Drought disaster vulnerability in Jember Regency

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Abstract. Drought is a disaster that often hits several areas in Jember Regency. The disaster caused various problems including: (1) clean water crisis, (2) crop failure, and (3) social conflict. The purpose of this study is to map the distribution of drought-prone areas in Jember as one example of the area entering the quarter volcano lane and tertiary volcano lane The method used is buffer and overlay data. Spatial data in this study are data relating to space, region and zone. The data will relate to areas that are often hit by drought. In addition, attribute data is also an important part of GIS analysis. Attribute data contains information relating to the condition of the quantity and quality of water available in drought-prone areas. The parameters used in this study include: (1) soil type, (2) geological structure, and (3) land form. The results showed that several regions in North Jember and South Jember. northern jember is an older volcanic depression compared to the surrounding region. South Jember is a karst zone that is very vulnerable to losing the ability to store a ground water.

1. Introduction
Karst is a landscape dominated by limestone rock formations and become one of the zones prone to drought. Drought disaster is one of the disasters that often hit the Jember people in the region with low rainfall including karst. The disaster can also be disruptive community activities especially those related to household water needs, agriculture, livestock, and industry. The disruption of the activity will also affect the economic conditions of the community and the conditions of the surrounding environment residence. Economic conditions are related to decreasing people's income.

Environmental conditions around the residence are related to sanitation and availability clean water. Low availability of clean water is related to the occurrence of disasters drought. Without clean water, people will find it difficult to do various things kinds of activities, especially those that deal with environmental health. Health environment in a society can be measured by the quality indicator of bathing, washing, and toilet. One area which often experiences drought in the karst region of the southern mountain zone East Java. In fact, the area is in danger of not being able to maintain resilience the food. When entering the dry season, water drought often occurs so that residents in the area must look for natural water sources that are far away or waiting for government assistance. Moreover, most of the villages are located in the zone the southern mountains of East Java cannot be serviced by the Regional Water Company Drink. The following data relating to drought in the Regency located in the mountainous zone south of East Java. Rapid population growth and increasing demand for resources and production, particularly irreversible resources such as water, bring to the attention of authorities consumer demand require planning and control [1].

The data above shows that the drought in the Southern Mountains East Java happened repeatedly. This happened because of the Southern Java Mountains East is one of the regions in Indonesia that has many landscapes karst. The landscape of the karst land is very vulnerable to causing drought in one region if the epicarst condition (upper horizon) is deformed. The recurrence of the disaster will certainly be very disturbing activities society. Even the region will experience difficulties in advancing

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infrastructure and human resources. This is caused by the affected areas very extensive and long periods of drought. Each drought is unique in its set of physical characteristics as well as in its geographic scope and location [2].

Therefore, it is necessary innovation to overcome these problems. One innovation that can be applied to overcome problems the need for clean water in drought-prone areas, namely sensing integration far infrared thermal with a geographic information system. This innovation can detect aquifers that are on the horizon in the soil layer. Infra remote sensing integration Red thermal with this geographical information system will be designed so that water needs clean in an area is always fulfilled. Next, it will be made as one reference in regional water spatial management. Characteristics of infrared remote sensing integration with the system geographical information that is always considering aspects of the carrying capacity of the environment in an area. This means that it will strengthen balance of ecosystems in a region. Technology that is not built will damage the environment, but it will have a positive impact on it other communities and living things.

2. Method
The variables observed and measured in this study consist of: (a) Water balance, (b) geological structure, (c) soil type, and (d) precipitation. These four variables will be observed with use daisies and landsat 8 images. Data analysis used is by weighting and scoring to divide zones that are vulnerable to drought.

| Table 1. Drought Parameters |
|----------------------------|
| Parameters                | Weight |
| Water Balance             | 20     |
| Geologycal structure      | 60     |
| Soil type                 | 10     |
| Precipitation             | 10     |

3. Results and Discussion

3.1 Distribution of Drought in Jember
The results of this study are drought in northern and southern Jember.

| Table 2. Distribution of drought |
|---------------------------------|
| Region  | Score |
| West Jember | 30 |
| South Jember | 70 |
| North Jember | 80 |
| East Jember | 50 |

Data processed (2018)

