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SURAT TUGAS
Nomor: 01/ST/LIT-LPPM/I/2023

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untuk melaksanakan Penelitian dengan judul "Analysis of Land Suitability based on Environmental Geology for Settlement Development in Ciamis District, Ciamis Regency". Kegiatan Penelitian dilaksanakan pada bulan Februari – Juli 2023 di Kecamatan Ciamis.
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Kepala LPPM,

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Rusli Daik <jsm@ukm.edu.my> 30 Mei 2023 pukul 15.00
Kepada: "Mr. Anan Iskandar" <ananiskandar1962@gmail.com>

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Analysis of Land Suitability based on Environmental Geology for Settlement Development in Ciamis District, Ciamis Regency

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ABSTRACT

The research area is located in Ciamis District, Ciamis Regency, West Java Province with an area of ± 3385 hectares. Its geomorphology consists of plains to steep undulating hills with young volcanic rocks as its constituent rocks. Residential land use in this area reaches ± 51.90% (± 1757 ha). The research method to be used to determine the suitability of residential land is a *quantitative descriptive method* by utilizing maps of geomorphology, land use, hydrogeology, soil types, ground movements, lithology and seismicity maps. From each of the geological parameter maps, the sub-classes are superimposed and the value (score) and value (weight) of each parameter are calculated, then classified based on the total weight obtained, a map of the level of land suitability for settlements is based on geology. Based on the results of the research, Ciamis Subdistrict can be classified into 3 (three) Land Suitability Levels, namely the Suitability Level for Settlement Land in accordance with an area of 1047 ha (30.930%), The Level of Suitability for Residential Land is Adequate in accordance with an area of 1979 ha (58.463%) and the Level of Suitability Inadequate residential land with an area of 358 ha (10.576%).
Keywords: Quantitative descriptive, land suitability level,

I. INTRODUCTION

1.1. Background

Population growth resulted in a very high demand for housing. The demand for housing (settlements) in the Ciamis District area is quite large because the population continues to increase from year to year and is accompanied by continued improvements in means and transportation facilities. The selection of the right residence (settlement) has important meaning in the spatial aspect, because this will determine the durability of the building, economic value and the impact of settlements on the surrounding environment (Sutikno, 1982). In determining the location of settlements, it is necessary to evaluate the terrain, in order to find out whether the parameters for settlement locations are safe and suitable for use in a particular area.

In determining a land for settlement, the community in general, because of limited knowledge, often does not consider the basic physical parameters that affect the feasibility of settlement in the long term. Parameters that affect settlements in the long term include geological parameters, such as morphological conditions, soil type, hydrogeology, lithology, areas prone to ground movement and earthquake-prone areas.

Because all these geological parameters greatly affect the feasibility of settlements as comfortable, safe and healthy dwellings in the long term for the survival of its inhabitants.

1.2. Objective

The purpose of this study was to obtain a land suitability level value based on local geological conditions in determining the most appropriate settlement location, besides that it also made a classification/categorization by giving scores and weights based on supporting and limiting factors for settlements, also to determine the distribution of land suitability levels. for settlements based on geology in the study area.

1.3. Location and Area Access

Administratively, the research area is located in Ciamis District, Ciamis Regency. The total area of Ciamis District is ± 3385 Ha. The Villages and Villages included in the Ciamis District area are as follows:

a. Ciamis sub district, Cisadap sub district
b. Fortress sub district, Imbanagara sub district
c. Kertasari sub district, Imbanagara sub district
d. Linggasari sub district, Panyingkiran sub district,
e. Sindangrasa sub district, Pawin sub district
f. Maleber sub district, g. Cigembor sub district

Geographically, it is located at coordinates -7°21'35" LS - 7°17'37" LS and 108°17'24" E - 108°22'50" E (Figure 1).

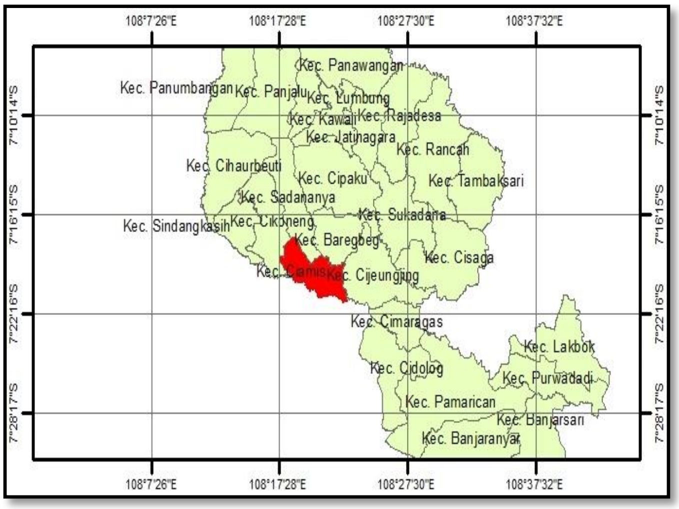

Figure 1. Map of the location of the investigation area (BAPPEDA Ciamis Regency)

II. RESEARCH METHODOLOGY

2.1. Quantitative Descriptive Method

The research method uses descriptive quantitative analysis which is a method by describing and providing an overview of the parameters of the object of investigation and assigning a value (score) to each parameter and giving a weighing weight to each parameter whose magnitude corresponds to its effect on land suitability for settlements.

The parameters used in this method consist of parameters that have subclasses so that each has an influence on the overlap analysis (overlay) in the stage of compiling the land suitability level map for settlements based on geology. The stages are as follows:

1. Determination of value (score) and value (weight)

The scoring of each parameter subclass is based on a theoretical approach that shows how important the parameter subclass is for residential land, while the weighting for each parameter is based on the most important and fundamental parameters for geology-based residential land. This stage is the stage of giving values (scores) and weights for each parameter. Giving a value (score) to each parameter ranges from 1 to 5. Giving a value (score) is given to each subclass of each parameter. The value (score) of 1 indicates low suitability, while the value (score) of 5 indicates that the suitability value is very high for residential designations. While the weight on each parameter shows the degree of importance of these parameters to the allotment of land for settlements. The weight of a parameter is relative, therefore the weight for each land use will be different. The range for this weight ranges from 2 to 5. In this case, number 2 indicates that this parameter has very low importance for land suitability for settlements, and number 5 indicates that this parameter is very important for land suitability for settlements.

