Multicriteria Analysis for Determining the Priority Scale of Village Road Construction Based on Aspiration Funds in the National Priority Rural Area (KPPN) of Praya using ANP-TOPSIS Method

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Keywords: ANP, Aspiration Fund, Development Priority, Praya Rural Priority Areas, Rural Roads, TOPSIS.

Abstract. This study aims to determine the priority scale for rural road development based on *the Aspiration Fund* of the *Regional House of Representatives* (DPRD) in *the National Priority Rural Area* (KPPN) of Praya, Central Lombok Regency. Amidst limited regional fiscal resources, the allocation mechanism of Pokir requires a systematic approach to ensure more targeted and sustainable development. A multi-criteria decision-making method was employed by integrating *the Analytic Network Process* (ANP) and *the Technique for Order Preference by Similarity to Ideal Solution* (TOPSIS). Five main criteria were analyzed—technical, cost, social, economic, and accessibility—further detailed into ten sub-criteria. The ANP results indicated that accessibility holds the highest weight (0.5222), followed by social (0.2667), technical (0.1074), economic (0.0637), and cost (0.0399). At the sub-criteria level, access to public facilities, remote areas, and the number of poor residents were the most influential. TOPSIS analysis produced a ranking of seven rural road segments, with Mekar Sari–Selong Belanak ranked as the highest priority (0.8913), followed by Mekar Sari–Banyu Urip–Kateng (0.8649), Tumpak–Prabu (0.6646), Bolor Gejek–Kelambi–Bonder (0.5330), Kateng–Banyu Urip–Tumpak (0.3646), Banyu Urip–Mangkung (0.2084), and Selangit–Mapasan–Bts. Lobar (0.0397). These findings provide policy insights for managing Pokir funds in accordance with local needs, participatory planning, and spatial equity.

Introduction

The construction of village roads is a fundamental element in strengthening connectivity, logistics distribution, basic social services, and local economic growth in rural areas. Village roads serve not only as connectors between settlements but also as the backbone of productivity in the agricultural sector, MSMEs, and tourism that are developing in rural areas. In the context of inclusive regional development, determining the priority scale for rural road development is key to addressing regional disparities and improving the welfare of the community evenly [1].

This study focuses on determining the priority scale for rural road development in *the National Priority Rural Area* (KPPN) of Praya, located in Central Lombok Regency, West Nusa Tenggara. The KPPN Praya serves as the primary buffer zone for *the Mandalika Special Economic Zone* (KEK) and comprises nine villages spread across three sub-districts: Praya Barat, Praya Barat Daya, and Pujut. The area spans 16,900 hectares with a population of approximately 64,447 people, the majority of whom rely on agriculture as their primary livelihood. However, the condition of road infrastructure in this area shows significant disparities: out of a total of 320 km of village road networks, only 25.6% are paved, 24.4% use gravel surfaces, and the remainder are still dirt roads [2].

This disparity directly impacts the limited access of the community to public service centers, agricultural production areas, and high-potential tourist destinations. Additionally, logistical inefficiencies and the isolation of certain areas result in low local economic value added and exacerbate socioeconomic disparities between villages within the KPPN Praya area. Therefore, an objective, systematic, and responsive mechanism for prioritizing road development is needed to address local complexities.

One significant instrument for financing village road development is *the Aspiration Fund* of the *Regional House of Representatives* (DPRD). This fund is derived from community aspirations gathered through legislative members' recess activities and working visits, which are then incorporated into the local government's annual planning documents. In practice, the Aspiration Fund has become one of the primary funding sources for small- and medium-scale infrastructure development, particularly in the sectors of neighborhood roads and village roads [3]. However, its management often faces technical and political challenges, such as overlap with sectoral programs, weak integration into the e-Planning or SIPD system, and a lack of evidence-based planning approaches.

This study aims to develop a decision-making model using ANP–TOPSIS to prioritize village roads funded through the Pokir mechanism**.** The model integrates technical, social, economic, and accessibility aspects to produce objective and participatory decisions in line with local needs.

Several previous studies have employed multi-criteria decision-making methods in infrastructure planning. For example, Irawati et al. combined AHP and TOPSIS to prioritize road projects in Batu Bara Regency, while Uygun et al. applied DEMATEL–ANP–TOPSIS integration in evaluating R&D projects [4][5]. Similarly, Hutagalung used AHP–TOPSIS to determine the feasibility of funding loans [6]. However, these studies primarily addressed broader project prioritization and financial decision-making contexts. By contrast, the novelty of this study lies in its application of ANP–TOPSIS for village road prioritization based specifically on the DPRD *the Aspiration Fund* mechanism, which has received little academic attention despite its significant role in regional development planning. This comparative perspective strengthens the justification for using ANP–TOPSIS in the KPPN Praya case.

