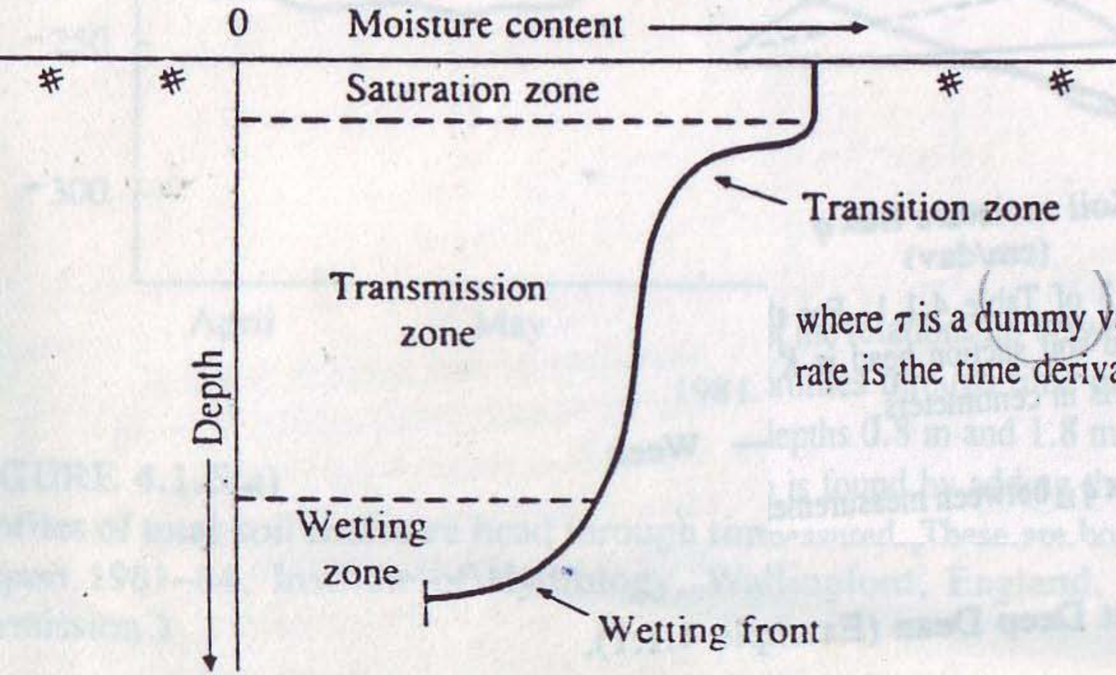
INFILTRASI

Konsep Infiltrasi

$$F(t) = \int_0^t f(\tau)\, d\tau \qquad (4.2.1)$$



where τ is a dummy variable of time in the integration. Conversely, the in
rate is the time derivative of the cumulative infiltration:

$$f(t) = \frac{dF(t)}{dt}$$

FIGURE 4.2.1
Moisture zones during infiltration.

Horton's Equation

One of the earliest infiltration equations was developed by Horton (1933 who observed that infiltration begins at some rate f_0 and exponentially d until it reaches a constant rate f_c (Fig. 4.2.2):

$$f(t) = f_c + (f_0 - f_c)e^{-kt}$$

where k is a decay constant having dimensions [T^{-1}]. Eagleson (19 Raudkivi (1979) have shown that Horton's equation can be derived from R equation (4.1.12) by assuming that K and D are constants independen moisture content of the soil. Under these conditions (4.1.12) reduces to

$$\frac{\partial \theta}{\partial t} = D \frac{\partial^2 \theta}{\partial z^2}$$

which is the standard form of a diffusion equation and may be solved the moisture content θ as a function of time and depth. Horton's equatior from solving for the rate of moisture diffusion $D(\partial\theta/\partial z)$ at the soil surfa

Atau

)

Penyelesaian Metoda Horton

- Data di ambil dari hasil pengamatan lapangan
- Alat yang digunalan Double Infiltrometer