2. Overlapping and calculating land capability values

After all parameters have been assigned values and weights, the next step is to find the number of classes formed and the class intervals for land suitability for settlements. The calculation to get the number of residential land suitability classes is to multiply the number of thematic maps using the Sturges Sudjana formula (1988: 19), as follows:

$$K = 1 + 3{,}22 \log$$

Description: K = the number of classes formed
N = overlaid map units

Then look for class intervals for each class, with the following formula:

Information :

Range = maximum total weight - minimum total weight

K = the number of classes

But before the calculation to find out the class interval is carried out, first look for the maximum total weight value and minimum total weight value of all parameters by overlapping and multiplying the value (score) with the value (weight) of parameter maps that have subclasses that have been given a value (score) and value (weight) with the formula (Darsoatmodjo, A., 2006) as follows:

Rumus :

$$H = (b \times A) + (b \times B) + (b \times C) + (B \times D) + (b \times E)$$

Information :

H = Total weight

b = parameter weight

A, B, C, D and E = parameter scores

In Figure 2 below is a flow chart for making a map of the level of land suitability for settlements.

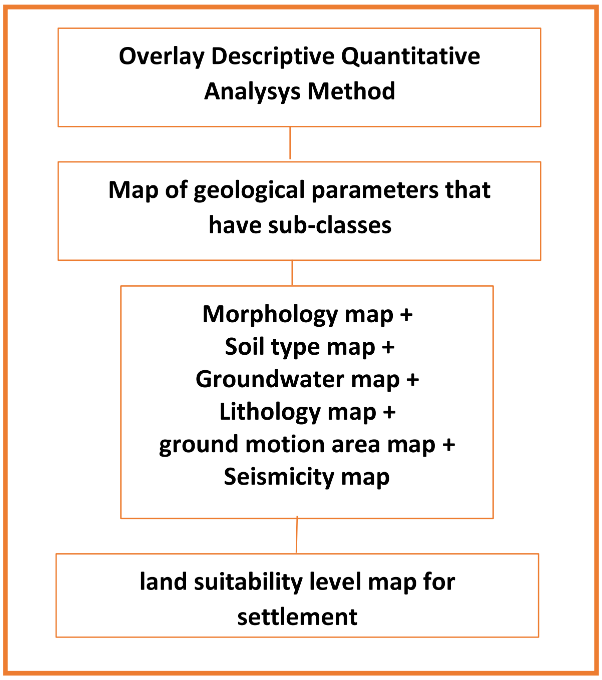

Figure 2. Flowchart for making land suitability maps for settlements

3. Analysis of the Total Weight

After overlapping and multiplying the value (score) with the value (weight) of the parameter maps that have subclasses that have been given a value (score) and value (weight), the maximum total weight value and minimum total weight value will be obtained which is then calculated by the formula to find out the class intervals as listed above. Then after these calculations it will be known the value of the land suitability class interval for settlements in the investigation area. After knowing the value of the class interval, then carrying out an analysis of combining the total weight values based on the class interval, after that it will be known which areas are included in the category of land suitability level for settlements that are suitable, quite suitable and not suitable.

III. GENERAL CONDITIONS OF THE RESEARCH AREA

3.1. Geography

1. Land Use

Land use in the research area consists of rivers, forests, plantations, settlements and rice fields (Figure 3)

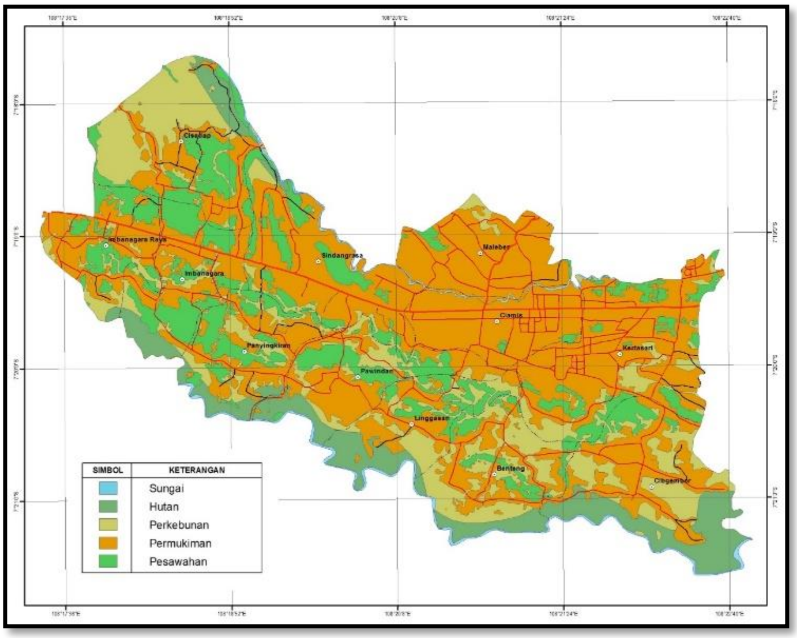

Figure 3. Land use map of Ciamis District
(2016 Land Use Map, INA-GEOPORTAL "BIG").

2. River

This land use occupies ± 1.18% (± 40 ha) of the total area of the investigation area. Located in all parts of Ciamis sub district (Figure 4). (Figure 4).

Figure `4. Photo of river land use appearance

3. Forest

This land use occupies ± 9.43% (± 319 ha) of the total area of the study area. Located in the northwest, southeast, south and southwest of the research area which includes Cisadap Village, Sindangrasa Village, Cigembor Village, Benteng Village, Linggasari Village, Pawindan Village, Panyingkiran Village, Imbanagara Village and Imbanagara Raya Village (Figure 5).

Figure 5. Photo of forest use in the study area

4. Plantation

This land use occupies ± 19.55% (± 662 ha) of the total area of the research area, covering almost the entire area of Ciamis District except Ciamis Village (figure 6).

Figure 6. Plantation land use in the Ciamis sub district area

5. Settlements

This land use occupies ± 51.90% (± 1757 ha) of the total area of the investigation area. Scattered throughout the Villages and Kelurahan in Ciamis District.

6. Rice fields

This land use occupies ± 17.81% (± 602 ha) of the total area of the investigation area. Scattered throughout the Villages and Kelurahan in Ciamis District.

Proper land use greatly influences the sustainability of people's lives, especially land use for settlements, so careful consideration is needed of the supporting and limiting factors that are very influential before utilizing vacant land for settlements.

3.2. Geology

1. Geomorphology

Morphology Unit

Morphological observations were carried out by grouping the investigation areas based on the slope, namely by grouping contour lines with relatively the same pattern on the topographic map, then drawing perpendicular lines to the contours and calculating the slope using the following equation:

$$S = \frac{(n-1) \times Ic}{d} \times 100\%$$

Information :

S : Slope (%)

N : The number of cut contours

Ic : Contour interval (m)

d : Actual distance (m)

Based on the magnitude of the slope in an area, the slope is classified by experts, one of which is the classification of slope slope according to Van Zuidam, 1983 (Table 1), namely as follows:

Table 1. Slope Slope Classification (Van Zuidam, 1983).

