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The Journal of Research on the Lepidoptera Volume 50 (3): 348-355 The Lepidoptera Research Foundation. September 2019 ISSN 0022-4324 (print) ISSN 2156-5457 (online) 348 Mapping of Soil Infiltration Rate in Krueng Meueh Watershed Aceh Province HALIM AKBAR1*, MULIANA2 AND ULY FARHAH HASNAH DAULAY3 1*Program Study Agroecotechnology, Faculty of Agriculture, University of Malikussaleh.

2Program Study Agroecotechnology, Faculty of Agriculture, University of Malikussaleh. 3Program Study Agroecotechnology, Faculty of Agriculture, University of Malikussaleh. 1*halim@unimal.ac.id Abstract. Infiltration is a very important component in soil conservation. Infiltration is a very important part of the hydrological cycle. The smaller the rate of soil infiltration then the run off rate will be greater and vice versa, because the run off rate is a difference in the rain intensity and the rate of infiltration. The physical state of the soil is one indicator that determines the speed of the soil in rainwater infiltration.

The aim of this research was to know the soil infiltration rate in Krueng Meueh Watershed Aceh Province using infiltrometer method and Horton equation model. The infiltration calculation is done in every unit of land. Double ring infiltrometer that pressed into the soil, and filled with water was used. The decreased of water was observed with interval of five minutes.

The results showed that the highest infiltration rate was 7,572 cm/hour (rather fast) found in SL 10 with 3 – 8% slope (rather sloping), Latosol soil type, shrubhs land cover and the smallest was 1,971 cm/hour (rather slowly) found in SL 12 with 8 – 15% slope, Red-Yellow Podsolic soil type and shrubhs land cover. Keywords. Infiltration Rate, Land Unit, Watershed.

Received: 23 July 2019 Accepted: 25 August 2019 The Journal of Research on the Lepidoptera Volume 50 (3): 348-355 The Lepidoptera Research Foundation. September 2019 ISSN 0022-4324 (print) ISSN 2156-5457 (online) 349 INTRODUCTION Forest with tightly land cover is always associated with positive function to the water in the watershed ecosystem, this is because the forest function to intervened rainwater (Noordwijk et al., 2004).

Forest soil has a thick layer of litter, high content of soil organic matter, and has a high number of macro porosity so that the rate of infiltration is higher compared to other land use (Hairiah et al., 2004). Land use change from vegetation to non vegetated land in watershed lately tends to increase in intensity according to space and time, this is as a consequence of the development activities and the rate of high population growth.

The increased intensity of change over the land function negatively impacts the hydrologi conditions of the watershed. Judging from the hydrologi cycle, the falling rain water will undergo the process of absorption directly by the plant, absorption by the soil (infiltration), flows as a surface flow (run off) and evaporates back by plants and land surfaces (evapotranspirasi) (Effendi, 2003).

Infiltration is the process of entering water into the soil through the soil surface due to the capillary force and gravitational force (Asdak, 2005). Furthermore Arsyad (2010) added that the water entry process into the ground vertically (infiltration) greatly affects the availability of water in the soil. In addition to land cover, soil infiltration rate is also heavily influenced by soil type factors, slope slope and several other factors such as soil texture, soil porosity, C-organic soil, permeability and bulk density.

Delima (2017) added that mixed plantation land cover with a very close density showed water entered into the land of time unity in the Krueng Mane watershed District of North Aceh for 8.202 cm/hour (rather quickly). Furthermore Utaya (2008) of his research results also mentioned that the vegetation factor has a very large role in the process of infiltration, especially in terms of the capability to propagate rainwater falling on the surface of the ground.

Some other factors such as organic material greatly affects the land aggregates and the capability of soil holding water (Abdurachman et al., 2006), Furthermore Suryatmojo (2006) added that the high ground porosity causes the soil to store and pass large quantities of water so that the rainwater falling above the surface of the ground can be rapidly infiltration.

Mapping is a very effective way to know the characteristics of a land, because one of the functions of the mapping is to provide the ease of obtaining data in making a planning a region (Puntodewo et al., 2010). The Krueng Meueh watershed with an area of 12,255.47 hectares is one of the Sub watershed from the Krueng Peusangan watershed which has a dry land agriculture area of 2,538.51 hectares The Journal of Research on the Lepidoptera Volume 50 (3): 348-355 The Lepidoptera Research Foundation.