atau

$$f(t) = fc + (fo - fc)e^{-kt}$$

$$f(t) - fc = (fo - fc)e^{-kt}$$

$$\frac{f(t) - fc}{fo - fc} = e^{-kt}$$

$$\ln(e^{-kt}) = \ln\left(\frac{f(t) - fc}{fo - fc}\right)$$

$$-kt = \ln\left(\frac{f(t) - fc}{fo - fc}\right)$$

$$k = -\frac{\ln\left(\frac{f(t) - fc}{fo - fc}\right)}{t}$$

$$f(t) = fc + (fo - fc)e^{-kt}$$

$$f(t) - fc = (fo - fc)e^{-kt}$$

$$\ln(f(t) - fc) = ln\,(fo - fc) + \ln\,(e^{-kt}$$

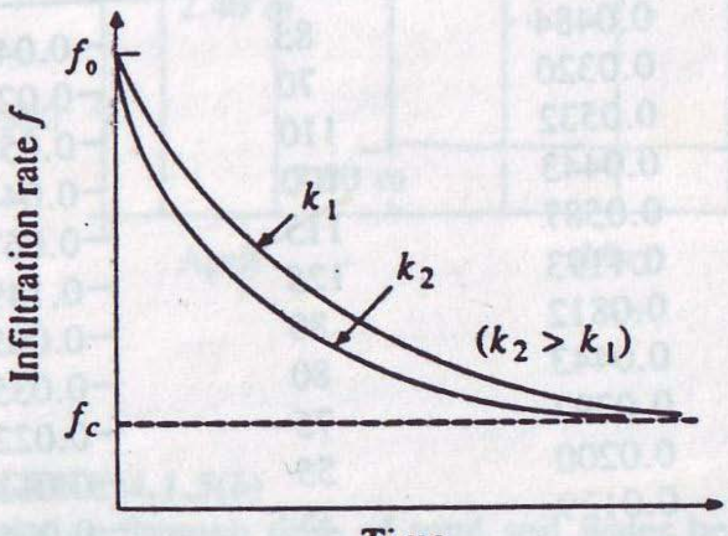
$$\ln(f(t) - fc) - ln\,(fo - fc) = -kt.lne$$

$$-kt = \ln(f(t) - fc) - ln\,(fo - fc)$$

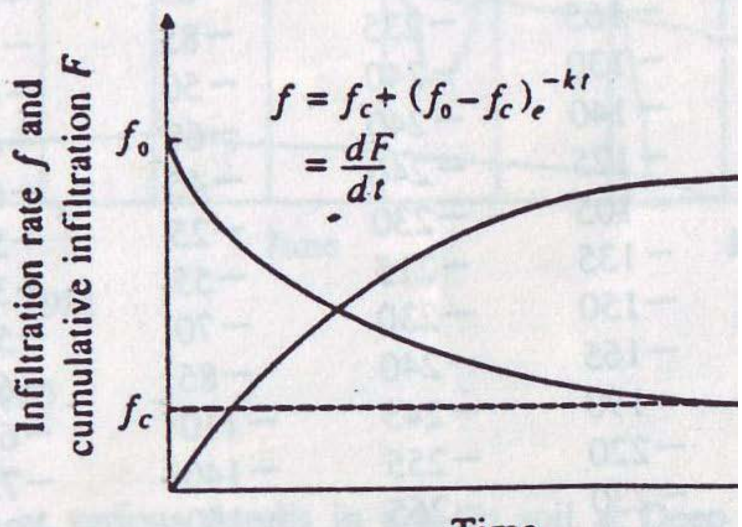
$$k = \frac{ln\,(fo - fc) - \ln(f(t) - fc)}{t}$$

Phillip's Equation

Philip (1957, 1969) solved Richard's equation under less restrictive co[…]
by assuming that K and D can vary with the mositure content θ. Philip e[…]
the Boltzmann transformation $B(\theta) = zt^{-1/2}$ to convert (4.1.12) into an […]
differential equation in B, and solved this equation to yield an infinite se[…]



(a) Variation of the parameter k.



(b) Infiltration rate and cumulative infi[…]

FIGURE 4.2.2
Infiltration by Horton's equation.

lative infiltration $F(t)$, which is approximated by

$$F(t) = St^{1/2} + Kt \tag{4.2.5}$$

e S is a parameter called *sorptivity*, which is a function of the soil suction tial, and K is the hydraulic conductivity.

By differentiation

$$f(t) = \frac{1}{2}St^{-1/2} + K \tag{4.2.6}$$

$\rightarrow \infty$, $f(t)$ tends to K. The two terms in Philip's equation represent the effects il suction head and gravity head, respectively. For a horizontal column of soil suction is the only force drawing water into the column, and Philip's ion reduces to $F(t) = St^{1/2}$.

Example 4.2.1. A small tube with a cross-sectional area of 40 cm^2 is filled with soil and laid horizontally. The open end of the tube is saturated, and after 15 minutes, 100 cm^3 of water have infiltrated into the tube. If the saturated hydraulic conductivity of the soil is 0.4 cm/h, determine how much infiltration would have taken place in 30 minutes if the soil column had initially been placed upright with its upper surface saturated.

Solution. The cumulative infiltration depth in the horizontal column is $F = 100\ cm^3/40\ cm^2 = 2.5$ cm. For horizontal infiltration, cumulative infiltration is a function of soil suction alone so that after $t = 15$ min $= 0.25$ h,

$$F(t) = St^{1/2}$$

and

$$2.5 = S(0.25)^{1/2}$$

$$S = 5\ cm \cdot h^{-1/2}$$

For infiltration down a vertical column, (4.2.5) applies with $K = 0.4$ cm/h. Hence, with $t = 30$ min $= 0.5$ h

