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## ASSESSMENT OF THE GROUNDWATER RECHARGE POTENTIAL AREAS USING GIS IN KAJOR KULON HAMLET, SELOPAMIORO, IMOIRI, BANTUL, YOGYAKARTA

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# Assessment of the groundwater recharge potential areas using GIS in Kajor Kulon Hamlet, Selopamioro, Imogiri, Bantul, Yogyakarta

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**Abstract.** Groundwater balance occurs in the presence of recharge and discharge. The process of entering the water in soil takes place with an infiltration-percolation to aquifers. The groundwater recharge area is identified by lithology, land use, slope, rainfall, land, and landform. Kajor Kulon Hamlet, Selopamioro Village, Imogiri Sub-district, Bantul Regency, Special Region of Yogyakarta becomes an area with hilly morphology, active fault areas, and including drought-prone regions. Change of the land function in hilly areas by making settlements and un-irrigation field for farming may cause decreased ability as a recharge area. Research aim sare to assessing, determining, and analyzing the conditions of the establishment in the research area. The variables used include land use, the slope of the land, rainfall, and soil texture as thematic maps to analysis its land ability. Data collection methods are measurement, inquiry, and mapping. Furthermore, the method of analysis is based on the Geographic Information Systems (GIS) with scoring-weighted overlay method. The results showed the classification of the between low, medium, and high. The medium class is currently occupying 67% of the area in the research area with an area of 719,916.03 m<sup>2</sup>. The distribution of each class is expressed through the groundwater recharge area map. The GIS is very efficient and effective in facilitating groundwater recharge area analysis.

**Keywords:** GIS, Groundwater, Overlay, Potential, Recharge Area, Selopamioro

## 1. Introduction

The process of continuous and balanced water movements on the Earth's surface is called the hydrological cycle (Kodoatie, 2012). Processes are taken place include evaporation and evapotranspiration, condensation, transportation, precipitation, infiltration, flow in aquifer or runoff and back to early process again (Todd & Larry, 1980). Surface water is flowing from highest to lowest topography. The balance of the hydrologic process occurs due to the flow of water through the river on the mainland and released in the sea, which then experienced evaporation into the atmosphere (Dirmeyer & Brubaker, 2007).

Groundwater is the whole water shooting space voids, pores, and joints in a geological formation that is sourced from precipitation so that it has infiltration-percolation (Olumuyiwa et al., 2012). The movement of groundwater is sluggish, or nil under a flat container with the material has porosity and permeability called aquifer so it can flow based on gravitational force (Tóth, 1963). In general, the type of aquifer is divided into the unconfined aquifer, confined aquifer, semi unconfined aquifer, and semi-confined aquifer (Todd & Larry, 1980). The condition of equilibrium in groundwater aquifer is formed from the presence of area recharge and discharge of the continuous area (Winter et al., 1998). This recharge system in the form of precipitation then occurs the infiltration-percolation of water in the soil while the discharge process includes evaporation, evapotranspiration, runoff, and flow to the lake or ocean (Tweed et al., 2007).

Groundwater recharge area is a place of water entry from the surface to deeper soil with infiltration and percolation (Yeh et al., 2016). Areas that can potentially be a recharge depend on lithology, landuse, drainage density, soil drainage, land shape, rainfall, slope, and other related factors (Singh et al., 2019). Of the hydrogeological aspect, the catchment area is characterized by the contour lines of the tight groundwater, the transition area is somewhat tightly, and the area of loose with the contours of the (Hendrayana, 2011). The identification determination of the immoral area is based on morphological differences between terrain and hills, a river flow pattern that has many short tributaries, the pop-up of springs along the foothills, the direction of the water flow of each other, and with natural isotopes (Kodoatie, 2012). Issues that often arise related to groundwater is reduced availability of clean waters. Many factors that caused this to occur include excessive exploitation, increasing population, and changing land function in the area of potential recharge areas (Wangsaatmaja et al., 2006)

Kajor Kulon Hamlet is located in Selopamiro Village, Imogiri District, Bantul Regency, Special Region of Yogyakarta. It borders the regency of Gunung Kidul in the south. This area includes earthquake prone areas and drought (Indonesian National Board for Disaster Management, 2014). Geological conditions in the research area are included in the Nglanggeran formations with a lithology of volcanic breccia and agglomerates with inserts by sandstones and tuf. Furthermore, this area was also passed by a major fault of the southeast to the northwest (Nasrullah & Irianto, 2017) with its regional morphology of hills and plains. In addition, there is a function of land on the hill slopes that serve as agricultural fields.

This research combined the geological mapping with Geographic Information Systems (GIS) applications to determine, identify and assess the condition of the area that could potentially be a groundwater recharge area. It is intended to facilitate the determination of these conditions so that it can be used as a basis in determining the future management direction. A GIS has the ability to cultivate many layers with various methods available to facilitate the analysis of spatial (Tweed et al., 2007). This GIS utilization is used to be able to get a complete picture of conditions in the field.

