Decision Support System for Determining Aid Priorities for Flood Victims Using the SMART Method Based on Android

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***Abstract*—These The flood disaster that occurred in several sub-districts in Tangerang city requires immediate assistance from the Tangerang City Social Service and the Disaster Management Agency. The Tangerang City Social Service, in collaboration with the Disaster Management Agency and the provincial government, provides aid in the form of food, medicine, and other relief supplies. Due to the limited number of relief personnel, a Decision Support System is needed to assist flood victims. The SMART method (Simple Multi-Attribute Rating Technique) and the Flodis Help application can be applied in this process. This research resulted in the Flodis Help application using the SMART method as a decision support system for providing aid to flood victims. The system's output includes a map of flood-affected areas, a priority aid list, victims' needs, access to the nearest hospitals, and flood relief posts. The application's output provides guidance to help the government and humanitarian organizations deliver aid quickly, accurately, and equitably.**

***Keywords*— Flood disaster, Decision Support System, SMART (Simple Multy Attribute Rating Tehnique).**

I. Introduction

Indonesia is a country with very high rainfall. Several areas in Indonesia often experience floods due to high rainfall that cannot be accommodated by rivers and lakes surrounding residential areas [1]. River siltation and garbage are suspected to be triggers for flood problems. In addition, population growth and construction also contribute to flooding in urban areas. Floods cause people to lose valuable belongings, easily contract diseases, and face difficulties in carrying out their activities. The city government, through the disaster management agency, in carrying out its mission to provide assistance often faces difficulties, mainly due to inaccurate disaster location information, leading to delays in decision-making to send aid [2][3]. Additionally, the limited number of search and rescue (SAR) members does not match the number of flood-affected victims. The disaster management agency, provincial health office, do not have real-time population data and adequate information systems for decision-making in flood disaster management actions. Information about flood-affected populations in districts, cities, and provinces in Indonesia will be prioritized based on a smart method for evacuation and hospital health services. Furthermore, priority assistance data will be designed in the form of a geographic information system-based application to receive immediate assistance according to smart criteria [4].

Tangerang City is located in Banten Province, consisting of 13 sub-districts and 104 sub-districts with an area of 164.55 km^2 [5] with a population of 2,093,706 in Tangerang City in 2021. This can be seen in Figure 1. Meanwhile, Tangerang City has 23 houses. Illnesses spread across sub-districts and community health centers at the sub-district level.

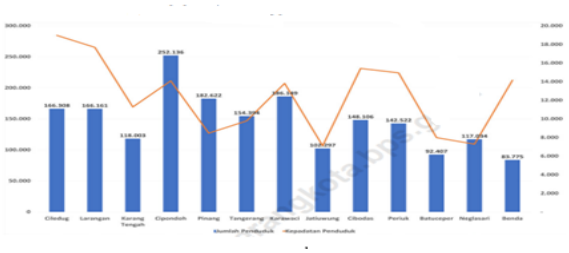

Figure 1 . Number of residents and population density level of Tangerang city

Meanwhile, high rainfall resulted in floods hitting residential areas in the city of Tangerang. Almost every year there are floods in areas in the city of Tangerang which result in disease and loss of property and life [6][7].

FloDis is a geographic information system-based application created based on a priority scale with a smart method that allows mobile phones to display flood area image data, accessible roads, and assistance needs information. Data can be received by disaster management agencies, local health offices [8], as well as city and provincial governments. This application can also be used as information for residents affected by floods to request health assistance from the government and medical personnel. The Health Service Information Model for flood-affected populations in Districts in Indonesia will be integrated into the smartphone application. The novelty of this application is its display of location with priority scale assistance indicated by numbering in affected locations. Additionally, this application can also display road data that can be traversed by social workers to provide assistance.

II. Literature Review

A. *Decision Support Systems*

DSS (Decision Support System) is a system built to provide support to managers in solving various managerial

problems by offering various alternative possibilities that are systematically processed with the help of information technology and computers. DSS can be developed as an interactive computer-based system that assists decision-makers in using data and models to solve unstructured problems. A Decision Support System (DSS) is an interactive information system that provides information, modeling, and data manipulation. The goal of implementing a Decision Support System is to help solve semi-structured problems, support managers in making decisions, and improve the effectiveness, not the efficiency, of decision-making.

