CERUCUK
Volume 8 No. 4 2024 (173-180)

Evaluation of Infiltrated Water Volume in the Liang Anggang Protected Forest Block 1

M. Aulia Ramadhani, Novitasari Novitasari
Lambung Mangkurat Univercity Civil Engineering Study Program
Jl. Jenderal Achmad Yani Km. 35,5 Banjarbaru, South Kalimantan - 70714
Email: mauliaramadhani010@gmail.com, novitasari@ulm.ac.id

ABSTRACT

The Liang Anggang Protection Forest is an area formed from peat soil. Peat soils have a role to play in conserving water resources, reducing flooding, preventing seawater seepage, and so on. Damage to the water system in peat soils is often caused by individual activities that are not well controlled. This is thought to have resulted in the depletion of water in peat soils, causing the soil to become dry and flammable in the dry season. The purpose of this research is to examine the rate of water infiltration in Liang Anggang Protected Forest Block 1. In this study, the method used in analyzing the infiltration rate was the Horton method by measuring the infiltration rate using a double-ring infiltrometer (turf-tec infiltrometer). According to the study's findings, the average decrease in infiltration rate of test 1 on bare or low-density land is 12.4 cm/hour, medium-density land is 2.7 cm/hour, very dense, closed, or forested land is 3.6 cm/hour, and test 2 on barren land is 2.4 cm/hour, medium density land is 2.7 cm/hour, and very dense, closed, or forested land is 4.7 cm/hour.

Keywords: *Double ring infiltrometer, Infiltration Rate, Horton Method, Liang Anggang Protection Forest*

1. INTRODUCTION

The Liang Anggang Protection Forest is an area formed from peat soil. Peat land is a type of soil that has a high water content (Amal et al., 2021). Peat soils have a role to play in conserving water resources, reducing flooding, preventing seepage of seawater, and so on. Damage to the water system in peat soils is often caused by individual activities that are not well controlled. This is thought to have resulted in the depletion of water in peat soils, causing the soil to become dry and flammable in the dry season. Forest and peatland fires occurred in Indonesia, including in the Liang Anggang Protection Forest. The forest and land fires that occurred in the Liang Anggang Protection Forest were caused by the existing conditions of the area, most of which are flammable peatlands. Peatland fires, especially in tropical ecosystems, are often caused by drought (Novitasari et al., 2019) and also a decrease in the groundwater level of peatlands (Fitriati, 2018). Infiltration is the process by which water enters the soil through the soil surface. Infiltration is a source of soil moisture that provides water for plant needs. There are

various things that affect the magnitude of the infiltration rate, among them the type of soil surface, how to cultivate the land, the density of the soil, and the nature and types of plants. In addition, changes in land use can lead to a reduction in the water catchment area, thereby reducing the infiltration of water (Bangun & Helda, 2022). This study aims to determine the rate of infiltrated water that occurs by measuring infiltration in the Liang Anggang Block 1 Protected Forest area.

2. THEORETICAL STUDY

Infiltration Rate

Water infiltration rate measures the volume of water that enters the soil crevices and flows beneath the soil surface during ongoing rain, which is expressed in units of mm/hour or cm/hour. The infiltration rate varies from the soil, which is still dry, so the value of the infiltration rate is at a high point until it decreases to a constant point due to water saturation (Arsyad, 2010). Time measured from the beginning of the rain (hours)Infiltration rate classification according to the United States Soil Conservation Service with units (mm/hour) for very slow classification 1, slow between 1-5, rather slow between 5-20, the medium between 20-63, fast between 63-127, fast between 127-254, and very fast > 254 (Ramadani, 2018).

Infiltration Capacity

Infiltration capacity is the strength of the soil in the process of water infiltration under certain conditions (Arsyad, 2010). Maximum infiltration rate is another term used for infiltration capacity. Several things can affect infiltration capacity, namely high water content on the soil surface, soil type, moisture in the soil, soil surface conditions, and ground cover (Ramadani, 2018).