The goal of this research is to know, identify, and assess the conditions and distribution of potential groundwater catchment areas in the region. Based on the data processed using the scoring-weighting and overlay methods on GIS software. It is expected to be able to determine the next step to preserve the conservation and groundwater availability in the area. The result shows specific condition and characteristic based on geological formation, geomorphology aspect, and the recharge's process.

## 2. Methodology

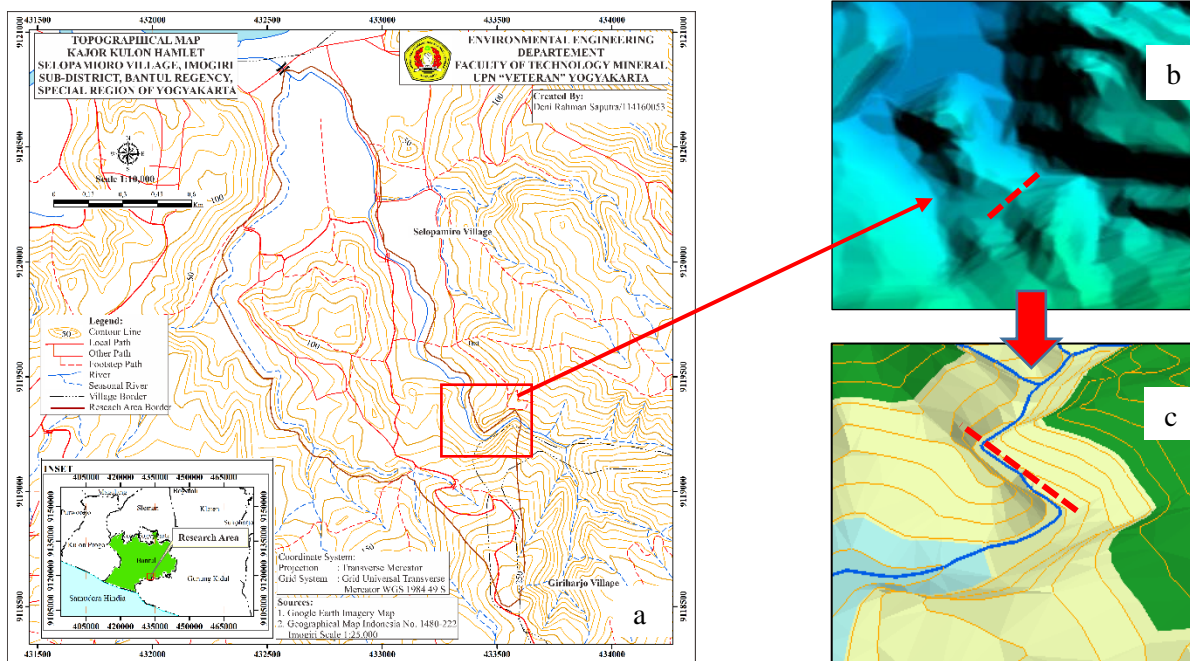
### 2.1. Study Area

The research is located in Kajor Kulon Hamlet, Selopamiro Village, Imogiri subdistrict, Bantul regency, Special Regency of Yogyakarta. Geographically, located at coordinates 91280884 mN to 9118526 mN and from 432241 mE to 433482 mE which is located 14 kilometres from the capital city center to the southeast. The research area has an area about 1,390,000 m<sup>2</sup> with a majority community condition as a farmer (Central Bantul of Statistics, 2018). The social aspect, the inhabitants of this hamlet occupy most of the hillside and plains areas. The entire population depends on the groundwater to supply water in the area about 723 villagers. However, in the hill's area existence of the groundwater is very limited. Thus, there is often a drought in the dry season, so there needs to be dropping water. Most of the villagers work as farmers and merchants with using land on the hillside.

The area of this research has a plain morphology with an elevation from 25 to 150 meters above sea level with a slope from 2 % to 43 %. The morphology of the research area is divided into hillsides,

hills, river valleys, and plains. It is composed of the main lithology of breccia, sandstone, tuff, and alluvium. It is scattered in areas with flat topography, while others are located in hilly areas. The rock conditions found have undergone intensive weathering so that it can be potentially as groundwater aquifer with an impermeable layer of breccia rocks, especially in the area of hillside land. In addition, the alluvium-shaped plains of the hills material that forms the sediment layer as a groundwater container. Based on the direct geological mapping, there is a path geological structure as fault in the northeast direction to the southwest.

Meanwhile, when viewed from morphology and process that takes place then the area with higher elevation will serve as a place of rain entry into the soil and into the water aquifer. The fault line can be recognized from the flow of river flows firmly and evidenced by looking at the Digital Elevation Model (Fajri et al., 2019). Figure 1 shows the location with the topography map and brown line as a border the research area based on landforms.