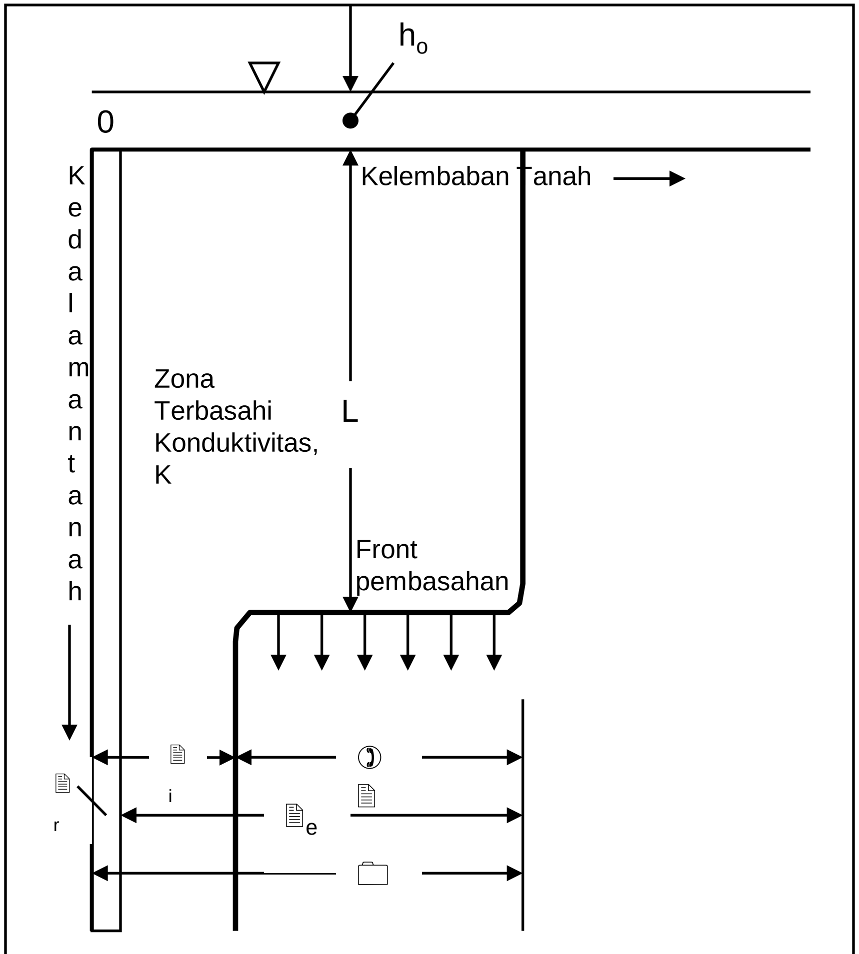
$$F(t) = St^{1/2} + Kt$$

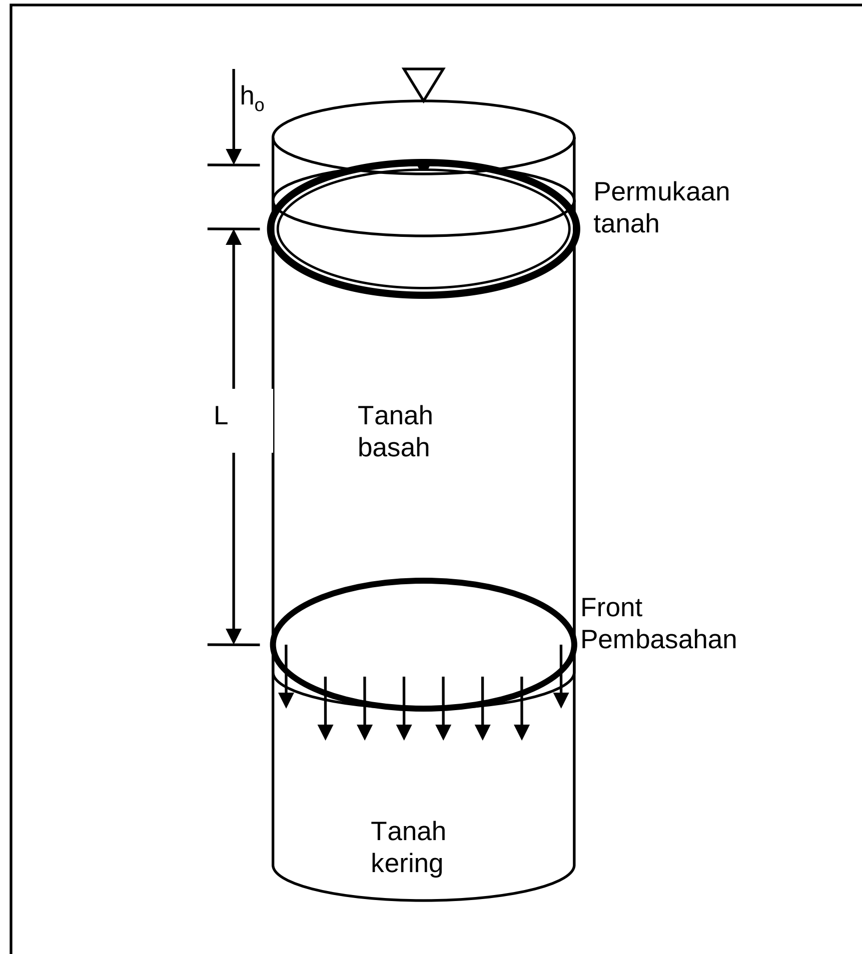
$$= 5(0.5)^{1/2} + 0.4(0.5)$$

$$= 3.74\ cm$$

Double Infiltrometer untuk Pengukuran Infiltrasi

