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DSS Determines the Best Urban Village in handling COVID-19 Using AHP Method

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Abstract−This study aims to develop a Decision Support System (DSS) using the Analytic Hierarchy Process (AHP) method to determine the best-performing urban village in handling COVID-19 in Medan City, Indonesia. The research addresses the problem of the absence of a structured, data-driven evaluation model to objectively measure the performance of 151 urban villages across 21 sub-districts during the pandemic. Four criteria were used in the decision-making process: number of deaths, number of recovered patients, number of active cases, and the level of community compliance. The DSS, developed using a website-based programming language and integrated with the AHP method, generated weighted scores and ranked all evaluated villages. The results indicate that Harjosari I Village (A1), located in Medan Amplas Sub-district, achieved the highest overall score and was identified as the best urban village in handling COVID-19. System usability testing also produced very positive results, with Clarity of Instructions (90), Material Content (90), Discussion (93), and Interface Appearance (90), yielding an average score of 90 categorized as Very Adequate. This study contributes a validated web-based DSS model that supports objective evaluation, enhances transparency, and strengthens evidence-based decision-making for local governments in managing public health crises.

Keywords: COVID-19; Analitycal Hierarchy Process; DSS; Medan city; Best Village.

1. INTRODUCTION

Indonesia is an archipelagic country consisting of provinces, districts, and cities. While other countries are focused and serious in dealing with COVID-19, so is Indonesia. All existing elements are assigned to be involved in handling COVID-19 [1], [2]. Including leaders at the provincial, district, and city levels. Regional leaders are asked to be creative and innovative in handling COVID-19. So that the areas they lead get out of the COVID-19 red zone. Areas included in the red zone category are areas where the level of exposure to COVID-19 is above the average threshold. The death rate and the active patient rate are high. Leaders must certainly measure their performance to see which leaders are implementing the right strategy. Not to look for excellence, but to see the creativity and innovative leaders [3], [4]. It is possible that other regional leaders can imitate the strategies and formulas used. Considering that no area in Indonesia is spared from the impact of COVID-19 [5].

The area that became the pilot project of the research is the city of Medan. The 5th largest city in Indonesia and is the capital of the province of North Sumatra. It consists of 21 sub-districts and 151 sub-districts. The Camat leads the sub-district level, and the Lurah leads the village. Periodically, the Camat and Lurah report to the mayor handling COVID-19 in their respective regions. Starting from the number of dead, the number of recovered, and active patients. The mayor will see how things develop. Is there a change for the better, or conversely, the level of exposure to COVID-19 in the area is getting worse or increasing?. If it increases, of course, there is something wrong and must be changed. However, if there is a change for the better, the strategies that have been carried out must be continued and combined with new strategies to support the performance of existing strategies that have been carried out previously. For every significant increase, the mayor will give awards to regional leaders. If the exposure level worsens, the mayor will punish, and even regional leaders can be threatened with being removed from office. Therefore, every regional leader is required to work seriously, focused, and programmed. Because if it applies the wrong strategy, there is a threat of punishment that awaits.

The context of a decision support system will be utilized. This context was chosen because the decision support system is identical to the assessment based on criteria and alternatives [6]. The context of the decision support system was chosen because it can rank based on predetermined value provisions [7]. Many studies have used the context of decision support systems and have been proven to provide effective, efficient, and detailed assessments [8]. Research [9]–[11] uses the context of a decision support system in selecting the best employees, students who are eligible to receive scholarships, and choosing the best halal tourism objects. The research went well, and the research results were accurate. Research [12]–[15] also uses the context of a decision support

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system to select the location for opening a business, selecting the best lecturers, selecting the most appropriate contractor, and selecting the best housing. It is proven that all research that uses the context of the decision support system runs well and can solve problems where the results are as expected. The context of the decision support system is combined with computer-based applications to maximize performance in the decision-making process. Like research [16]–[19], in the research they did with the context of a decision support system, each combined it with computerized-based applications, with desktop-based, website-based, and mobile-based android applications. The whole decision-making process went well, the results were also accurate, and the resolution quickly.

