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Research Paper

Priority Scale Analysis for Determining Irrigation Network Rehabilitation Program by AHP Method in Tulungagung – Indonesia

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ABSTRACT : *Budget constraint or shortcoming fund pressuring local government to manage development fund in an efficient and effective way. Irrigation networks as strategic infrastructure has equal importance to have a rational prioritization in determination of any rehabilitation program. So far, Tulungagung Regency government only determined irrigation network rehabilitation work based on community suggestions through development planning meetings (musrembang) and proposal, by giving consideration on both technical and non-technical aspects. However. This process is not supported by a systematic and measurable method, so this study aims to determine the weight of each aspect and criteria to be compiled into irrigation network ranks and establishes rehabilitation priority based on the budget constraint.*
This study uses the Analytical Hierarchy Process (AHP) method based on a questionnaire to 30 respondents involved in allocating the irrigation network rehabilitation budget.
Result study able to indicate most influential aspect is Irrigation Workperformance (0.459), followed by Institutions and Participation (0.241), Area Size (0.166), Funding Sources (0.073), and Budget Targets (0.061). In the irrigation workperformance aspect, the most important criterion is water availability (0.510) while in the institutional aspect, the highest criterion is the ability to settle or resolve conflicts (0.429). Based on the ranking results, the priorities for irrigation network rehabilitation in Tulungagung Regency are respectively: Dadapan (0.294), Blader (0.203), Sumber Kundung (0.192), Sumber Bandung (0.161), and Sumber Banyuurip (0.151).

KEYWORDS: *Priority, Budget, Rehabilitation, Irrigation, Analytical Hierarchy Process*

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I. INTRODUCTION

Tulungagung Regency is one region of East Java Province with promising agricultural potential and plays a strategic role in supporting development of regional food sector. Its geographical location dominated by agriculture land and high availability of surface water resources makes irrigation infrastructure management acts as a crucial factor for increasing agriculture productivity and farmers welfare.

However, work performance from the irrigation network nowadays declines because of structural damage, ageing technical condition also maintenance limitation. In order to make irrigation network rehabilitation program run in effective and efficient way, it needs strict or fix boundaries of budget availability, timeline for implementation, location of the work activity and workperformance targets. Main constraints in this subject are the budget limitation/constraint where there are too many numbers of irrigations areas that need rehabilitation work in limited budget ceiling; therefore, prioritizing rehabilitation works becomes unavoidable choice.

A prioritization act for irrigation network rehabilitation program in Tulungagung Regency so far has been based on community suggestions/proposals through community meetings on development planning agenda also from proposals sent to related technical agencies. While assessment on the workperformance generally conducted based solely on budget availability and technical condition of the irrigation network without any structured and scientific analysis applied to this matter. As a result, level of importance of each criteria remains unclear and often leading to many disagreements in establishment of prioritization.

The actual controversy has focused more to selection of priority location rather than on criteria and decision-making method. Moreover, the involvement of multiple stakeholders with diverse interests keeps demanding a fair, transparent and accountable approach to this subject.

Therefore, a call for research is needed to develop an objective and measurable method for making a priority in the irrigation network rehabilitation program. Then, Analytical Hierarchy Process (AHP) method was chosen since it able to arrange problems in structure of hierarchy and determine the weight of criteria through quantitative way based on stakeholder assessment.

According to several conducted literature review, many previous studies have been employed the AHP method in the context of irrigation network management both for maintenance and rehabilitation purposes. One study from Nuriaman *et.al* entitled "*Penentuan Prioritas Pemeliharaan Daerah Irigasi Akibat Refocussing Anggaran Menggunakan AHP"* or "Determining Irrigation Area Maintenance Priority due to Budget Refocussing Through AHP Method" is carried out by AHP method to select the priority of maintenance on the irrigation network since there was budget refocusing on the project, where the main focus of this study is a work of light routine maintenance, not a rehabilitation work. [1]

Based on these conditions, this study has aim to conduct a risk management analysis on Tambibendo Dam Rehabilitation project in Tulungagung Regency. This study proposes the application of ISO 31000:2018 to develop a structured risk management framework as follows: (1) how is the weight of aspects considered in the determination of alternative irrigation network rehabilitation in Tulungagung Regency? (2) how is the weight of criteria from each aspect considered in the determination of alternative irrigation network rehabilitation in Tulungagung Regency? and (3) how is the alternative ranking order of irrigation network in Tulungagung Regency that need a rehabilitation work?

II. LITERATURE REVIEW

From the previous research studies, determining priority of irrigation network rehabilitation has been carried out by so many types of multi-criteria decision-making methods such as AHP, ELECTRE, SAW, ANP, TOPSIS, WASPAS, and MOORA.

These methods have proven to be effective in determining rehabilitation priorities based on technical and non-technical cteria (including damage level, area size, water availability and budget targets). Among these methods, the Analytical Hierarchy Process (AHP) is one of the most widely used method due to its ability to create a solid structure of hierarchical decisions and systematically weight criteria and alternatives at the same time.