B. Smart Method

The steps for using the SMART method: (Goodwin and Wright, 2004 as cited in Novianti (2016:462)). Determine the number of criteria to be used. Determine the criteria weights for each criterion using the interval 1-100 for each criterion with the most important priority [9]. Calculate the normalization of each criterion by comparing the criterion weight values with the total criterion weights. The formula for calculating normalization is:

$Normalization = \frac{w_j}{\Sigma w_j}$, Where wj is the weight value of a criterion, and ∑wj is the total sum of weights for all criteria. The next step is to assign parameter values to each criterion for each alternative. Determine the utility value by converting the criterion values for each criterion into benchmark data criterion values. The utility value can be obtained by the equation:

$$u_i(a_i) = \frac{c_{out} - c_{min}}{c_{max} - c_{min}} \ldots..$$

Where ui(ai) is the utility value of criterion i for alternative ai, cmax is the maximum criterion value, cmin is the minimum criterion value, and cout i is the criterion value for criterion i. These criterion values are converted into a benchmark data value to determine the utility value. If the value of cout i = 1, then the value of ui(ai) = 0. If the value of cout i = 2, then the value of ui(ai) = 0.5. If the value of cout i = 3, then the value of ui(ai) = 1. Next, determine the final value of each criterion by transferring the values obtained from normalizing the benchmark criterion data values with the normalized criterion weight values, then summing the values from these multiplications. The final value of each criterion can be obtained by the equation:

$$u(a_i) = \sum_{j=1}^{m} w_j u_i(a_i) \ldots. (5)$$

Where u(ai) is the total value of alternative ai, wj is the result of normalizing criterion weights, and ui(ai) is the result of determining the utility value.

No.	Titlel/Year	Author	Destination
1.	Application of the K-Means Method for Clustering Land and Building Tax Payments Based on Tax Types (Case Study: BPKPAD Binjai City)	Riski Ramadhansyah, Akim Manaor Hara Pardede, Anton Sihombing	Data on PBB payments for the people of Binjai City continues to increase every year, causing a buildup of data in the land and building tax archives. The solution is a data processing system to manage data using data mining which can process data into information based on criteria.
2.	Web-Based Decision Support System for Café Selection Using the SMART Method (Simple Multi-Attribute Rating Technique) (Case Study: Samarinda City) / 2016	Dwi Novianti, Indah Fitri Astuti, Dyna Marisa Khairina	Decision-making information media for consumers to decide on a Café choice that fits their desires and facilitates consumers in determining a suitable Café location.
3.	Implementation of K-Means Clustering Algorithm for Grouping Family Welfare Levels for the Indonesia Smart Card Program / 2018	Eric Fammaldo, Lukman Hakim	The implementation of data mining using the K-Means Clustering algorithm in grouping families classified as poor, moderate, and wealthy.
4.	Study of the Simple Multi-Attribute Rating Technique For Decision Support	Risawandi, Robbi Rahim	This study provides an overview of how the methods SMART (Simple Multi-Attribute Rating Technique) works with many criteria

III. RESEARCH METHOD

A. SMART Calculation Analysis

SMART (Simple Multi Attribute Rating Technique) is a decision-making method based on the theory that each alternative consists of several criteria with values, and each criterion has a weight that reflects its importance compared to other criteria. This weighting is used to evaluate each alternative to obtain the best alternative [10][11] The following are the steps of SMART resolution:

a. Determine the number of criteria used. The criteria include the number of flood victims, flood locations, the area affected by floods, flood posts, medical aid, road infrastructure, and evacuation boats.
b. Determine the weight of each criterion between 1-100 based on the most important priority. Weighting is done to determine the priority order based on the criteria for assistance, which will then calculate the criterion parameters. This can be illustrated in Table 1.

Table 1. Weighting of Assistance Criteria

No.	Criteria	Weight (WJ)
1.	The number of flood victims	30
2.	Location	20
3.	The area affected	15
4.	Flood posts	10
5.	Medical personnel	10
6.	Road infrastructure	10
7.	Evacuation boats	5
Totally		100

Making a score for each criterion is based on the data that has been received and then normalized.