Method

This study uses a descriptive quantitative approach by combining two multi-criteria decision-making methods, namely the *Analytic Network Process* (ANP) and the *Technique for Order Preference by Similarity to Ideal Solution* (TOPSIS). The objective of this approach is to develop a systematic model for establishing priority scales for rural road development funded through *the Aspiration Fund* in *the National Rural Priority Area* (*Kawasan Perdesaan Prioritas Nasional – KPPN*) of Praya, Central Lombok Regency. The complexity of development planning, which involves numerous technical and non-technical criteria, necessitates the use of a decision-making method capable of capturing the interrelationships among criteria and accommodating decision-makers' preferences in a structured and objective manner.

To ensure representativeness, a total of 10 expert respondents were selected using a purposive sampling method. The respondents consisted of technical officials and planners from *the Regional Development Planning Agency* (Bappeda), *the Public Works and Housing Department* (PUPR), members of *the Regional People's Representative Council* (DPRD), and community leaders who understand the conditions of village road development and the management of the Pokir Fund.

The research process began with identifying the criteria and sub-criteria deemed most relevant in the road development prioritization process. The criteria were established based on literature reviews, objective field conditions, and considerations from local decision-makers. After the criteria were determined, the next step was to establish interdependencies between the criteria, both within a group (innerdependence) and between groups (outerdependence) [7]. These relationships are important for forming the network structure that will be analyzed using the ANP method. This network model depicts a complex decision-making system where elements influence one another, which will be analyzed using Super Decisions software.

The data used in this study consisted of primary and secondary sources. Primary data were obtained through three types of questionnaires: (i) a questionnaire on the relationships between criteria to construct the ANP network, (ii) a pairwise comparison questionnaire for ANP processing, and (iii) an alternative judgment questionnaire used in TOPSIS calculations. Secondary data included regional infrastructure planning documents, village road network maps, and socio-economic data from official government sources.

The analysis process began by processing the results of the pairwise comparison questionnaire using the ANP method. The results of this processing were the priority weights of each sub-criterion obtained through the supermatrix and limiting supermatrix. These weights serve as the basis for constructing the decision matrix used in the TOPSIS stage. In the TOPSIS method, the decision matrix is normalized based on the performance of each road alternative against each subcriterion, followed by matrix weighting using the weights from the ANP results. The next step is to determine the positive ideal solution and the negative ideal solution, which are the best and worst values for each subcriterion [8][9]. After that, the distance of each alternative from the positive and negative ideal solutions is calculated, followed by the calculation of their relative proximity values. The alternative with the highest proximity value is considered the top priority for development.

The final result of this process is the priority ranking of the seven main village roads in the KPPN Praya area, which will serve as the basis for formulating recommendations for the allocation of *the Aspiration Fund* in a more objective and targeted manner. This process not only produces a development priority list that is academically and technically justifiable but can also serve as a tool in the annual development planning and regional budgeting processes. The validity of the ANP analysis results is tested through the consistency ratio, where paired comparison results must have a CR (Consistency Ratio) ≤ 0.1 to be considered acceptable for use. Meanwhile, the TOPSIS ranking results are validated through triangulation of results with the opinions of local decision-makers involved in focused group discussions.

By applying this approach, the research not only contributes to the development of evidence-based priority scales but also offers a decision-making model that can be replicated for other regions with similar characteristics and issues. The technical details of the analysis stages, including the ANP calculations and the TOPSIS process, will be explained further in the results and discussion section. The steps taken in the research to solve the problem can be seen in **Fig. 1**.

Results and Discussion

In the ANP process, the determination of priority criteria for village road development based on the Pokir Fund is carried out in several stages. The initial step begins with the formulation of criteria and sub-criteria relevant to the objectives of village development, particularly in the context of strategic areas such as the Praya KPPN. These criteria are developed based on literature reviews and planning documents, then validated by stakeholders through the distribution of questionnaires and in-depth interviews. This process resulted in five main criteria: technical aspects, cost aspects, social aspects, economic aspects, and accessibility aspects. Each criterion is broken down into measurable sub-criteria, such as road condition, road length, estimated construction costs, number of poor residents, and others.