Class	Slope (%)	Morphological Classification
1	0-2	Flattening
2	2-7	Sloping hills
3	8-13	The rolling hills
4	14-20	Steep undulating hills
5	21-55	Steep hills
6	55-140	The hills are very steep
7	>140	Sharp hills

From the results of field observations and interpretation of topographic maps from the density of contour lines and elevations, the slope slope classification in the investigation area is divided into 4 morphological unit classes (Figure 7).

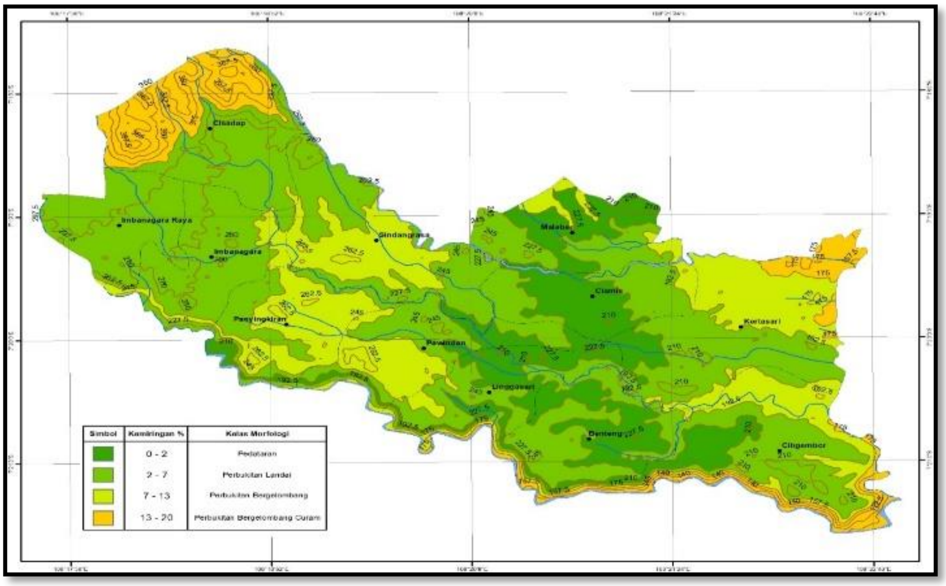

Figure 7. Morphological Map of Ciamis District, Ciamis Regency, West Java Province.

- Plains Morphology Unit

  Classification of slope slope with plains morphological units dominates the central north-south part of the study area with a slope of 0% - 2%, an average elevation of 227 meters above sea level and a distribution of ± 16.28% (± 550 ha) of the total area of the study area. .
- Sloping Hills Morphology Unit

  Classification of slope with morphological units of gently sloping hills is located in the west-eastern part of the study area with a slope of 2% - 7%, an average elevation of 245 meters above sea level and a distribution of ± 52.08% (± 1763 ha) of the total area of the study area. .
- Wavy Hills Morphology Unit

  The slope slope classification with the morphological unit of wavy hills dominates the western and central parts of the study area map with a slope of 7% - 13%, an average elevation of 262 meters above sea level and a distribution of ± 21.88% (± 740 ha) of the total area. investigation.
- Steep Wavy Hills Morphology Unit

  Classification of slope with morphological units of steep wavy hills dominates the northwestern, northeastern and southeastern parts of the study area with a slope of 13% - 20%, an average elevation of 332 masl and a distribution of ± 9.76% (± 330 ha) of the total the area of the investigation.

The slope is the degree of slope which is reflected in the morphology. The greater the level of the slope, in general, the more dangerous the settlement will be in the threat of ground movement. Because this is related to the existence of a gravitational force that pulls the rock mass from top to bottom. The higher the slope, the easier it will be for the rock to be pulled down, resulting in ground movement. For this reason, settlements are not suitable to be built in an area with a high slope.

2. Type of Soil

Based on the results of interpolation from field survey data on the types of soil found in each Kelurahan and Village in the investigation area, the types of soil in the investigation area are divided into 5 types of soil, namely gravel sand, sand, gravel loam sand, loamy sand and sandy loam (Figure 8).).

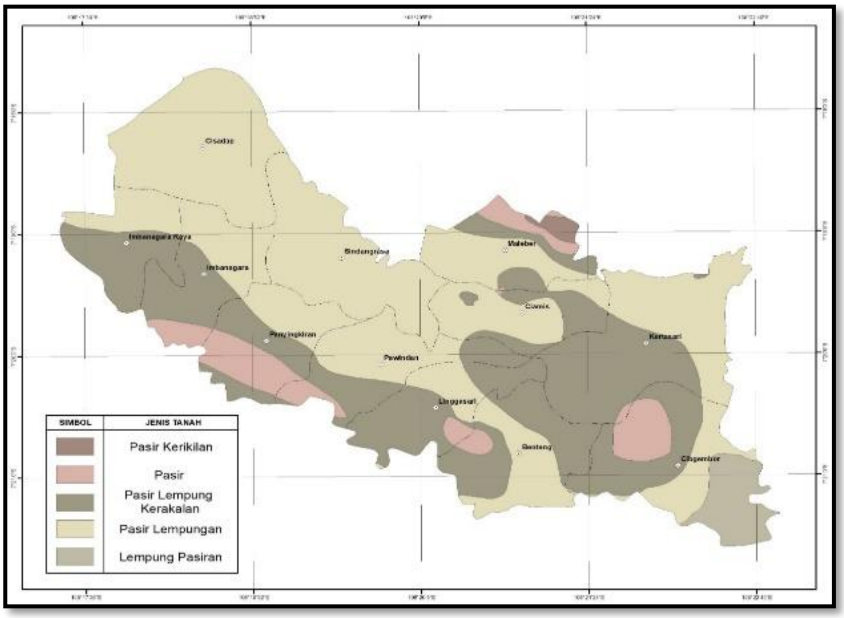

Figure 8. Map of Soil Types in Ciamis District (Interpolation from Field Survey Data).

This type of gray gravel-sand soil, only spread in Maleber Village with a distribution area of ± 0.49% (± 17 ha).

Sand soil is grayish brown in color, the distribution of this soil type includes Maleber Village, Kertasari Village, Cigembor Village, Benteng Village, Linggasari Village, Pawindan Village, Panyingkiran Village, Imbanagara Village and at least is in Ciamis Village with a total distribution area of ± 7, 04% (± 238 ha).

The clay-sandy sand soil is yellowish-red brown in color, the distribution of this type of soil is spread throughout almost all sub-districts and villages in Ciamis sub-district, except in Sindangrasa sub-district and Cisadap village with a total distribution area of ± 35.50% (± 1201 ha).