Table 2. The number of flood victims

Description	Score
1-100	3
101-200	2
>200 people	1

Table 3. Location

Description	Score
>30 Km	4
21-30 km	3
11-20 km	2
0-10 Km	1

Table 4. The area affected

Description	Score
>30000m^2	3
20010-30000 m^2	2
10000-20000 m^2	1

Table 5. Floods Post

Description	Score
Puskesmas	3
Tempat ibadah	2
Tenda Darurat	1

Table 6. Medical Personnel

Description	Score
Doctor	3
Nurse	2
No Medical Assistance	1

Table 7. Road Infrastucture

Description	Score
Can be Traversed	3
Damaged road	2
The road is cut off	1

Table 8. Evacuation Boats

Description	Score
Ready For Use	3
Not Ready	2
No Evacuation Boats	1

B. Network Architecture

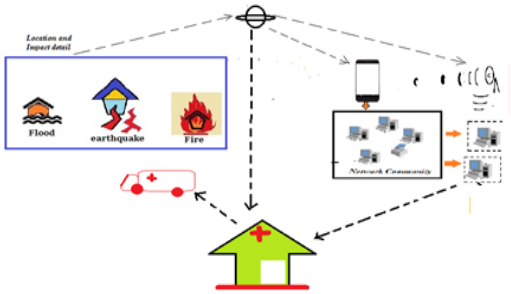

Figure 2. Network Architecture

IV. RESULTS AND DISCUSSION

A. Normalization of Each Criterion

The next step after weighting is to calculate the normalization of each criterion using the formula

$$\frac{W_j}{\sum W_j} \text{.....(2)}$$

Table 9. Normalization Results

No.	Criteria	Weight (WJ)	Normalization
1.	The number of flood victims	30	30/100 = 0.3
2.	Location	20	20/100 = 0.2
3.	The area affected	15	15/100=0.15
4.	Flood posts	10	10/100= 0.1
5.	Medical personnel	10	10/100= 0.1
6.	Road infrastructure	10	10/100= 0.1
7.	Evacuation boats	5	5/100= 0.05

Creating sample calculations using three standard conditions: normal, half-pressing, and urgent, as shown in Table 10.

Table 10 Calculation Sample Data

No.	Condition	C1	C2	C3	C4	C5	C6	C7
1.	Urgent	1	2	2	2	3	3	1
2.	Half pressing	2	3	3	3	2	3	2
3.	Normal	3	1	3	3	1	3	2

The calculation of utility values is performed using the equation:

$$u_i(a_i) = \frac{C_{out} - C_{min}}{C_{max} - C_{min}} \text{ ……...(3)}$$

Where Cout is the criterion value for criterion i, Cmin is the minimum criterion value, and Cmax is the maximum

criterion value.

Table 11. Calculating the utility value

No.	Condition	N. Float	Location	Area	Flood Post	Treatment	Road	Evacuation
1.	Urgent	(1-1) / (3-1)	(2-1) / (4-1)	(2-1) / (3-1)	(2-1) / (3-1)	(3-1) / (3-1)	(3-1) / (3-1)	(1-1) / (3-1)
2.	Half Pressing	(2-1) / (3-1)	(2-1) / (4-1)	(3-1) / (3-1)	(3-1) / (3-1)	(2-1) / (3-1)	(3-1) / (3-1)	(2-1) / (3-1)
3.	Normal	(3-1) / (3-1)	(1-1) / (4-1)	(3-1) / (3-1)	(3-1) / (3-1)	(1-1) / (3-1)	(3-1) / (3-1)	(2-1) / (3-1)

Table 12. The result of the utility value

No.	Condition	C1	C2	C3	C4	C5	C6	C7
1	Urgent	0	0.33	0.33	0.33	1	1	0
2	Half pressing	0.5	0.67	1	1	0.5	1	0.5
3	Normal	1	0	1	1	0	1	0.5

Next, determine the final value of each criterion by transferring the values obtained from normalizing the raw criterion data values with the normalized criterion weight values. Then, sum the values from these multiplications.

$$u(a_i) = \sum_{j=i}^{m} w_j u_i(a_i) \quad \text{.....(4)}$$

Where u(ai) is the total value of alternatives, Wj is the result of normalizing criterion weights, and ui(ai) is the result of determining the utility value.