Relevance aspect from results of many previous research showed that the use of AHP method for this research is very appropriate since it has been proven to be able to produce objective and measurable decisions in determining irrigation rehabilitation priorities.

2.1. Asssesment Criteria of Irrigation Rehabilitation Program

The determination of priority scale in irrigation network rehabilitation project requires selecting process of appropriate and relevant criterias to the field condition. This criteria selection is very important because it serves as basis for assessing and comparing the alternative irrigation areas that will be rehabilitated in which the general criterias used are reflecting technical, economy, social and environmental aspects that influence the effectiveness and efficiency of irrigation network utilization.

"By applying Analytical Hierarchy Process, there are four criterias can be selected starting from light damage, moderate damage, severe damage and length of damage." [2]

In general, there are several main criterias often used that listed in previous studies, such as:

2.1.1. Technical Conditions of Irrigation Structure

This criterion is covering physical condition canals, water/sluice gates, intake structures, and other supporting infrastructures. Irrigation networks that experiencing severe damage or significal functional decline are usually become top priority in rehabilitation program. Assessment of technical condition is carried out through field inspection or from technical reports coming from irrigation operation officers. In a study by Pramana Illahi *et.al* technical condition placed as highest weighting rank in assessing the sustainability aspect of an irrigation system, indicating the importance of this aspect in rehabilitation decision-making. [3]

2.1.2. The Extent of Irrigation Service

The more extensive area served by an irrigation network the greater its impact on agricultural/farming productivity and for the farmers' welfare. Therefore, irrigation areas with vast or wide service coverage are generally prioritized for rehabilitation. As stated in a study of Hidayat, that also said the service area size is an important consideration in calculating irrigation efficiency and water resource utilization. [4]

2.1.3. Cost Estimation of Rehabilitation Activity

This criterion relates to allocation of budget needed for implementing rehabilitation activities. In situation of budget constraints, cost estimation is a strategic consideration to make sure the rehabilitation project able to

continue in optimum way with maximum impact. Projects that have cost-efficient aspect with broad impact tend to be prioritized.

2.1.4. Water Necessity and Critical Level of Water Supply

This criterion is assessing the volume of irrigation water necessity during a given planting season and water condition availability from that area. Areas with continuous water shortages or those areas that prone to drought condition are typically be considered more critical and prioritized for drainage/irrigation improvements.

2.1.5. Limited Local Government Funding

This criterion is used to assess fiscal or financial capacity of a region to finance any rehabilitation project. Such alternatives with realistic costs within available budget are more likely to be realized in short term period.

2.1.6. Preference of Local Stakeholders

The preference from involved stakeholders such as farmers, P3A (*Perkumpulan Petani Pemakai Air/* Water User Farmer Association) and local community leaders are vital part in the assessment process. Their involvement reflecting the real needs on the work field and creates a sense of ownership to the expected rehabilitation program.

By combining technical and non-technical criterias proportionally, a decision-making process in irrigation network rehabilitation project can be carried out in more objective, fair, and contextual ways. This approach also enables such method like AHP able to produce accountable decision since all assessment elements are structured and weighted according to their level of importance.

2.2. Analytic Hierarchy Process (AHP) Method

Analytic Hierarchy Process or AHP is a structured, multi-layered decision-making procedure. The method was first developed by Thomas L. Saaty, a mathematician at University of Pittsburgh in United States during 1970s. AHP is a flexible model that allows user to make decision through combining personal consideration and personal values in a logical way. [5]

AHP is used to examine problem that starts from carefully defining problem to organizing it into layered of hierarcy consists of several levels (objective, aspect, criteria and alternatives). After arranging problem into hierarchy, the next step is assigning numerical values to subjective considerations acknowledging level of preference between elements at each level of hierarchy. AHP final result is a priority of existing alternatives to be used to meet the objectives of posed problem. [5]

III. RESEARCH METHOD

3.1. Type of Research

This study is applied research with a descriptive qualitative approach aimed to provide practical solutions to study problem of determining priority scale for irrigation network rehabilitation project in Tulungagung Regency.

Selection of problem alternatives with multiple criterias can be done using many decision-making methods such as Dominance, Feasible Ranges, Lexicography, Effectiveness Index, and Analytical Hierarchy Process (AHP). Whereas in this study, form of data used was a pairwise comparison obtained from expert respondents (expert judgment) then put into mathematical analysis by AHP method. [6]

Research approach was held using a survey method to collect opinions, experiences, and assessment of respondents who understand the problem of irrigation network rehabilitation. The primary data was obtained through distribution of questionnaire consisting of predetermined aspects, criteria and alternatives.

While descriptive nature of this study aims to describe conditions and characteristics of each irrigation area based on the criteria and sub-criteria used. This study is not testing hypotheses but rather finding prioritization for rehabilitation project in a systematic, objective and measurable manner.

The collected data then processed by Expert Choice 11 software to gain the priority weights and ranking for the alternatives. The research results are expected to provide recommendations for decision-making of local government in optimizing management and rehabilitation planning for irrigation networks in Tulungagung Regency.