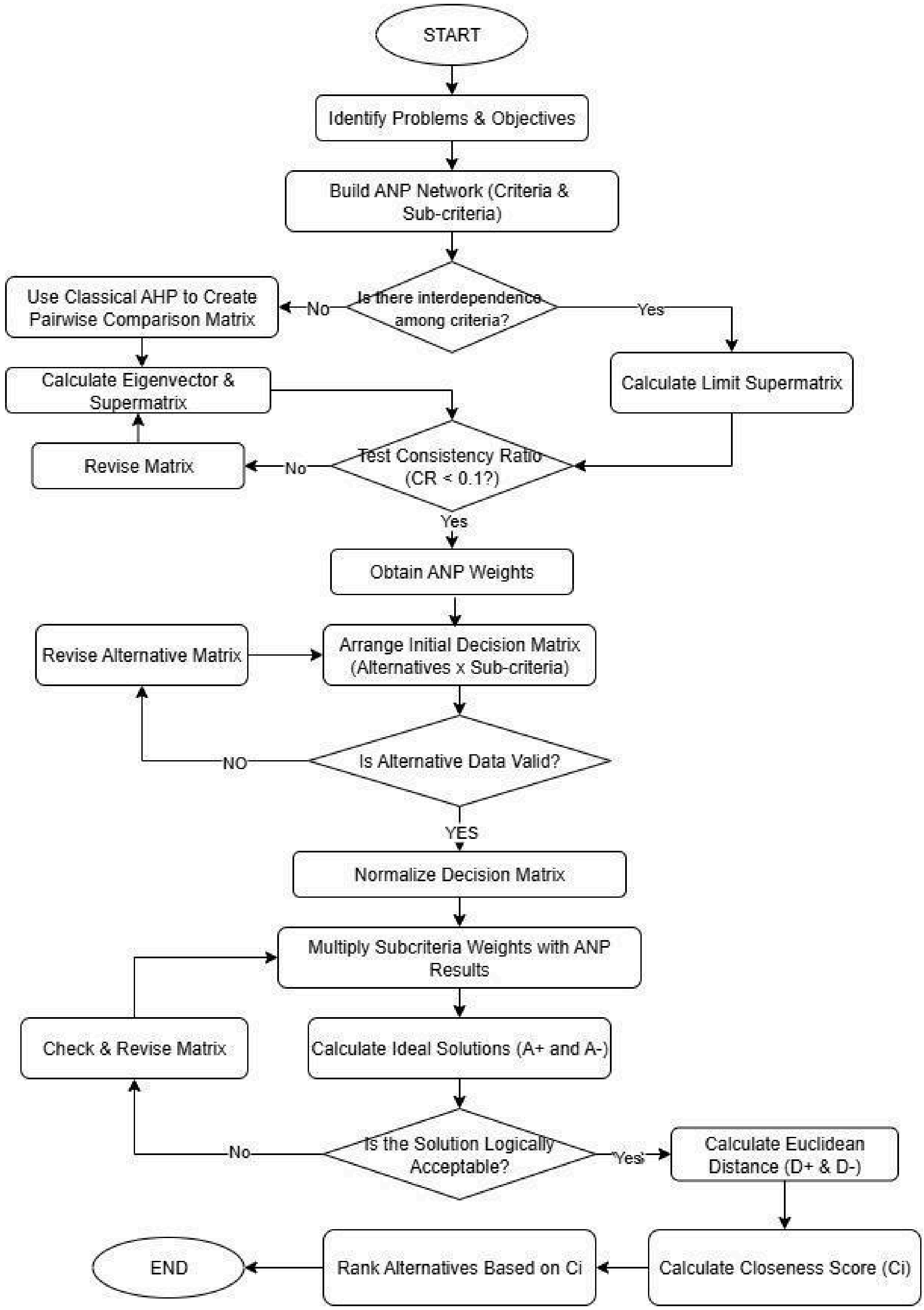


Fig. 1. Research Flow Chart

The core stage of the ANP method begins with forming a decision network structure, which represents the interrelationships between criteria and sub-criteria comprehensively. Unlike AHP, which is hierarchical and linear, ANP allows for non-linear relationships through feedback mechanisms between elements. This is important because, in the context of rural road development, one sub-criterion can influence another sub-criterion reciprocally. For example, the poverty level in a region can affect the level of accessibility, and vice versa.

To support this process, a pairwise comparison questionnaire was used, based on the approach [10]. Respondents were asked to assess the relative importance of elements using a fundamental

1–9 scale developed by [10]. Data collected from 10 respondents who are experts in infrastructure planning, public budgeting, and legislative representation were then processed using Super Decisions software.