The research will use the context of a decision support system using the Analytical Hierarchy Process (AHP) method. The AHP method is a method that can solve complex, unstructured problems into several components in a hierarchical arrangement by giving subjective values about the relative importance of each variable and determining which variable has the highest priority. Many studies use the AHP method in decision-making. Research [20]–[23] uses the AHP method to select the best tourist attractions, select suitable areas to build for subsidized housing, select the best staff, and select export quality fruit. The whole study went well, and the results were very accurate. Management who uses the AHP method in their decision-making is greatly helped because all stages of the process dash and the results are also accurate. In line with these studies, [24]–[30] conducted research using the AHP method. The research included choosing the best vocational school, choosing majors, selecting flag bearer members, choosing the best education personnel, choosing the best flight attendants, choosing the best call center services, and choosing the best obstetrician practice. The research carried out succeeded in providing the best and detailed decisions. There is time efficiency in the decision-making process carried out. The AHP method is very appropriate to be used in this study.

The research will determine which urban village is the best in handling COVID-19—using the context of a decision support system with the AHP method. As for the object of research, namely urban villages in the city of Medan, with 151 villages. The criteria for decision-making are the number of deaths, the number of recovered patients, the number of active patients, and the level of community compliance. The context of a decision support system using the AHP method is combined with computer-based applications with web-based programming languages to support decision-making performance. When the author searches for research that has been done, journal publications, and other types of publications, there is no research to determine the best village in handling COVID-19. The topic of COVID-19 needs to be researched, especially regarding the development of its handling. The novelty and difference of this research with previous research are the criteria used, then a large number of alternatives is 151 urban villages in the city of Medan. The next novelty that distinguishes it is the combination of the context of a decision support system with applications built using a website-based programming language.

Research must be carried out because COVID-19 is spreading so rapidly, so any handling must be transparent. Research has needs to be done because COVID-19 has begun to decrease the level of exposure but remain vigilant in dealing with it. Its means that the reduction should not satisfy all parties, but the management strategy must be carried out intensively and sustainably. As for what this research must do, COVID-19 is only one of the epidemics that hit globally. Other outbreaks may appear in the future, so this research can be the foundation and material in dealing with outbreaks that are not expected but have the potential to appear in the future. The context of a decision support system using the AHP method combined with technology-based applications using a website-based programming language will be a solution and medium to deal with outbreaks such as COVID-19 in the future.

2. RESEARCH METHODOLOGY

So that the research goes well and the results are accurate as expected, and by the research objectives, the researcher makes a research sequence. The sequence is made in stages, where each stage is a process that supports the achievement of research objectives. The stages must be carried out in order because the sequence made is a unified whole to support the smooth running of the research. The research sequence is as shown in Figure 1.

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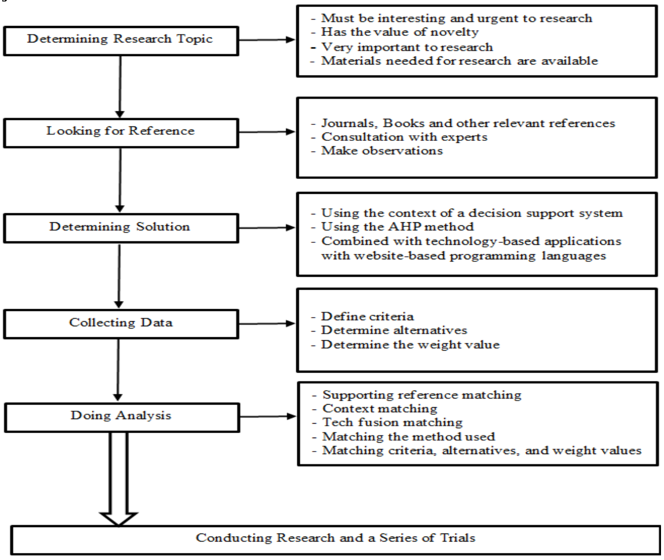

Figure 1. Research Stage Order

Explanation of Figure 1:

1. Determine the research topic.
   A fascinating and urgent study topic with new value and research materials available. This criteria must be followed to ensure the chosen study topic is of high quality and researchable.
2. Looking for references
   Journals, books, and other relevant references shall be used as references. Expert consultation is also required to improve the research's weight and quality.
3. Determine the solution
   Determine the solution to the chosen study topic. This study used the AHP technique with technology applications using a website-based programming language.
4. Collecting data
   A study's data is vital. It is impossible to do a valid study without accurate data. So, start collecting data from criteria, alternatives, and weight values. The data came from Medan's city hall. Thus, the total number of data samples utilized in this research is 151 data samples, representing all 151 kelurahan in Medan City.
5. Doing analysis
   Final analysis ensures that all study needs are genuine and acceptable.
   Like references, context, technology mix, criteria, alternatives, and weight values, if they are all found to be suitable and valid, then study, and trials can begin.
6. Conducting research and a series of trials
   To find the best community to handle COVID-19. Using AHP in a decision support system environment. The AHP technique is solved by [25] :
   - Determine the level of importance
   - Determine the pairwise comparison matrix
   - Summing the element values of each column from the element values of the criteria matrix
   - Divide each element in the column by the appropriate number of columns of the matrix element values
   - Sum each row in the matrix
   - Calculate Eigen Vector values

$$(\sum C1 - Cn)/n \quad (1)$$

   - Find the total ranking for each village

As for the criteria, sub-criteria, and weights, as in table 1 below :

Table 1. Criteria, Sub-criteria, and Weights

Criteria	Criteria Name	Sub-Criteria	Weights
C1	Number of Deaths	>20	8
		<20	6
C2	Positive Number	>30	8

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Criteria	Criteria Name	Sub-Criteria	Weights
		<30	6
C3	Recover Amount	>35	8
		<35	6
C4	Population Compliance	Very Obedient	8
	Rate	Obey	6
		Not Obey	4

3. RESULTS AND DISCUSSION

The steps to determine the best village in handling COVID-19 are as follows:

3.1. Set of Alternative Values

The set of alternative values, as in table 2 below:

Table 2. Set of Alternative Values

Alt	Village	(C1)	(C2)	(C3)	(C4)
A1	Harjosari I	8	6	6	8
A2	Harjosari II	6	6	6	6
A3	Timbang Deli	6	6	6	8
A4	BangunMulia	8	6	6	8
A5	Sitirejo II	8	6	6	8
A6	Sitirejo III	8	8	6	8
A7	Amplas	6	6	6	4
A8	PandauHulu II	6	6	6	6
A9	SeiRengas II	6	6	6	6
A10	SeiRengasPermata	8	6	6	4
A17	Tegal Sari II	6	8	8	6
A18	Tegal Sari III	6	6	6	6
A19	PasarMerahTimur	6	8	6	4
A20	Kesawan	6	6	6	4
A72	SudiRejo I	8	8	8	8
A73	SudiRejo II	8	8	6	8
A74	SitiRejo I	6	6	6	8
A75	Besar	6	8	6	8
A76	Martubung	6	6	6	8
A77	SeiMati	6	8	8	8
A78	PekanLabuhan	6	6	6	8
A79	Nelayan Indah	6	6	6	4
A80	Tangkahan	8	6	6	6
A146	KemenanganTani	6	6	6	6
A147	Lau Cih	8	8	6	6
A148	Namu Gajah	6	6	6	6
A149	Sidomulyo	6	8	8	6
A150	LadangBambu	6	8	8	4
A151	Mangga	8	8	6	4

3.2. Pairwise comparison matrix and Sum the element values of each column from the element values

The initial input is to determine the criteria value. As in table 3 below:

Table 3. Pairwise comparison matrix and Number of elements per column

Criteria	C1	C2	C3	C4	Criteria	C1	C2	C3	C4
C1	1	3	5	2	**C1**	1	3	5	2
C2	1/3=0.33	1	5/3=1.67	2/3=0.67	**C2**	0.33	1	1.67	0.67
C3	1/5=0.20	3/5=0.60	5/5=1	2/5=0.4	**C3**	0.20	0.60	1	0.4

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Criteria	C1	C2	C3	C4	Criteria	C1	C2	C3	C4
C4	1/2=0.5	3/2=1.5	5/2=2.5	2/2=1	**C4**	0.5	1.5	2.5	1
					AMOUNT	2.03	6.1	10.17	4.07