3.2. Population of the Study

The study population for this research were individuals who understand and involved in the Irrigation Network Rehabilitation project at the Public Works and Spatial Planning Department (*Dinas Pekerjaan Umum dan Penataan Ruang)* of Tulungagung Regency with total population of 32 individuals.

3.3. Sample of the Study

Population of this study was determined based on the field experience of individuals that considered to have reliable experience and knowledgable of development process from its initial planning aspect, then procurement process and physical construction process in the work field, where these individuals are coming from within each agency or company. Meanwhile the sample was taken from population considered representative of all agencies/companies. In this study, sample was taken in random method using disproportionate stratified random sampling. With mathematical formula of Slovin [7, 8]:

$$n = \frac{N}{1 + Ne^2} \qquad (1)$$

n : number of sample study
N : number of population study = 32
e : acceptable margin of error = 0,05

So, the collected sample study calculation will be:

$$n = \frac{32}{1+32(0.05)^2} = 29{,}63 \approx 30 \text{ individuals}$$

Table 1. Aspects and criterias of the research

Aspect	Criteria
Irrigation workperformance (A)	Physical Infrastructure (A1) Planting Productivity (A2) Water Availability (A3)
Size of area (B)	Large Size Area (B1) Medium Size Area (B2) Small Size Area (B3)
Funding source (C)	Central Government Funding (C1) Local Government Funding (C2) Grant / Foreign Funding (C3)
Budget target (D)	Food Security (D1) Improvement of Irrigation Service (D2) Improvement of Irrigation Management Efficiency (D3)
Institution and participation (E)	Institution Power (E1) Farmer Participation (E2) Ability to settle conflict (E3)

3.4. Data Collection

Data collection was taken through a questionnaire with statement items related to assessment of each aspect – criteria – alternatives using a 9 – 1 – 9 scale paired comparison where number 1 is a code of respondents' response stating that both elements are equally important and the highest number of 9 is a code of respondents' response stating that one element is absolutely more important than the other elements.

Table 2. Criteria of importance level value [5]

Definition	Equally Importance	Weak/ Slight Importance	Moderate Importance	Moderate Plus Importance	Strong Importance	Strong Plus Importance	Very Strong Importance	Very, Very Strong Importance	Extreme Importance
Scale	1	2	3	4	5	6	7	8	9
Scale	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9

From the questionnaire, it obtained data regarding number of respondent answers about the level of importance of an event which then analyzed in the following discussion.

3.5. Structure of Hierarchy

A functional hierarcy is very beneficial in guiding a system toward its desired goals. In this study, the hierarchy used is a functional hierarchy which composed of four levels as follow:

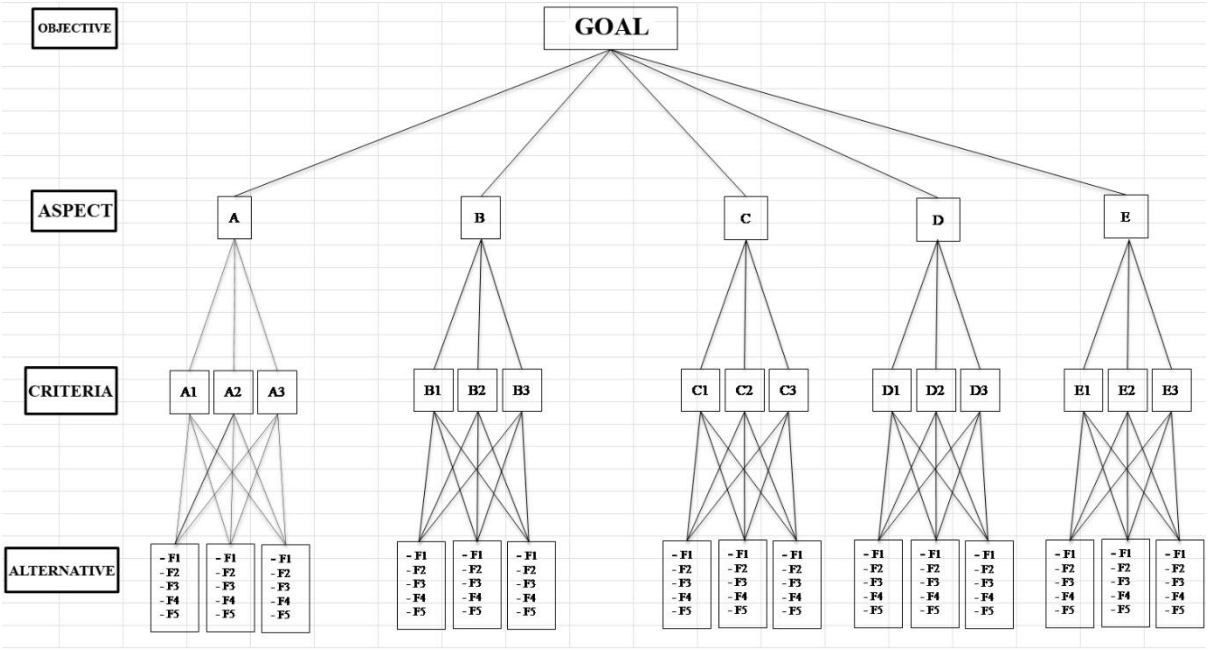

Figure 1. Structure of hierarchy

1. First level is the goal, which is criteria establishment of determinant causal factors for conducting irrigation network rehabilitation program.