Teori Fisik :
Metode Infiltrasi Green-AMpt





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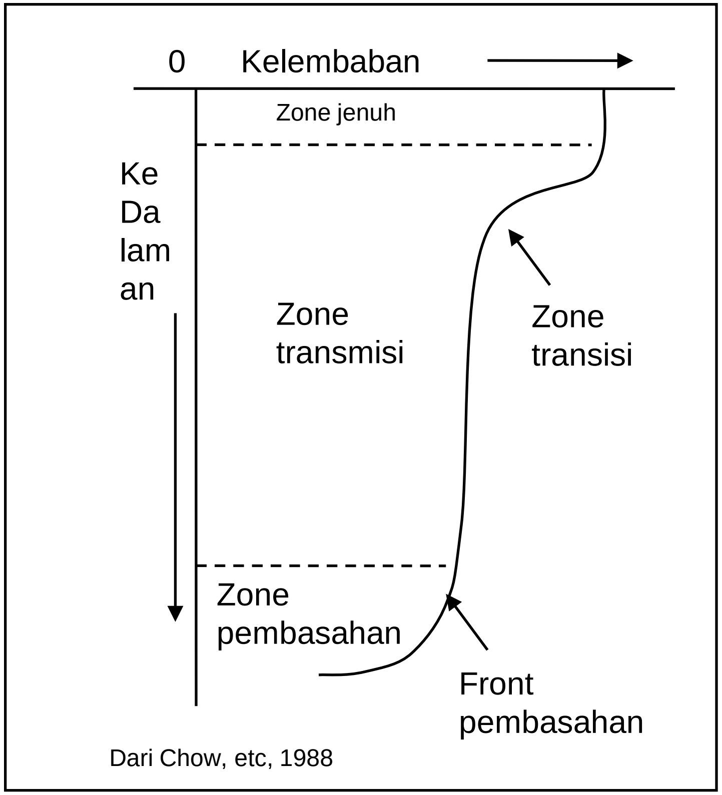
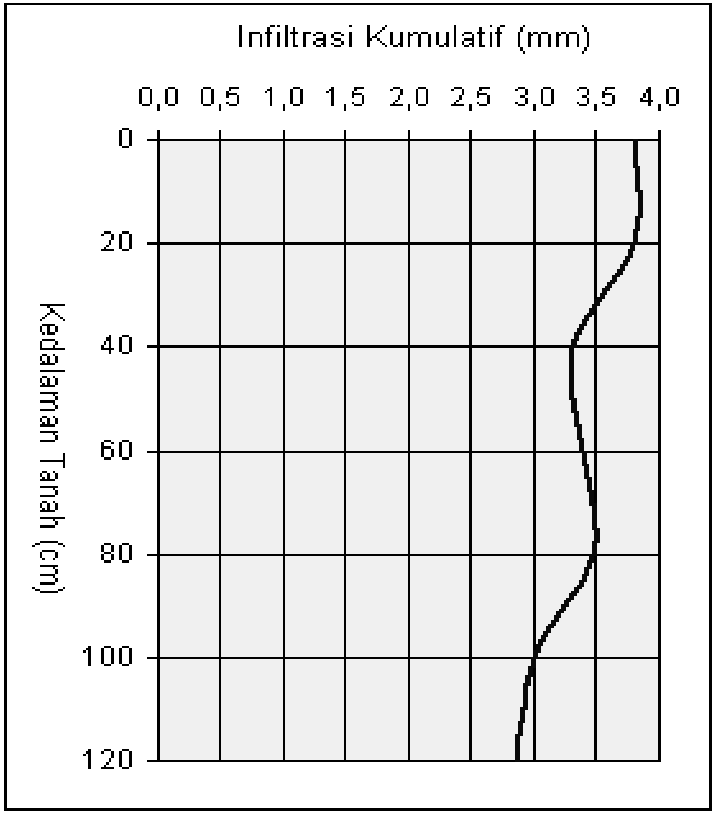
Tinjau_Pustaka