**Figure 1.** (a). The Topographical Map of Study Area (b). Visualizations with DEM (c) Visualizations with 3D (red line refers to fault plane)

## 2.2. Research Variables

This research will be based on GIS so that the variables used will be spatially converted. Table 1. there are 4 spatial variables, such as the slope of land, soil texture, annual rainfall and land use (Ministry of Public Works and Public Housing, 2015). The entire variable will be transformed into spatial data, making it easier to perform subsequent analyses. It corresponds to the identification of the recharge area and discharge area (Freeze & Cherry, 1979). The pertinent aspects include rainfall, runoff, hydrogeological characteristics, and topography. To facilitate the analysis using the GIS software then the entire variables are converted into a thematic map or in the form of spatial data

Meanwhile, the weight value of each variable is based on adjustment with its role in entering the soil through the recharge area. Next, the scoring value is adjusted by the classification of each variable with a score of 5 to 1. Score 5 shows the highest value while the lowest one value. The categorization is defined based on each classification of each variable describing the ability to do infiltration-surface water percolation (Danaryanto et al., 2007). The weights of each variable are also determined based on their influence on the ability to infiltration surface water into the ground.

**Table 1.** Variables, Criteria, Classification and Recharge Area Determination

| Variable & Weight   | Criteria  | Classification      | Category  | Score |
|---------------------|---|---------------------|-----------|-------|
| Rainfall<br>40      | The area with rainfall > 3,000 mm/year will have a higher water catchment potential than the area in which precipitation is < 500 mm/year                       | >3,000 mm/year      | Very high | 5     |
|                     |   | 2,000-3,000 mm/year | High      | 4     |
|                     |   | 1,000-2,000 mm/year | Are       | 3     |
|                     |   | 500-1,000 mm/year   | Low       | 2     |
|                     |   | <500 mm/year        | Very low  | 1     |
| Slope of land<br>10 | Areas with flat ground slope (< 5%) will have a higher water catchment capability than slope (> 60%)  | <5%                 | Very high | 5     |
|                     |   | 5-20%               | High      | 4     |
|                     |   | 20-40%              | Are       | 3     |
|                     |   | 40-60%              | Low       | 2     |
|                     |   | >60%                | Very low  | 1     |
| Landuse<br>35       | Areas with forest land that will have higher water catchment capabilities than areas that have residential land   | Forest              | Very high | 5     |
|                     |   | Grassland           | High      | 4     |
|                     |   | Unirigation field-  | Are       | 3     |
|                     |   | Mixed Garden        |           |       |
|                     |   | Paddy-Pond-Swamp    | Low       | 2     |
| Soil texture<br>15  | Areas that have a soil texture in the form of sand will have a higher water catchment capability compared to areas that have a soil texture in the form of clay | Settlements         | Very low  | 1     |
|                     |   | Sand                | Very high | 5     |
|                     |   | Sanded sand         | High      | 4     |
|                     |   | Sandy Clay          | Are       | 3     |
|                     |   | Fine Sandy Clay     | Low       | 2     |
| Clay                | Very low  | 1                   |           |       |

(Sources: Ministry of Public Works and Public Housing, 2015; Danaryanto et al., 2007)

### 2.3. Data Collection and Processing

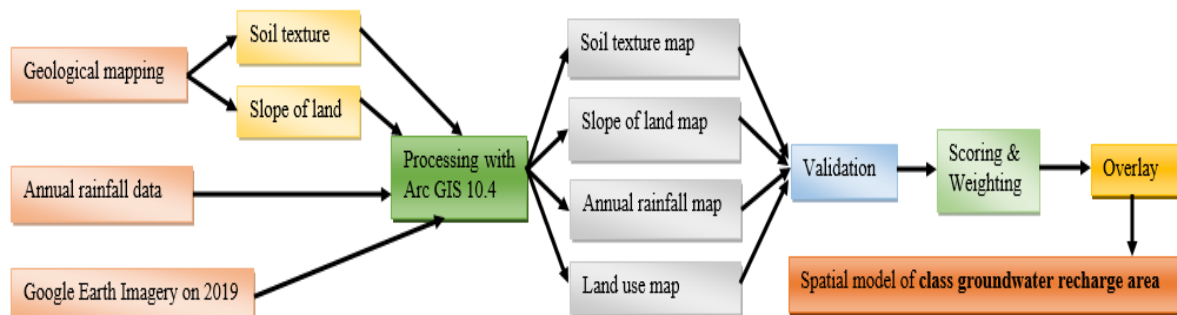
This study will use predefined variables based on Table 1. Variables slope of land and soil texture are gathered with field mapping and checking. Rainfall data is collected using secondary data from the Meteorological Climatological and Geophysical Agency (BMKG) from 2009 to 2019. The rainfall data is then calculated to determine the annual rainfall from the 3 nearest rainfall stations. While the determination of land use in the area is done with GIS from the latest Google Earth imagery performed the digitalization process. Table 2 shows the explanation of each required and data sources. Overall data used according to the need of variables in this study with field checking on the research study area. It is done to adjust to the actual conditions that exist so that the results will represent the conditions and characteristics of the recharge area.

