Erodibility Factor in Weathered Volcanic Rock in Jatinangor, West Java, Indonesia

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Abstract. A regional development will decrease the open green space that will affect the less water infiltration during the rainy season and causing the high intensity of the erosion rate. Jatinangor is a well-known new satellite city that located in undulating volcanic hills as the part of the Southeast Mt Manglayang. This area has been degraded from agricultural land into the residential and educational area. This study aims to determine the erodibility factor potential as one of the important factors to an erosion prediction. The data were obtained by collecting several undisturbed samples and tested the grain size and hydrometer analysis, atteberg limit test to know the grain size distribution. This result showed that Jatinangor Area has a high potential value of erodibility that caused by the silt domination and Ilite clay mineral that potential to swelling. The high erodibility values are affected by volcanic material as the parent rock that consists of Tuff, Lapilli Tuff, Grain supported and matrix supported Breccia with Plagioclase and K-Feldspar percentage 15-35%. Whereas the low erodibility value in the higher clay soil percentage is affected by the less percentage of plagioclase and K-fledspar, and the Tuffaceous sand matrix that difficult to erodible. The conservations are needed to decrease the erodibility effect and minimize the erosion rate annual.

Keywords: Erodibility, Erosion, Weathered Volcanic Rock, Jatinangor

1. Introduction

A regional development will decrease the open green space that will affect the less water infiltration during the rainy season and causing the high intensity of the erosion rate [1] [2]. The erosion is a natural process that accelerated by human activities. This environmental problem would cause land degradation and soil productivity loss. Some erosion problem also considered in causing flood disaster. The two main factor causing erosion are erosivity and erodibility. The erodibility is the susceptibility of soil to erode using USLE by Wischmeier and Smith [3]. The less erodible soil is coarse soil and very fine soil e.g. clay that has cohesion due to the cementation. While the high erodible soils are silt and very fine sand [4] [5] [6].

Jatinangor is a well-known satellite city that located 25 km from Bandung City. This city has rapidly grown and changed the agriculture area to educational and residential area. Several universities built with several apartment and housing complex [7]. Jatinangor is located on undulating volcanic hills on the southern part of Mt. Manglayang. [7]. The major lithological found is Quaternary Undifferentiated Young Volcanic product, tuffaceous sand, lapilli, lava, agglomerate mostly from Mt. Tangkubanparahu and Mt. Tampomas [8]. Geology is a key factor to build a smart city. As mentioned by De Rita and Häuber, when a city is built as a Smart City, the geological hazard and risks should be...
considered as a key factor. The city morphological aspect, the flood analysis, and also several hazards like active volcanic mountain are some major factor in built a city [9].

Figure 1. Research Map

Jatinangor as a satellite city could having rapid growth population and urban expansion that will lead to higher risk hazard than previous years. The erodibility factor as one of erosion control needs to be analyzed not only by remote sensing analysis but by a surface survey from the engineering geological aspect.

2. Research Method
This research was done by field survey and collecting some samples form hand auger and undisturbed sample on completely weathered zone around Jatinangor area. The soil characteristics were analyzed in the laboratory, resulting in grain size analysis and hydrometer analysis. The soil erodibility is using Wischmeier and Smith formula [3] shown as

$$100K = 2,721 \cdot 2,1 M^{1.14} (10^{-4}) (12-a) + 3,25 (b-2) + 2,5 (c-3)$$

K = Soil erodibility
M = Particle Percentage (% of very fine sand + % of silt x (100 - % clay))
a = organic matter content
b = soil structure
c = soil permeability
3. Result and Discussion

Based on the previous study, the lithology found in Jatinangor area were weathered volcanic rocks such as weathered tuff, lapilli tuff, breccia, agglomerate, and some lava. The percentage of plagioclase from 15-20 % and k-feldspar range between 5 to 35 % [10]. Later Fahranaz et al. categorized the lithological found dominantly by tuff and laharik breccia [11]. Djadja and Hermawan had categorized the soil in Jatinangor into the reddish-brown residual soil as resulted of volcanic rocks dan consist of silty clay and sandy silt [8]. While detailed engineering geological mapping near Universitas Padjadjaran resulted high to low plasticity silt to high plasticity clay according to Khoirullah et al. and Fahranaz et al. [9] [10].

![Figure 2](image_url)

**Figure 2.** The typical Soil In Jatinangor, reddish Brown soil, contain fine-grained material, more fragile in dry condition due to swelling and shrinking and easily to erodible in less vegetation condition.

Based on laboratory identification, the grain size distribution in Jatinangor is shown in this figure below.
Based on the laboratory test, the distribution of grain size in this research area was dominated by fine-grained soil, clay, and silt, with silt is more dominant than clay. This residual soil is interpreted as weathering product from tuff than contain plagioclase. This soil texture has an important role to erodibility factor. The higher silt distribution will affect the higher erodibility value. To calculate, soil erodibility, the other factor considered is soil structure, permeability, and organic matter content. The soil structure dominated by very fine grain (< 1mm) and low to very low permeability using Arysad classification [12]. The organic content was using visual observation and found less organic material. The resume of erodibility value is shown in this figure below,

Based on 20 samplings, the dominant erodibility value in Jatinangor is high to very high. The high erodibility will cause higher erosion potential. The high erodibility value is caused by a soil particle that consists of silt domination. The silt and very fine sand are easier to wash away to the weight than sand. While clay has the cohesion that made the structure is more stable. Although the erosion is a natural process, the accelerated erosion due to human activities should be noted. The tropical climate and the rainy season would lead surface erosion. Based on lithological and soil particle, Jatinangor has high erosion potential. The soil conservation needs to be done to prevent flood by the accumulation of the fine-grained on the river.
4. Conclusion
Jatinangor is built by weathered volcanic rock, e.g. Tuff and Breccia. This lithology resulted in fine-grained soil and dominated by silt soil. The rich silt soil would make higher erodibility value and prone to eroded due to rainfall. The soil conservation needed to do as part of a smart city program on the smart environmental program.

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