The clay sand soil is yellowish brown in color, the distribution of this soil type is spread throughout the Kelurahan and Villages in the Ciamis District with a distribution area of ± 53.84%

(± 1822 ha), this soil type is the type of soil with the widest distribution compared to other soil types. is in the research area

Red-gray sandy clay soil, the distribution of this soil type is only in Cigembor Village with a distribution area of ± 3.13% (± 106 ha).

3. Hydrogeology

Shallow Groundwater

The availability of shallow groundwater in a land is very important, considering the function of shallow groundwater as a source of clean water supply for various needs, especially during long dry spells where surface water (PDAM) is insufficient. Starting from this, the analysis of land suitability for settlements based on geology is carried out with the aim of knowing the ability of the land to support the availability of free groundwater.

Based on the results of interpolation from field survey data on residents' dug wells in each kelurahan and village in the investigation area, we classified the investigation area into 3 levels of depth in obtaining free groundwater, namely shallow groundwater areas with a groundwater surface depth of 0.5 – 4.466 m, moderate groundwater areas with a groundwater surface depth of 4.5 – 8.466 m and deep groundwater areas with a groundwater surface depth of 8.5 – 12.4 m from the local soil surface (Figure 9).

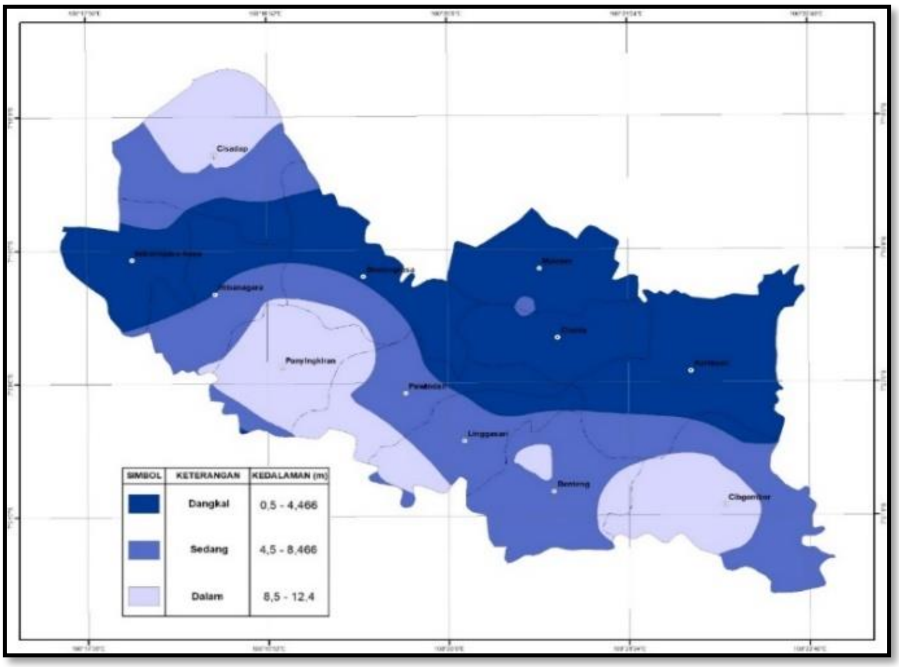

Figure 9. Map of the depth of groundwater in Kec. Nice
(Interpolation from Field Survey Data).

The description of the classification level of free groundwater depth is reviewed from the aspect of reducing costs for excavation or drilling of groundwater, so based on this, free groundwater with a surface depth of 0.5 – 4.466 m can reduce costs more, than groundwater with a surface depth of 4.5 – 8.466 m and free groundwater with a surface depth of 8.5 – 12.4 m.

4. Lithology

Based on part of the Tasikmalaya Geological Map sheet 1308-4 (T. Budhitrisna, 1986), the lithology of the research area is composed of Quarter rocks with a distribution of ± 100% (± 3385 ha) which extends from northwest to southeast (figure 10).

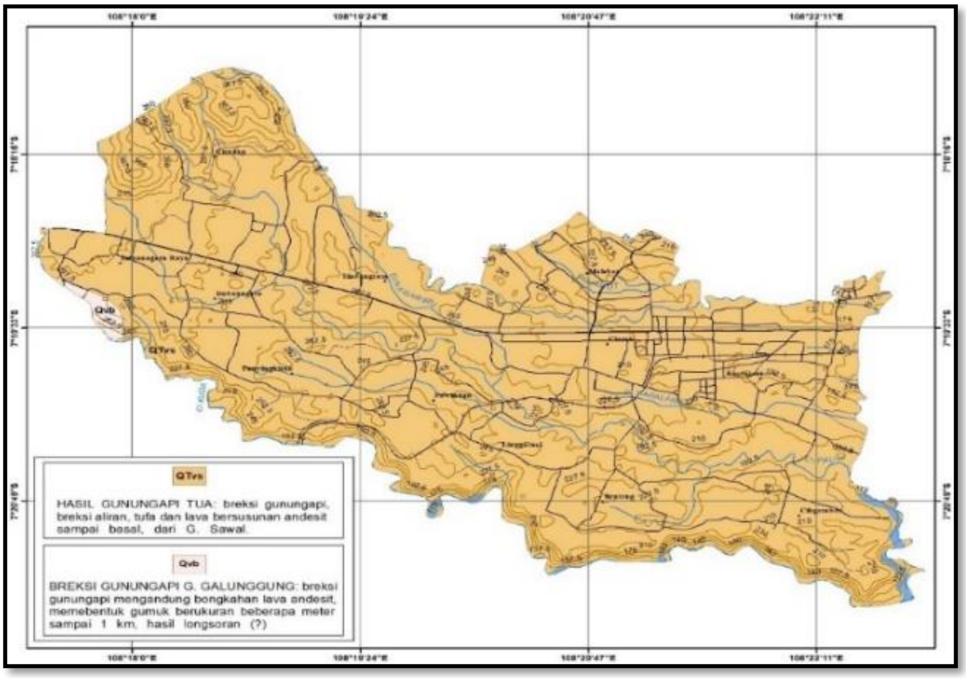

Figure 10. Lithology Map of Ciamis District, Ciamis Regency, West Java Province.

The lithology found during field observations consisted of alluvium deposits in the Benteng Village area. Tuffaceous breccia composed of andesite to basalt in the flow path of the Ci Leueur river in the Kertasari Village area, a member of the results of the OldVolcanoes G. Syawal (Figure 11).

Figure 11. Photo of tuffaceous breccia on the Cileueur river flow path in the Kertasari Village area.

5. Ground Movement

Based on the Map of Land Movement Prone Areas of Ciamis Regency (Center for Volcanology and Geological Hazard Mitigation, Ministry of Energy and Mineral Resources), Ciamis Regency has high, medium, low to very low levels of vulnerability to ground motion. So based on its geographical location, the investigation area includes areas prone to high, medium, low and very low ground motions (Figure 12).