Zonasi Kelembaban Tanah Menurut Kedalaman Tanah



Teoritik

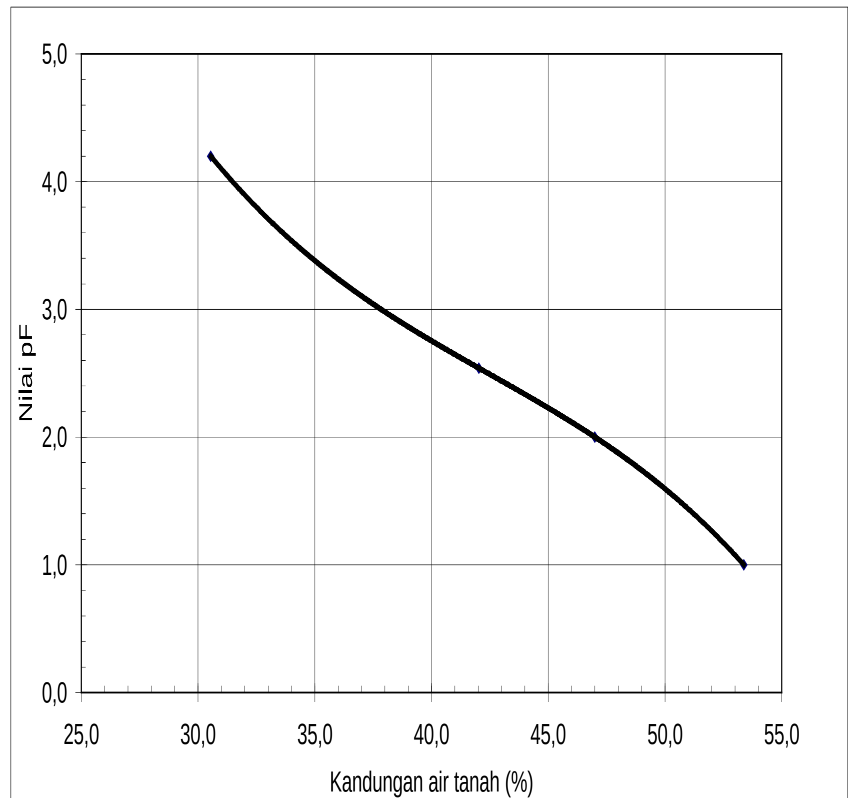


Empirik

Pendugaan Suction Head *(☼) Berdasarkan Kelembaban Tanah*

- pF = log (-Ψ), atau
- pF = 29,30 – 1,684 θ + 0,0371 θ^2 – 0,00029 θ^3
- Ψ = -(10^{pF})
- θ = kelembaban tanah (%)

$$\psi = -(10)^{29,30 - 1,684\theta + 0,0371\theta^2 - 0,00029\theta^3}$$



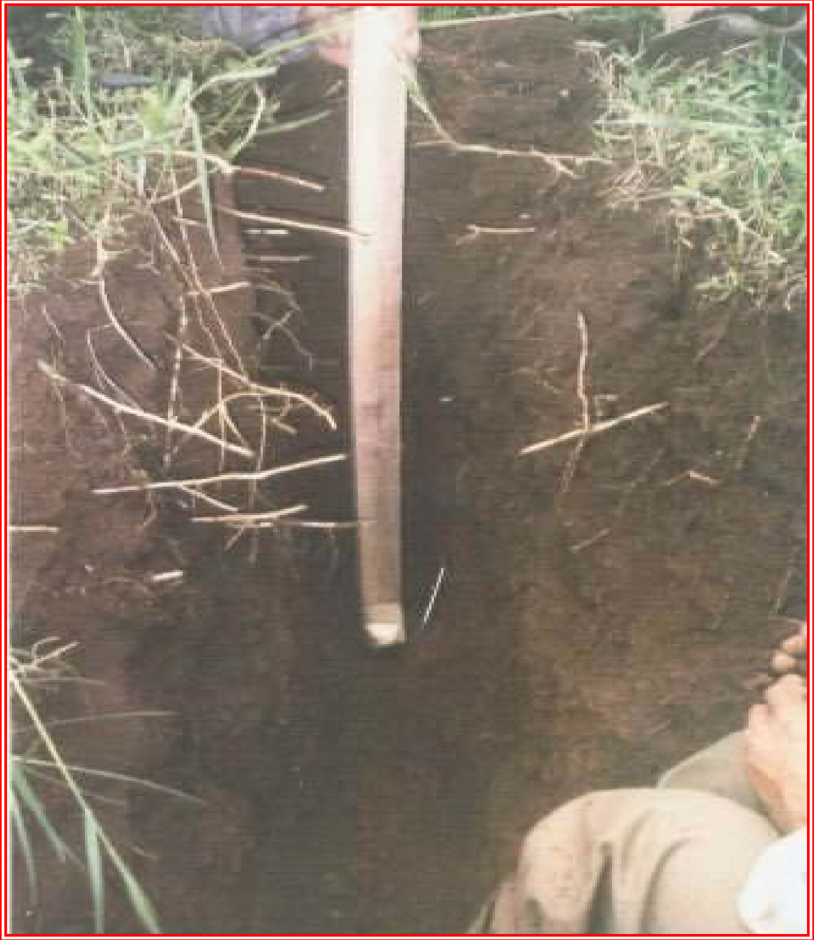
Pendugaan Nilai Permeabilitas (K) Berdasarkan Sifat Fisik Tanah