C1 = 1+0.33+0.20+0.14 = 2.03 **C2** = 3+1+0.60+0.42 = 6.1
C3 = 5+1.67+1+0.7 = 10.17 **C4** = 7+2.33+1.4+1 = 4.07

3.3. Divide each element in the appropriate column from the matrix element values

The normalization matrix calculated by dividing each element. Calculated as in table 4 below:

Table 4. The corresponding number of columns of matrix element values

Criteria	C1	C2	C3	C4	Criteria	C1	C2	C3	C4
C1	1/2.03	3/6.1	5/10.17	2/4.07	**C1**	0.4926	0.4918	0.4916	0.4914
C2	0.33/2.03	1/6.1	1.67/10.17	0.67/4.07	**C2**	0.1626	0.1639	0.1642	0.1646
C3	0.20/2.03	0.60/6.1	1/10.17	0.4/4.07	**C3**	0.0985	0.0984	0.0983	0.0983
C4	0.5/2.03	1.5/6.1	2.5/10.17	1/4.07	**C4**	0.2463	0.2459	0.2458	0.2457

3.4. Sum each row in the matrix

Then add up each row in the matrix. The number of rows is calculated as follows:
C1 = 0. 4926+0.4918+0.4916+0.4914 = 1.9674 **C2** = 0. 1626+0. 639+0.1642+0.1646 = 0.6553
C3 = 0.0985+0.0984+0.0983+0.0983 = 0.3935 **C4** = 0.2463+0.2459+0.2458+0.2457 = 0.9837

3.5. Calculate EigenVector value

Calculated by the number of criteria (n = 4) so that the priority value calculated as follows :
C1 = 1.9674/4 = 0.491850 **C2** = 0.6553/4 =0.163825
C3 = 0.3935/4 =0.098375 **C4** = 0.9837/4 = 0.245925
Presented in table 5 below:

Table 5. Vector Value

Criteria	C1	C2	C3	C4	$\sum C1 - Cn$	Eigen Vector $(\sum C1 - Cn)/n$
C1	0.4926	0.4918	0.4916	0.4914	1.9674	0. 491850
C2	0.1626	0.1639	0.1642	0.1646	0.6553	0. 163825
C3	0.0985	0.0984	0.0983	0.0983	0.3935	0. 098375
C4	0.2463	0.2459	0.2458	0.2457	0.9837	0. 245925

$$\alpha\ max = (2.03 * 0.491850) + (6.1 * 0.163825) + (10.17 * 0.098375) + (4.07 * 0245925)$$

$$\alpha\ max = 0.984555 + 0.9993325 + 1.00047375 + 1.00091475$$

$$\alpha\ max = 3.9991765$$

Calculating the consistency index : to calculate the consistency index using the formula :

$$CI = \frac{\alpha\ max - n}{n-1} \qquad CI = \frac{3.9991765 - 4}{4-1} \qquad CI = \frac{-0.00082}{3} = -0.00027$$

RI (Random Index) is a value obtained from a random table; random values can be seen in table 6.

Table 6. Random Index (RI) Value

Matrix Size	1,2	3	4	5	6	7	8	9	10
Index Random	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

For n = 4, RI = 0.900, so :

$$CR = \frac{-0.00027}{0.90}$$

$$CR = -0.0003$$

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Because CR < 0.100 means that the respondent's preference is consistent

3.6. Find the total ranking for each village

Find the total ranking for each village and priority Weighting Criteria. CR value of <0.1; then, the eigenvectors can be used to determine the best village against each criterion. Can be seen in table 7.

Table 7. Priority Weight Criteria and Results of the Priority Weighting Criteria (Eigen Vector)