**Table 2.** Data and Sources

| Variable      | Explanation                                     | Year      | Source   |
|---------------|---|-----------|--|
| Rainfall      | Used to know the distribution in the area       | 2009-2019 | Meteorological Climatological and Geophysical Agency (BMKG) Yogyakarta |
| Slope of land | Used to create slope map of land                | 2019      | Geological mapping and field measurement                               |
| Landuse       | Used to determine the type and distribution     | 2019      | Google Earth Imagery   |
| Soil texture  | Used to determine soil texture and distribution | 2019      | Geological mapping and field checking                                  |

This research uses an overlay method with the scoring and scaling of each class of a given variable. This method is used to measure universally against different variables that are then sorted and combined to facilitate the analysis (Belay et al., 2015). All variables will be expressed as spatial information in the form of visualization map using ArcGIS 10.4 software. All spatial information will try raster data so it can be easier to do an overlay method with a weighted. Method of determining the type and area of each land use with digitalization based on Google Earth imagery. The process uses the assistance of Software ArcGIS 10.4 by moving images into a polygon according to the type of land use and it is transferring data based raster. The process of moving images into raster data is called digitalization with a shapefile-formatted output. As raster data serves as a storage, manage, and analysis as needed so as to be able to display the visual data of the analysis results that have been done (Store & Jokimäki, 2003). Soil texture determination using the rapid survey method in Notohadiprawiro (1983)

Each map has been created in the form of a thematic map so that it can be sorted by the classes of each category and can make it easier to do the weighted based on the influence of each variable. Recharge This potential area is the result of an overlay of the entire thematic map created (Kuruppath, & Kannan, 2017). In addition, to know the breadth of each class of recharge areas, researchers use pivot table method with Micosoft Excel 2016. The process is explained in the flowchart in Figure 2.



**Figure 2.** Flowchart Diagram

### 2.3. Data Validation

The whole variable has been converted into spatial data by going through the digitalization process using ArcGIS 10.4, resulting in a thematic map. Thematic map must be validation in advance in order to represent the actual condition in the field. It is intended to be a map of the recharge area in the research area can indicate the actual condition. Data that will be done validation process include thematic map of annual rainfall, land use, slope of land, and soil texture. The methods used in this validation are in the form of checking, mapping, measuring, and observing in the field directly. If there is an error when the field is checked for the second, it can be revised again. Figure 3 land use in research areas in the form of agricultural areas. The entire type of land use will be checked to determine its existence and boundaries so that it corresponds to the conditions in the field. Figure 4 identification techniques for soil texture by taking soil samples that are then matched with the investigation schemes used by researchers. All thematic maps used in determining the condition of the recharge area will be validated by checking in the field by adjusting the appropriate techniques.



**Figure 3.** Landuse Mapping and Checking



**Figure 4.** Soil Texture Checking

The validation of spatial data on the thematic maps used in this research is useful to improve the accuracy and suitability of the whole variable with the conditions in the research area. The quality of the data used based on GIS databases is seen from the process of data collection, data retrieval, and reusability of the data. In general, the validation of this GIS data can use several techniques including spatial data quality, data completeness, consistency, thematic accuracy, temporal accuracy, and position accuracy (Balakrishnan, 2019). This research will use the validation techniques of the quality of data retrieval directly in the field and retrieval of complete data so that it complies with the real condition.

#### 2.4. Data Analysis

The research using spatial raster data uses several variables which are then conducted by assessment of each of the criteria (Waikar & Nilawar, 2014). This research all variables will be transformed into spatial data in the form of thematic maps to facilitate the processing of the overlay method in GIS software. The analytical techniques used in this study use the results matching technique from the overlay of each variable that has been performed scoring and weighted. The overlay results of the usage variable land use, annual rainfall, slope of land, and soil texture in the form of a recharge area class in the research area. Table 3 shows a recharge area class with a specific score range. The score in Table 3 is derived from the multiplication between the scores of each criterion and the weight of each variable which is then aggregated based on the overlay results of all the thematic maps.

Each category of this class will describe areas in the research site that have the ability to enter surface water or rainwater into the soil. In addition, through these results can be known the level of land ability and can be used as a basis in knowing how large the surface water can be infiltration towards. For example, an area based on analysis results shows the area class category of very high as a groundwater recharge area. It means that the area with rainfall, land use, type of soil texture, and the slope of certain land has a very high ability in the process to infiltration of the runoff or rainwater.

