Development Of Planning Support System For Urban Rehabilitation And Reconstruction In Case Sidoarjo Mud Flow Post Disaster

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Abstract

Sidoarjo mud disaster impact that has lasted more than 3 years are very influential on other aspects of life in Porong and surrounding areas. The need for information systems that can inform the public about the catastrophic conditions is absolutely necessary. In previous research has established a disaster management information system that is treated with the approach to Geographic Information Systems (GIS) consisting of the phases of mitigation, evacuation and warning his own.
Mitigation system that was built covering the field of catastrophe risk modeling using network analysis, mapping mudguard embankment area, information about alternative routes and other public facilities information. Evacuation system provides information on areas that can be used as an evacuation site if a disaster occurs, such as health centers and referral hospitals and information about the stages of evacuation if the disaster occurs. Early warning system that allows agencies related to the Sidoarjo Mud Mitigation Agency (BPLS) provide information directly via WEB and SMS that can be accessed by the public via the WEB and SMS.
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The next stage is the stage of recovery. To that end, the research platform designed with integrated GIS Decision Systems (DSS) for regional development planning. Platform that includes a planned relocation of the transportation system and the relocation industry. Relocation of industrial zones by the method of analytical hierarchy process to produce recommendations relocate industrial park. Modeling facility relocation alternative transport route network transformation results.

Keywords: Geographic Information System, recovery, relocation, analytic hierarchy process, facilities network transformation

1. Introduction

Generally there are two types of natural disasters, namely slow and fast. One example of this type of disaster is a slow distribution of hot mud that has lasted nearly two years in Porong East Java. Overflow of hot mud in Porong known as the mudflow has caused moral and material losses to the people who lost resources, infrastructure damage, suspension of economic activities, the loss of lives and other losses.

One of them is the cycle of disaster management and disaster recovery. The problems that arise in this disaster is that until now have been exposed to the disaster area will not be updated. Therefore, take into account other forms of disaster recovery. One of the alternatives offered in this study is to move all the objects that have been affected. Account, life in the town of Sidoarjo, not so much social and economically hopes that "die" from this disaster. All existing potential areas is expected to keep well developed.

By integrating information technology and methods of the Decision Support System (DSS) data sources and infrastructure for data ready to be processed into a decision support system to both government and the people associated with the relocation, especially the relocation and establishment of industrial and residential. Everything is based on the conditions that exist today, which means that the system information is not intended

to establish a new area but help relocating by using the infrastructure already available.

2. Case Study

Some of the research related to disaster management-based Geographic Information System has been done. Among other things associated with this type of disaster. The use of remote sensing and GIS for disaster management strategy development and positioning frameworks for monitoring, assessment and mitigation, identifies areas - areas and recommend appropriate strategies for disaster management [1]. Russ Johnson [2] describes emergency management for natural disasters have a very wide range of activities. All levels of government, from local to central government, have primary responsibility for the management of this emergency. Research on disaster also called mud volcano mud (mud volcanoes) conducted by Matthew Patrick [4]. Cone mud volcano is a small spout of water, gas and mud in relative terms, and occurs worldwide. Because a lot of mud volcanoes, mud eruption of warm (10-40 ° C) can be detected with high-resolution satellite imagery with respect to heat. Plus the Landsat 7 Enhanced Thematic Mapper (ETM +) monitor the development of activated sludge. At the stage of mitigation and evacuation, geographic information systems can already be implemented in such a way that it can act as a server-based map (map-server) is ready to serve requests (queries) from the user via a local network (intranet) or internet network (web based). Terbebankan job is no longer on a single computer system to optimize the role of client and server. Visualization of information relating to the Sidoarjo mud disaster has been done in previous studies (Wahjoe et al, 2008) [3]. Maps are constructed in the form of a database maps Sidoarjo, road network, electricity grids, water supply, population, industry, and several public facilities such as schools, health centres and hospitals, government agencies and other public places. These data are rendered as geographic information systems in a Web form that people can access to such information.