Alt	(C1)	(C2)	(C3)	(C4)	(C1)	(C2)	(C3)	(C4)	Total
A1	8*0.4918	6*0.1638	6*0.0983	8*0.2459	3.93480	0.98295	0.59025	1.96740	7.47540
A2	6*0.4918	6*0.1638	6*0.0983	6*0.2459	2.95110	0.98295	0.59025	1.47555	5.99985
A3	6*0.4918	6*0.1638	6*0.0983	8*0.2459	2.95110	0.98295	0.59025	1.96740	6.49170
A4	8*0.4918	6*0.1638	6*0.0983	8*0.2459	3.93480	0.98295	0.59025	1.96740	7.47540
A5	8*0.4918	6*0.1638	6*0.0983	8*0.2459	3.93480	0.98295	0.59025	1.96740	7.47540
A6	8*0.4918	8*0.1638	6*0.0983	8*0.2459	3.93480	1.31060	0.59025	1.96740	7.80305
A7	6*0.4918	6*0.1638	6*0.0983	4*0.2459	2.95110	0.98295	0.59025	0.98370	5.50800
A8	6*0.4918	6*0.1638	6*0.0983	6*0.2459	2.95110	0.98295	0.59025	1.47555	5.99985
A9	6*0.4918	6*0.1638	6*0.0983	6*0.2459	2.95110	0.98295	0.59025	1.47555	5.99985
A10	8*0.4918	6*0.1638	6*0.0983	4*0.2459	3.93480	0.98295	0.59025	0.98370	6.49170
…	…	…	…	…	…	…	…	…	…
A17	6*0.4918	8*0.1638	8*0.0983	6*0.2459	2.95110	1.31060	0.78700	1.47555	6.52425
A18	6*0.4918	6*0.1638	6*0.0983	6*0.2459	2.95110	0.98295	0.59025	1.47555	5.99985
A19	6*0.4918	8*0.1638	6*0.0983	4*0.2459	2.95110	1.31060	0.59025	0.98370	5.83565
A20	6*0.4918	6*0.1638	6*0.0983	4*0.2459	2.95110	0.98295	0.59025	0.98370	5.50800
.	.	.	.	.	.	.	.	.	.
..	..	..	..	..	..	..	..	..	..
A72	8*0.4918	8*0.1638	8*0.0983	8*0.2459	3.93480	1.31060	0.78700	1.96740	7.99980
A73	8*0.4918	8*0.1638	6*0.0983	8*0.2459	3.93480	1.31060	0.59025	1.96740	7.80305
A74	6*0.4918	6*0.1638	6*0.0983	8*0.2459	2.95110	0.98295	0.59025	1.96740	6.49170
A75	6*0.4918	8*0.1638	6*0.0983	8*0.2459	2.95110	1.31060	0.59025	1.96740	6.81935
A76	6*0.4918	6*0.1638	6*0.0983	8*0.2459	2.95110	0.98295	0.59025	1.96740	6.49170
A77	6*0.4918	8*0.1638	8*0.0983	8*0.2459	2.95110	1.31060	0.78700	1.96740	7.01610
A78	6*0.4918	6*0.1638	6*0.0983	8*0.2459	2.95110	0.98295	0.59025	1.96740	6.49170
A79	6*0.4918	6*0.1638	6*0.0983	4*0.2459	2.95110	0.98295	0.59025	0.98370	5.50800
A80	8*0.4918	6*0.1638	6*0.0983	6*0.2459	3.93480	0.98295	0.59025	1.47555	6.98355
….	….	….	….	….	….	….	….	….	….
A146	6*0.4918	6*0.1638	6*0.0983	6*0.2459	2.95110	0.98295	0.59025	1.47555	5.99985
A147	8*0.4918	8*0.1638	6*0.0983	6*0.2459	3.93480	1.31060	0.59025	1.47555	7.31120
A148	6*0.4918	6*0.1638	6*0.0983	6*0.2459	2.95110	0.98295	0.59025	1.47555	5.99985
A149	6*0.4918	8*0.1638	8*0.0983	6*0.2459	2.95110	1.31060	0.78700	1.47555	6.52425
A150	6*0.4918	8*0.1638	8*0.0983	4*0.2459	2.95110	1.31060	0.78700	0.98370	6.03240
….	….	….	….	….	….	….	….	….	….