2. The second level is criteria consisted of 5 aspects:
   A. Irrigation Workplace
   B. Area Size
   C. Funding Resources
   D. Budget Target
   E. Institution and Participation

3. Third level is sub-criteria consisted of 15 items as listed below:
   A1. Physical Infrastructure
   A2. Planting Productivity
   A3. Water Availability
   B1. Large Area Size
   B2. Medium Area Size
   B3. Small Area Size
   C1. Central Government Funding
   C2. Local Government Funding
   C3. Grant or Foreign Funding
   D1. Food Security
   D2. Improvement of Irrigation Service
   D3. Improvement of Irrigation Management Efficiency
   E1. Power of Institution
   E2. Farmers Participation
   E3. Ability to Resolve Conflict

4. Fourth level is alternative criteria consisted of 5 types of criteria as listed below:
   F1. Rehabilitation work of irrigation network on Sumber Kundung area, Tanggulkundung Village, Besuki District
   F2. Rehabilitation work of irrigation network on Sumber Bandung area, Wonorejo Village, Pagerwojo District
   F3. Rehabilitation work of irrigation network on Sumber Banyuurip area, Kendal Village, Gondang District
   F4. Rehabilitation work of irrigation network on Blader area, Pucangan Village, Kauman District
   F5. Rehabilitation work of irrigation network on Dadapan area, Punjul Village, Karangrejo District

IV. RESULT AND DISCUSSION

4.1. Priority Determination by Expert Choice

4.1.1. Weight Determination and Consistency Testing

1. Pairwise comparison between aspects

Initial stage for data tabulation begins by entering result of inter-aspect comparison questionnaire taken from 30 respondents using assessment weight based on Table 1. After the comparison matrix has been compiled, the next step is calculating Consistency Ratio (CR) by comparing the Consistency Index (CI) against Random Consistency Index (RI) under provision that CR value must not exceed the predetermined tolerance limit. If all data fullfilled the consistency criteria then the geometric mean value of each pair of aspects can be calculated and these values then be used as basis for weight calculation of each aspect.

2. Aspect weighting

Table 3. Weight and cosistency ratio for pairwise matrix of aspects

Criteria	Weight
Irrigation Workperformance (A)	0.459
Area Size (B)	0.166
Funding Source (C)	0.073
Budget Target (D)	0.061
Institution and Participation (E)	0.241
CR (Consistency Ratio)	**0.05**

A percentage distribution diagram of weight values calculation results from the pairwise comparison matrix between aspects is displayed in the following figure (Figure 2).

