

Prioritization Of Enhancing Environmental Road Infrastructure

In Slum Residential Zones

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ABSTRACT

This research was conducted using the AHP method to determine how to prioritize the handling of environmental roads in Pemulutan District, Ogan Ilir Regency. This research aims to prioritize the villages for environmental road handling in Pemulutan District, Ogan Ilir Regency. We employ a quantitative research approach, collecting data based on the established criteria. The data used includes secondary data and primary data. The stages of the research conducted include problem identification, followed by location determination, literature study, criteria determination and questionnaire design, data collection, data analysis using the Expert Choice application, and conclusion making. The research results show that among the several criteria established, the criteria of environmental road condition have 26,6% in determining the priority for environmental road improvements in the slum areas of the Pemulutan sub-district. We have identified Ibul Besar II Village as the village with the highest priority.

1. Introduction

Several indicators are mentioned in the Regulation of ministry of public works and public housing of the Republic of Indonesia Number 14/PRT/M/2018 regarding the management of slum areas. These include fire protection, environmental roads, drinking water supply, environmental drainage, wastewater management, and building conditions [1]. Out of the seven indicators, the state of the local roadways serves as the primary means of resolving the other six. Thus, the first step in organizing slum residential neighborhoods can be to fix the local roads. Additionally, some locations' poor road infrastructure might make it difficult for the local population to travel around, which can hinder their access to necessities like health, education, and trade. It can even interfere with their economic activity. The result is a drop in the income level of the community, which might lead to poverty in the region [2]. The state of the local



Copyright © 2025 M. Arma Muslimin[•] et,al. This work is licensed under a <u>Creative Commons</u> <u>Attribution-ShareAlike 4.0 International License</u>. Allows readers to read, download, copy, distribute, print, search, or link to the full texts of its articles and allow readers to use them for any other lawful purpose. roads is another element contributing to traffic accidents, in addition to that influence. The occurrence of extremely high economic losses will be greatly impacted by these traffic accidents, which will cause worse air quality, increased noise pollution, supply disruptions, and uncertainty in travel times [3].

The Ogan Ilir Regency Regent's Decree No. 09/KEP/PERKIMTAN/2022 also says that Pemulutan District is part of the largest slum area in Ogan Ilir Regency. This area is made up of 5 villages that have been designated as slum areas: Ibul Besar II, Ibul Besar III, Pegayut, Pipa Putih, and Sungai Buaya [4]. Between the five villages, there is a network of roads that are still in poor condition and require repairs by the relevant department. Ibul Besar II Village is one of the villages considered in determining the location, with a total length of damaged roads amounting to 157 meters. Access to the local roads in this village is still difficult due to the dirt road contours. The research location also takes into account Ibul Besar III Village, which has a damaged road of 2035 meter. Some of the roads in this village are still dirt paths. Another village with poorly maintained and difficult-to-access roads is Pipa Putih Village, with a total length of 889 meters of damaged roads. The fourth village is Sungai Buaya, where the road conditions are damaged along 197 meters, and there are even footpaths that still use wooden materials or planks. Next, Pegayut Village has a total length of 2000 meters of damaged roads. This village does not even have a drainage system, causing the roads and surroundings to become muddy and obstructing access. Considering the data above, road improvements are necessary, including enhancing the road pavement structure and widening the road, performing embankment according to the alignment and road width plan, creating a drainage plan such as culverts or box culverts to channel water to the river, and finally, making a pavement plan [6].

To have a sufficiently strong foundation, the determination of infrastructure development and maintenance in the villages of Ogan Ilir Regency needs to establish a priority scale based on several criteria in handling access roads within slum areas. Several methods can be used in determining decision priorities, especially in prioritizing the handling of environmental road repairs. The formulation in Appendix 2 of PUPR Regulation No. 14 of 2018 can be used in determining the priority for handling slum locations. In addition, many mathematical models can be used to priorities decision-making, one of which is the Analytic Hierarchy Process (AHP) model. Some advantages of the AHP method include that it is not only used in institutions but can also be applied for individual research purposes related to priority strategic policies [7]. In addition, this method is subjectively assessed by the interested parties, who then draw various considerations. AHP can also help solve complex problems by establishing criteria.