The recovery phase, there are several systems that must be built. As a parent made the platform decision system of informational support of management of economic resources. The application of these systems was done by Liang Wang [4] for e-Government is the integration between some of the national information system in China and Changjun Zhu [5] for water resources management. Unlike the second study was on variables and parameters used. For the second year in a research grant is a platform used in the decision-making process at the choice of moving areas with varying kinds of natural resources, human resources and capabilities. As a supporter of a network of information systems that support infrastructure. The establishment of a network of information systems were Wenjun Yin, etc. [6] by using the analysis object network (FAO) on the basis of service-oriented architecture (SOA), while Guo Zhanglin [7] make detection system in case of problems on the transport network in the event of natural gas networks in the city. For a research grant is an object used in the existing network of transportation, especially roads, provincial roads and district roads. Variables used in population density, industrial, road capacity and density conditions. In the meantime, to support the transition of residential and industrial needs of information management network was made transportasi.Sistem Giani Costa, etc. [8] and Jianhe Guan and others. [9] and for logistic system that is adaptive.

3. System Design

Design of decision support systems Sidoarjo mud disaster recovery system can be seen in Figure 1. The optimal form of the system are made by considering various factors issues and needs that have been determined. The design includes the design of systems architecture, web, and database.

3.1 Data Collection

Data used for this study can be seen in Table 1

3.2 Relocation Method

Relocation method is used to relocate industrial sites and transportation routes Sidoarjo mud disaster. Relocation of industrial uses analytic hierarchy process (AHP) to determine the temporary relocation relocation transportation using modeling Facility Network Transformation (FNT) as the transport system of decision-making.

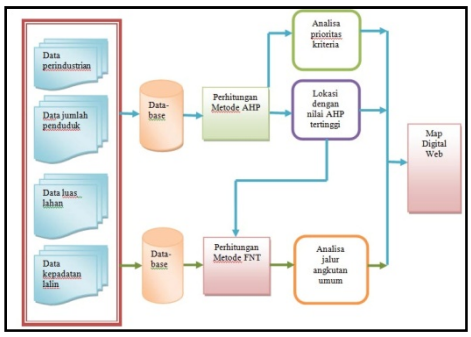

Figure 1. Diagram of the overall system design

Figure 1 shows the overall design of the system integration between AHP method to calculate the area of high priority-based AHP criteria that have been identified. Although NTBFS method is used to produce analysis of public transport lines, which are to be resettled.

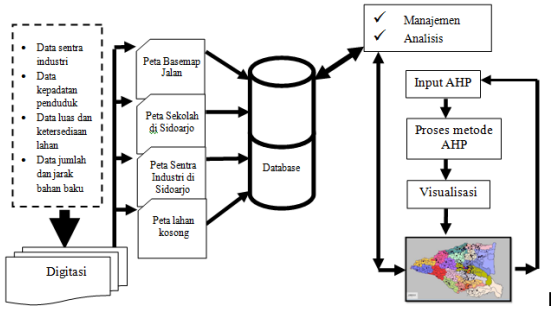

Figure 2. AHP Method as decision support system

Although Figure 2 describes the method of AHP itself as part of the system. Conducted before the calculation is to collect various data that previously required. These data as indicated in table 1, and then made the process of digitizing in digital maps that can be displayed on the website later. After digitization is stored in the database, we have taken account of AHP for advice for the relocation of business/indstri hit the dirt. This, of course, depending on the type of product and priorities with regard to the perpetrators of these industries with a view to obtaining advice on the place that best suits their type of industry

Table 1. Data used as system base.

No	Nama	Sumber
1.	rural transport data and the trajectory path who skipped	Dishub
2.	traffic accident data on each line trajectory transport	Dishub
3.	data centers and small craft industries of each district	Koperindag
4.	data of existing small and medium enterprises in each district in Sidoarjo	Koperindag
5.	data area of each district and its population	Bappekab
6.	district road network data	Dinas PU Bina Marga

Method of Analytic Hierarchy Process (AHP) is used as a decision support system (DSS) in which this method can determine the decision alternatives based on the resulting priorities. To build a system of decision-making with the AHP hierarchical tree is formed that indicates the purpose of the system, the required criteria and the alternative location of new industries. Hierarchy tree is used in decision-making system can be seen in Figure 2.
criteria criteria used for decision making are as follows:

1. Population of each area of the village village
2. Road conditions with reference to the percentage of good road conditions
3. Square kilometers of land area
4. Raw materials include subkriteria is :
   - the amount of available raw materials
   - distance from areas with raw materials

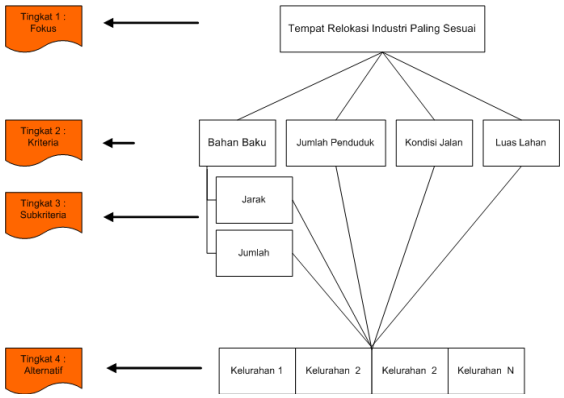

Figure 3. AHP hierarchy to find the relocation place

The following is the criterion used in the calculation of the AHP process for the transfer market.