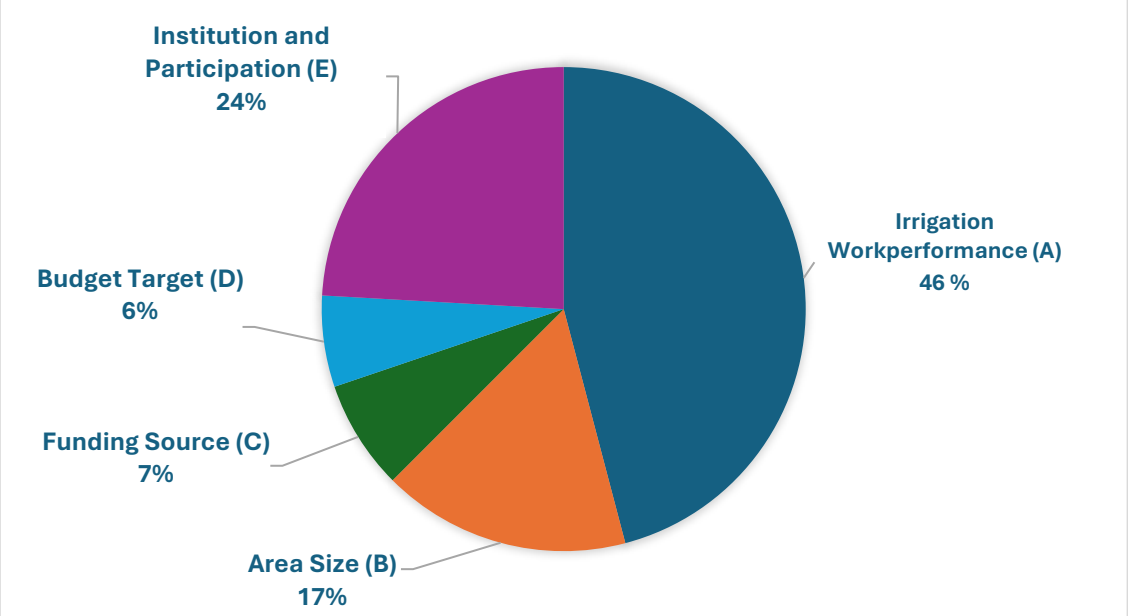

Figure 2. Weight value of pairwise matrix of aspects

4.1.2. Comparison of Pairwise Criteria Within Aspects

A comparison of criteria pairs within each aspect is conducted to assess the relative importance of each criterion based on the established aspects. The next step is inputting questionnaire data about criteria comparison within each aspect that obtained from 30 respondents using assessment weight as listed in Table 1. After the comparison matrix created, a calculation of Consistency Ratio (CR) is performed by comparing the Consistency Index (CI) to Random Consistency Index (RI) under a provision that CR value must not exceed the established tolerance limit. If all data meets the consistency requirements, the geometric mean value for each criterion pair can be calculated, which then, this value be used as the basis for calculating weight of each criteria in the next stage.

1. Aspect of workperformance irrigation

Table 3. Weight and consistency ratio values for criteria on irrigation workperformance aspect

Criteria	Weight
Physical Infrastructure (A1)	0.222
Planting Productivity (A2)	0.268
Water Availability (A3)	0.510
CR (Consistency Ratio)	**0.02**

2. Aspect of area size

Table 4. Weight and consistency ratio values for criteria on area size aspect

Criteria	Weight
Large Area Size (B1)	0.566
Medium Area Size (B2)	0.271
Small Area Size (B3)	0.166
CR (Consistency Ratio)	**0.03**

3. Aspect of funding source

Table 5. Weight and consistency ratio values for criteria on funding source aspect

Criteria	Weight
Central Government Funding (C1)	0.440
Local Government Funding (C2)	0.323
Grant or Foreign Funding (C3)	0.237
CR (Consistency Ratio)	**0.02**

4. Aspect of budget target

Table 6. Weight and consistency ratio values for criteria on budget target aspect

Criteria	Weight
Food Security (D1)	0.312
Irrigation Service Improvement (D2)	0.376
Improvement on Irrigation Management Efficiency (D3)	0.312
CR (Consistency Ratio)	**0.00**

5. Aspect of institution and participation

Table 7. Weight and consistency ratio values for criteria on institution and participation aspect

Criteria	Weight
Institution Power (E1)	0.315
Farmer Participation (E2)	0.256
Ability to settle conflict (E3)	0.429
CR (Consistency Ratio)	**0.0003**

The recapitulation result of priority weighting values based on the aspects and criterias is presented in the following table (Table 8).

Table 8. Recapitulation of weights of aspect and criteria

Aspect	Weight Value	Criteria	Weight Value
Irrigation Workperformance (A)	0.459	Physical Infrastructure (A1)	0.222
		Planting Productivity (A2)	0.268
		Water Availability (A3)	0.510
Size of Area (B)	0.166	Large Area Size (B1)	0.566
		Medium Area Size (B2)	0.271
		Small Area Size (B3)	0.163
Funding Source (C)	0.073	Central Government Funding (C1)	0.440
		Local Government Funding (C2)	0.323
		Grant or Foreign Funding (C3)	0.237
Budget Target (D)	0.061	Food Security (D1)	0.312
		Improvement of Irrigation Service (D2)	0.376

Aspect	Weight Value	Criteria	Weight Value
		Improvement of Efficiency Irrigation Management (D3)	0.312
Institution and Participation (E)	0.241	Institution Power (E1)	0.215
		Farmer Participation (E2)	0.256
		Ability to settle conflict (E3)	0.429

4.1.3. Alternative Weighting Score Based on Criteria

1. Alternative comparison in each criteria

The next phase is entering the data from questionnaire results against the alternative comparison of criteria within aspect which obtained from 30 respondents with weight assessment of 1 and will be calculated by comparison. Then, the reseachers will calculate Consistency Ratio by comparing the Consistency Index (CI) with Random Consistency Index (RI) under condition that it must not exceed the specified threshold value. After all data is declared consistent, the geometric mean value $\overline{X}_g$ of each pair of aspects can be obtained and then put into weight aspect calculation as stated in the following explanation.

2. Criteria from irrigation workperformance aspect

The comparison between alternatives based on Irrigation Workperformance aspect consisted of five pairwise comparison matrices and the value of alternative weight for each criteria within work performance irrigation aspect is listed in the following table (Table 9).

Table 9. Table of priority alternatives by criteria of workperformance irrigation aspect (A)

Alternatives	Physical Infrastructure	Planting Productivity	Water Availability
Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District	0.193	0.204	0.278
Rehabilitation work of irrigation network on Sumber Bandung Area, Wonorejo Village, Pagerjowo District	0.163	0.146	0.172
Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District	0.168	0.133	0.148
Rehabilitation work of irrigation network on Pucangan Village, Kauman District	0.205	0.233	0.160
Rehabilitation work of irrigation network on Dadapan Area, Punjul Village, Karangrejo District	**0.269**	**0.284**	**0.243**
CR (Consistency Ratio)	**0.02**	**0.002**	**0,01**

According to table 9, the result of AHP analysis on CR weight value and consistency ratio value for pairwise comparison matrix between criterias obtained CR values of 0.02, 0.002, and 0.01 for three criterias which means the matrix of three criterias is said to be consistent since the CR value is < 10 %.