**Table 3.** Class of Groundwater Recharge Area

| Score Range | Class Category |
|-------------|----------------|
| 100-180     | Very low       |
| 180-260     | Low            |
| 260-340     | Medium         |
| 340-420     | High           |
| 420-500     | Very high      |

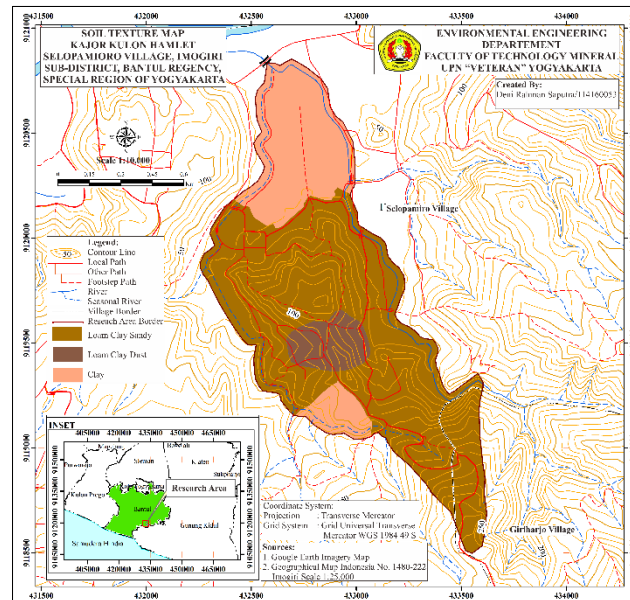
(Source: Rohmat et al., 2015)

### 3. Results

#### 3.1. Soil Texture Map

The land is collecting from a variety of components of both organic and inorganic materials that provide for one unit (Balasubramanian, 2017). Soil texture mapping begins with the type of rock mapping in the research area. It is based that the soil is formed due to the process of weathering the parent rocks due to the driving factors both physics, chemistry, biology, and time (Hillel, 2008). In addition, different

types of parent rocks and human activity will also cause differences in the type, texture, and soil structure of the area. Soil texture will represent from the size distribution of soil grain that controls the ability to pass water, store, and land structures (Martín et al., 2018). The size of the soil texture is differentiated into three types sand (0.02-2 mm), silt (0.002-0.02 mm), and clay (< 0.002 mm) with different characteristics (Hristov, 2013). Soil texture investigation techniques are carried out with testing in the field using determination of soil type based on the Soeprahardjo classification (1961). The investigation by taking a number of soil samples that were then in the form of a blob and then pressed using the thumb of the hand in an elongated, then measured how long the soil samples and matched with the key determination available.



**Figure 3.** Soil Texture Map

While the soil texture silt and clay tends to have a low permeability to pass the water in the soil. Based on soil texture mapping, the research area has 3 types of textures that are loam clay sandy, loam clay dust, and clay. It is based on the investigation and testing of textures directly in the field. Soil texture types in each region will certainly affect the ability of water to enter the soil since affects large porosity and permeability of soil composition vertically. In addition to the parent rock factor, if it is correlated with land use in the research area, it can be known that the area with land use as rice field tends to have a clay texture. The influence of human activity above the ground surface will certainly affect the type of soil texture because the soil has been treated or already processed. The soil texture spread map (Figure 3) shows the loam clay sandy texture dominating in the area. In addition, the soil texture of the loam clay dust only occupies in the hillside area locally only. Based on soil texture thematic map then get the score of each type for clay worth 1, loam clay sandy worth 3, and loam clay dust worth 2.

