Priority Management of Regency Roads Using Multi Criteria Analysis (MCA) Method on Aceh Besar Regency Roads

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ABSTRACT--Aceh Besar Regency has 629 toll roads with a total length of 1,279.44 km. The condition of road stability reached 678.62 km (53.04%) and the unstable road reached 600.83 km (46.96%). The length of the road is not stable with the tendency of budget constraints each year in the road sector, then Aceh Besar Regency takes several years to complete the road handling program completely. Considering that the Government of Aceh Besar Regency for the allocation of APBK in 2019 is only able to handle 3 sections, the 12 proposed proposals for handling APBK allocation in 2020 need to look for priority handling. This study aims to identify the dominant criteria that need to be considered in the handling of roads and roads that are the priority order for handling in Aceh Besar Regency. The Aceh Besar Regency road sections reviewed are 3 sections that are being handled in 2019 and 12 that are proposed for handling in 2020. This study uses a quantitative method approach by observing vehicle traffic volumes and distributing questionnaires. Respondents were addressed to 10 stakeholders in Aceh Besar Regency. Road handling priorities are used in Multi-Criteria Analysis (MCA), where the criteria reviewed are road damage, land use, accessibility, traffic volume, and APBK allocation. The results of the study showed that the dominant criteria that need to be considered in handling roads in Aceh Besar Regency are road damage criteria with an average criteria weight of 0.40. Road sections that become priority handling in Aceh Besar Regency with an alternative performance value (Pi) > 5, there are 7 sections, namely Sp. Mata Ie - Indrapuri road sections with a Pi value of 6.45, Sp. Cot Paya - Lambitra road sections with a Pi value of 5.94, Lampeuneurut - Peukan Biluy road sections with a Pi value of 5.82, Lampakuk - Keumiree Road section with a Pi value of 5.75, Sibreh - Peukan Biluy Road section with a Pi value of 5 , 21, Lamteh - Lambadeuk road sections with a Pi value of 5.16, and Sp. Tumbo Baro - Reukih road sections with a Pi value of 5.06.

Key words—management, regency road, multi criteria analysis, method,aceh ,besar regency roads

I. INTRODUCTION

Roads as one of the transportation infrastructures which are the arteries of people's lives have an important role in efforts to develop national and state life. The development of national and state life can be seen from the existence of development targets such as equitable development, economic growth, and the realization of social justice for all Indonesian people. The government as the holder of government power has the authority in organizing the road. The government must ensure the implementation of the role of the road based on the Regional Spatial Plan (RTRW) with due regard to interregional connectivity and be carried out conceptually and thoroughly.

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Local governments need to allocate an adequate Regency Revenue Budget (APBK) to the road sector, to provide the maximum level of road services. To achieve the maximum level of road services, handling of a number of roads that have unstable conditions is needed. The limitations of the APBK in the road sector will have implications for not carrying out comprehensive road handling. Therefore, local governments need to pay great attention in regulating the proportion of the APBK allocation so that the existing budget is sufficient to finance the handling of road infrastructure.

Aceh Besar Regency has 629 toll roads with a total length of 1,279.44 km. Basic Data on Road Infrastructure (DD1) of Aceh Besar Regency in 2019, informs that the condition of road stability reaches 678.62 km (53.04%) and unstable roads reach 600.83 km (46.96%). The problem in this study is that the Aceh Besar Regency Government for the allocation of the 2019 APBK and the 2020 APBK proposal, has a limited budget in the road sector to finance the entire handling of unstable road sections. Therefore, the Government of Aceh Besar Regency needs to determine the main priorities in handling roads. The next problem is the Office of Public Works and Spatial Planning of Aceh Besar Regency in handling roads, only prioritizing the criteria for the level of road damage without considering other criteria. Other criteria that need to be considered in handling roads are land use, accessibility, traffic volume, and APBK allocation. Based on the above problems, the researcher is interested in conducting research on priority handling of Regency roads using the Multi-Criteria Analysis (MCA) method (case study: on the Aceh Besar Regency road section).

II.   RESEARCH METHODS

This research uses a quantitative method approach. Quantitative methods are used to analyze stakeholder perceptions through questionnaire data collection. The research methodology includes the location of the study, sampling techniques, and data analysis techniques.