$$\ln K = -2{,}391 - 0{,}090.\theta + 0{,}161.\eta_c + 0{,}845.\eta_l$$

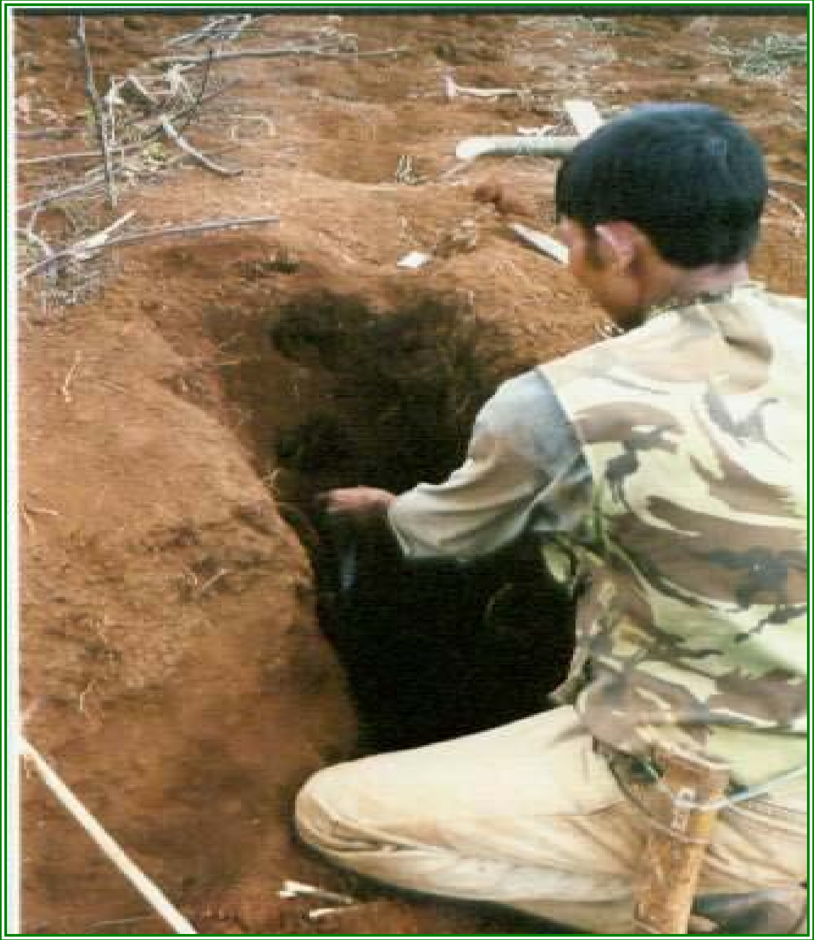
$$K = e^{-2{,}391 - 0{,}090.\theta + 0{,}161.\eta_c + 0{,}845.\eta_l}$$

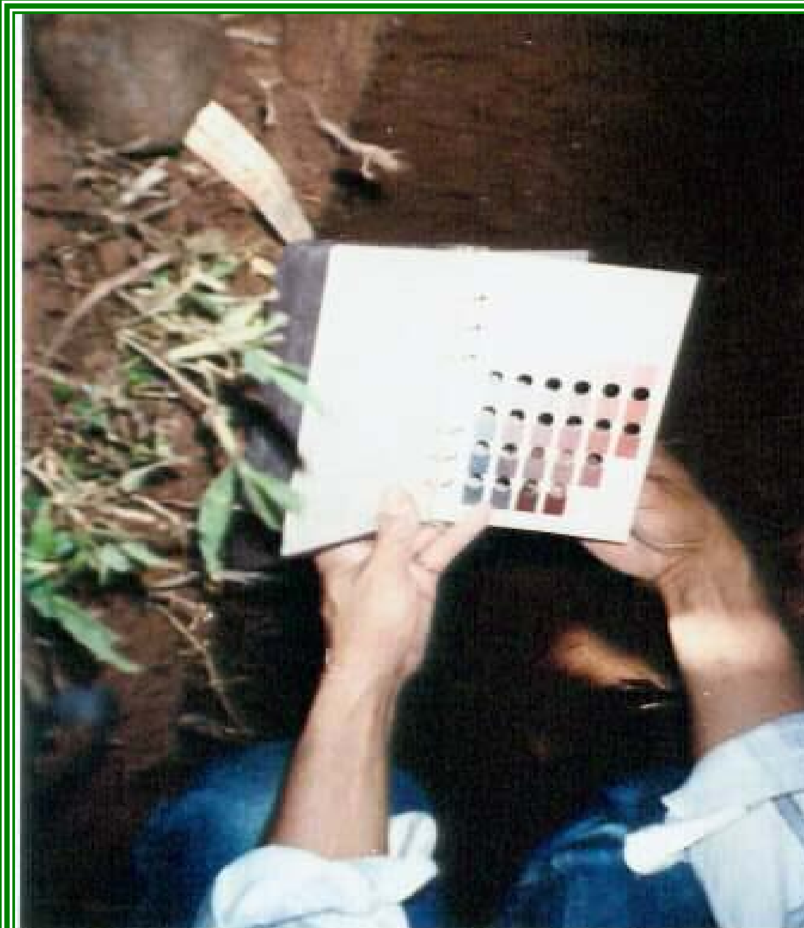
- θ =
- η_c = kandungan pori drainase cepat (%)
- η_l = kandungan pori dainase lambat (%)

