance level of road lighting

NO	Indicator	I	P	G
A1	Road lighting for safety from crimes	4,85	2,15	-2,7
A2	Road lighting on safe driving	4,75	2,5	-2,25
A3	Road lighting on driving comfort	4,77	2,42	-2,35
A4	Road lighting on driving navigation	4,65	2,55	-2,1
A5	Road lighting for vehicles from the same direction	4,67	2,47	-2,2
A6	Road lighting for vehicles from the opposite direction	4,66	2,52	-2,14
A7	Road lighting on activities besides traffic-related	4,55	2,5	-2,05
A8	Road lighting to sharp turns	4,75	2,38	-2,37
A9	Road lighting to the bridge	4,67	2,35	-2,32
A10	Road lighting avoids the risk of damage	4,65	2,75	-1,9

Figure 2. The importance and performance level of road lighting

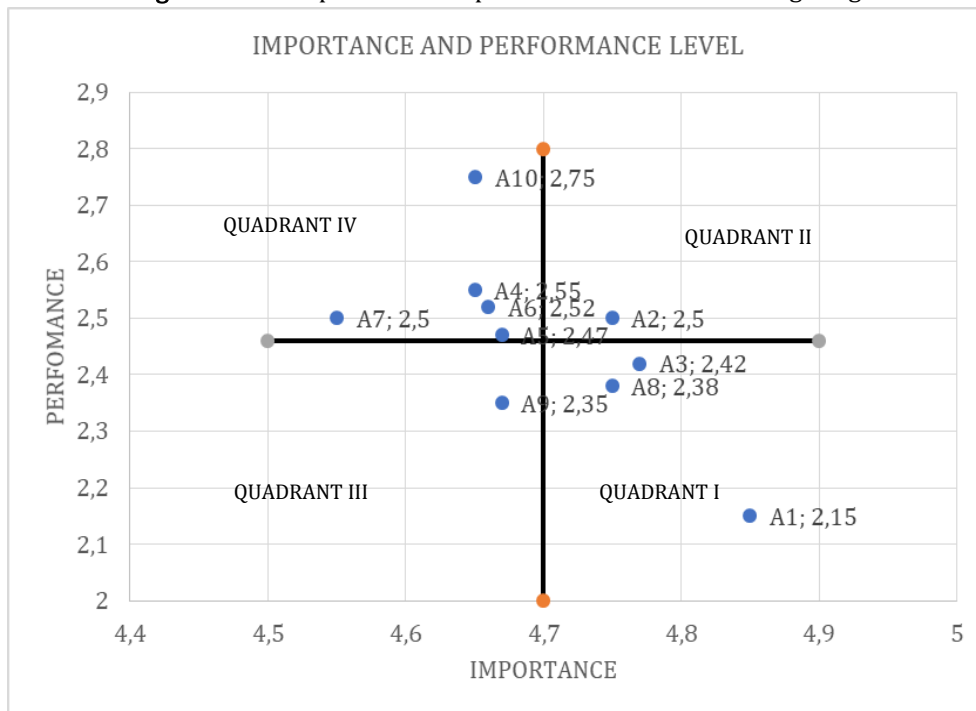


Table 2 above shows that there is a minus gap value, which means that lighting needs do not meet the level of road user needs. Then, in Figure 2, Quadrant IV is a variable whose importance value is quite low but has the highest performance. Quadrant III has the same low level of importance and performance. Quadrant II is a variable that has high importance with equally high performance, so it must be maintained. Quadrant I is the number of variables with the highest level of importance but the lowest level of performance and, therefore, require the greatest improvement.

After obtaining information on road users' perceptions of various aspects of the level of lighting on the Ketajati - Kadipaten road, 40 respondents were asked whether road lighting needed improvement. There are five response scales from disagree to agree strongly. This variable is very important to prove the comfort level of road users when crossing the Kertajati - Kadipaten road and is used as a standard for assessing the level of road lighting.

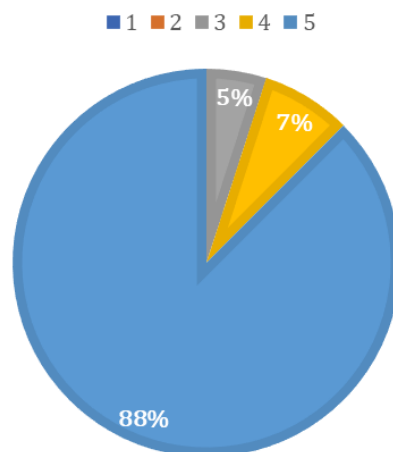


Figure 3. Road lighting improvement

In the Road Lighting Improvement diagram, there is an 88% answer scale of strongly agree, while no respondents gave an answer scale of 1 or 2. This proves that road users really hope for improvements in lighting on the Kertajati - Kadipaten road to better guarantee the safety and security of road users.

5. Conclusion

The research results show that the average level of importance of street lighting is 4.70. However, the level of road performance has only reached an average of 2.46; there is a gap between interest and satisfaction of -2.3. The minus value indicates the level of road performance that must be improved to achieve a balance between road performance and the interests of road users. Then, the vehicles that mostly use the Kertajati - Kadipaten road are motorbikes, making them more susceptible to crime on this road. Furthermore, the parameter that is considered the most important is lighting for safety from crime on the road, and the highest satisfaction is given to lighting to avoid damage on the road. Meanwhile, the parameter that is considered not very important is lighting for activities other than those related to traffic, and the lowest level of satisfaction is lighting for safety from crime on the road. Then, as many as 88% of respondents hoped for improvements in street lighting.

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