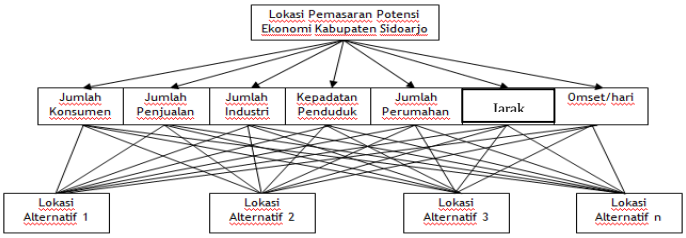

Figure 4. AHP hierarchy for the transfer market

Criteria used for decision making are as follows

1. Number of sales per day
2. Number of consumen per day
3. Number of industries in one district
4. Population Density in one district
5. Number of housing in one district
6. Distance from the market in resource location
7. Turnover per day

Transportation management information system contains relocation alternative transport system, particularly in public transport. In this case, the basic data highway that exists does not mean the addition of new routes. Done is to change the trajectory of the system with variable density, industry, power, roads and the density of roads for this condition. The template used on Wenjun Yin [6]. The Office conducted a partial transport on each

track. Is used as the weighting method of AHP. The expected results, as shown in Figure 3.9.

For relocation transport modeling is done using the Network Facility Transportation (FNT). Diagram of decision-making system for the transport route FNT relocation can be seen in Figure 3.

4. Testing Results

4.1 Testing of industrial relocation

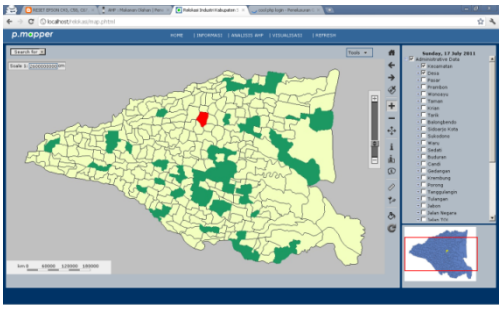

Figure 5. Example of digital map output.

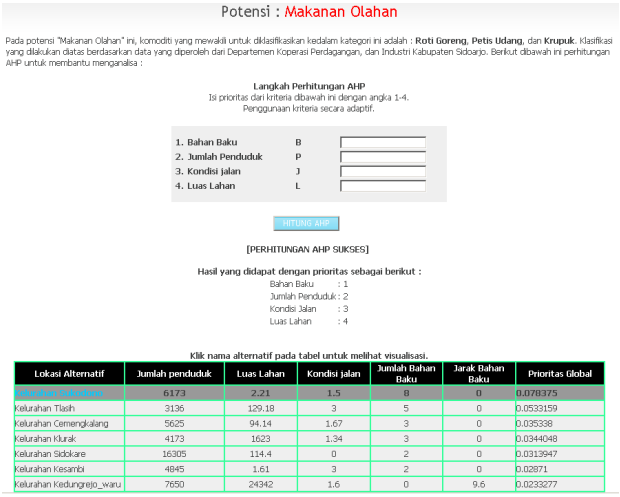

Figure 6. Example of the output of the AHP calculation result table

To determine the possible relocation of industry to use method of Analytic Hierarchy Process (AHP) to determine the area of relocation alternatives based on criteria such as the criteria tree in Figure 2. As an initial input set priority criteria for the relocation of industrial areas as in Table 2. Each priority will be given preference values to provide a clearer distinction between the criteria.