Pengambilan Sampel Tidak Terganggu untuk Uji Sifat Fisik Tanah



Pengambilan Sampel Tanah Terganggu dan Deskripsi Sifat Tanah di Lapangan





Sampel Tanah untuk Uji Sifat Fisik dan Pengangkutan Sampel ke Lab. Puslittanak Bogor

Analisis Kelembaban Tanah di Lab. BLKKP Lembang

Tanah yang Siap Oven dan Dua Alat Oven yang Digunakan

Hubungan F(t) = f (R(t)) Empirik

- Formula Umum :

$$F(t)_{Cr} = 10^{K_{Cr}} - 1$$

$F(t)_{Cr}$= infiltrasi kumulatif empirik (mm)
K_{Cr} = pola hubungan F(t) dengan R(t)
Cr = palawija (W); agroforestri (A); tidak digarap (N); kayu campuran (N); dan pemukiman (P)

- K_{Cr} adalah :

K_W = -0,0005.(R(t)^2 + 0,045.R(t) + 0,37

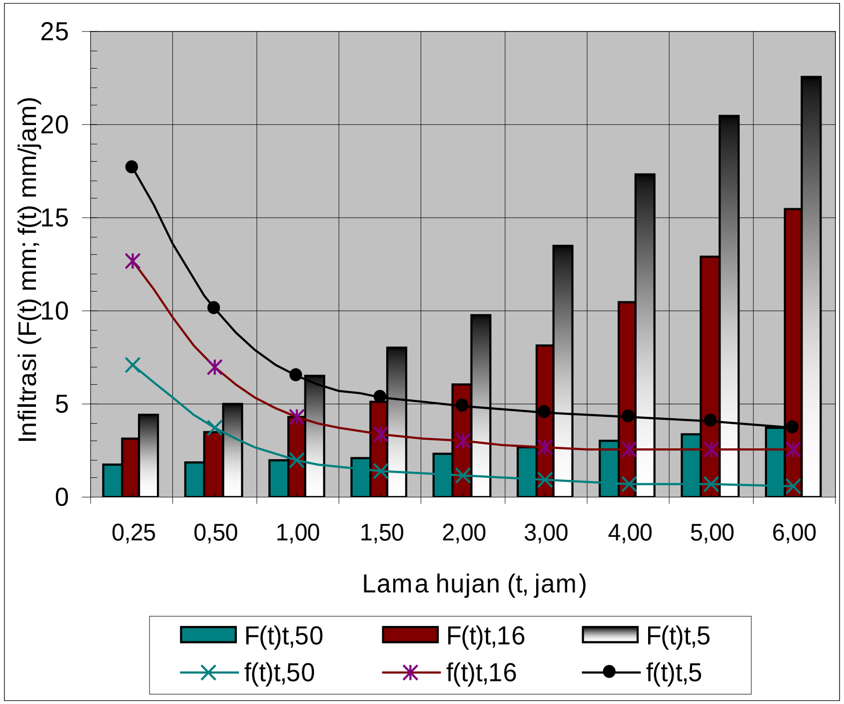
K_A = $-0{,}0005(R(t))^2 + 0{,}045.R(t) + 0{,}40$

K_N = $-0{,}0004(R(t))^2 + 0{,}039.R(t) + 0{,}38$

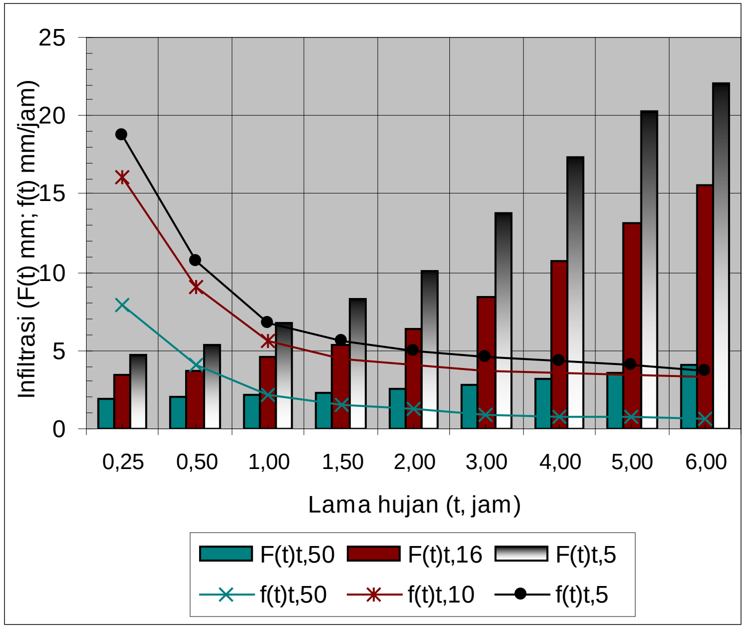
K_H = $-0{,}0006(R(t))^2 + 0{,}050.R(t) + 0{,}33$