Table 8. Ranking

Alt	Village	C1	C2	C3	C4	Total	Rank
A1	Harjosari I	3.934800	0.982950	0.590250	1.967400	7.475400	1
A7	Amplas	2.951100	0.982950	0.590250	0.983700	5.508000	2
A12	Matsum II	2.951100	0.982950	0.590250	0.983700	5.508000	3
A20	Kesawan	2.951100	0.982950	0.590250	0.983700	5.508000	4
A25	SeiAgul	2.951100	0.982950	0.590250	0.983700	5.508000	5
A30	Padang Bulan	2.951100	0.982950	0.590250	0.983700	5.508000	6
A31	TitiRantai/Rante	2.951100	0.982950	0.590250	0.983700	5.508000	7
A42	Kota Bangun	2.951100	0.982950	0.590250	0.983700	5.508000	8
	Tegal Sari						
A44	Mandala I	2.951100	0.982950	0.590250	0.983700	5.508000	9
A46	Tegal Sari	2.951100	0.982950	0.590250	0.983700	5.508000	10

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Alt	Village	C1	C2	C3	C4	Total	Rank
	Mandala III						
A47	Denai	2.951100	0.982950	0.590250	0.983700	5.508000	11
A57	KwalaBekala	2.951100	0.982950	0.590250	0.983700	5.508000	12
A59	Gedung Johor	2.951100	0.982950	0.590250	0.983700	5.508000	13
A60	Kedai Durian	2.951100	0.982950	0.590250	0.983700	5.508000	14
A61	SukaMaju	2.951100	0.982950	0.590250	0.983700	5.508000	15
A64	PasarBaru	2.951100	0.982950	0.590250	0.983700	5.508000	16
A79	Nelayan Indah	2.951100	0.982950	0.590250	0.983700	5.508000	17
A92	PandauHilir	2.951100	0.982950	0.590250	0.983700	5.508000	18
A97	Sidorame Barat I	2.951100	0.982950	0.590250	0.983700	5.508000	19
A99	SidorameTimur	2.951100	0.982950	0.590250	0.983700	5.508000	20
.	.	.	.	.	.	.	.
..	..	..	..	..	..	..	..
A27	PetisahHulu	2.951100	0.982950	0.590250	1.967400	6.491700	72
A28	Babura	2.951100	0.982950	0.590250	1.967400	6.491700	73
A37	BelawanBahagia	3.934800	0.982950	0.590250	0.983700	6.491700	74
A38	TanjungMulia	3.934800	0.982950	0.590250	0.983700	6.491700	75
A40	Mabar	3.934800	0.982950	0.590250	0.983700	6.491700	76
A41	MabarHilir	2.951100	0.982950	0.590250	1.967400	6.491700	77
A56	CintaDamai	2.951100	0.982950	0.590250	1.967400	6.491700	78
A62	TitiKuning	3.934800	0.982950	0.590250	0.983700	6.491700	79
A63	PandauHulu I	3.934800	0.982950	0.590250	0.983700	6.491700	80
...	...	...	...	...	...	...	...
....	....	....	....	....	....	....	....
	PasarMerah						
A69	Barat	3.934800	1.310600	0.590250	1.967400	7.803050	146
A73	SudiRejo II	3.934800	1.310600	0.590250	1.967400	7.803050	147
A11	Matsum I	3.934800	1.310600	0.787000	1.967400	7.999800	148
A35	Bagan Deli	3.934800	1.310600	0.787000	1.967400	7.999800	149
	Tegal Sari						
A45	Mandala II	3.934800	1.310600	0.787000	1.967400	7.999800	150
A72	SudiRejo I	3.934800	1.310600	0.787000	1.967400	7.999800	151

Although several alternatives in Table 8 have identical final scores (such as 5.508000), they are assigned different ranking positions because the study uses a sequential ranking method rather than a tied-ranking approach. In sequential ranking, each alternative receives a unique rank based on its position in the sorted list, even when the total scores are the same, ensuring a clear and continuous priority sequence. This method is commonly applied in AHP-based decision-support systems to avoid ambiguity and maintain a distinct priority order for all alternatives, meaning that the differing ranks reflect the ranking technique used rather than an error in the data. Based on this ranking process, it was found that the best urban village in handling COVID-19 was **Harjosari I (A1)** Village, located in Medan Amplas sub-district, Medan City, North Sumatra Province.