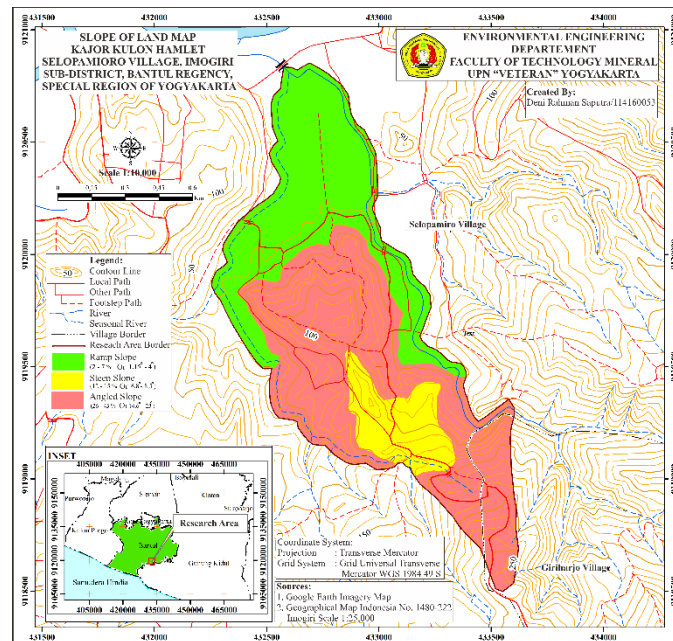
### 3.2. Slope of Land

Groundwater recharge capacity can be known through the slope parameter of an area. An area with a steep slope is considered to have the low ability as a recharge area due to higher slope, rapid runoff, and low infiltration. Furthermore, the area that has a higher slope will cause rapid runoff and recharge capability to be low (Shaban et al., 2006). Based on slope mapping in the field shows a steep slope located in an area with a morphological slope of the hills. The rugged slope value of the steep slope reaches 26 - 43% based on the Van Zuidam classification in 1983. Furthermore, ramps slope with a slope value of 2-7% spread to the morphology of the plains along the river flow. In addition, for the angled slope with the value of 12-15% centered between the two hills on the research area.

Based on the thematic map, it can be known scores for these variables are 5, 4, and 3. Slope of land maps can be seen on Figure 4. Slope map shows that on hill areas have the category of steep slopes and angled slope so the ability to incorporate surface water into the ground with considerable capability. In addition, it also depends on the condition of land surface whether many overgrown vegetation or not.



It certainly affects the flow of runoff. Grass vegetation at surface of land can withstand the flow rate of surface water. In addition, it depends also on the shape of the slope used by farmers in the efforts to utilize land for agriculture. Land with terrace formed will certainly slow the flow of runoff.



**Figure 4.** Slope of land map

### 3.3. Landuse

Landuse in research areas includes settlements, paddy fields, non irrigation field, and fields. Settlements include buildings and vacant land around it. Based on Figure 5, shows landuse as dominating. The distribution of the non irrigation field and field is located on the slopes of the hillside while the paddy fields tend to be in a flat morphology area. Landuse became an important aspect of the recharge process on groundwater (Olumuyiwa et al., 2012). Any kind of land use will certainly have a difference in ground surface conditions that will affect the nature of the soil. It affects the ability of water to conduct infiltration into the soil. If unable to perform the infiltration process-percolation will usually be runoff and puddle. Land use has a great influence on the ability of the land to insert surface water into the soil. Due to changes and treatment of soil conditions are hardened either compacted or not greatly affect them. The type of land use is determined by the community activities conducted on the soil so that based on land use thematic map can be determined score 3, 2, and 1.

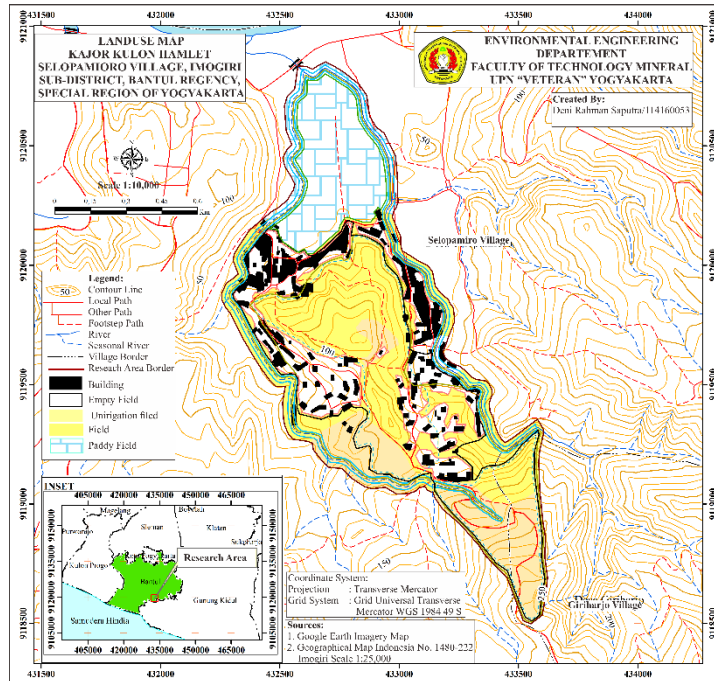


Figure 5. Landuse map

### 3.4. Annual Rainfall Map

Annual Rainfall Map is created using the average rainfall per day over the past 10 years. The data uses rainfall from the nearest 3 stations in the research area, which is Dlingo, Siluk, and Paliyan rainfall stations. This is so that it can be made a map of rainfall distribution using the Isohyet method. Rainfall plays a vital role in the sustainability of the hydrological cycle as it becomes a groundwater supply in aquifer. In addition, the existence and amount of groundwater in the aquifer depends on how much precipitation falls in the region. Figure 6 shows the rate of rainfall in the research area. The research area in the boundary with brown polyline so it has rainfall classification of 1,000-2,000 mm/year.