2.1 Research Location

The sections of the research location are 3 sections that are being handled in 2019 and 12 sections that are proposed for handling in 2020 in Aceh Besar Regency. The road sections based on the 2019 APBK allocation currently under management are as follows:

1. Lampeuneurut Road Section - Peukan Biluy with a width of 5 m and a length of 4.9 km.
2. Sibreh - Peukan Biluy Road Section with a width of 5 m and a length of 5.6 km.
3. Siem - Cot Lam Mee Road Section with a width of 5 m and a length of 3.75 km.

The road sections based on the 2020 APBK allocation proposed for handling are as follows:

1. Indrapuri Road Section - Krueng Jrue Irrigation with a width of 5 m and a length of 6 km.
2. Road Section Sp. Japakeh - Peukan Biluy with a width of 5 m and a length of 5.9 km.
3. Lampakuk Road Section - Keumiree with a width of 5 m and a length of 9.1 km.
4. Road Section of Sp. National Road - Baet with a width of 4 m and a length of 1.15 km.
5. Road Section of Sp. Tumbo Baro - Reukih with a width of 5 m and a length of 9.5 km.
6. Section Sp. National Road - Suci Budha Housing with a width of 4 and a length of 2.5 km.
7. Lamteh - Lambadeuk Road Section with a width of 4 m and a length of 5 km.
8. Road section of Lampenerut - Sp. Puni is 4 m wide and 3.1 km long.

9. Road section of Lamsayun - Sp. Bayu with a width of 4 and a length of 2.4 km.

10. Saree - Leungah Road Section with a width of 5 and a length of 18 km.

11. Road Section of Sp. Mata Ie - Indrapuri with a width of 5 and a length of 10.5 km.

12. Road Section of Sp. Cot Paya - Lambitra with a width of 5 and a length of 4.6 km.

2.2 Sampling Techniques

The sampling method used in this study is nonprobability sampling with a purposive sampling technique. Purposive sampling is a sampling technique with certain considerations. Considerations in this study are based on stakeholders and policymakers (stakeholders) in Aceh Besar Regency. The total sample of this research was determined by 10 stakeholders, where the parties involved were as follows:

1. Head of the Department of Public Works and Public Housing (PUPR) (respondent 1).

2. Head of Bina Marga Division of PUPR Office (respondent 2).

3. Head of Program Development Division of PUPR Service (respondent 3).

4. Head of the Road and Bridge Construction Section (respondent 4).

5. Head of Road and Bridge Maintenance Section (respondent 5).

6. Head of the Rural Road and Bridge Development Section (respondent 6).

7. Head of Regional Development Program Regional Development Planning Agency (BAPPEDA) (respondent 7).

8. Members of the Aceh Besar Regency House of Representatives (DPRK) Commission D Regional Development Sector (respondent 8).

9. Road planning and consultant (respondent 9).

10. Development observer (respondent 10).

2.3 Data Analysis Techniques with Multi-Criteria Analysis

This data analysis uses a multi-criteria analysis. This multi-criteria analysis is used to identify the dominant criteria in road handling and in determining the order of priority in handling road segments in Aceh Besar Regency. The steps of a multi-criteria analysis can be described as follows:

1. Make a pairwise comparison matrix for each respondent.

2. Calculate eigenvector (Wi), criterion weight (xi), eigenvalue (aksmax), consistency index (CI), and consistency ratio (CR) for each respondent.

3. Calculate the weight of the average criteria (xi), by means of the criteria weights, added together then divided by the number of respondents (10). The weight of the highest average criteria indicates that the dominant criteria need to be considered in road handling in Aceh Besar Regency.

4. Calculate alternative scores against criteria.

a. The criteria for road damage assessed are minor damage and severe damage.

b. The land use criteria assessed are agricultural area, plantation area, and fishery area.

c. The accessibility criteria assessed are access to national roads and access to the sub-Regency centre.

d. The traffic volume criteria assessed are the Average Daily Traffic (LHR).

e. The APBK allocation criteria assessed are handling fees.

5. Make a recapitulation of the performance score criteria.

6. Create an alternative performance matrix. The output of the alternative performance matrix is an alternative performance (Pi) for each road section. The highest to the lowest alternative performance values indicate the road sections that are the priority order for handling in Aceh Besar Regency.