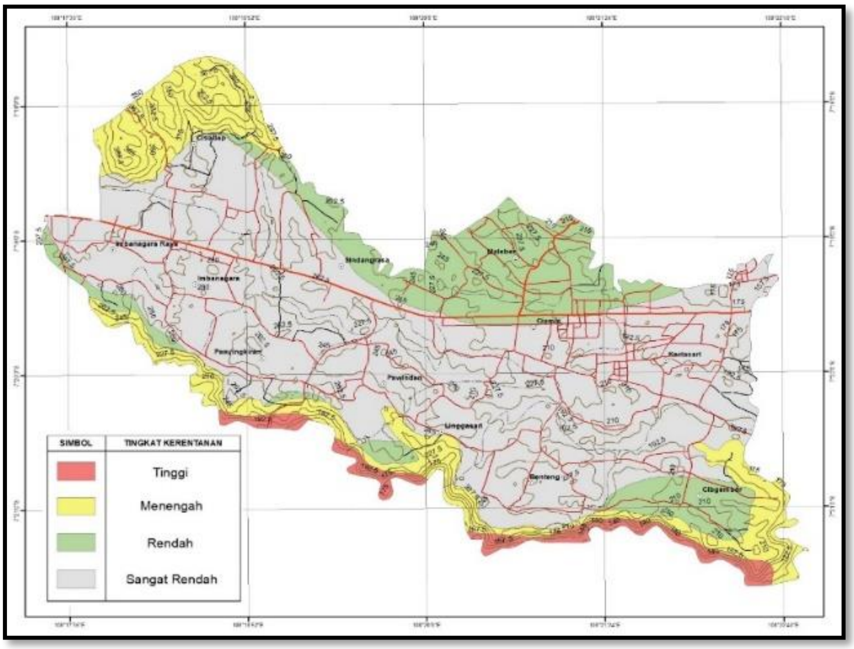

Figure 12. Map of the area prone to ground movement in Ciamis District (Center for Volcanology and Geological Hazard Mitigation, Ministry of Energy and Mineral Resources).

- Very Low Ground Movement Susceptibility Zone

  Areas that have a very low level of vulnerability to land movement. In this zone there is rarely or almost never ground movement, both old and new ground motions, except in small areas on the river banks.

  Is a flat to gently sloping area with a slope of less than 15% and the slope is not formed by sedimentary soil movement, heap material or clay that is plastic or expands. The area of this very low ground motion vulnerability zone occupies ± 63.42% (± 2147 ha) of the total area of the investigation area.

- Low Earth Movement Vulnerability Zone

  Areas that have a low level of vulnerability to land movement. In general, in this zone, ground motion rarely occurs if there is no disturbance on the slope, and if there is long soil movement, the slope has stabilized again. Small dimensions of ground motion may occur, especially on river valley banks.

  Slopes range from gentle (5 - 15%) to very steep (50 - 70%), depending on the physical and technical characteristics of the rock and soil forming the slope. On steep slopes it is generally formed by thin weathered soil and good cover vegetation, generally in the form of forests or plantations. The area of this low ground movement susceptibility zone occupies ± 17.96% (± 608 ha) of the total area of the investigation area.

- Intermediate Land Movement Vulnerability Zone

  Areas that have a medium level of vulnerability to being hit by ground motion. In this zone, ground movement can occur, especially in areas bordering river valleys, escarpments, road cliffs or if slopes are disturbed. Old soil movements can be active again due to high rainfall and strong erosion. The slope ranges from gentle (5 - 15%) to steep to almost vertical (> 70%), depending on the physical and technical characteristics of the rock and weathering soil forming the slope. The condition of the vegetation cover is generally less to very sparse. The area of this intermediate soil movement susceptibility zone occupies ± 15.45% (± 523 ha) of the total area of the investigation area.

- High Ground Movement Vulnerability Zone

  Areas that have a high level of vulnerability to ground motion. In the zone, frequent ground motions occur, while old and new soil movements are still actively moving, due to high rainfall and strong erosion.

  Slope ranges from slightly steep (30 ~ 50%) to nearly upright (> 70%) depending on the physical and technical properties of the rock and weathering soil forming the slope. The condition of the vegetation cover is generally very poor. The area of this high ground movement vulnerability zone occupies ± 3.13% (± 106 ha) of the total area of the investigation area.

6. Seismicity

The vibrations trigger damage to residential buildings which can cause both material and non-material losses. Based on the Earthquake-Prone Area Map of Ciamis Regency (Cecep Sulaeman and Amalfi Omang; 2014), this area has medium to high intensity earthquakes (figure 13).

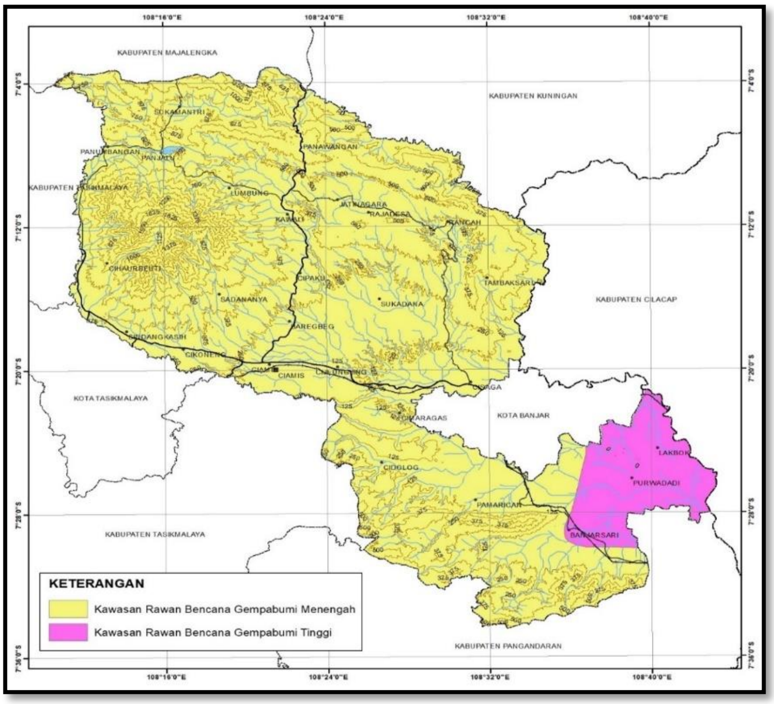

Figure 13. Map of the earthquake-prone area of Ciamis Regency (Cecep Sulaeman and Amalfi Omang; 2014).