3.7. Analysis of System Test Results

The system built with a website-based programming language, a combination of the context of a decision support system with the AHP method, is tested on several users to see if the system built is by and meets the requirements. As for the assessment parameters, namely, clarity of instructions for use, material content, discussion, and appearance. System testing is then carried out on 25 people who are selected as users to carry out testing. The 25 selected people were asked to use the website built by first being given instructions for use. After that, the 25 people used the website; they were then asked to fill in the assessment on the paper provided. System Rating Parameters and The accumulated results from the assessments of the 25 users are as shown in For complete as in table 9 below:

Table 9. System Rating Parameters and and The accumulated results from the assessments

No	Vulnerable Value	Classification	No	Classification	Rating	Information
1	0 - 26	Inadequate	**1**	Clarity of Instructions for Use	90	Very Adequate

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No	Vulnerable Value	Classification	No	Classification	Rating	Information
2	27 - 51	Adequate	**2**	Material Content	90	Very Adequate
3	52 - 76	Adequate	**3**	Discussion	93	Very Adequate
4	77 - 100	Very Adequate	**4**	Appearance	90	Very Adequate

The results of tests carried out by table 9 show that the system built with an average value of 90, with the description Very Adequate.

3.8. Discussion

The determination of the best urban village in handling COVID-19 was carried out through a structured multi-criteria decision-making process using the Analytical Hierarchy Process (AHP), beginning with the compilation of alternative values for 30 villages based on four criteria (C1-C4). A pairwise comparison matrix was then constructed to assess the relative importance of these criteria, followed by normalizing each column and summing the normalized values to produce the eigenvector weights: C1 = 0.491850, C2 = 0.163825, C3 = 0.098375, and C4 = 0.245925. The consistency ratio (CR =-0.0003) confirmed that the judgments were consistent and suitable for further analysis. Each village's score was computed by multiplying its performance ratings by the corresponding criterion weights, resulting in a total priority value for each alternative. Based on these calculations, Harjosari I Village (A1) achieved a total score of 7.475400, placing it at the top of the ranking and identifying it as the best-performing urban village in managing the COVID-19 response.

These findings highlight several important insights. First, the weighting results show that Criterion 1 (C1) holds the strongest influence in determining village performance, suggesting that structural readiness or service capacity plays a more dominant role than other factors during a public health crisis. Second, the approach demonstrates how AHP can effectively convert complex qualitative assessments into quantifiable and comparable scores, enabling policymakers to make transparent, evidence-based decisions. Third, the emergence of Harjosari I as the top-ranked village indicates that targeted interventions, community responsiveness, and coordinated local governance may significantly shape COVID-19 management outcomes at the micro-administrative level. The AHP model also reveals performance gaps between villages with similar baseline characteristics, emphasizing the need for differentiated policy strategies rather than uniform interventions.

Shows that AHP provides not only a ranking mechanism but also a diagnostic tool to understand which criteria most strongly affect local government performance in health emergencies. These insights can guide city officials in designing more focused capacity-building programs and allocating resources more effectively. For future research, expanding the model by integrating additional criteria, such as real-time case trends or digital surveillance capabilities, could enhance the accuracy of the assessment. Moreover, combining AHP with other decision-support techniques such as TOPSIS, PROMETHEE, or Fuzzy-AHP may yield a more robust and comprehensive evaluation framework for pandemic response and other complex policy problems.

4. CONCLUSION

This study addressed the urgent need for an objective and systematic mechanism to assess the performance of urban villages in handling COVID-19, a challenge that required accurate data, clear evaluation criteria, and a transparent decision-making model. By employing the Analytical Hierarchy Process (AHP) within a decision support system, the research successfully demonstrated that the method is capable of structuring complex criteria, weighing their importance, and generating a rational ranking of alternatives. The findings reveal that Harjosari I Village achieved the highest score of 7.475400, positioning it as the best-performing urban village in managing the COVID-19 response in Medan City. The integration of AHP into a website-based decision support system further strengthened the study, as shown by system testing results with an average score of 90, categorized as Adequate, indicating that the system functions reliably for practical decision-making. This research contributes to the field by providing an empirical example of how data-driven evaluation models can support local governments in crisis management, enhance accountability, and improve strategic responses. The implications of the findings highlight the importance of adopting standardized decision-support tools to ensure consistency and validity in public health assessments. Future researchers are encouraged to expand this study by incorporating alternative multi-criteria decision-making methods, integrating real-time data analytics, or applying the model to broader public health and disaster-management contexts, thereby enriching the body of knowledge on data-driven governance during health emergencies.

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