III.   RESULTS AND DISCUSSION

3.1 Respondents Perception

Perception is a response based on the thoughts of the respondent regarding a matter that was asked of the him. The question regarding perceptions of respondents was the partial importance of inter-criteria importance in road handling in Aceh Besar Regency. The criteria in question are road damage criteria (A), land use criteria (B), accessibility criteria (C), traffic volume criteria (D), and APBK allocation criteria (E). The intensity of importance between the criteria is used by the Saaty scale. Scale 1 shows that one criterion with another criterion is equally important. Scale 3 shows that one criterion is slightly more important than the other criteria. Scale 5 shows that one criterion is more important than the other criteria. Scale 7 shows that one criterion is more important than the other criteria. Scale 9 shows that one criterion is absolutely more important than the other criteria. Scales 2, 4, 6, and 8 show one criterion with other criteria being close together or doubtful of their importance. The respondent's perceptions of the intensity of interest between the criteria can be seen in Table 1.

Table 1: Respondents perceptions of the intensity of interest between the criteria

No.	Respondents	Respondents Perceptions									
		A B	A C	A D	A E	B C	B D	B E	C D	C E	D E
1	Respondent 1	7	5	5	1	2	1	3	3	3	1
2	Respondent 2	7	3	3	1	2	1	5	3	3	1
3	Respondent 3	5	3	5	1	2	5	3	2	2	2
4	Respondent 4	5	4	6	1	2	1	3	4	3	1
5	Respondent 5	7	3	3	1	2	1	5	3	2	3
6	Respondent 6	5	5	5	1	3	3	3	3	3	1
7	Respondent 7	5	5	5	1	2	1	3	3	3	1
8	Respondent 8	5	3	3	1	2	1	5	3	3	1
9	Respondent 9	5	3	3	1	2	5	3	2	2	2
10	Respondent 10	5	4	5	1	2	1	3	4	3	1

Table 1 shows that respondents had their own assessment of the intensity of interests between road handling criteria in Aceh Besar Regency. All respondents have different perceptions. That is because one's perception is influenced by subjective ways of thinking and feeling. These respondent's perceptions are further useful for the application of multi-criteria analysis.

3.2 Dominant Criteria in Road Handling

The role of multi-criteria analysis in identifying the dominant criteria for road handling is in the first stage, namely compiling a pairwise comparison matrix. Paired comparison matrices are used to map the value of the rating scale of the respondent's perceptions to obtain the criteria weight (xi). The dominant criteria that need to be considered in handling roads lie in the highest weighted criteria that have been averaged for all respondents. The weighting of the average criteria in handling roads can be seen in Table 2.

Table 2: Average of weight criteria

No.	Criteria	Weight Criteria										Average of Weight Criteria
		1	2	3	4	5	6	7	8	9	10	
1	Road damage	0,45	0,38	0,39	0,42	0,37	0,42	0,43	0,36	0,36	0,41	0,40
2	Land use	0,10	0,09	0,08	0,11	0,09	0,09	0,11	0,10	0,08	0,11	0,10
3	Accessibility	0,06	0,07	0,09	0,07	0,08	0,06	0,07	0,08	0,09	0,07	0,07
4	Traffic volume	0,14	0,17	0,17	0,15	0,13	0,18	0,15	0,17	0,19	0,16	0,16
5	APBK Allocation	0,25	0,29	0,27	0,25	0,32	0,25	0,25	0,29	0,28	0,25	0,27

Table 2 shows that the highest average weighting criteria were obtained for road damage criteria of 0.40. This means that the dominant criterion that needs to be considered in handling roads in Aceh Besar Regency according to stakeholders' perceptions is the criteria for road damage. This dominant criterion has similarities with the main considerations of the Regency Government of Aceh Besar, in determining the criteria for road handling. The Aceh Besar Regency Government in determining road handling criteria, only focused on the level of damage. Through the application of multi-criteria analysis in addition to road damage criteria, the order of other criteria that need to be considered in handling roads in Aceh Besar Regency according to stakeholders' perceptions is the criteria for APBK allocation, traffic volume, land use, and accessibility.