Horton's Method

According to Horton, as the running time increases, the infiltration capacity decreases until it approaches a constant value. He also expressed the opinion that causes on the surface rather than those underground would have a greater influence on the decline in infiltration capability. Then, several factors that have an influence on reducing infiltration rates include land cover, closed soil cracks due to soil colloids and the

formation of a soil crust, destruction of the land surface layer, and the removal of fine particles on the surface caused by rainwater (Aidatul F., 2015). The Horton model can be expressed mathematically by following the following equation (Arsyad, 2010).

$$f = f_c + (f_o - f_c)\, e^{-kt} \quad (2.1)$$

Description:

f : Infiltration capacity or maximum infiltration rate (cm/hour)

f_o : At the start of the infiltration process, infiltration capability (cm/hour)

f_c : Infiltration capacity constant (as t approaches infinity) (cm/hour)

e : 2.71828 (base of the Naperian logarithm)

k : Constant for soil type

t : Time measured from the beginning of the rain (hours)

3. METHOD

The steps involved in this research include: (1) preparation and study of related literature; (2) conducting surveys at research sites; (3) determining infiltration test points; (4) conducting infiltration tests at predetermined points using a double-ring infiltrometer; and (5) Using the Horton approach, calculate the infiltration rate equation.

4. RESULT AND DISCUSSION

Research sites

The research was conducted at the location of Liang Anggang Protected Forest Block 1, Gambut District, Banjar Regency, and Liang Anggang District, Banjarbaru City, South Kalimantan. Based on the Public Works and Spatial Planning Office of Banjarbaru City, the Liang Anggang Block 1 Protected Forest area covers 948.59 ha, as shown in Figure 1.

Figure 1 Protected forest area according to Public Works and Spatial Planning Office of Banjarbaru City
Source: Public Works and Spatial Planning Office of Banjarbaru City

Results of Horton Method Infiltration Rate Analysis

There were three runs of the infiltration test: on August 7th, September 17th, and October 29th, 2022. Three tests were performed while keeping the limitations of tool calibration in mind so that only good enough data would be used later. The experiments were conducted on three types of land: bare land, medium-density land, and very dense (covered or forested) land. Analysis of a measure of the Horton method's infiltration rate was only carried out on the data from tests 1 and 2. In the data from test 3 at GHL 1-1, there was no data from the infiltration test results because, during the test, the land conditions were waterlogged. Whereas at point GHL 2-1, there was no data on the results of the infiltration test because, during the test, there was no decrease in infiltration on the infiltrometer (double ring infiltrometer). The results of the analysis of the infiltration rate of the Horton method for tests 1 and 2 are shown in Table 1.

Table 1 Outcomes of the Horton Method of Infiltration Rate Analysis on Several Lands

Point Name	Testing 1		Testing 2		Land Conditions
	f (cm/hour)	Classification	f (cm/hour)	Classification	
GHL1-1	3,665	Medium	4,865	Medium	Very tight/closed/jungle
GHL2-1	27,978	Very Fast	10,865	Rather Fast	Bare density
GHL2-2	3,665	Medium	3,665	Medium	Medium density
GHL2-3	27,665	Very Fast	21,670	Fast	Very tight/closed/jungle
GHL3-1	4,865	Medium	2,683	Medium	Bare density
GHL3-2	7,331	Rather Fast	7,265	Rather Fast	Very tight/closed/jungle

From the results of the Horton method infiltration rate analysis presented in Table 2, it can be concluded that at each test point, there is no significant difference between Test 1 and Test 2 in terms of infiltration rate classification. However, there is a difference between test 1 and test 2 at the GHL2-1 point, where the density of barren land with very fast classification becomes rather fast, and the GHL2-3 point of very dense, closed, or forested land with very fast classification becomes fast.

Horton Method Infiltration Rate Curve

Infiltration rate curves for the Horton method of testing one and testing two on several fields can be seen in Figures 2 to 7.