- Moderate Earthquake Hazard Area, this area has the potential to be hit by earthquake shocks with an intensity scale ranging from VII-VIII MMI (Modified Mercally Intensity). Soil cracks, weathering, landslides on steep hills in small dimensions are still possible. Build with good design and construction not damaged or only slightly damaged. Buildings with normal, well-constructed structures suffered light to moderate damage. Poorly built buildings with poor structures can suffer heavy damage. Fence walls, chimneys, piles of goods and monuments may collapse (figure 14).

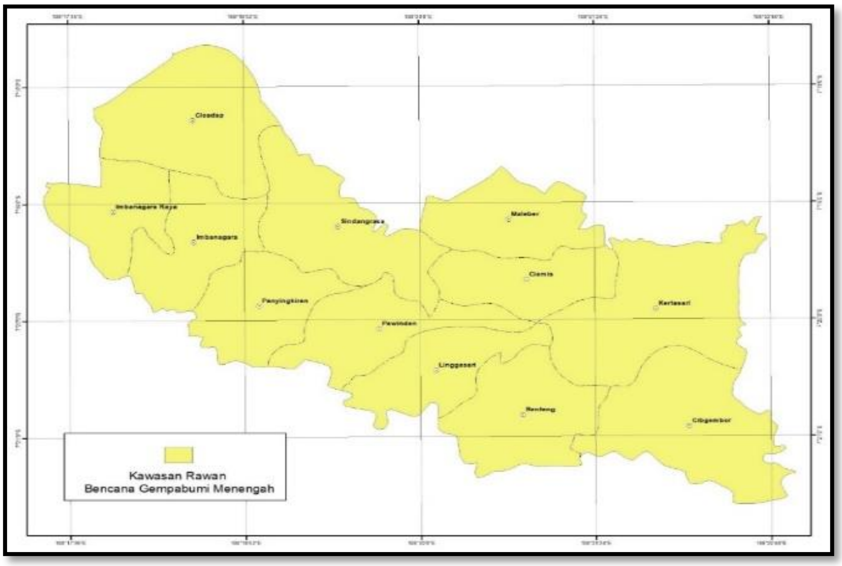

Figure 14. Map of earthquake-prone areas in Ciamis District, Ciamis Regency,

IV. RESULTS AND DISCUSSION

4.1. Land Suitability Level For Settlements

The level of land suitability for residential locations in the research area is compiled using a quantitative descriptive method as follows:

Quantitative Descriptive Method

Classification and assessment of scores and parameter weights in this method consist of morphology, soil type, groundwater, lithology, and areas prone to ground movement.

The morphological units in the study area consisted of plains morphology units with a score of 5, sloping hills with a score of 4, undulating hills with a score of 3 and steep undulating hills with a score of 2, while the weights for these parameters were given a score of 4 (Table 2).

Table 2. Giving scores and weights to morphological parameters in the study area

Slope **(%)**	% Slope Class	Unit Morphology	**Score**	Consideration Score	Scoring Weight
0 – 2	Flat	Plains	5	Flat slopes will make it easier to place building foundations, reduce construction costs and be safe from the dangers of landslides and earthquakes	4
2 – 7	Slope	Sloping hill	4		
7 - 13	Rather steep	Undulating hill	3		
13 - 20	Steep	Steep undulating hills	2		

Soil types in the study area consisted of gravelly sand with a score of 5, sand with a score of 4, silty sand with a score of 3, loamy sand with a score of 2 and sandy loam with a score of 1, while the weight for this parameter was given a number of 3 (Table 3).

Table 3. Scoring and weighting of soil type parameters

Jenis Tanah	Skor	Pertimbangan Pemberian Skor	Bobot
Gravel sand	5	Based on the strength of the soil for building foundations	3
Sand	4		
Clay sand garvel	3		
Clayey sand	2		
Sandy clay	1		

Groundwater in the investigation area based on the depth of the groundwater surface consists of shallow groundwater with a score of 5, medium groundwater with a score of 4 and deep groundwater with a score of 3, while the weight for this parameter is given a score of 5, because water is the most important parameter for a settlement (Table 4). .

Table 4. Scoring and weighting of groundwater parameters in the investigation area.

Groundwater	Score	Consideration Scoring	Weight
Shallow	5	Shallow groundwater is more effective and efficient for a settlement and saves more costs	5
Moderate	4		
Deep	3		

The lithology in the research area consists of young volcanic product lithology with a score of 4 and old volcanic product lithology with a score of 5, while the weights for these parameters are given a score of 2 (Table 5).

Table 5. Giving scores and weights to lithology parameters in the investigation area.

Lithology	Score	Consideration scoring	Weight
Young Volcanic	4	It consists of breccias which are very strong rocks for building foundations	2
Old volcanic	5		

Areas prone to ground movement in the study area consist of areas prone to high ground movement with a score of 1, areas prone to medium ground movement with a score of 2, areas prone to low ground movement with a score of 4 and areas prone to very low ground movement with a score of 5, while the weights for parameters it is given the number 2 (Table 6).

Table 6. Scoring and weighting of ground motion parameters in the investigation area

Areas prone to land movement	Score	Value Giving Considerations	Weight
High	1	No designated residential areas located in a disaster-prone area (PerMen PU No. 41/2007)	2
Moderate	2		
Low	4		
Very low	5		

The next step after all parameters are given a value (score) and value (weight) is to find the number of classes formed and the class intervals of land suitability for settlements. The calculation to get the number of settlement land suitability classes is by multiplying the number of thematic maps using the Sturges formula in Sudjana (1988: 19), as follows:

$$K = 1 + 3{,}322 \log N$$

Information :

K = the number of classes formed

N = overlaid map units

There are 5 map units that are overlaid in classifying the level of land suitability for settlements in the research area. So based on the Sturges formula the calculation is as follows:

$K = 1+3.322 \log N$

$K = 1+3.322 \log 5$

$K = 1+3.322 \times 0.698$

$K = 3.016$ rounded to 3

From these calculations, it is obtained that there are 3 classes of land suitability for settlements. Then look for class intervals for each class by first overlaying the thematic map units that have been given a value (score) and value (weight) so that the maximum total weight value and minimum total weight value are known (Figure 15), with the following formula:

$$IK = Range/K$$

Information :