September 2019 ISSN 0022-4324 (print) ISSN 2156-5457 (online) 350 (20.71%), secondary forest of 4,138.27 hectares (33.77%) and scrub lands 5,578.69 hectares (45.52%) (BPDAS ACEH, 2018). This research aims to determine the level of soil infiltration in the Krueng Meueh watershed in Aceh province. MATERIALS AND METHODS The research was conducted in Krueng Meueh watershed Aceh province which is administrati through North Aceh Regency, Bener Meriah Regency and Bireuen regency. The research was carried out from January to February 2019.

Materials used included soil type maps, topographic maps, earth maps, land use maps of each scale of 1:125,000, rainfall data, and chemicals for laboratory analysis. Equipments used included double ring infiltrometer, Global Positioning System (GPS), water pass, stopwatch, abney level, ring samples and drill ground. This study used a survey method consisting of: 1) preparation phase 2) preliminary surveys, 3) main surveys and 4) data analysis and result presentation.

Calculation of infiltration The calculation of infiltration in this study uses the Horton model. This model recognizes that the infiltration capacity decreases as the time increases until close to the constant value (Horton, 1933). Model Horton may be stated mathematically following the following equation: f = fc + (f0 – fc) .

e – kt Description: f = Real rate of infiltration (cm/hour) f0 = early infiltration rate (cm/ hour) fc = Fixed infiltration rate (cm/ hour) k = Constanta t = time (hour) e = Natural number (2,718) RESULTS AND DISCUSSION Land Use Land use in Krueng Meueh watershed is currently consists of a scrub lands area of 5,578.69 hectares (45.52%), secondary forest area of 4,138.27 hectares (33.77%) and dry land agriculture area of 2,538.51 hectares (20.71%) (BPDAS Aceh Province, 2018) (Table 1). The Journal of Research on the Lepidoptera Volume 50 (3): 348-355 The Lepidoptera Research Foundation.

September 2019 ISSN 0022-4324 (print) ISSN 2156-5457 (online) 351 Table 1. Land use in Krueng Meueh Watershed No Types of Land Use Area Ha % 1 Scrub lands 5.578.69 45.52 2 Dry Land Agriculture 2.538.51 20.71 3 Secondary Forest 4.138.27 33.77 Total 12.255.47 100 Infiltration rate The results showed that the infiltration rate would

decrease in line with increasing time.

At the beginning of infiltration, water will penetrate into the soil to fill the soil moisture deficiency. When the ground water level has reached a large capacity, the excess water will flow down ward into the ground water reserve. The results of infiltration rate measurement at Krueng Meueh watershed can be seen in Table 2. Table 2.

Rate of infiltration the Krueng Meueh Watershed in Bireuen district SL Slope (%) Soil type Land cover Infiltration rate (cm/hour) Value Criteria *** 1 0 3 Aluvial Scrub lands 7004 agak cepat 2 3 8 PC Scrub lands 5406 sedang 3 8 15 Mediteran Secondary Forest 7104 agak cepat 4 3 8 Mediteran Secondary Forest 7116 agak cepat 5 3 8 Mediteran Scrub lands 4378 sedang 6 8 15 Mediteran Scrub lands 2483 sedang 7 3 8 Mediteran Dry Land Agriculture 6544 agak cepat 8 8 15 Mediteran Dry Land Agriculture 5187 sedang 9 3 8 Latosol Secondary Forest 7127 agak cepat 10 3 8 Latosol Scrub lands 7572 agak cepat 11 8 15 Latosol Dry Land Agriculture 7413 agak cepat 12 8 15 PMK Scrub lands 1712 agak lambat 13 3 8 PMK Scrub lands 6297 sedang 14 3 8 Latosol Dry Land Agriculture 6841 agak cepat 15 3 8 Aluvial Scrub lands 2,94 sedang 16 0 3 Aluvial Dry Land Agriculture 7107 agak cepat 17 3 8 Aluvial Dry Land Agriculture 2656 sedang Description: PC = Podsolik Coklat; PMK = Podsolik yellow red ***) Klasifikasi menurut Uhland and O'Neal (1951) The Journal of Research on the Lepidoptera Volume 50 (3): 348-355 The Lepidoptera Research Foundation.

September 2019 ISSN 0022-4324 (print) ISSN 2156-5457 (online) 352 The results of the soil infiltration rate measurement in each land unit (SL) is 1.971-7.572 cm/hour (rather slow - rather fast). The highest infiltration rate is found in SL 10 (slope of 3-8%, Latosol soil type, shrub land cover) of 7.572 cm/hour (rather fast), and the lowest infiltration rate found in SL 12 (slope 8- 15%, podsolik yellow red soil type, scrub land cover) is 1.712 cm/hour (rather slow).