Table 13 Calculate the total value of alternatives

No.	Condition	C1	C2	C3	C4	C5	C6	C7
1.	Urgent	0.3x0	0.2x0.33	0.15x0.33	0.10x0.33	0.1x0.67	0.10x1	0.05 x 0
2.	Half Pressing	0.3x0.5	0.2x0.67	0.15x1	0.10x1	0.05x0.3	0.10x1	0.05x 0.5
3.	Normal	0.3x1	0.2x0	0.15x1	0.10x0.1	0.05x 0	0.10x1	0.05x 0.5

Table 14 Total value of alternatives

No.	Condition	C1	C2	C3	C4	C5	C6	C7	Total
1.	Urgent	0	0.067	0.05	0.033	0.067	1	0	1.22
2.	Half Pressing	0.15	0.134	0.15	1	0.15	1	0.25	2.834
3.	Normal	0.3	0	0.15	1	0	1	0.25	3.7

B. Application Interface

The Flodis Help application is developed based on the calculations presented above using smart methods. The symbols displayed in the application can be in the form of colors or brief explanations of the results of calculations using smart methods to provide information on the priority level of assistance based on the urgency weight of the assistance needs.

1. Dashboard

Figure.3. Dashboard

The application interface starts with a dashboard or initial display. The dashboard offers users the option to register for the application in order to operate it. Additionally, once users have registered, they can directly log in and navigate within this application.

2. Login

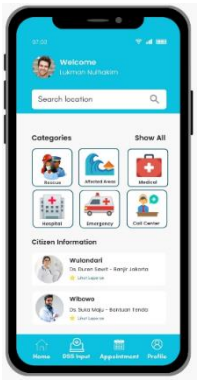

Figure.4 Login

After logging in, users will be given a menu selection consisting of categories:

- "Rescue" which includes the rescue of disaster victims and immediate assistance needs,
- "Affected Area" explaining the disaster-affected areas consisting of the number of human casualties, the extent of the affected area, water levels, and routes that can be taken to reach the location,
- "Hospital" which lists the nearest hospitals that can be accessed to evacuate or provide medical care to disaster victims,
- "Emergency" which provides emergency assistance contacts or access points to reach victims in need of help. Emergency options may include ambulance services, emergency room reservations, and medical staff availability.

The "Call Center" serves as the administrative desk handling reports from application users and providing requested information. In this view, clicking "Show All" will display numerous assistance menus available for use.

3. Flood-affected area

Figure.5 Search Affected area

Furthermore, the selection of the affected area category menu can be further refined by searching for specific areas. Inside, satellite images of flood-affected infrastructure will be displayed. Starting from the location distance, the difficulty level of the area, and the route to the location. Additionally, in this display, there are explanations indicated by a cursor pointing to triangular images in red, yellow, and green, each with its own meaning.

4. Affected Area Reports

Figure. 6 Affected Area Report

The final part of the application consists of reports obtained from calculations using the smart method. Subsequently, the displayed reports can serve as a reference for users to contribute by providing assistance or donations.

V. CONCLUSION

Decision support systems in providing assistance to flood victims can be done by determining a priority scale. This is because the number of aid workers is not proportional to the number of affected victims requiring assistance. Meanwhile, assigning tasks for flood victim management can also be hindered without mapping and prioritization scales. Therefore, a smart method is needed to calculate the priority scale for the needs of flood victims [12]. Furthermore, after identifying flood-affected areas and calculating the priority scale, a flood location map is created. This is done to determine the extent of the affected area, thereby providing guidance for disaster management agencies to provide assistance with appropriate transportation [13]. Government cooperation with relevant institutions such as health insurance agencies [14], disaster management agencies, and local residents is a key factor in successfully addressing and providing assistance in flood-prone areas. Assistance to flood disaster victims can be provided by anyone through guidance from the built application [15]. The latest information on disasters can be received through the Flodis application by receiving information from social media such as WhatsApp, Twitter, Instagram, and other social media platforms so that unaffected communities can help provide assistance. In the future, the Flodis application will be managed by a third party and can be downloaded from the app store.