3.3 Determination of Road Handling Priorities

The role of the multi-criteria analysis in identifying the priority sequence for road handling is to continue the second stage, which is to calculate the performance criteria score and the final stage to compile an alternative criteria matrix. The second stage calculates the performance score of the criteria in order to get the value of the service of the road sections against the observed criteria. The final stage is to compile an alternative criteria matrix in order to map the multiplication results of the performance of the criteria by weighting the criteria in order to obtain alternative performance (Pi). The alternative performance with the highest to lowest value shows the road sections that are the priority order for handling in Aceh Besar Regency. The order of priority for road handling based on APBK can be seen in Table 3.

Table 3: The priority order for road handling is based on the APBK

No.	Road Sections	Alternative Performance (Pi)

A	APBK Allocation in 2019	
1	Lampeunereut - Peukan Biluy	5,82
2	Sibreh - Peukan Biluy	5,21
3	Siem - Cot Lam Mee	3,34
B	APBK Proposed in 2020	
4	Sp. Mata Ie - Indrapuri	6,45
5	Sp. Cot Paya - Lambitra	5,94
6	Lampakuk - Keumiree	5,75
7	Lamteh - Lambadeuk	5,16
8	Sp. Tumbo Baro - Reukih	5,06
9	Lampenerut - Sp. Puni	4,86
10	Lamsayun - Sp. Bayu	4,81
11	Sp. Japakeh - Peukan Biluy	4,61
12	Sp. Nasional street- Perumahan Budha Suci	4,17
13	Indrapuri - Irigasi Krueng Jrue	3,76
14	Saree - Leungah	3,62
15	Sp. Nasional street - Baet	3,69

The priority order for road handling in Aceh Besar Regency for the 2019 APBK allocation is the Lampeunereut - Peukan Biluy Road section with a Pi value of 5.82, the Sibreh - Peukan Biluy Road section with a Pi value of 5.21, and the Siem - Cot Lam Mee Road section with a Pi value of 3.34. The priority order for road handling in Aceh Besar Regency for the proposed APBK 2020 is the Sp. Mata Ie - Indrapuri Road sections with a Pi value of 6.45, section of Jalan Sp. Cot Paya - Lambitra with a Pi value of 5.94, Jalan Lampakuk - Keumiree section with a Pi value of 5.75, Lamteh - Lambadeuk Road section with a Pi value of 5.16, Sp. Tumbo Baro - Reukih Road sections with a Pi value of 5.06, Lampenerut - Sp. Puni Road sections with a Pi value of 4.86, Lamsayun - Sp. Bayu Road sections with a Pi value of 4.81, Sp. Japakeh - Peukan Biluy Road sections with a Pi value of 4.61, Road sections Sp. National Road - Suci Budha Housing with Pi value of 4.17, Road sections of Indrapuri - Krueng Jrue Irrigation Section with Pi value of 3.76, Saree - Leungah Road section with Pi value of 3.62, and Road sections of Sp. National Road - Baet with a Pi value of 3.69. The order of priority for road handling based on the combined APBK can be seen in Table 4.

Table 4: The priority order for road handling is based on the APBK

No.	Road Sections	Alternative Performance (Pi)
1	Sp. Mata Ie - Indrapuri	6,45
2	Sp. Cot Paya - Lambitra	5,94
3	Lampeuneurut - Peukan Biluy	5,82
4	Lampakuk - Keumiree	5,75
5	Sibreh - Peukan Biluy	5,21

6	Lamteh - Lambadeuk	5,16
7	Sp. Tumbo Baro - Reukih	5,06
8	Lampeuneurut - Sp. Puni	4,86
9	Lamsayun - Sp. Bayu	4,81
10	Sp. Japakeh - Peukan Biluy	4,61
11	Sp. Nasional street - Perumahan Budha Suci	4,17
12	Indrapuri - Irigasi Krueng Jrue	3,76
13	Sp. Nasional street - Baet	3,69
14	Saree - Leungah	3,62
15	Siem - Cot Lam Mee	3,34