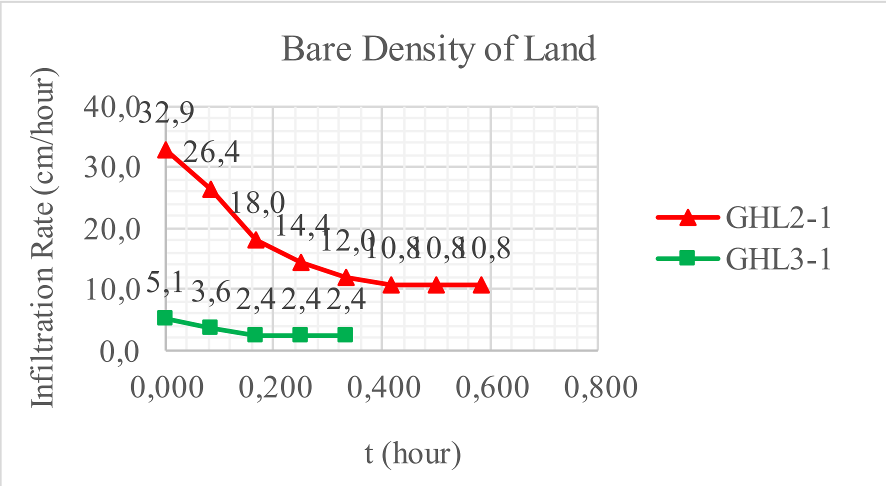

Figure 2 Curve of Infiltration Rate for Test 1 on Bare Density Land

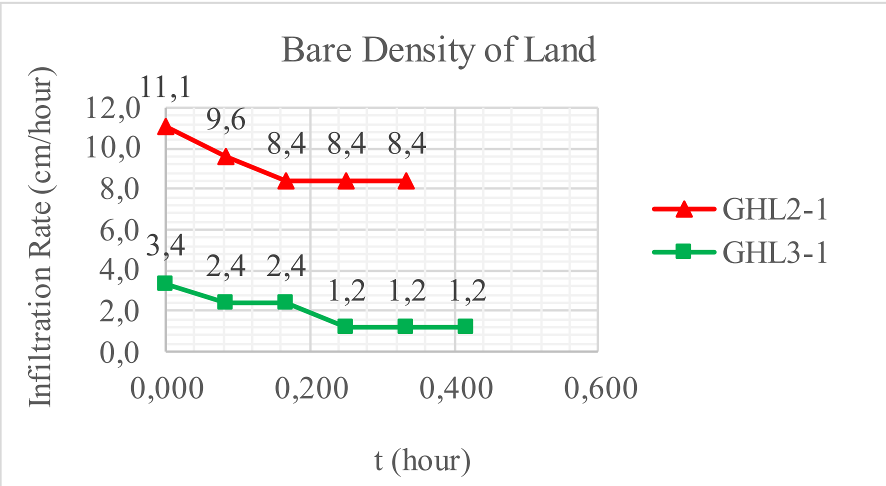

Figure 3 Curve of Infiltration Rate for Test 2 on Bare Density Land

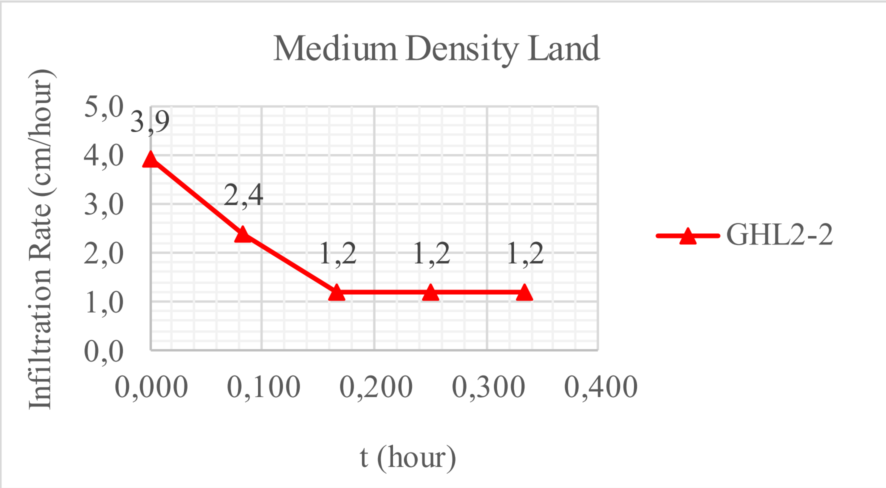

Figure 4 Curve of Infiltration Rate for Test 1 on Medium-Density Land

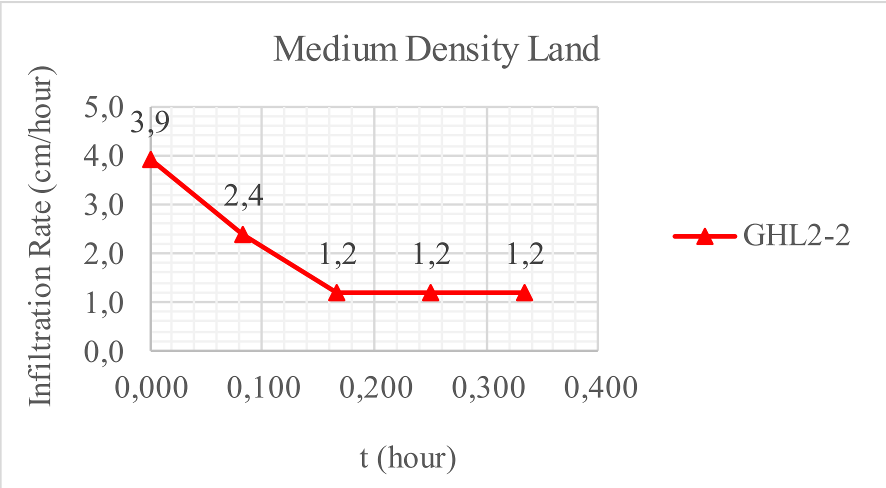

Figure 5 Curve of Infiltration Rate for Test 2 on Medium-Density Land

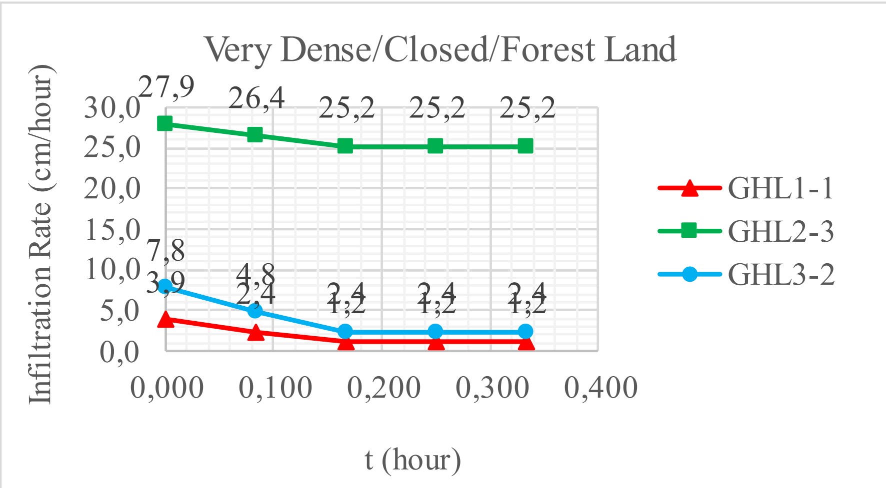

Figure 6 Curve of Infiltration Rate for Test 1 on Very Dense/Closed/Forest Land

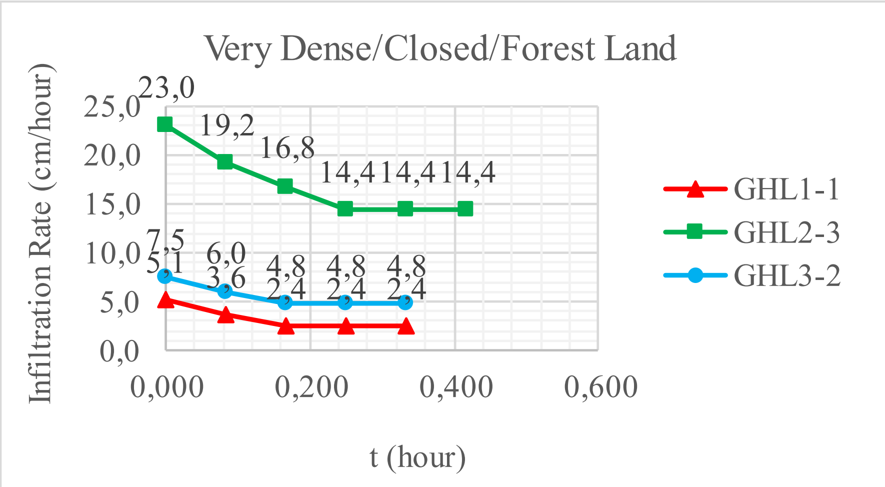

Figure 7 Curve of Infiltration Rate for Test 2 on Very Dense/Closed/Forest Land

From Figure 2 to Figure 7, it can be concluded that the average decrease in the infiltration rate of test 1 on bare, low-density land is 12.4 cm/hour, medium-density land is 2.7 cm/hour, very dense, closed, or forested land is 3.6 cm/hour, and test 2 on bare, low-density land is 2.4 cm/hour, medium density is 2.7 cm/hour, and very dense, closed, or forested land is 4.7 cm/hour.