REFERENCES

[1] Departemen geofisika IPB, “Explaining heavy rains floods in Indonesia,” https://geomet.ipb.ac.id/sistem-informasi/berita-artikel/294-explaining-heavy-rains-floods-in-indonesia.

[2] T. Magrisa, K. D. K. Wardhani, and M. R. A. Saf, “Implementasi Metode SMART pada Sistem Pendukung Keputusan Pemilihan Kegiatan Ekstrakurikuler untuk Siswa SMA,” *Inform. Mulawarman J. Ilm. Ilmu Komput*, vol. 13, no. 1, p. 49, 2018.

[3] Fauziah, “Sistem Pendukung Keputusan Penentuan Pemberian Raskin untuk Masyarakat Menggunakan Metode SMART,” *Universitas Jember*, 2015.

[4] L. Syed, S. Jabeen, S. Manimala, and A. Alsaeedi, “Smart healthcare framework for ambient assisted living using IoMT and big data analytics techniques,” *Future Generation Computer Systems*, vol. 101, pp. 136–151, 2019.

[5] Dukcapil Kemendagri, “The Ministry of Internal Affairs Data Penduduk Indonesia,” https://dukcapil.kemendagri.go.id/berita/baca/809/distribusi-penduduk-indonesia-per-juni-2021.

[6] Detik.Com, “Taman Asri Tangerang housing complex was flooded up to 1 meter in full,” https://news.detik.com/foto-news/d-6694886/perumahan-taman-asri-tangerang-sempat-banjir-untuk-1-meter.

[7] Pusdatin Kemkes, “The ministry of health of the Republic of Indonesia. Profil kesehatan Indonesia ,” The ministry of health of the Republic of Indonesia. Profil kesehatan Indonesia.

[8] G. A. Adeyemi, D. Onimowo, B. I. Oniemayin, and A. A. Eletu, “The place of geoinformatics in waste management, sanitation and health risks prevention in Ado-odo/Ota local government area,” in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, 2019, p. 012108.

[9] R. Ramadhansyah, A. M. H. Pardede, and A. Sihombing, “Application of the K-Means Method for Clustering Land and Building Tax Payments Based on Tax Types (Case Study: BPKPAD Binjai City),” *International Journal of Health Engineering and Technology (IJHET)*, vol. 1, no. 3, 2022.

[10] D. Novianti, I. F. Astuti, and D. M. Khairina, “Sistem Pendukung Keputusan Berbasis Web Untuk Pemilihan Café Menggunakan Metode Smart (Simple Multi-Attribute Rating Technique)(Studi Kasus: Kota Samarinda),” in *Prosiding Seminar Sains dan Teknologi FMIPA Unmul*, 2016, pp. 461–465.

[11] F. A. S. Faizal and M. Diponegoro, “Implementasi Sistem Pendukung Keputusan dengan Metode SMART untuk Merangking Kemiskinan dalam Proses Penentuan Penerima Bantuan PKH,” *Coding Jurnal Komputer dan Aplikasi*, vol. 5, no. 2, 2017.

[12] D. P. Kristiadi, M. Hasanudin, F. Sudarto, and R. Tarmizi, “Indhci: Indonesian districts health care information model,” in *Journal of Physics: Conference Series*, IOP Publishing, 2021, p. 012214.

[13] Dinsos Buleleng, “Aid/Help Needed for Victims of Natural Disasters/Humanitarian Tragedy,” https://dinsos.bulelengkab.go.id/informasi/detail/artikel/bantuan-pertolongan-yang-dibutuhkan-korban-bencana-alam-tragedi-kemanusiaan-61.

[14] Bpjs kesehatan, “The Health Social Security Administration,” https://bpjs-kesehatan.go.id/bpjs/.

[15] BNPB, “Indonesian disaster management agency, Potential threat of disaster,” https://www.bnpb.go.id/potensi-ancaman-bencana.

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