The analysis results produced local and global weights for each subcriterion. The network structure consists of five main clusters, each containing two to three subcriteria. The following is a list of criteria and subcriteria used in the ANP model:

Table 1. Criteria and Sub-criteria

Criteria	Sub-Criteria
Technical Aspect	Road conditions, Road length, Road width
Cost Aspect	Estimated construction costs
Social Aspect	Frequency of community proposals
Economic Aspect	Number of poor residents, Poverty rate
Accessibility Aspects	Access to public facilities, Access to remote areas

The relationship structure in the ANP-TOPSIS model is designed to map the interconnections among the goal, criteria, sub-criteria, and development alternatives. This model consists of five main clusters—technical, cost, social, economic, and accessibility aspects—each comprising relevant sub-criteria identified through literature review and field observations. These sub-criteria are then linked to alternative rural road segments that are subject to prioritization.

As illustrated in **Fig. 1**, the interrelations among elements in the ANP-TOPSIS model are represented, showing how each sub-criterion influences the assessment of development alternatives. The network structure visualizes the flow from decision goals down to the prioritization of alternatives, integrating the Analytic Network Process (ANP) for weighting and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for ranking.

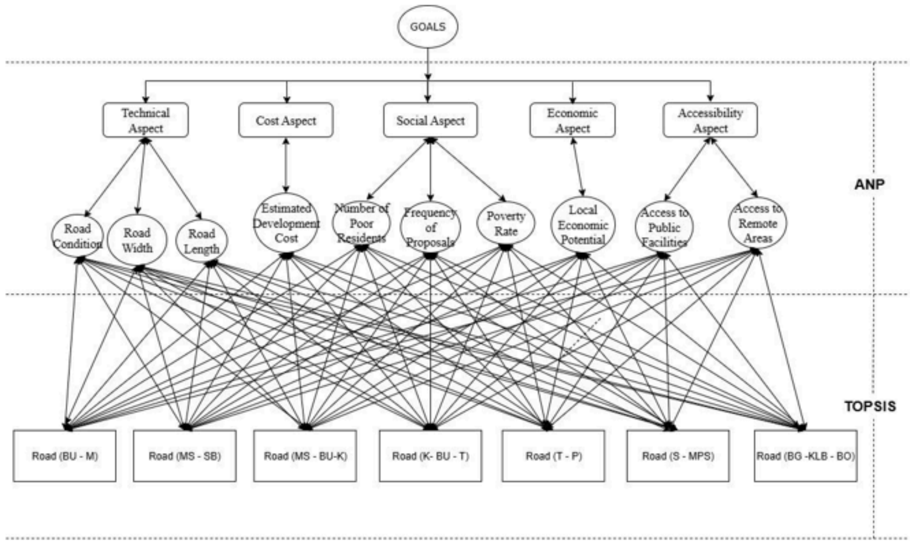


Fig. 2. ANP-TOPSIS Network Structure for Determining

Furthermore, based on the results of mapping the interrelationships between elements shown in the Figure, an ANP model was constructed using Super Decisions software. The Decision-Making Hierarchy Model is Model is shown in **Fig. 2**.

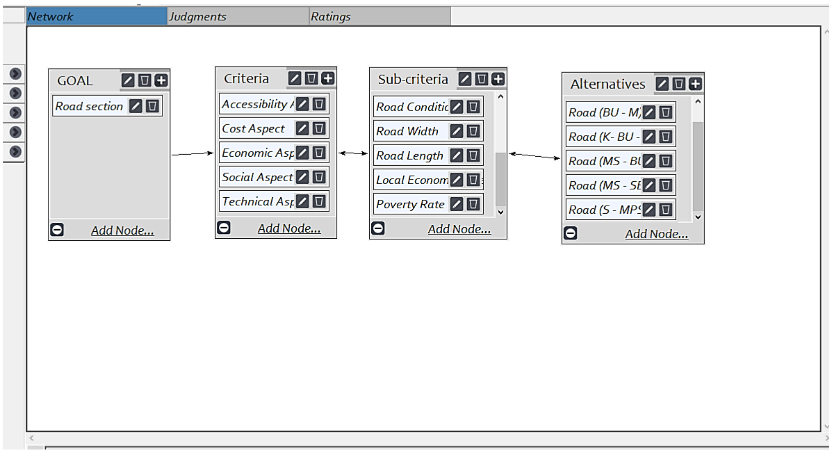
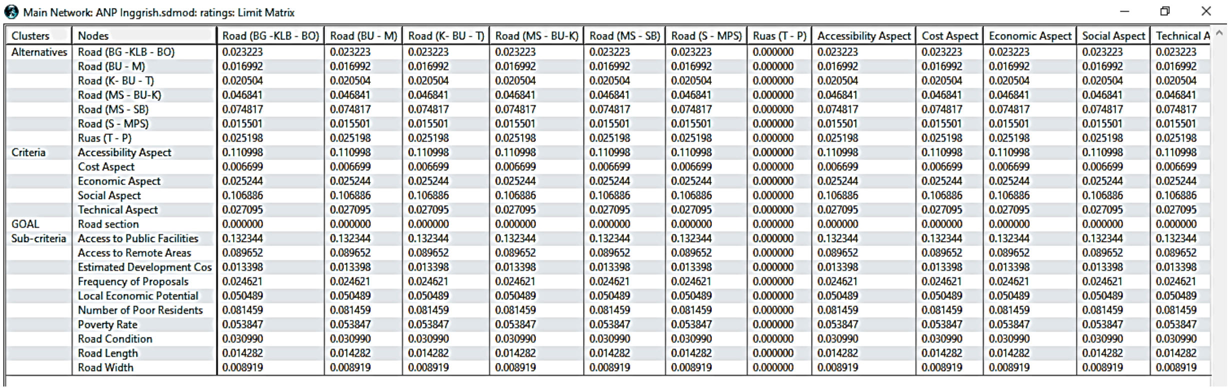