Similar research in determining the priority for improving local roads has been conducted by several previous researchers, including [8] [9] [10]. Based on the results of this research, it was found that road condition is the main criterion that most influences the determination of priority in road repair handling. Unlike [11] and [12], the results of the conducted research obtained the order of criteria most influential in determining the priority of road repairs, which is maintenance costs or economic factors. [13] also uses several criteria for determining road improvements, namely vehicle load, policy, land use, and the type of road damage factor. The results show that vehicle load ranks highest as the criterion that most affects road repair, followed by land use, road damage, and policy factors. [14] used several criteria such as vehicle load, policy, land use, and type of damage. The results showed that the type of damage has the highest weight compared to other criteria.

This study aims to establish the priority ranking of roadways, consistent with prior research. The distinction between the prior research and the forthcoming study is in the research location; this investigation will take place in the Pemulutan District, Ogan Ilir Regency, South Sumatra, which has not previously experienced the prioritization procedure. The prioritization of slum area organization at this site traditionally lacked a solid foundation, leading to misallocated or unproductive budget expenditures. Consequently, it is imperative to thoroughly examine the criteria for prioritizing neighborhood road enhancements in this region. This research will focus on identifying the most significant criteria for prioritizing the management of environmental roads in the Pemulutan District, Ogan Ilir Regency, use the AHP approach. Furthermore, the AHP approach will be employed to ascertain the prioritization of villages for the management of environmental roads in the Pemulutan District, Ogan Ilir Regency.

2. Literature Review

The Analytical Hierarchy Process was devised by mathematician Thomas L. Saaty. As stated by Saaty in [15], the AHP technique facilitates the resolution of intricate problems by organizing a hierarchy of criteria, stakeholders, and results, while integrating diverse considerations to establish weights or priorities.



Source: Munthafa & Mubarok, 2017 Figure 1. Hierarchy Structure

The identification of AHP variables or criteria in this study was derived from prior research. Furthermore, it relies on technical data for the execution of environmental/village road enhancements accessible at Dinas Perumahan Rakyat dan Kawasan Permukiman serta Pertanahan (DISPERKIMTAN) of Ogan Ilir Regency. This study will employ the AHP analytic calculation methodology to establish priorities for enhancing environmental roads in five villages within the Pemulutan District, classified as slum areas in Ogan Ilir Regency. The AHP model is employed to create a pairwise comparison matrix utilizing the criteria of road condition aspect, road technical, social, accessibility level, land use, and economic, as well as to ascertain the consistency index and consistency ratio values. The Analytic Hierarchy Process (AHP) is a measuring theory utilized to derive ratio scales from either discrete or continuous pairwise comparisons [16]. AHP decomposes intricate multi-factor or multi-criteria issues into a hierarchical structure. The hierarchy mentioned is represented as a pairwise comparison matrix

table utilized in the calculating procedure. The AHP calculation technique involves criteria and weights utilized in the computation, as outlined by [17]. in [18] The pairwise comparison matrix for alternatives and criteria uses values from 1 to 9, which constitute the optimal scale in AHP comparison measurement, as noted by Panjaitan et al. in [18], [19].

The following are the steps involved in the deployment of AHP. The techniques or steps in the AHP method are outlined by Kusrini in [19], [20]: (1) Create a hierarchical structure, (2) Determine the pairwise comparison matrix for road improvement priority criteria, (3) Calculate the aggregate of each column in the pairwise comparison matrix, (4) Execute normalization by dividing each column's value by the total sum of that column, (5) Calculate the sum of the values from the normalization matrix row and dividing it by the number of criteria to derive the Total Priority Value (TPV) of the normalization criteria, (6) Each column of the matrix values is multiplied by the corresponding column of the Total Priority (TPV) normalization criteria values to yield the Total Priority Value (TPV) of the alternative criteria, (7) Calculate the sum of the values from the TPV (Total Priority Value) row of the alternative criteria and dividing it by the TPV (Total Priority Value) outcome. Criteria for Normalization to Achieve Maximum Value, (8) Calculate Consistency Index, (9) The Consistency Ratio, about the random index (RI), can be calculated based on the number of criteria employed. This study employs four criteria, with a random index set at 0.90. If the CR result is less than 0.1, the hierarchy is considered consistent, (10) Calculate Consistency Ratio.