Range = maximum total weight - minimum total weight

K = Number of classes

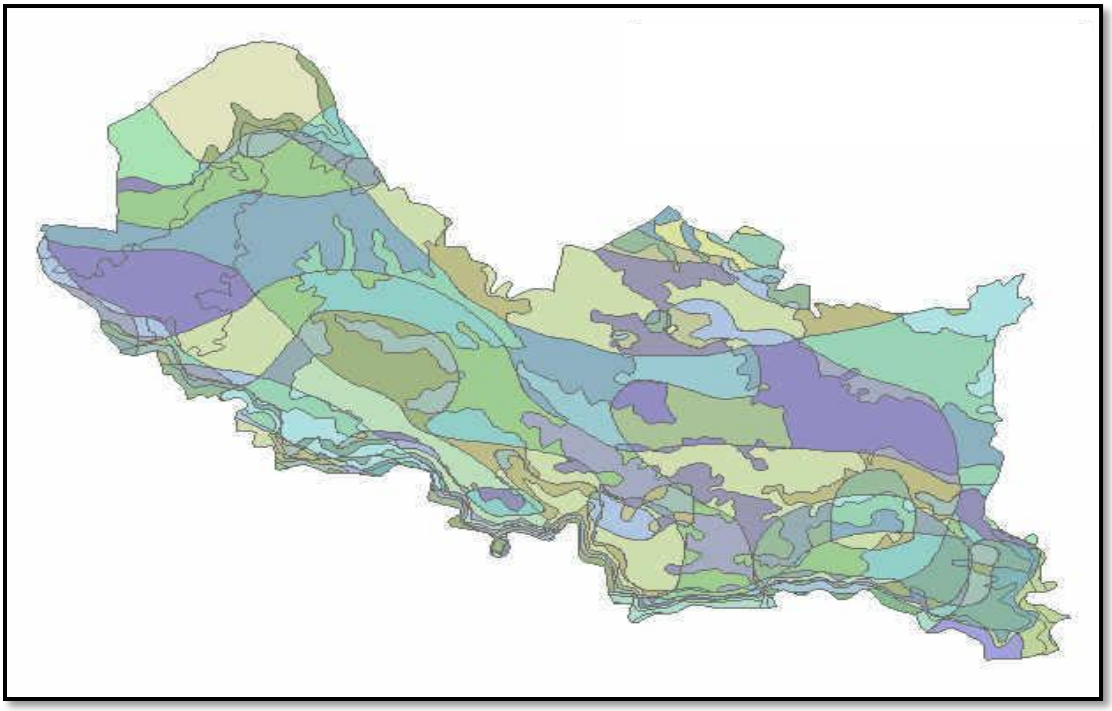

Figure 15. Overlapping (overlay) map of the quantitative descriptive analysis method

Based on the results of the overlapping (overlay) parameter map that has been given a value (score) and value (weight) a maximum total weight of 78 is obtained and a minimum total weight of 41. So the calculation of the formula for this method based on the data above is as follows:

IK = Range/K

IK = minimum score-maximum score/number of classes

CI = 78-41/3

CI = 37/3

CI = 12.333

From these calculations, the land suitability class intervals are obtained which are 12.

After obtaining the number of classes and class interval values of land suitability for settlements. Then the total weight values are combined based on the class intervals (Tables 7 and 8), so from the results of the combined total weight values it will be possible to determine the suitability areas for residential land that are suitable, quite suitable and not suitable as follows (Figure 16).

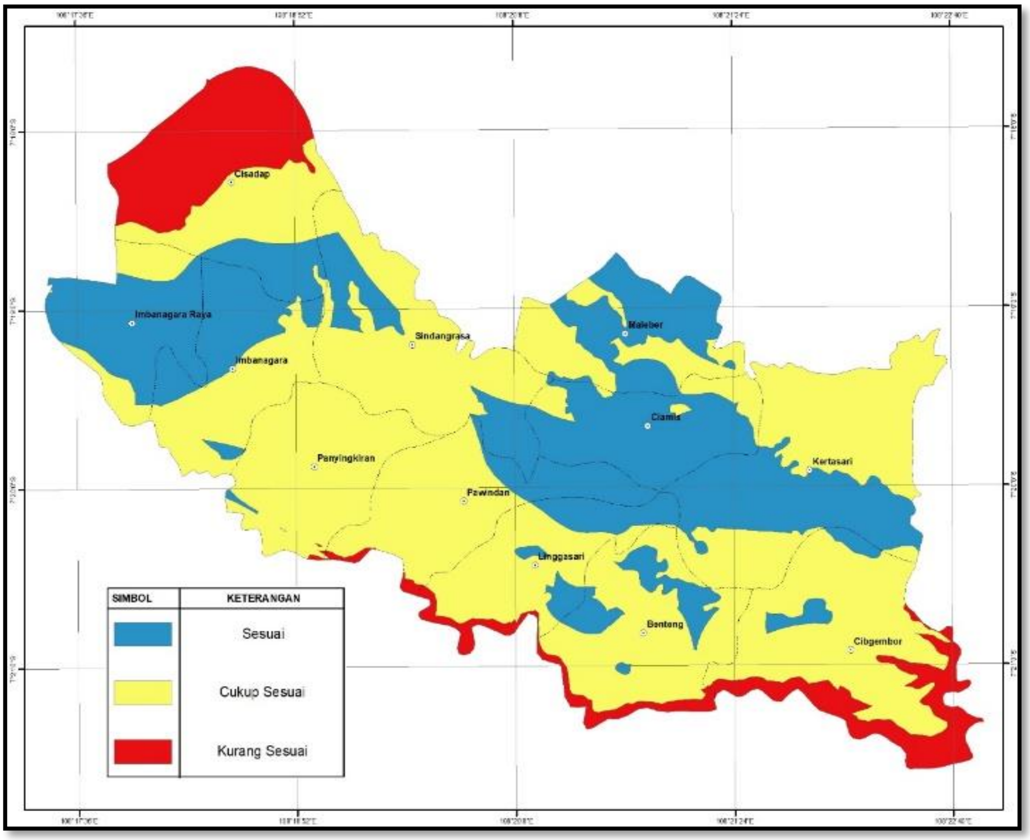

Figure 16. Map of land suitability for settlements based on environment geology.

Table 7. Classes and Class Intervals of land suitability for settlements based on geology Class Interval Class

Class	Class Interval
I (Suitable)	67-78
II (Fairly suitable)	54-66
III (Not suitable)	41-53

Table 8. Classification of land suitability for settlements quantitative descriptive analysis method.