3. Criteria from area size aspect

The comparison between alternatives based on Area Size aspect consisted of five pairwise comparison matrices and the value of alternative weight for each criteria within area size aspect is listed in the following table (Table 10).

Table 10. Table of priority alternatives by criteria of area size aspect (B)

Alternatives	Area Size	Medium Size Area	Small Size Area
Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District	0.278	0.151	0.128
Rehabilitation work of irrigation network on Sumber Bandung Area, Wonorejo Village, Pagerjowo District	0.172	0.090	0.087
Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District	0.148	0.109	0.117
Rehabilitation work of irrigation network on Pucangan Village, Kauman District	0.160	0.266	0.201

Rehabilitation work of irrigation network on Dadapan Area, Punjul Village, Karangrejo District	**0.243**	**0.384**	**0.467**
CR (Consistency Ratio)	**0.01**	**0.01**	**0,04**

According to Table 10, the result of AHP analysis on CR weight value and consistency ratio value for pairwise comparison matrix between criteria obtained CR values of 0.01, 0.01 and 0.04 for three criterias which means the matrix of three criterias is said to be consistent since the CR value is < 10 %.

4. Criteria from funding source aspect

The comparison between alternatives based on Funding Source aspect consisted of five pairwise comparison matrices and the value of alternative weight for each criteria within funding source aspect is listed in the following table (Table 11).

Table 11. Table of priority alternatives by criteria of funding source aspect (C)

Alternatives	Central Government Funding	Local Government Funding	Grant/Foreign Funding
Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District	0.154	0.112	0.167
Rehabilitation work of irrigation network on Sumber Bandung Area, Wonorejo Village, Pagerjowo District	0.215	0.093	0.189
Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District	0.151	0.126	0.109
Rehabilitation work of irrigation network on Pucangan Village, Kauman District	0.175	0.200	0.189
Rehabilitation work of irrigation network on Dadapan Area, Punjul Village, Karangrejo District	**0.304**	**0.469**	**0.446**
CR (Consistency Ratio)	**0.02**	**0.02**	**0,02**

According to Table 11, the result of AHP analysis on CR weight value and consistency ratio value for pairwise comparison matrix between criteria obtained CR values of 0.02, 0.02 and 0.02 for three criterias which means the matrix of three criterias is said to be consistent since the CR value is < 10 %.

5. Criteria from budget target aspect

The comparison between alternatives based on Budget Target aspect consisted of five pairwise comparison matrices and the value of alternative weight for each criteria within budget target aspect is listed in the following table (Table 12).

Table 12. Table of priority alternatives by criteria of budget target aspect (D)

Alternatives	Food Security	Improvement irrigation service	Improvement of efficiency on Irrigation Management
Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District	0.229	0.124	0.267
Rehabilitation work of irrigation network on Sumber Bandung Area, Wonorejo Village, Pagerjowo District	0.111	0.121	0.119
Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District	0.106	0.182	0.094
Rehabilitation work of irrigation network on Pucangan Village, Kauman District	0.196	0.214	0.179
Rehabilitation work of irrigation network on Dadapan Area, Punjul Village, Karangrejo District	**0.358**	**0.357**	**0.340**
CR (Consistency Ratio)	**0.04**	**0.04**	**0,07**

According to Table 12, the result of AHP analysis on CR weight value and consistency ratio value for pairwise comparison matrix between criteria obtained CR values of 0.04, 0.04 and 0.07 for three criterias which means the matrix of three criterias is said to be consistent since the CR value is < 10 %.

6. Criteria from institution and participation aspect

The comparison between alternatives based on Institution and Participation aspect consisted of five pairwise comparison matrices and the value of alternative weight for each criteria within budget target aspect is listed in the following table (Table 13).

Table 13. Table of priority alternatives by criteria of institution and participation aspect (E)

Alternatives	Institution Power	Farmer Participation	Ability to settle conflict
Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District	0.135	0.099	0.142
Rehabilitation work of irrigation network on Sumber Bandung Area, Wonorejo Village, Pagerjowo District	0.120	0.1.07	0.229
Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District	0.204	0.139	0.194
Rehabilitation work of irrigation network on Pucangan Village, Kauman District	0.194	0.301	0.180
Rehabilitation work of irrigation network on Dadapan Area, Punjul Village, Karangrejo District	**0.346**	**0.353**	**0.254**
CR (Consistency Ratio)	**0.03**	**0.04**	**0,01**

According to Table 13, the result of AHP analysis on CR weight value and consistency ratio value for pairwise comparison matrix between criteria obtained CR values of 0.03, 0.04 and 0.01 for three criterias which means the matrix of three criterias is said to be consistent since the CR value is < 10 %.