Source: Data Processed by the author, 2025 **Figure 2**. Hierarchy Structure of Ogan Ilir Regency

A literature analysis was performed to ascertain the criteria employed in this research, referencing prior academic journals to compare the most influential or commonly utilized

criteria in earlier studies and evaluating their relevance to the specific characteristics of this research. This illustrates the correlation between the criteria utilized and those applied in prior research:

1. Aspect of Environmental Road Conditions :

In the investigations [21] and [22], environmental road conditions are utilized as a primary criteria. The state of the road environment encompasses road service coverage, road surface quality, and technical conditions, as referenced in the Regulations of Kementerian PUPR No. 14 of 2018. This research underscores the significance of roadways integrated into an efficient network that facilitates economic operations and ensures optimal accessibility for local inhabitants.

2. Road Technical Criteria:

Numerous studies utilize road technical criteria as the primary focus of their research, including those by [23] and [24]. These technical criteria assess the quality of road infrastructure, including length, width, and pavement thickness, and identify the necessity for repairs depending on traffic volume and road condition.

3. Social

The studies by [25] and [26] associate social criteria with the prioritization of road infrastructure. Social aspects encompass population size, community engagement, educational attainment, and environmental security. This underscores the significance of environmental roads that facilitate neighborhood social life, encompassing access to essential services and the government's involvement in development.

4. Accessibility Level

The study by [24] emphasizes the significance of accessibility levels in establishing route priorities. Accessibility pertains to the convenience with which inhabitants may access essential facilities, including economic hubs and public services vital for regional growth.

5. Land Use Plan

Similar to the studies [13] and [25], land use planning is employed to establish development priorities according to its uses, including agricultural land, fisheries, residential zones, educational institutions, or commercial hubs. These characteristics affect the necessity for road infrastructure, as each category of land use possesses distinct access requirements.

6. Economy

The study referenced in [26] incorporated economic criteria such as employment, monthly income, and the strategic significance of the location; however, this research adopted an alternative approach, emphasizing the impact of handling costs and land acquisition expenses on local authorities' prioritization of road damage management policies.

This research identifies primary criteria, including road conditions, technical features, social concerns, accessibility, land use, and economic considerations derived from comparisons with prior studies. These criteria are relevant for prioritizing enhancements to environmental roads in slum residential areas, including accessibility needs, social functions, economic factors, and policies regarding expenses and land usage. This methodology is anticipated to establish a thorough foundation for identifying road enhancement priorities that correspond with the attributes of the research region.

3. Research Method

The data collection process in this research commences with the filing of a data assistance request letter via official correspondence from Sriwijaya University, then followed by visits to pertinent offices, including the sub-district office, village office, and relevant stakeholders. The data utilized in this research can be categorized into two types: primary data and secondary data.

Multiple analyses will be performed to fulfill the research objectives. The forthcoming analysis will be a quantitative assessment, utilizing the AHP method to evaluate data from slum areas to prioritize environmental road management for specific villages. AHP calculations can be conducted by formulaic computations in Microsoft Excel or by utilizing the Expert Choice application.

1. Population and Samples.

The study's population comprises stakeholders directly engaged in the administration of environmental highways in Pemulutan District, Ogan Ilir Regency. The purposive sampling technique subsequently selected a sample from the aforementioned population based on the following criteria:

- a) They possess the authority to determine road management in Pemulutan District, Ogan Ilir Regency.
- b) They are proficient individuals possessing extensive knowledge and comprehension of the requisite facts.
- 2. Instrument Analysis Tool.

The primary instrument utilized in this study is a paired comparison questionnaire, completed by 35 respondents, including policymakers and experts in environmental roads. This questionnaire evaluates the priority weights of each criterion defined in the research. The analysis utilized the Expert Choice application, which facilitates the automatic computation of priority weights through the Analytical Hierarchy Process (AHP) method. We performed an analysis using the Expert Choice tool, which automates the computation of priority weights using the Analytical Hierarchy Process (AHP) methodology.