Fig. 3. Super Decision Software Network Model

The ANP model was constructed and visualized in Super Decisions as a network cluster consisting of five groups of criteria with ten interrelated subcriteria. This model is used to calculate the local and global weights of each subcriterion. The calculation process involves the preparation of a pairwise comparison matrix, normalization, consistency testing, the formation of an initial supermatrix, and the preparation of a limiting supermatrix that provides the final weight of each subcriterion.



Main Network: ANP Inggrish.sdmod: ratings: Limit Matrix

Clusters	Nodes	Road (BG -KLB - BO)	Road (BU - M)	Road (K- BU - T)	Road (MS - BU-K)	Road (MS - SB)	Road (S - MPS)	Ruas (T - P)	Accessibility Aspect	Cost Aspect	Economic Aspect	Social Aspect	Technical A
Alternatives	Road (BG -KLB - BO)	0.023223	0.023223	0.023223	0.023223	0.023223	0.023223	0.000000	0.023223	0.023223	0.023223	0.023223	0.023223
	Road (BU - M)	0.016992	0.016992	0.016992	0.016992	0.016992	0.016992	0.000000	0.016992	0.016992	0.016992	0.016992	0.016992
	Road (K- BU - T)	0.020504	0.020504	0.020504	0.020504	0.020504	0.020504	0.000000	0.020504	0.020504	0.020504	0.020504	0.020504
	Road (MS - BU-K)	0.046841	0.046841	0.046841	0.046841	0.046841	0.046841	0.000000	0.046841	0.046841	0.046841	0.046841	0.046841
	Road (MS - SB)	0.074817	0.074817	0.074817	0.074817	0.074817	0.074817	0.000000	0.074817	0.074817	0.074817	0.074817	0.074817
	Road (S - MPS)	0.015501	0.015501	0.015501	0.015501	0.015501	0.015501	0.000000	0.015501	0.015501	0.015501	0.015501	0.015501
	Ruas (T - P)	0.025198	0.025198	0.025198	0.025198	0.025198	0.025198	0.000000	0.025198	0.025198	0.025198	0.025198	0.025198
Criteria	Accessibility Aspect	0.110998	0.110998	0.110998	0.110998	0.110998	0.110998	0.000000	0.110998	0.110998	0.110998	0.110998	0.110998
	Cost Aspect	0.006699	0.006699	0.006699	0.006699	0.006699	0.006699	0.000000	0.006699	0.006699	0.006699	0.006699	0.006699
	Economic Aspect	0.025244	0.025244	0.025244	0.025244	0.025244	0.025244	0.000000	0.025244	0.025244	0.025244	0.025244	0.025244
	Social Aspect	0.106886	0.106886	0.106886	0.106886	0.106886	0.106886	0.000000	0.106886	0.106886	0.106886	0.106886	0.106886
	Technical Aspect	0.027095	0.027095	0.027095	0.027095	0.027095	0.027095	0.000000	0.027095	0.027095	0.027095	0.027095	0.027095
GOAL	Road section	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sub-criteria	Access to Public Facilities	0.132344	0.132344	0.132344	0.132344	0.132344	0.132344	0.000000	0.132344	0.132344	0.132344	0.132344	0.132344
	Access to Remote Areas	0.089652	0.089652	0.089652	0.089652	0.089652	0.089652	0.000000	0.089652	0.089652	0.089652	0.089652	0.089652
	Estimated Development Cos	0.013398	0.013398	0.013398	0.013398	0.013398	0.013398	0.000000	0.013398	0.013398	0.013398	0.013398	0.013398
	Frequency of Proposals	0.024621	0.024621	0.024621	0.024621	0.024621	0.024621	0.000000	0.024621	0.024621	0.024621	0.024621	0.024621
	Local Economic Potential	0.050489	0.050489	0.050489	0.050489	0.050489	0.050489	0.000000	0.050489	0.050489	0.050489	0.050489	0.050489
	Number of Poor Residents	0.081459	0.081459	0.081459	0.081459	0.081459	0.081459	0.000000	0.081459	0.081459	0.081459	0.081459	0.081459
	Poverty Rate	0.053847	0.053847	0.053847	0.053847	0.053847	0.053847	0.000000	0.053847	0.053847	0.053847	0.053847	0.053847
	Road Condition	0.030990	0.030990	0.030990	0.030990	0.030990	0.030990	0.000000	0.030990	0.030990	0.030990	0.030990	0.030990
	Road Length	0.014282	0.014282	0.014282	0.014282	0.014282	0.014282	0.000000	0.014282	0.014282	0.014282	0.014282	0.014282
	Road Width	0.008919	0.008919	0.008919	0.008919	0.008919	0.008919	0.000000	0.008919	0.008919	0.008919	0.008919	0.008919