4.1.4. Overall Determination of Alternative Priorities

The overall determination of alternative priorities becomes the final conclusion of several main priorities that has been obtained based on selected aspects and criterias. The weighted result for local and global priorities as a whole are summarized in the following table (Table 14).

Table 14. Overall alternative priority scale

Alternatives	Weight	Rank
Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District	0.192	3
Rehabilitation work of irrigation network on Sumber Bandung, Wonorejo Village, Pagerwojo District	0.161	4
Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District	0.151	5
Rehabilitation work of irrigation network on Blader Area, Pucangan Village, Kauman District	0.203	2
Rehabilitation work of irrigation network on Dadapan Area, Punjul Village, Karangrejo District	0.294	1

Meanwhile, percentage distribution diagram based on the overall alternative priority scale is depicted in the following figure (Figure 3).

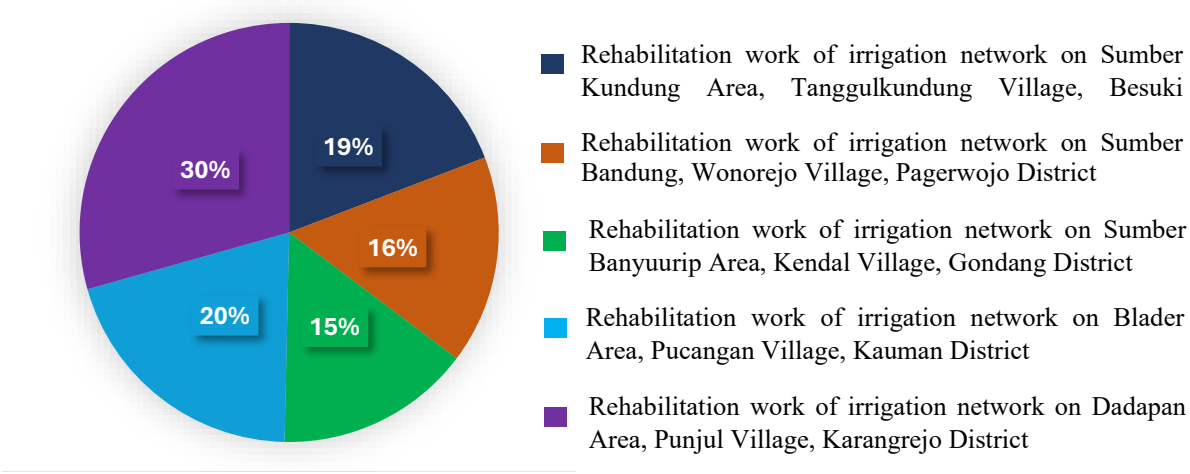

Figure 3. Overall alternative priority scale

According to Table 14, the researchers acquired result priority of irrigation network that needs rehabilitation program:

1. Rehabilitation work of irrigation network on Dadapan Area, Punjul Village, Karangrejo District.
2. Rehabilitation work of irrigation network on Blader Area, Pucangan Village, Kauman District.
3. Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District.
4. Rehabilitation work of irrigation network on Sumber Bandung Area, Wonorejo Village, Pagerwojo District.
5. Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District.

From the explanation above, it revealed from overall aspects the fifth alternative (Rehabilitation of Dadapan irrigation network in Punjul Village of Karangrejo District) has the highest overall weight (29.4 %) when compared to other alternatives, therefore, it can be stated that the Rehabilitation of Dadapan Irrigation network in Punjul Village of Karangrejo District becomes the highest rank of reccomendation to receive the first funding allocation.

4.2. Alternative Priority Determination Based on Budget Ceiling

Priority determination of which irrigation networks must be rehabilitated according to the ranking (as calculated by AHP method) to make the fund allocation order for implementation irrigation network rehabilitation project can be determined according to the available budget ceiling can be seen in the following table (Table 15).

Table 15. Alternative priority based on budget ceiling

No. Rank	Alternatives	Cost	Cumulative Fee
1.	Rehabilitation work of irrigation Network on Dadapan Area, Punjul Village, Karangrejo District.	Rp 1.320.484.000,-	Rp 1.320.484.000,-
2.	Rehabilitation work of irrigation Network on Blader Area, Pucangan Village, Kauman District.	Rp 1.129.033.000,-	Rp 2.449.517.000,-
3.	Rehabilitation work of irrigation network on Sumber Kundung Area, Tanggulkundung Village, Besuki District	Rp 675.766.000,-	Rp 3.125.283.000,-
4.	Rehabilitation work of irrigation network on Sumber Bandung Area, Wonorejo Village, Pagerwojo District	Rp 896.452.000,-	Rp 4.021.735.000,-
5.	Rehabilitation work of irrigation network on Sumber Banyuurip Area, Kendal Village, Gondang District.	Rp 1.091.766.000,-	Rp 5.113.501.000,-

Table 15 explains the alternative priority orders along with the cumulative costs required to work on the program. If the allocated budget only limited to IDR. 4.000.0000.000,-, then irrigation networks in rank 1 to 4 are the irrigation networks that will receive optimal rehabilitation work. Whereas for the rest of irrigation networks that can not have rehabilitation work due to limited funds will be allocated into the Revised Regional Revenue and Expenditure Budget (*Perubahan Anggaran Pendapatan Belanja Daerah*/PAPBD) of Tulungagung Regency for 2026 fiscal year or in the following fiscal year.