Types of Data	Description	Source
Primary Data	Questionnaire	 (1) Head of the Department of Public Housing, Settlement Areas, and Land Affairs of Ogan Ilir Regency, (2) Head of Bappeda of Ogan Ilir Regency, (3) Head of the Settlement Department, (4) Head of the Department of Infrastructure, Facilities, and Public Utilities, (5) Head of the Department of Infrastructure and Regional Development, (6) Head of the Spatial Planning Department, (7) Head of the Housing Department, (8) Head of the Planning Sub-section, Department of Public Housing, Settlement Areas, and Land Affairs of Ogan Ilir Regency, (9) Head of District Pemulutan, (10) Chief of Ibul Besar II, Ibul Besar III,

Table 2.	Types	of Data	and F	Research	Sample	List
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		Pegayut, Sungai Buaya, Pipa Putih, (11) parties
		involved in the construction of environmental
		road in Ogan Ilir Regency.
	Villes Des Cile Le Compartie e	Each district and data from the Department of
G 1	Village Profile Information	Disperkimtan of Ogan Ilir Regency.
Secondary		
Data	RP2KPKPK document	DISPERKIMTAN of Ogan Ilir regency
	(Strategy for the	
	mitigation and	
	enhancement of	
	informal housing and	
	slum communities)	

Source: Data Processed by the author, 2025

3. Definition of Variable Operations.

This study categorizes the variables into six primary criteria, each comprising the following sub-criteria:

Variable	Variable Indicator
Aspect of Environmental Road Conditions	Environmental road service coverage,
	Condition of the environmental road surface.
	Road length,
Road technical criteria	Road width,
	Thickness of road pavement,
Social	Region,
	Demographic profile,
	Principal commodities,
Accessibility level	Location,
	Accessibility to primary roads,
	Linkage of segments to the primary roads
Land use plan	Agriculture,
	Fisheries,
	Residential area
Economy	Land acquisition,
	Management expenses.
	1 2025

Tabel 3. Operational Definition

Source: Data Processed by the author, 2025

4. Data Analysis Techniques.

Numerous analyses will be conducted to achieve the research objectives. The upcoming research will be a quantitative evaluation that employs the AHP method to review data from slum regions to prioritize environmental road maintenance for designated villages. AHP calculations can be performed using formulaic computations in Microsoft Excel or the Expert Choice application.

4. Results and Discussions

The paired comparison questionnaire data was analyzed utilizing a specialized application employing the AHP approach. The assessed results are further examined about pertinent ideas and compared with prior research to enhance comprehension and address the research objectives formulated.



Source: Data Processed by the author, 2025 Figure. 3 Analytic Hierarchy Process Calculation Result Chart

The respondents involved in the assessment are experts, stakeholders, and individuals who are usually engaged in environmental road survey work and provide pairwise comparison assessments between criteria [27]. This comparison uses a 1-9 scale according to the Analytical Hierarchy Process (AHP) method. After the assessments were collected, the results from all 35 respondents were combined using the Combine Judgements feature in the Expert Choice Application to obtain the final priority weights for each criterion.

Figure 3 indicates that the criteria "Factors about environmental road conditions" holds the highest priority weight, making it the most significant criterion. The responses say that environmental road conditions are the predominant aspect to consider when enhancing the area's environmental roadways. The sub-criteria "Extent of Environmental Road Services" possesses the highest priority weight of 0.654 (65.4%), signifying that respondents regard it as

96

more advantageous for the surrounding community and thus warranting primary focus.

Upon establishing the criteria and sub-criteria for enhancing environmental roads, the subsequent stage is to evaluate which village will be prioritized for intervention based on the relevant sub-criteria. This study compares the settlements of Ibul Besar II, Ibul Besar III, Pegayut, Pipa Putih, and Sungai Buaya Village. The evaluation was executed similarly to previous instances, with 35 participants utilizing the "Combine Judgements" feature on the Expert Choice application to get the conclusive priority weights for each community. The outcomes of the aforementioned comparative study reveal the priority weights assigned to each village, along with the characteristics that predominantly determine which community should be prioritized for improvement.