Fig. 4. Graphical Matrix Limit

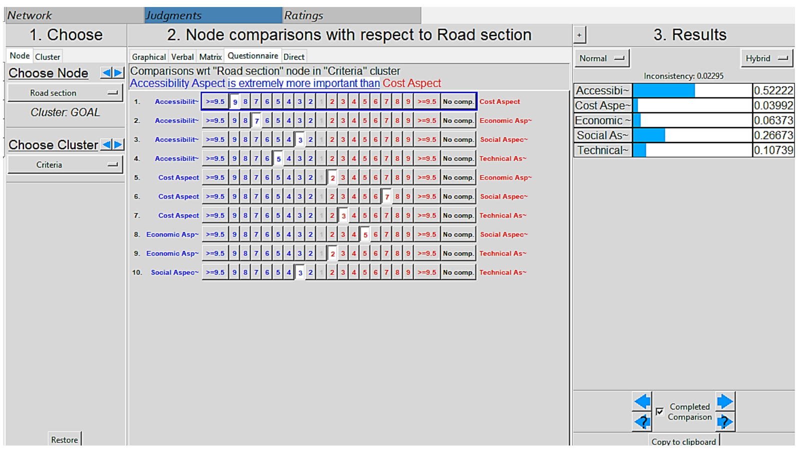


Fig. 5. Comparisons with Road Section Node in Criteria Cluster

In conducting paired comparisons, consistency in the respondents' answers in filling out the questionnaire is required, where the maximum allowable inconsistency value is 0.1 [10]. **Table 2** shows the inconsistency ratio values for each criterion cluster.

Table 2. Inconsistency Ratio Values

Cluster (Criteria)	Inconsistency
Accessibility Aspect	0,00000
Cost Aspect	0,00355
Economic Aspect	0,00000
Social Aspect	0,00000
Technical Aspect	0,01361

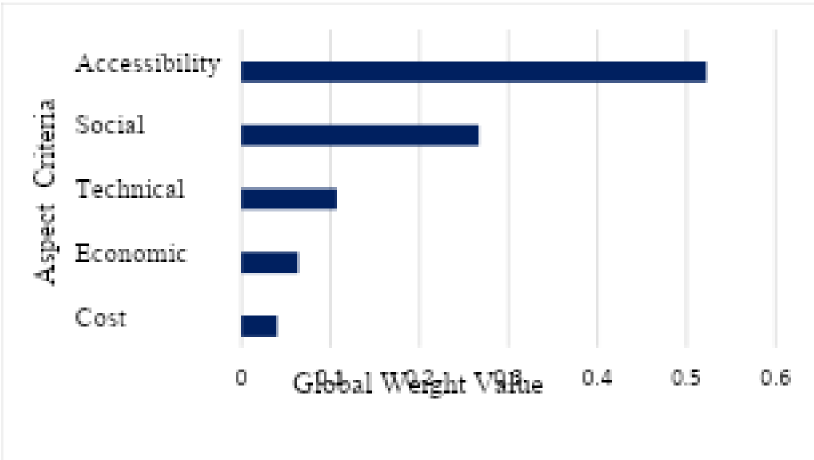


Fig. 6. Weight Value (Normalized by Aspect Cluster)

Fig. 6 illustrates that the Accessibility aspect is the main criterion influencing the selection of road development priorities in the *Praya Rural Priority Area* (KPPN), with an average value of 0.5222. The criterion with the second-highest average value is the Social Aspect with a value of 0.2667, followed by the Technical Aspect criterion with a value of 0.1074. The fourth criterion is the Economic Aspect with a value of 0.0637, and the fifth criterion is the Cost Aspect with a value of 0.0399.