West Jember is not prone to drought because its stratigraphy is still dominated by young igneous rocks with inceptisol and andisol soils. North Jember is prone to drought because its stratigraphy is dominated by igneous rocks older than latosol soil types. This type of soil has less porosity and is not good at holding water. West Jember is not prone to drought because its stratigraphy is still dominated by young igneous rocks with inceptisol and andisol soils. North Jember is prone to drought because its stratigraphy is dominated by igneous rocks older than latosol soil types. This type of soil has less porosity and is not good at holding water. South Jember is prone to drought because its stratigraphy consists of a combination of carbonate rocks and tertiary igneous rocks. East Jember is dominated by quaternary igneous rocks and latosol land with land use that is still balanced, so it is not prone to drought. The soil characteristics as a cause of drought in Jember are explained in the following table
Table 3. The soil characteristics

| Region      | Type of Soil | The soil characteristics |
|-------------|--------------|--------------------------|
| West Jember | aluvial      | high porosity            |
| South Jember| terarosa     | low porosity             |
| North Jember| latosol      | low porosity             |
| East Jember | aluvial      | high porosity            |

Data processed (2018)

West Jember has good soil porosity because it is related to its ability to store large amounts of water in aquifers. This will cause the groundwater needs of the population to be fulfilled throughout the year. North Jember has poor porosity due to the ability of latosol soils that are not as good as other volcanic soils. Latosol has rocky properties ranging from the upper horizon to aquifers, causing percolation to not run optimally. South Jember actually has good ability in storing ground water. However, because the dominating bedrock is lime, then when there is damage to the upper horizon it will cause very little percolation. This will have a negative impact on the surrounding community. In addition, the attractiveness of the karst region to become a mining area is a factor that increases the level of vulnerability to drought in the region. East Jember is still very much influenced by the activities of the mountain raung who are in their quarter, so that the existence of the land is better. Soil in the upstream area is dominated by andosols, while the land in residential areas is dominated by alluvial soil which has very good ability to store ground water.

Geological structure factors also greatly influence the occurrence of drought in Jember. The geological structures related to the stratigraphy in Jember are explained in the following table.

Table 4. The stratigraphy of Jember

| Region      | upper rock | The rock characteristics |
|-------------|------------|--------------------------|
| West Jember | clay stone | low litification         |
| South Jember| limestone  | low litification         |
| North Jember| Andesit    | fast litification        |
| East Jember | tuff       | low litification         |

Data processed (2018)

Clay stone is a rock that has a long lithification ability because this process occurs in alluvial plains that are not directly affected by the volcanoes. This causes the upper horizon of the land to not have andesite which is a barrier to rainwater seeping into the ground. Limestone has a very high level of sensitivity to environmental changes. This can be demonstrated by the loss of percolation ability on the horizon on land when mining exploitation occurs. Andesite rocks are very much found in northern Jember because this region is a part of the depression of the solo zone that is older than the volcano area. This is due to the existence of argopuro volcanoes which have very low activity. So that the spread of andesite in the soil is always static. In addition, the large andesite size in the upper aquifer is also strongly influenced by the low volcanic activity. Tuffs in the upstream area have characteristics that are not easily congested because they are not compact and are influenced by eolian energy. The existence of tuff will only have an impact on the quality of andosol soils that are very good for agriculture. Jember Stratigraphy seen from the comparison between other regions can be seen in the following figure.
Infrared remote sensing is remote thermal red was successfully used to identify groundwater [3], it will have an impact on more efficient use of resources. The results of these studies show the advantages of thermal infrared remote sensing consisting of (a) able to detect underground water, (b) able to reduce the cost of surveys to the body water, (c) able to help rehabilitate ex-mining areas.

**Figure 1.** The Stratigraphy of East Java

Thermal infrared remote sensing is an image formed from the temperature of the earth's surface recorded by thermal sensor objects. Image it has a two-dimensional image of the pictorial type. This

**Figure 2.** geology and the rock type of Jember by Hall and Smith
image is capable record objects on the surface of the earth day and night. Recording process carried out when sunny weather conditions for optimal image results. Geographical Information Systems (GIS) act as a link between images-infrared thermal with earth map, attribute data, and cartographic aesthetics.