As can be seen from the study results in Fig. 3 above, Ibul Besar II has the highest priority value at 0.29 (29%). Due to several crucial elements found through the examination of pertinent criteria and sub-criteria, Ibul Besar II Village was given the highest priority score for managing environmental road repairs. Figure 4 below illustrates the environmental road conditions in Ibul Besar II Village that require immediate correction. [28] notes that the state of damaged roads is a prevalent issue that arises in several parts of Indonesia's major cities. Road segments with minor damage are frequently neglected, which exacerbates the damage and lowers the road's capacity. The road in Ibul Besar II Village is 4,512 meters long overall, and most of it is still pathways that are only accessible by two-wheeled vehicles. Furthermore, as can be seen in figure 5 below, there are still roughly 157 meters of this road that are of low quality. It is still a brittle wooden plank route that is between 1.5 and 2 meters wide. Additionally, during the wet season, it is quite challenging to navigate. The community's mobility and accessibility will be improved, which will ultimately improve their general well-being.



Source: Photo Taken by the Author, 2025 **Figure. 4** State of the Ibul Besar II Village Thoroughfare

The repair costs at Ibul Besar II Village are comparatively cheaper due to its lesser road damage length of 157 meters, in contrast to neighboring villages with more extensive damage. Villages like Ibul Besar III Village, Pegayut, Pipa Putih, and Sungai Buaya possess more comprehensive and intricate road repair requirements, necessitating greater financial resources for management. Ibul Besar II Village demonstrates enhanced financial efficiency, since a reduced investment facilitates immediate road repairs, resulting in direct benefits for the community. The prioritizing of repairs in Ibul Besar II Village, encompassing a road damage length of 157 meters, offers substantial benefits, including reduced handling costs, efficient money allocation, expedited economic impact, and prospects for sustainable infrastructure growth. This indicates that the investment in repairs in Ibul Besar II Village produces

substantial and prompt outcomes relative to other villages that necessitate higher expenditures and longer durations for more extensive infrastructure renovations.

Furthermore, from a geographical standpoint, it significantly warrants prioritization for management [29]. Ibul Besar II Village is next to the city of Palembang. Its proximity to urban regions facilitates access to many amenities and public services, including markets, healthcare facilities, and educational institutions. Enhancing local roadways will facilitate access to this city, thereby supporting the mobility of the village inhabitants.



Source: Photo Taken by th Author, 2025 **Figure. 5** Illustration of the Ibul Besar II Village Border

Figure 5 illustrates that the right side of the road corresponds to the region of Desa Ibul Besar II, whilst the left side pertains to the administrative jurisdiction of the City of Palembang. The location of Desa Ibul Besar II is in proximity to or right next to the City of Palembang. Closeness to urban regions facilitates access to many amenities and public services, including markets, healthcare facilities, and educational institutions. The enhancement of local roadways will facilitate access to this city, thus supporting the mobility of the village inhabitants.

This study also analyzes on reactions and perspectives Participants'. 93.8% of participants concurred that improving the state of the roads and the environment should be a priority. Moreover, all respondents agreed that Desa Ibul Besar II should receive priority for enhancement over other villages in Ogan Ilir Regency.

5. Conclusion and Suggestion

5.1 Conclusion

This study concludes that the most influential criteria for prioritizing improvements to environmental roads in the slum areas of Pemulutan District are the factors about environmental road conditions, which have the highest weight of 0.266, supported by the sub-criteria of environmental road service coverage, weighted at 0.654. Simultaneously, the village designated as the greatest priority, Desa Ibul Besar II, possesses a weight of 0.290, indicating its primary importance for environmental road enhancements in the impoverished region of Pemulutan District, Ogan Ilir Regency.

5.2 Suggestion

Based on the analysis conducted using the AHP method, this study recommends that the local government prioritize road improvements in Ibul Besar II Village, with particular

98

emphasis on the condition of neighborhood roads, specifically the sub-criterion of road service coverage as the primary focus. Additionally, Dinas Perumahan Rakyat dan Kawasan Permukiman Serta Pertanahan of Ogan Ilir Regency is encouraged to establish a more systematic framework for determining repair priorities to enhance program effectiveness and budget efficiency. Moreover, the findings of this study can serve as a valuable reference for academics and practitioners in developing more objective decision-making models, particularly in optimizing road infrastructure to improve community welfare. Future research should consider expanding the scope of analysis by incorporating additional criteria and sub-criteria that align with the specific conditions of the study area.

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