5. CONCLUSION

According to the study's findings, the average decrease in infiltration rate of test 1 on bare or low-density land is 12.4 cm/hour, medium-density land is 2.7 cm/hour, very dense, closed, or forested land is 3.6 cm/hour, and test 2 on bare land is 2.4 cm/hour, medium density land is 2.7 cm/hour, and very dense, closed, or forested land is 4.7 cm/hour.

REFERENCES

Aidatul F., N. (2015). *Pemetaan Laju Infiltrasi Menggunakan Metode Horton di Sub Das Tenggarang Kabupaten Bondowoso*. Skripsi, Universitas Jember.

Amal, N., Sujono, J., Jayadi, R., & Ohgushi, K. (2021). Variability of Water Table Elevation and Flow Response of Tropical Peatland Case Study at Pulang Padang, Riau, Indonesia. *Lowland Technology International*, *22*(4), 135–141. https://cot.unhas.ac.id/journals/index.php/ialt_lti/article/view/674

Arsyad, S. (2010). Konservasi Tanah & Air. In *Institut Pertanian Bogor*. IPB PRESS.

Bangun, J. B. B., & Helda, N. (2022). Penerapan Metode Horton dalam Studi Laju dan

Kapasitas Infiltrasi di Lahan Kampus Universitas Lambung Mangkurat Banjarbaru. *Jurnal Rivet, 02*(01), 1–11. https://doi.org/10.47233/rivet.v2i01.467

Fitriati, U. (2018). Karakteristik Hidrologi untuk Perencanaan Kolam Konservasi di Lahan Gambut Kecamatan Liang Anggang. *Buletin Profesi Insinyur, 1*(1), 9–12. https://doi.org/https://doi.org/10.20527/bpi.v1i1.3

Novitasari, N., Sujono, J., Harto, S., Maas, A., & Jayadi, R. (2019). Drought Index for Peatland Wildfire Management in Central Kalimantan, Indonesia During El Ni ˜no Phenomenon. *Journal of Disaster Research, 14*(7), 939–948. https://doi.org/10.20965/jdr.2019.p0939

Ramadani, P. L. (2018). *Analisis Penentuan Dan Pengukuran Laju Infiltrasi Menggunakan Model Green-Ampt Desa Tulungrejo Kecamatan Bumiaji Kota Batu*. Skripsi, Universitas Brawijaya.