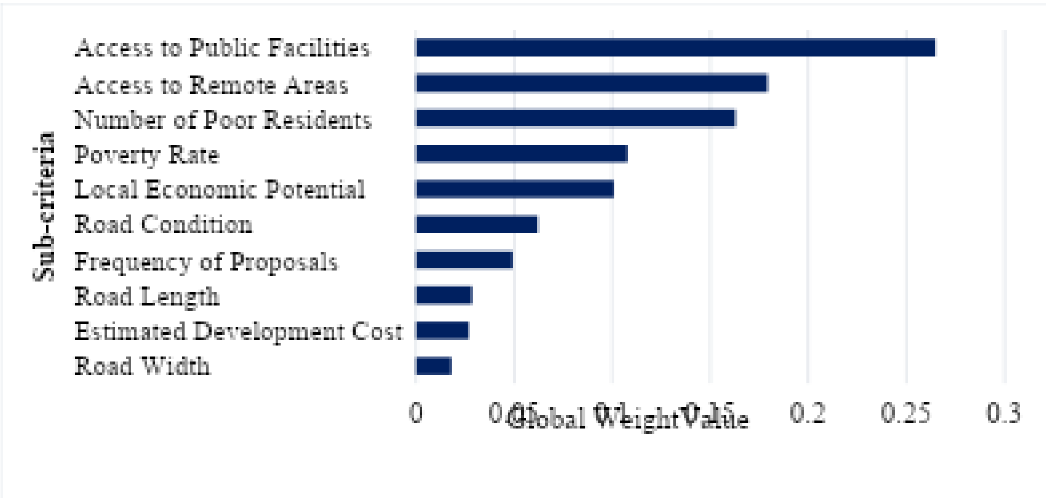


Fig. 7. Weight Value (Normalized by Sub–Criteria)

At the subcriteria level, **Fig. 7**, the highest weights were given to Access to Public Facilities (0.2647), Access to Remote Areas (0.1793), and Number of Poor People (0.1629). Sub-criteria such as Road Condition (0.0619), Road Length (0.0286), Road Width (0.0178), and Cost (0.0268)

After obtaining the weights for each criterion and sub-criterion, the next step is to determine the ranking of each alternative using the TOPSIS method. Data processing using the TOPSIS method is assisted using Microsoft Excel software. The results can be seen in **Table 3** and **Table 4**.

Table 3. Decision matrix for prioritizing KPPN roads

Alternatives	Accessibility	Cost	Economic	Social	Technical
Road (BG -KLB - BO)	5,900	6,700	8,000	6,200	5,900
Road (BU - M)	4,100	6,400	6,900	4,000	3,900
Road (K- BU - T)	5,100	5,000	5,500	5,200	5,000
Road (MS - BU-K)	8,000	3,800	4,700	7,800	7,800
Road (MS - SB)	8,300	2,800	4,000	8,800	8,700
Road (S - MPS)	3,200	1,000	3,700	3,900	2,800
Road (T - P)	6,800	1,200	2,000	7,100	7,100

Table 4. Normalization of the KPPN Road Priority Selection Decision Matrix

Alternatives	Accessibility	Cost	Economic	Social	Technical
Road (BG -KLB - BO)	0,361	0,575	0,569	0,367	0,359
Road (BU - M)	0,251	0,550	0,491	0,237	0,237
Road (K- BU - T)	0,312	0,429	0,391	0,308	0,304
Road (MS - BU-K)	0,490	0,326	0,334	0,462	0,475
Road (MS - SB)	0,508	0,240	0,285	0,521	0,530
Road (S - MPS)	0,196	0,086	0,263	0,231	0,170
Road (T - P)	0,416	0,103	0,142	0,420	0,432

After the normalized matrix values are obtained, the weighted normalized matrix is calculated by multiplying the normalized matrix by the weights of each criterion and sub-criterion, resulting in the output shown in **Table 5** Weighted Normalized Matrix.