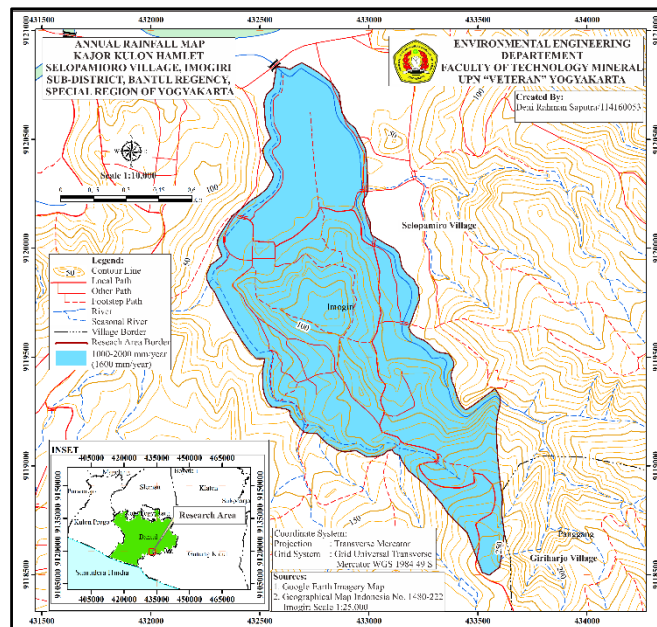


Figure 6. Annual Rainfall Map

### 3.5. Groundwater Recharge Area Map

Based on the results of the weight overlay method that has been done using GIS can find out the category of the recharge area and its distribution. The category of class recharge area in the area includes low,

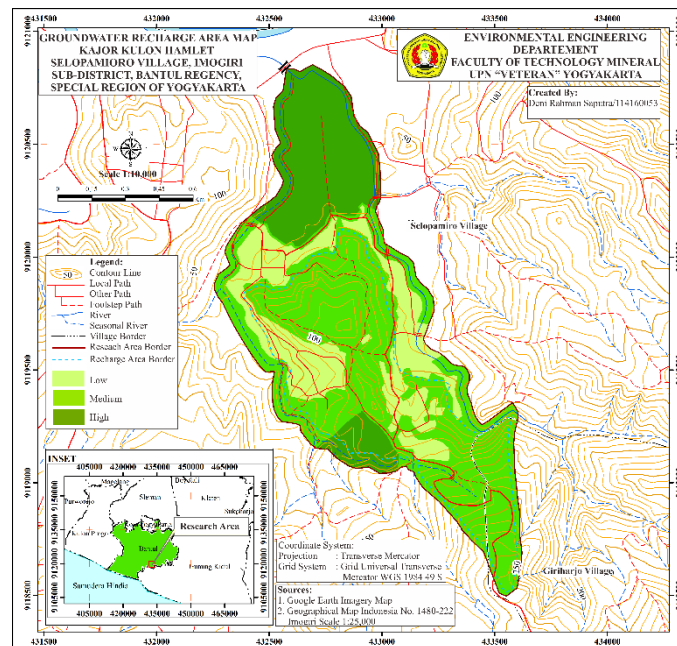
medium, and high. Each class is then presented through a thematic map of the recharge Recharge area indicating the yellowish green colour has a low grade, the light green colour has a moderate class, and the dark green colour has a high grade (Figure 7). The area of recharge area on the thematic map is indicated in a blue dashed polyline boundary while the outer boundary area is included in the discharge area. Of course, the limits of this recharge area are based on morphology and landform in the research area. Groundwater Recharge Area Map will certainly describe the condition of the area that serves as a recharge area. Furthermore, through these thematic maps can be determined the area of each class by using pivot table so that it makes it easier.

The results of the analysis using GIS software indicate that the recharge area in the dominance of the medium class occupies 67% of the entire region. It shows that the ability of land as a recharge area is still in good condition even though it has been converted into farmland. Furthermore, 27 % of the area's overall entry is low in class which means the ability to recharge area is also low while high class occupies only 6 %.. The area of each recharge class is presented in Table 4.

**Table 4.** Class of Groundwater Recharge Area

| Class Category | Area (m <sup>2</sup> ) |
|----------------|------------------------|
| Very low       | 0                      |
| Low            | 292,383.99             |
| Medium         | 719,916.03             |
| High           | 55,485.78              |
| Very high      | 0                      |
| Grand Total    | 1,067,785.81           |

The distribution of each class of recharge conditions is presented in Figure 7. Based on the map, it can be known that the class spread is dominating almost throughout the area while the very high class is next to the north of the research area. Areas along the river flow have the ability to absorb water in the high category. In addition, only a small portion of the area belongs to the low class. Of course, every class of recharge area will certainly describe the condition of the relation of each variable used in this analysis. This can make it easier to determine future management in order to solve existing problems in the area.