Morphology	Soil type	Ground water	Lithology	Mass Movement	Weight analysis	Weight Class Value	Suitability level
3	1	4	5	4	53	41-53	Not suitable
4	4	4	5	4	66	54-66	Fairly suitable
5	5	5	5	4	78	67-78	Suitable

So from the results of this method a map of the level of land suitability for settlements based on geology is obtained

From the results of the overlapping (overlay) parameter map of the quantitative descriptive analysis method, a map of the level of land suitability for settlements based on geology is obtained which consists of :

1. The level of land suitability for settlements is appropriate (± 30.930%/± 1047 ha), its distribution occupies almost the entire sub district and Village area in Ciamis sub district, generally controlled by the morphology of plains to gently sloping hills, soil types of curly sand to silty sand and shallow groundwater .
2. The level of land suitability for settlements is quite suitable (± 58.463%/± 1979 ha), its distribution occupies almost the entire sub district and Village area in Ciamis sub district, generally controlled by undulating hill morphology, sandy to sandy loam soil types and moderate groundwater.
3. The level of land suitability for settlements is not suitable (± 10.576%/± 358 ha), the distribution is in the northwest, southeast and south with the most extensive area being in the Cigembor sub district and Cisadap sub district and with the least area being in the Benteng sub district area , Linggasari sub district, Pawindan sub district and Panyingkiran sub district , are generally controlled by the morphology of steep wavy hills, sandy to loamy soil types and deep groundwater.

VI. CONCLUSION

From the results of "Environmental Geology-Based Land Suitability Analysis for Settlement Development in Ciamis District, Ciamis Regency, West Java Province", the following conclusions can be drawn:

1. The most dominant morphological unit for residential land in the study area is a morphological unit of gently sloping hills with a slope of 2% - 7%, an average elevation of 245 masl and a distribution of ± 52.08% (± 1763ha) of the total area of the investigation area.
2. The most suitable type of soil for settlements in the study area is gravel sand, because it is very strong to be used as a building foundation.
3. The free groundwater level ranges from 0.5 – 12.4 m from the surrounding soil surface, sufficient to support settlement development.
4. Based on the overlapping (overlay) map of geological parameters, a map of the level of land suitability for settlements is produced, which consists of:

1) The suitability level of settlement land is appropriate (± 30.930%/± 1047 ha) which is generally controlled by plain morphology units, soil types from gravel sand to sand loam pebbles, shallow free groundwater and areas prone to very low soil movement.
2) The level of land suitability for settlements is quite suitable (± 58.463%/± 1979 ha) which is generally controlled by sloping morphology units, sand to loamy soil types, moderate free groundwater and areas prone to low soil movement.
3) The level of land suitability for settlements is not suitable (± 10.576%/± 358 ha) which is generally controlled by slightly steep to steep morphological units, soil types from sandy loam to sandy loam, deep loose groundwater and areas prone to medium to high soil movement .

5. Settlement development needs to pay attention to landslides and earthquakes. Ground motion disasters in the study area are classified as very low to high ground motion disaster prone areas, while seismicity is classified as medium earthquake prone areas with an intensity scale ranging from VII-VIII MMI (Modified Mercally Intensity). Soil cracks, weathering, landslides on steep hills in small dimensions are still possible. Buildings with good design and construction are not damaged or only slightly damaged.

REFERENCES

Akhmad D, Brilian CH, Barkah MN, Suganda BR, Kesesuaian Lahan Berdasarkan Aspek Geologi Lingkungan Untuk Pengembangan Permukiman Pada Daerah Margacinta Dan Sekitarnya, Kecamatan Cijulang, Kabupaten Pangandaran, Padjadjaran Geoscience Journal, Vol 4 No 4 Agustus 2020, ISSN 2597-4033.

Alwin, Sya'ban, Adiputra.A, Spatial Analysis of Earthquake Vulnerability Based on Geographic Information System (GIS) in Disaster Mitigation Efforts, Vol 20 No 1 (2020): Spatial : Wahana Komunikasi dan Informasi Geografi

Anonymous, 2013, Report of the RPJMD of Ciamis Regency, Bappeda of Ciamis Regency.

Anonymous, 2010 to 2014, Reports of Land Movement in Ciamis Regency, West Java, Center for Volcanology and Geological Hazard Mitigation.

Bakosurtanal, 1999, Topographical Map of Indonesia Sheet Pageurageung 1308 – 434 s.d Topographical Map of Indonesia Padaherang Sheet 1308 - 234, BAKOSURTANAL.

Budhitrisna. T, 1986, Regional Geological Map of Tasikmalaya Sheet, Bandung: Geological Research and Development Center (P3G).

Darsoatmodjo, A., 2006, Catalog of Methodology for Making Geo-Hazard Maps, Banda Aceh.

Kastowo, 1975, Regional Geological Map of Majenang Sheet, Bandung: Geological Research and Development Center (P3G).

Grandmont K, Cardille Ja, Assessing Land Suitability For Residential Development In Permafrost Regions: A Multi-Criteria Approach To Land-Use Planning In Northern Quebec, Canada, Journal of Environmental Assessment Policy and ManagementVol. 14, No. 01, 1250003 (2012)

Immanuella, Rosalina and Hidajat, Wahju Krisna and Santi, Narulita (2017) *Analisis Geologi Lingkungan dalam Penentuan Daerah Kesesuaian Lahan untuk Penataan dan Pengembangan Wilayah Perkotaan Kecamatan Purwodadi dan Sekitarnya, Kabupaten Grobogan, Provinsi Jawa Tengah.* Undergraduate thesis, Faculty of Engineering, Thesis (Undergraduate), Departemen Teknik Geologi, Fakultas Teknik, Universitas Diponegoro Semarang, Oktober 2017

Mu Y, Developing a Suitability Index for Residential Land Use: A case study in Dianchi Drainage Area, A thesis presented to the University of Waterloo in fulfillment of the thesis requirement for the degree of Master of Environmental Studies in Geography, Waterloo, Ontario, Canada, 2006

Nowar.W, Baskoro PT, Tahyono B, Analisis Kesesuaian Lahan Komoditas Unggulan dan Arahan Pengembangannya di Wilayah Kabupaten Cianjur, Fakultas Pertanian, Institut Pertanian Bogor, https://doi.org/10.14710/tataloka.17.2.87-98

Setyadi GP, Yan TW, Suganda BR, Barkah MN, Hidayat T, Rustam, Hadian SD, Kesesuaian Lahan Untuk Pengembangan Perkotaan Berdasarkan Aspek Geologi Lingkungan Pada Daerah Pangandaran, Provinsi Jawa Barat, Padjadjaran Geoscience Journal, Vol 2 No 5 Agustus 2018, ISSN 2597-4033.

Simandjuntak. T.O, Surono, 1992, Regional Geological Map of Pangandaran Sheet, Bandung: Geological Research and Development Center (P3G).

Sugianti K, Mulyadi D, and Sarah D, 2014, Classification of the Vulnerability Level of Land Movement in the South Sumedang Region Using the Storie Method, LIPI Geotechnology Research Center.

Supriatna. S, Sarmili. L, Sudana. D, Koswara. A, 1992, Regional Geological Map of Karangnunggal Sheet, Bandung: Geological Research and Development Center (P3G).

Suwarna. N, 1996, Regional Geological Map of Majenang Sheet, Bandung: Geological Research and Development Center (P3G).