The flexibility of GIS is in its ability to change spatial data as well adjust it to the actual conditions quickly. Current climate dynamics happens will require changes in spatial data in the GIS application. Change of data can be done quickly because the GIS application has features that allow it registration process, digitization, and lay out takes place quickly. The combination of infrared thermal remote sensing with GIS is one form of innovation in drought risk management. This disaster management will make it easier for stakeholders to monitor conditions drought in the area because it has been assisted by GIS applications. GIS is capable presenting a mapping of drought areas with a wide range inside shows the condition of groundwater availability. Areas lacking water the net will be monitored easily, so that the parties involved will also be easy inside follow up on this.

The topography of the area of Jember has an altitude of 0-3,300 above sea level (asl). Ketinggina in urban areas is approximately 87 meters above sea level (asl). In general, the City of Jember has a varying slope, which ranges from 0-40%. The slope details are: (1) 0-8% covering an area of 6493,355 Ha, (2) 8-15% covering an area of 2742.53 Ha. (3) 15-25% of 330.08 Ha (4) 25-40% covering an area of 177.74 ha. (5) > 40% covering an area of 164.05 ha.

Most areas are at elevations between 100 and 500 meters above sea level, 37.75%. The plains are the depressive zone of the movement of the mountains which is quite large flanking the city of Jember. Jember is surrounded by Meru Betiri National Park, Watu Pecah Mountain, Mangar Mountain, Argopuro Mountain, Sadden Mountain, and the Indonesian ocean plate which causes the upper surface of the earth to change into folds or fractures of the earth. The mountains that flank the city of Jember belong to the southern mountain zone which is a row of young volcanoes which are generally raised and sloping sea blocks, resulting in a large depression zone. There are also karstic mountains in the Puger area, which is the Hydrology of the city of Jember, influenced by shallow surface water, springs and river flows that cross it. The river that crosses the City of Jember is the Bedadung River which originates from the Iyang mountains. The plain of the city of Jember is dominated by litosol and regosol yellowish brown soil types. This type of soil greatly determines the level of fertility and the effective depth of the soil, where the fertility level is above 90 cm. The shape of the land in the city of Jember is also dominated by marine katena origin which is directly adjacent to the southern sea, and there is a uniqueness in one of the beaches in Papua, papuma beach which has white sand different from other beaches because the rocks in the local mountains contain a lot of limestone where the papuma beach is indeed close to the karst puger mountains. Drought and flood disaster is a kind of natural disaster occurred frequently in karst area [4].

3.2 Geomorphological Factors
Jember is an area that is included in the geomorphological range that exists in East Java and includes two zones namely the solo zone and the southern mountain zone. Jember can be divided into 2, namely the north to the south. In the north to the middle of Jember, it is included in the solo zone because it is still in one unit zone in East Java. In the area around Jember, it is surrounded by active volcanic volcanoes such as Mount Bromo, Mount Semeru, Raung Mountain, and Mount Argopuro which are now no longer active.

The central part to the south of Jember is the southern mountain zone because it is still in one unitary zone in East Java. The southern part of jember is formed due to the appointment process. The southern part of Jember is also part of the tertiary fire mountains, so the age of the rocks is old. In the southern part of Jember, karst is also found which is carried out by mining every day, which may damage the existing ecosystem around the mining area in the future. The social dilemmas arising during droughts underscore the need for well-defined property rights, and the development of nested institutions that are well-matched with local conditions [5].

Old volcanic bedrock is the most influential factor in aquifer conditions. Aquifers will be different from the regions where the basic rocks are formed by the process of working the river. Aquifers in Jember are found in many andesite scales on a large scale and extend mainly in northern and southern Jember. So even though rainfall is very high, precipitation will not contribute optimally to the high volume of agricultural water.
4. Conclusion

Drought in Jember occurs in old volcanic rocks with latosol. This is caused by the weak capacity of the soil to hold water, so that appropriate mitigation is needed when the rainy season is sufficient to store water. The geomorphological condition which is a graben also affects the condition of groundwater in Jember.

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References

[1] Farideh N I and Somayeh B 2014 Journal of Middle East Applied Science and Technology 10 2305-0225
[2] Donald A W and Michael H G 1985 Water International 10 111-120
[3] Anne R, Kristi K N, Velli P S 2017 International Mine Water Association 1286-1292
[4] Zhou R, Guo C, Fu Q, Pan L 2012 International Conference on Modern Hydraulic Engineering 28 277-281
[5] Dustin E G 2018 International Journal of the Common 12 301-331