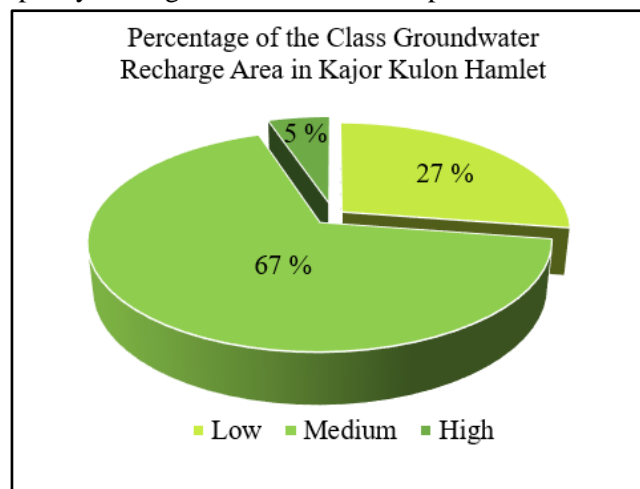
**Figure 7.** Groundwater Recharge Area Map

#### 4. Discussion

The determination of the recharge area in this research area is based on spatial variables according to the Ministry of Public Works and Public Housing in 2015. The variables used include the annual rainfall, slope of the land, land use, and soil texture which are then performed by the overlay method using GIS. Each variables certainly has a specific classification so that it can be categorized and given a score. It is the weighted value based on how big the role and the impact of water flow can be infiltration in the groundwater recharge (Shaban et al., 2006). The linkage between variables lies in its influence on the ability of the land as a recharge area shown at varying weights with rainfall variables play an important role for the condition of recharge areas in the research area

Based on Table 1 shows that rainfall has high weights so that rainfall is an important factor to increase groundwater supply. Obviously, as large or whole groundwater in the aquifer is supplied through precipitation or rain to the surface of the Earth. Furthermore, land use which also plays a role in determining groundwater recharge area conditions. Landuse as a forest will certainly have the ability to enter water in the soil from the settlement. Activities on the ground surface will affect the condition of the soil either solid or not. This use of land will also affect the texture of the soil, especially on the surface and will affect the ability of water for infecting the percolation. Additional slope is also an important factor because higher slope will cause rapid surface water flow. A widely used effective and efficient way to reduce surface flows, grass and scrub is needed (Zuazo & Pleguezuelo, 2008).

When associated with geological conditions many geological structures found in the form of joints and fault are recorded in lithology. This would make it easier for the rocks to weathering process in the gaps of the rocks. In addition, it will facilitate the process of forming land and the gaps in the ground rocks can be a pathway for water in the soil flowing to the aquifer. Existence of this geological structure can indicate the first time there is a massive tectonism activity so that it forms morphological form of hill. Interconnected rock cracks make it easier for the flow of water to the aquifer. It is certainly very helpful in increasing the capacity or magnitude of infiltration-percolation of the surface water.



**Figure 8.** Percentage of the class groundwater recharge area in Kajor Kulon Hamlet

Based on the map Gorundwater recharge area, it can be known under the overall area that potentially as a recharge area including medium class amount 67 %. The value is influenced by the type of land use as an agricultural field with the texture loam clay sandy. These two variables play an important role causing them to be in the Medium class category. The area that is considered a potential area as a recharge area is present in the area with the morphology of the slopes of the hills. When viewed from land use in the area was used as a field and part of the piece on a steep and sloped slope. Furthermore, the low class occupies only 27 % because in the area it develops into a residential area coupled with a soil texture of dust clay. Figure 8 states the percentage of the broad-grade recharge area. The area that is potential as the recharge area is an area that is inside the blue dotted line corresponding to Figure 7.

Meanwhile, the land function change as a field especially in the potential area as a recharge area certainly plays a big role in determining the condition of its class. Landuse in this potential area that serves as a settlement certainly cause reduced water ability for infiltration-percolation. The variables

used can be shown and illustrate the condition of the recharge area. Based on the results, then it can be known that the condition of the establishment of the area in the research area is still in good condition to become a groundwater recharge area. The linkage of each variable is of course a role and affects the infiltration that comes from runoff or precipitation to fill aquifer groundwater. It indicates that the utilization of GIS will make it easier to know, assess, and analyze the recharge area efficiently and effectively.

#### 4. Conclusions

The conclusion of this study, among others, that the hamlet Kajor Kulon, Selopamiro village, Imogiri subdistrict, Bantul Regency, Special Region of Yogyakarta amounted to 67%, including the medium class of the groundwater recharge area. The variables used are the slope of the land, land use, soil texture, and annual rainfall presented in spatial thematic maps. Furthermore, GIS can be effectively and efficiently used to know, assess, and analyze the condition of the groundwater recharge area in the research area. The results of this research are expected to be used on the basis to preserve the sustainability of groundwater in the area through classes that display and describe the conditions of its land ability.

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