Table 5. Weighted Normalized Matrix

Alternatives	Accessibility	Cost	Economic	Social	Technical
Road (BG -KLB - BO)	0,189	0,023	0,036	0,098	0,039
Road (BU - M)	0,131	0,022	0,031	0,063	0,025
Road (K- BU - T)	0,163	0,017	0,025	0,082	0,033
Road (MS - BU-K)	0,256	0,013	0,021	0,123	0,051
Road (MS - SB)	0,265	0,010	0,018	0,139	0,057
Road (S - MPS)	0,102	0,003	0,017	0,062	0,018
Road (T - P)	0,217	0,004	0,009	0,112	0,046

Table 6. Positive Ideal Solution and Negative Ideal Solution

Ideal Solution	Accessibility	Cost	Economic	Social	Technical
A+	0,2653	0,0230	0,0363	0,1389	0,0569

A-	0,1023	0,0034	0,0091	0,0616	0,0183

The final step is to calculate the relative proximity to the positive ideal solution, thereby obtaining the rankings of each tourism area. The results of this calculation can be seen in **Table 7** Relative Proximity Calculation Results.

Table 7. Results of relative proximity calculations

Alternatives	Preference (V)	Ranking
Road (BG -KLB - BO)	0,533022759	4
Road (BU - M)	0,208443297	6
Road (K- BU - T)	0,364638034	5
Road (MS - BU-K)	0,864912825	2
Road (MS - SB)	0,891341746	1
Road (S - MPS)	0,039673122	7
Road (T - P)	0,664583799	3

Through processing using the Analytic Network Process (ANP) method assisted by Super Decisions software, the priority weights of each criterion were obtained. The results show that accessibility has the highest weight (0.5222), followed by social aspects (0.2667), technical aspects (0.1074), economic aspects (0.0637), and costs (0.0399). At the sub-criteria level, the highest weights were assigned to access to public facilities (0.2647), access to remote areas (0.1793), and the number of poor residents (0.1629). This indicates that decisions regarding the allocation of rural road development are more influenced by considerations of equitable access and community welfare than by technical efficiency or budgetary constraints. Sub-criteria such as road condition, road length, and construction costs receive lower weights, emphasizing that in the context of *the Aspiration Fund*, social and spatial considerations are more dominant.

The final results of integrating the ANP and TOPSIS methods produce a priority ranking of seven alternative rural road development projects in the KPPN Praya region. The Mekar Sari–Selong Belanak (MS–SB) section ranks first, followed by the Mekar Sari – Banyu Urip – Kateng section (MS-BU-K), Tumpak – Prabu section (T-P), Bolor Gejek – Kelambi – Bonder section (BG-KLB-BO), Kateng – Banyu Urip – Tumpak section (K-BU-T), Banyu Urip – Mangkung section (BU-M), and finally the Selangit – Mapasan – Bts. Lobar section (S-MPS). This ranking reflects the importance of strengthening inter-regional connectivity and basic community services in determining the direction of village infrastructure development based on aspirations. Thus, the ANP–TOPSIS multi-criteria approach has proven effective in formulating more objective, transparent, and contextually relevant priority development decisions in line with local needs.

Beyond the technical ranking, the Mekar Sari–Selong Belanak segment emerged as the highest priority primarily because of its high accessibility to major tourism centers, strong potential for supporting local economic activities, and its role in connecting remote villages to service hubs. This finding is consistent with the regional development agenda outlined in *the Regional Medium-Term Development Plan* (RPJMD) of Central Lombok 2021–2026, which emphasizes improving connectivity to tourism destinations and promoting rural economic growth. The alignment of our results with policy directions highlights the practical relevance of the ANP–TOPSIS model in supporting evidence-based planning and budgeting for *the Aspiration Fund* allocation.

The results provide guidance for local governments, particularly in aligning the allocation of the *Aspiration Fund* with *the Regional Medium-Term Development Plan* (RPJMD) of Central Lombok 2021–2026. Specifically, prioritizing the Mekar Sari–Selong Belanak and other highly ranked segments supports regional policies on improving accessibility to tourism destinations, strengthening agricultural value chains, and reducing inter-village disparities. Furthermore, this study demonstrates how the ANP–TOPSIS model can serve as a practical decision-support tool for

DPRD and Bappeda in formulating evidence-based, participatory, and spatially equitable infrastructure programs.

Conclusion

Future research may expand the study area to other districts, apply comparative approaches with alternative multi-criteria decision-making methods, and integrate Geographic Information Systems (GIS) to enhance spatial analysis. In addition, conducting sensitivity tests on the ANP–TOPSIS model would be beneficial to evaluate the robustness and reliability of the results under different weighting scenarios.

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