K_P = $-0{,}0004(R(t))^2 + 0{,}040.R(t) + 0{,}42$

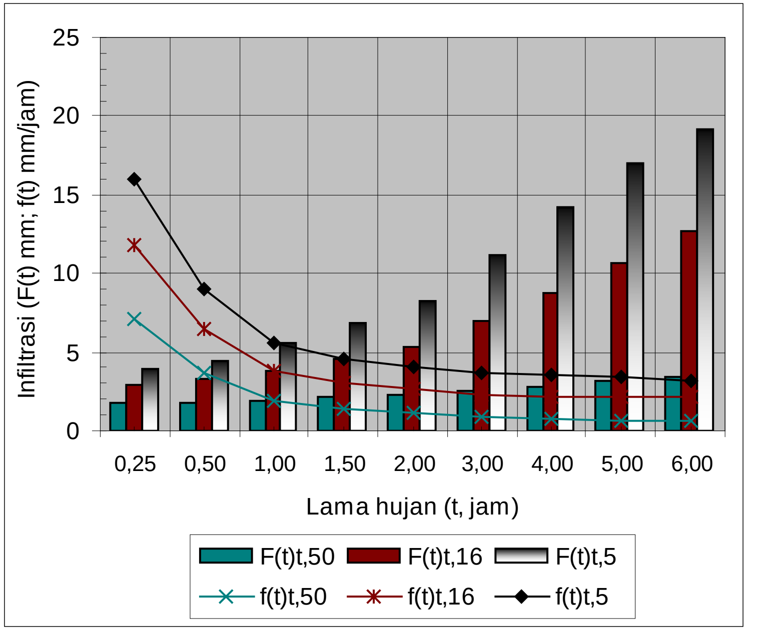
Lahan Palawija



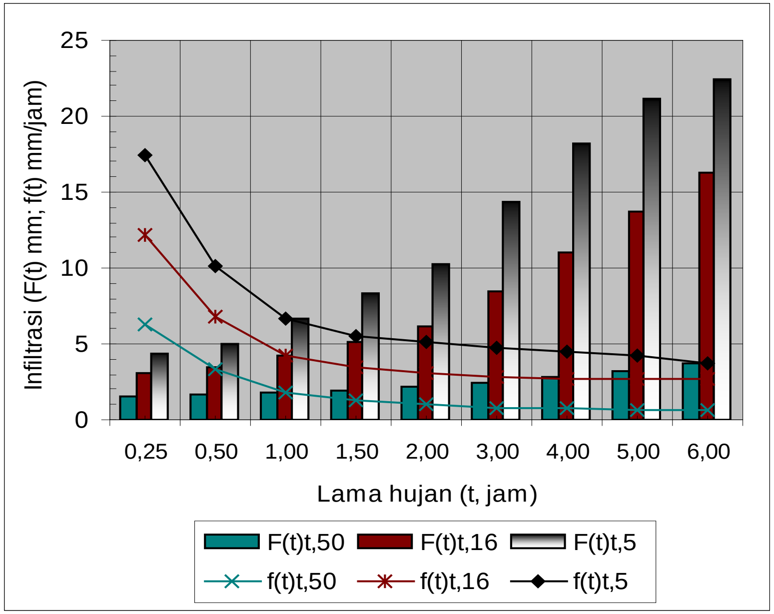
Lahan Agroforestri



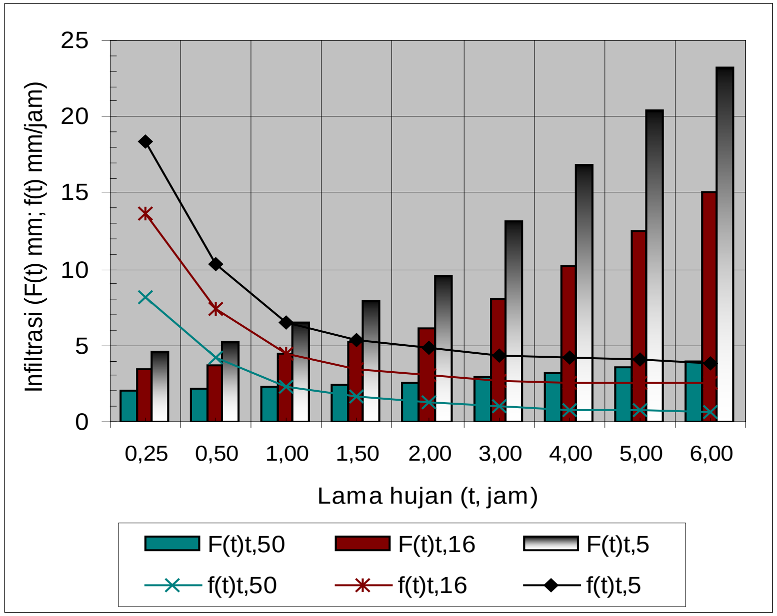
Lahan Tidak Digarap



Lahan Kayu Campuran



Lahan Permukiman



Data angka…   Lingkup…

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