Hardjowigeno (2010) to mentions that the differences in each type of soil cause soil characteristics are also different, it is seen in the Latosol soil that has better soil physical properties. Furthermore Purnama (2004) stated that the difference in soil type, relatively more influential to the rate of infiltration compared with land use differences.

The Latosol soil has a variable soil texture (loam - clay), the difference between the horizon is not firmly, granular soil structure, crumbs to the blocky, the consistency of soil (moist) is a loose, good drainage, and permeability high aggregate stability, low erosion sensitivity. While the PMK soil has the characteristics of easy to wash soil, the top layer is light gray to yellowish, red undercoat or yellow, there is accumulated clay to a relatively heavy texture, blocky structure, low permeability, low aggregate stability, low organic

matter, low base saturation, low pH 4.2-4.8 (Hardjowigeno, 2010).

Podsolik yellow red soil has a sensitive nature of erosion, low percolation and infiltration, low soil pH, high content, low organic matter content and nutrient availability for low crops (Harjoso and Purwantono, 2002). The results of the measurement of the rate of infiltration and analysis of some of the soil parameters on SL 10 (slope slope 3-8%, Latosol soil type and scrub land cover) showed that the texture of the clay, bulk density 1.17 gr/cm3, porosity 55%, permeability 1.27 cm/hour, water content of 5.15% and organic material 3.20%.

These results indicate that the properties of these soils greatly affect the rate of infiltration, so that at SL 10 the infiltration rate is higher than that of other SL. This is due to the high content of soil organic matter that can trigger soil micro organism activity in soil grazing and the manufacture of soil pores (Kusumawardani, 2010).

Organic material is very influential to the ability of the soil to pass water, the higher the content of organic matter in the soil, then the structure of soil is increasingly crumb, so that the land is easier to pass water (Hanafiah, 2009). Land cover of the shrub land also undergo a process of weathering relatively fast although the source of organic material is not much because the environment is quite conducive to microbial activity of the wave (Yulnafatmawita et al., 2009).

The results of the rate of infiltration and analysis of some of the soil parameters on SL 12 (slope slope 8 - 15%, soil type Podsolik yellow red and shrub land cover) has a clay texture, bulk density 1.23 gr/cm3, porosity 52.69%, Permeability 1.21 cm/hour, water content 2.10% and organic material 1.00%. These results indicate that the properties of the soil affect the low rate of infiltration. Clay texture causes the soil difficult to escape water.

The soil texture differences in SL 10 (loam) and on SL 12 (clay) cause The Journal of Research on the Lepidoptera Volume 50 (3): 348-355 The Lepidoptera Research Foundation. September 2019 ISSN 0022-4324 (print) ISSN 2156-5457 (online) 353 the texture of the clay to provide greater infiltration capacity than the clay texture, this is due to the percentage of soil pores on clay soil is more dominated by macro pores (Asdak, 2005).

Organic matter is one of the factors affecting the infiltration rate. Organic material that has undergone weathering has the ability to absorb and withstand high water. Organic materials can also absorb water by two to three times the weight.

The higher the content of organic matter on the soil, hence the crumb structure of the land so it is easier to pass the water. Organic matter is also closely related to vegetation covering the soil. The function of quality vegetation can reflect the ability of the soil in the absorption of rain air, maintaining or increasing the rate of infiltration and the products in the air-holding (Widiarto, 2008).

The role of vegetation that is on the surface of the soil is to inhibit the flow of water at the surface so that the chance of infiltration becomes greater, and from the system of its soil will also condend the structure of land so more vegetation above level, the infiltration rate tends to be higher (Nurmegawati, 2011). Fig. 1. Map Soil Infiltration Rate at DAS Krueng Meueh The Journal of Research on the Lepidoptera Volume 50 (3): 348-355 The Lepidoptera Research Foundation.

September 2019 ISSN 0022-4324 (print) ISSN 2156-5457 (online) 354 CONCLUSIONS The highest infiltration rate of 7.572 cm/h (rather quickly) is at SPL 10 with a slope of 3 – 8% (slightly sloping), the Latosol soil type, scrub land cover, and the lowest infiltration rate of 1.971 cm/h (slightly slow) is available at SPL 12 with Slope of 8 – 15% (ramps) soil type of red yellow Podsolik (PMK), land cover of the shrub.

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