Table 2. Priorities of the criteria the criteria for relocation of industries

Priority	Criteria	Preference value
1	Raw materials	4
2	Population Density	3
3	Area	2
4	The condition of road	1

Alternative values for each alternative location for the sub-existing criteria, the calculation of priority values by the weighting factor of the eigenvectors calculated for each criterion. The biggest priority value indicates the highest value of recommendations that resulted from the system. Value priorities that have been sequenced in Table 4.8. Based on Table 3 districts recommended by the system to be the location of industrial relocation is Kelurahan Sukodono with the highest priority value **0.078375.**

Table 3. Relocation sites recommendations based on the order of greatest priority value

Lokasi Alternatif	Prioritas Global
Kelurahan Sukodono	**0.078375**
Kelurahan Tlasih	0.0533159
Kelurahan Cemengkalang	0.035338
Kelurahan Klurak	0.0344048
Kelurahan Sidokare	0.0313947
Kelurahan Kesambi	0.02871
Kelurahan Kedungrejo_waru	0.0233277
Kelurahan Kedungpandan	0.0232477
Kelurahan Trompoasri	0.0232238
Kelurahan Semambung	0.023148

4.2 Testing of Market Relocation

Here is the table of priority that used for the market calculation.

Table 4. Priorities of the criteria for the meat market relocation criteria

Priority	Criteria	Preference Value
1	Number of sales	1
2	Number of consumen	2
3	Turnover per day	3
4	Population Density	-
5	Number of Industry	4
6	Number of Housing	-
7	Distance	-

.

Hasil Prioritas Pilihan User :

Jumlah Penjualan : 1
Jumlah Konsumen : 2
Omset per hari : 3
Jumlah Industri : info
Kepadatan Penduduk: 4
Jumlah Perumahan : info
Jarak : info

HASIL PERHITUNGAN AHP

Lokasi Alternatif	Jumlah Penjualan	Jumlah Konsumen	Jumlah Omset/hari	Jumlah Industri	Kepadatan Penduduk	Jumlah Perumahan	Jarak *km	Prioritas Global
Pasar Larangan - JL.Sunandaf Priyo Sudarmo	90	150	Rp. 4.300.000	46	135434	13	18.5	0.127666
Pasar Separijang - JL Kaljaten	80	120	Rp. 3.800.000	350	202154	15	17	0.112501
Pasar Krian - JL Raya By Pass	85	110	Rp. 4.000.000	102	116753	11	3	0.110541
Pasar Kebonagung - JL Porong Raya	75	90	Rp. 3.500.000	13	89127	6	30.1	0.0947784
Pasar Tropodo - JL Raya Tropodo	40	50	Rp. 2.000.000	128	210590	15	26.5	0.0580205
Pasar Wadungasri - JL Raya Wadungasri	35	50	Rp. 1.600.000	128	210590	15	25.6	0.0526621
Pasar Prambon - JL Raya Prambon	30	45	Rp. 1.500.000	7	77402	5	7.9	0.0427032
Pasar Sawotratap - JL Joyoboyo	25	40	Rp. 1.350.000	133	120096	12	21.3	0.038996
Pasar Sidokare - JL Raya Tenggulunan	18	27	Rp. 1.000.000	68	210592	16	18.6	0.0323482
Pasar Wedoro - JI Belahan Wedoro	6	14	Rp. 2.750.000	128	210590	15	23.6	0.0321664

Figure 7. Example output of the AHP calculation result table

- Pasar – Larangan : Kecamatan Candi
- Number of sales : 90
- Number of consumen : 150
- Number of industry : 40
- Population Density : 135434
- Number of housing : 13
- Density : 18,5
- Turnover per day : Rp 4.300.000
- Global Priority : 0.127666

Alternative values for each alternative location for the sub-existing criteria, the calculation of priority values by the weighting factor of the eigenvectors calculated for each criterion. The biggest priority value indicates the highest value of recommendations that resulted from the system. Value priorities that have been sequenced in Table 4.8. Based on Table 3 districts recommended by the system to the highest market relocation site is a priority market with a value of 0.127666 Prohibition. The figure below is a visualization of the relocation of the market trial. Can be seen that the box symbol on the map is the first alternative of the AHP calculation.

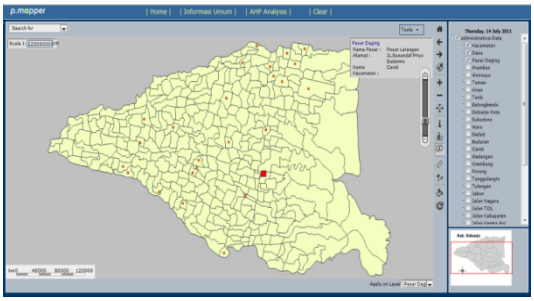

Figure 7. Market relocation trial visualization

4.3 Testing of Transportation Relocation

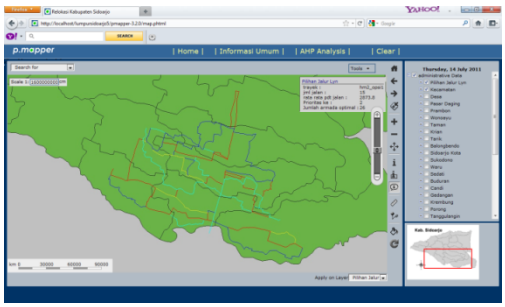

Figure 8. Example of the output transportation system

Roads used in this application is a way around the track used Lyn 7. Selection of the road is intended to make the distribution of goods in the initial trajectory is not compromised. For example, if line A has 100 people who normally use A1 lyn, the relocation as well as a possible alternative marus carrying 100 passengers as well.