The priority order for road handling in Aceh Besar Regency based on the combined APBK is the Jalan Sp. Mata Ie - Indrapuri with a Pi value of 6.45, section of Jalan Sp. Cot Paya - Lambitra with a Pi value of 5.94, Jalan Lampeuneurut - Peukan Biluy section with a Pi value of 5.82, Lampakuk - Keumiree Road section with a Pi value of 5.75, Sibreh - Peukan Biluy Road section with a Pi value of 5 , 21, Jalan Lamteh - Lambadeuk section with a Pi value of 5.16, section for Jalan Sp. Tumbo Baro - Reukih with a Pi value of 5.06, Jalan Lampeuneurut section - Sp. Puni with a Pi value of 4.86, Jalan Lamsayun - Sp. Bayu with a Pi value of 4.81, Jalan Sp. Japakeh - Peukan Biluy with a Pi value of 4.61, section Sp. National Road - Suci Budha Housing with Pi value of 4.17, Section of Indrapuri Road - Krueng Jrue Irrigation Section with Pi value of 3.76, Section Sp. National - Baet Road with a Pi value of 3.69, Saree - Leungah Road section with a Pi value of 3.62, and the Siem - Cot Lam Mee Road section with a Pi value of 3.34. The Aceh Besar Regency road sections that are being handled during the 2019 APBK allocation, when combined with the 2020 APBK proposal are not all top priorities. In this case, the Lampeunereut - Peukan Biluy Road section is the 3rd priority order, the Sibreh - Peukan Biluy Road section is the 5th priority sequence, and the Siem - Cot Lam Mee Road section is the 15th priority sequence. Application of multi-criteria analysis shows that it should be allocated APBK in 2019, the road section that must be prioritized first is the Sp. Mata Ie - Indrapuri and Sp. Cot Paya – Lambitra Road section. The results of determining the priority of road handling in Aceh Besar Regency are already very in accordance with the existing conditions.

Road Section of Sp. Mata Ie - Indrapuri is the 1st priority in road handling in Aceh Besar Regency. Road Section of Sp. Mata Ie - Indrapuri passes through the Montasik and Indrapuri District. Criteria for road damage are 2.98 km of minor damage and 3.07 km of severe damage. The land use criteria for agricultural areas are 12,510 ha, plantation area is 791 ha, and fishery area is 77 ha. Accessibility criteria for access to national roads and access to the sub-Regency center are very close. The criteria for traffic volumes has 1,821 vehicles per day. APBK allocation criteria have a handling fee of Rp. 15,125,000,000. Likewise, with other alternative road segments, they are considered to be in accordance with the existing conditions of each road. This suitability is obtained by analyzing each criterion based on stakeholder considerations in determining the priority of road handlers in Aceh Besar Regency.

IV.   CONCLUSIONS

Based on the results and discussion of Regency road-handling priorities using the Multi-Criteria Analysis (MCA) method on the Aceh Besar Regency road, the following conclusions can be drawn:

1.   The dominant criteria that need to be considered in handling roads in Aceh Besar Regency are road damage criteria with an average criteria weight of 0.40. Furthermore, other criteria that need to be considered are the APBK allocation criteria with an average criteria weight of 0.27, the traffic volume criteria with an average criteria weight of 0.16, land use criteria with an average criteria weight of 0.10, and accessibility criteria with an average criteria weight of 0.07.

2. The road sections that are the priority order for handling in Aceh Besar Regency are as follows:

a.   Road Section of Sp. Mata Ie - Indrapuri with a Pi value of 6.45.

b.   Road Section of Sp. Cot Paya - Lambitra with a Pi value of 5.94.

c.   Lampeuneurut - Peukan Biluy Road Section with a Pi value of 5.82.

d.   Lampakuk - Keumiree Road Section with a Pi value of 5.75.

e.   Sibreh - Peukan Biluy Road Section with a Pi value of 5.21.

f.   Lamteh - Lambadeuk Road Section with a Pi value of 5.16.

g.   Road Section of Sp. Tumbo Baro - Reukih with a Pi value of 5.06.

h.   Lampeuneurut - Sp. Puni road section with a Pi value of 4.86.

i.   Lamsayun - Sp. Bayu road section with a Pi value of 4.81.

j.   Road Section of Sp. Japakeh - Peukan Biluy with a Pi value of 4.61.

k.   Section Sp. National Road - Holy Buddhist Housing with a Pi value of 4.17.

l.   Indrapuri Road Section - Krueng Jrue Irrigation with a Pi value of 3.76.

m.   Section Sp. National Road - Baet with a Pi value of 3.69.

n.   Saree - Leungah Road Section with a Pi value of 3.62.

o.   Road section of Siem - Cot Lam Mee with a Pi value of 3.34.

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