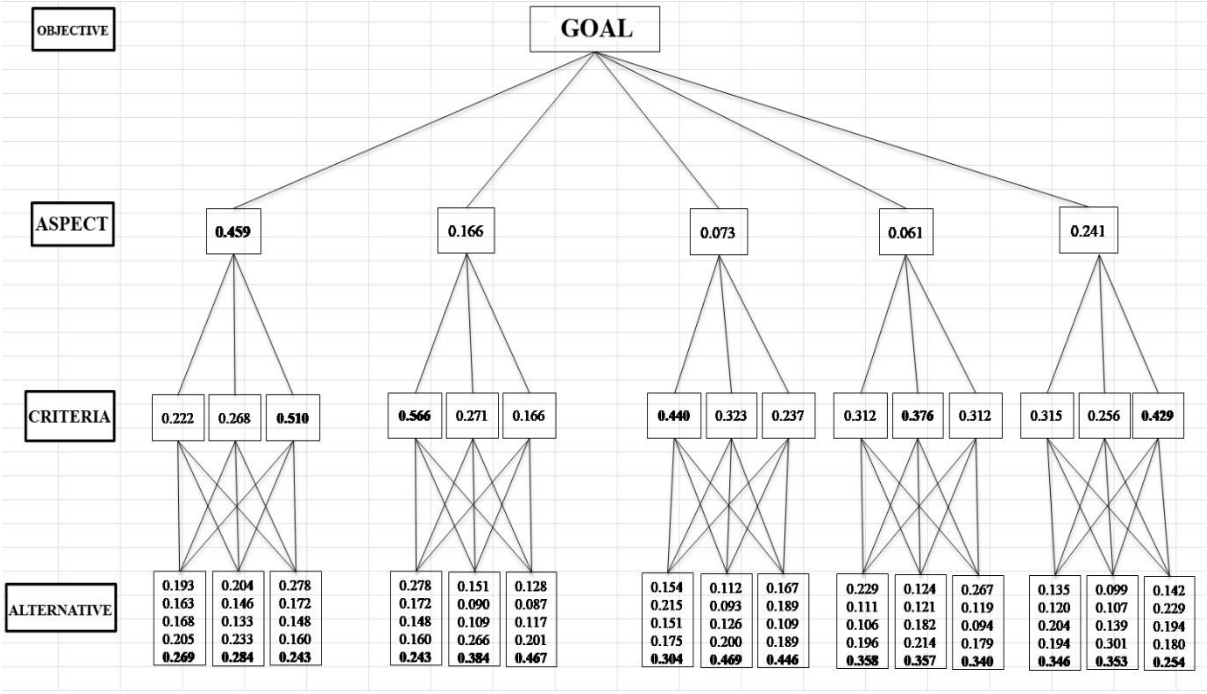

Figure 4. Result of hierarchycal structure for irrigation network rehabilitation project

V. CONCLUSION

According to data processing and data analysis by Analytic Hierarchy Process (AHP) method, this study able to produce a rehabilitation priority scale for several irrigation networks under authority of Tulungagung Regency local government. Prioritization process was carried out through the preparation of hierarchical structure, pairwise comparison assessment, weighting, consistency testing, and a creation of a final score for each alternative. The following conclusions were drawn from the analysis and discussion sections:

1. Based on the weighting results, the most influential aspects in determining the rehabilitation of irrigation networks in Tulungagung Regency is put in rank as follow: irrigation workperformace with weight value of 0.459 (45.9%), institutional and participation aspects with weight value of 0.241 (24.1%), area size with weight value of 0.166 (16.6%), funding sources with weight value of 0.073 (7.3%), and budget targets with weight value of 0.061 (6.1%).
2. The considered criteria have different weights value for each aspect. In the irrigation workperformance aspect, the highest weight is found in water availability criteria (0.510). While in the area size aspect, the highest weight is found in large size area criteria (0.566). In funding source aspect, the highest weight is found in central government funding criteria (0.440). In the budget target aspect, the highest weight is found in improving irrigation service criteria (0.376). In the institution and participation aspect, the highest weight is found in the ability to resolve conflict criteria (0.429). For overall result, the most influential criteria are the large size area.
3. Result of ranking priority to alternative irrigation network rehabilitation program showed the following priority order: (1) Dadapan with value of 0.294, (2) Blader with value of 0.203, (3) Sumber Kundung with value of 0.912, (4) Sumber Bandung with value of 0.161, (5) and Sumber Banyuurip with value of 0.151. While considering the budget ceiling in this study, then the recommended rehabilitation priority put in ranks are: Dadapan, Blader, Sumber Kundung and Sumber Bandung as the selected sites of irrigation rehabilitation program.

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