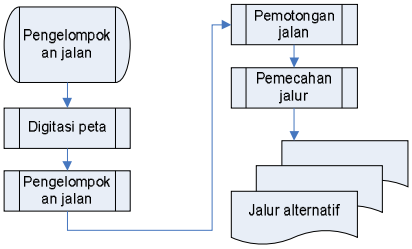

Figure 9. Method of grouping the road

Step in the grouping of the road :

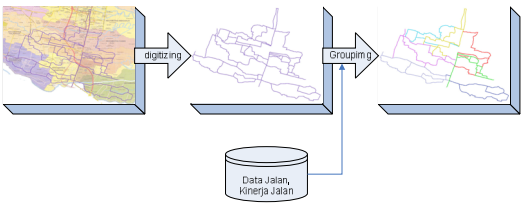

Figure 10. Path grouping

The first step is to digitize the roads, digitized by an analog card using ArcView software. According to the results of sampling in the form of a shape file is received, the next step is the classification of roads on the basis of data obtained from the survey results. The results of grouping the data later in the piece at each intersection where the road ends meet, with 2 or 3 other roads (a t-shaped junction or crossing the street).

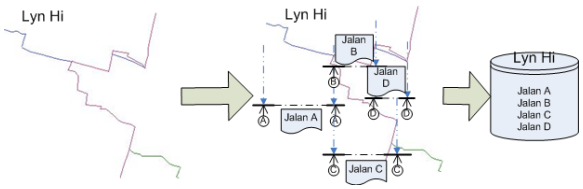

Figure 11. Path grouping

The path of the route, both the route and the existing routes of resettlement. Trajectory consists of more than 1 piece of road cutting results (Figure 4.8). The results of the training is stored in the database in accordance with the Group's trajectory. Path, and then grouped by the 7lyn mentioned above. Alternatives that can be used by members of the group within the group.

The weight of the AHP process that existed at the intersection of the roads, and then combined with other existing pieces of roads on the same route.

$$\sum tr = tr_i + tr_{i+1} \quad (1)$$

Function 1 *weight of one route*

$$FNT = \frac{\sum tr}{\sum TR} x \sum amd \quad (2)$$

Function 2 *FNT Model*

Based on the data obtained, the weights obtained from the trajectory of each as shown in Table 5.

Table 5. Weight of route

	Alternative ($\sum tr$)			$\sum amd$
	1	2	3	
HM2	737	595	431	10
HM1	466	254	320	11
HL	704	702	750	12
HB1	550	475	535	62
HB2				
HC	588	568	457	41
HF	437	553	418	20
HI	346	435	323	11
HK	572	570	548	21
HN1	485	618	737	27
$\sum TR$	4885	4770	4519	215

By applying equations on Function 2 and weight in the Table 5, the results obtained as shown in Table 6.

Table 6. Value of FNT

	Alternatif (FNT)		
	1	2	3
HM2	32.43705	26.81866	20.50564
HM1	20.50972	11.44864	15.22461
HL	30.98465	31.64151	35.68267
HB1	24.20676	21.40985	25.45364
HB2	0	0	0
HC	25.87922	25.60168	21.74264
HF	19.23337	24.92558	19.88714
HI	15.22825	19.60692	15.36734
HK	25.17503	25.69182	26.07214
HN1	21.34596	27.85535	35.06417
$\sum amd$	215	215	215

5. Conclusion

From the results of system tests Sidoarjo mud disaster relocation obtained the following conclusions:

- Relocation of industries based on criteria of population density, type of industry, transport, land and raw materials for industries producing alternative relocation sites by using the method of analytic hierarchy process.
- Modeling the network transformation facility relocation alternative transportation routes based on the most appropriate starting point and end point.
- Decision-making systems for industrial relocation and transportation routes can be used as part of disaster recovery system specifically Sidoarjo mud disaster.

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