

Potential for Land and Lengan Available to Water Needs on the Clove Land in Ternate Island

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ABSTRACT

Land and climate are important land potentials in agricultural ventures. Land other than as a medium also grows water storage for plants. Rainfall is the climate element of the water provider for plants. Clove Plant as one of the main plantation plants that are cultivated on farmland by the people of Ternate Island. Dry season, clove plants suffer from drought and die of water shortages. This research was conducted to find out (1) the level of the available lengthen; (2) The physical nature of soil and climatic conditions as an influential land potential as well as its management against the availability of water in clove plant land. The method of surveying and sampling soil is piqued and not affected at depths of 0-20, 20-40, and 40-60. Measurement of infiltration using double ring infiltrometer and surface flow Chinometer method. Analysis of soil lengthen, texture, body weight, density, saturated hydraulic conductivity and C-organic in the laboratory. Descriptive analysis, correlation statistics and regression are used for the data processing of research results. The results of the study, showed that there are available soil cloves plant land ranging from 0.09 – 0.32 cm³/cm³. On average, the available perlayer is 0.20 cm³/cm³ in layers 0-20 cm, 0.21 cm³/cm³ at 20-40 and 0.13 cm³/cm³ layers at 40-60 cm layer. Soil weight ($r = 0.5519$; $R^2 = 0.304$), porosity ($r = 0.5769$; $R^2 = 0.332$), and saturated hydraulic conductivity ($r = 0.5430$; $R^2 = 0.294$) strong impact on the available level of Lengeven. Organic materials and dust fractions are influential enough strongly against the available downsides. Rainfall 113.2 mm and the rate of infiltration between 2.60 – 0.46 cm/min could potentially increase water availability, while evaporation of 13.9 mm and the surface flow of 14.10 mm could potentially decrease water availability in the soil. The amount of rainfall in Ternate is 2,307.3 mm/year and the evapotranspiration (ETc) of 1,288.2 mm/year. Clove Age plant production requires water as much as 1,521.7 mm/year then carried out irrigation water for 33.4 mm/year.

Keywords: soil physical properties, climate, Lengan available, water needs plant, clove

I. INTRODUCTION

In the year 2016, the clove plant in Ternate Island, many of which suffered drought and died, resulting from the dry season in the years 2014 and 2015. According to [1], the category of plantation plants dry and die the most on the north slope of Ternate Island in the village Tobolo namely Clove Plant as many as 163 plants, then nutmeg plant 3 trees and coconut plants 2 trees While the rather dry as many as 89 trees clove plants; Nutmeg Plant 17 trees and palm plants 7 trees.

The dryness and death of clove plants is caused by the main factors of climate change namely declining rainfall, rising months of dry (> 6 months) and high Evapotranspirasi. Land factors and the physical properties of the soil affecting drought are the slope of the ramps to sloping slopes, the dominant ground conditions of sand and dust, ground crumb structures and rapid soil permeability and disruption of the hydrological system As a result of the reduced area of forest and high surface air

temperatures [1]. Low availability of groundwater pad rooting zone causes water pressure (crop water stress) as a result of the physiological process of the clove plant is hindered. As according to [2], that plant water pressure is deficient in water supply, due to reduction of groundwater content or the physiological response of the plant to water shortages.

Water for plant needs is sourced from rainfall which is generally gained from the soil through the absorption of plant roots. So land as a medium to drain and water storage while rainfall as the main climate factor of plant water sources. According to [3], The ability to bind water on the ground is influenced by organic textures and materials. The physical properties of the soil influence directly on the availability of water, especially the ability to transmit and store water. Soil texture as a comparison of the fractions of sand, dust and clay, when the soil is dominated by clay fraction then the fine pores are so much that it will improve ability in binding and storing water.

Soil pores serve as a transportation pathway to distribute water both vertically and horizontally. In addition, the pore soil is able to store water and air after the movement of water and air reaches a constant point. Furthermore the largest porosity of land will improve soil permeability. Organic material derived from the remnants of plants, especially leaves and twigs that accumulate in the surface and in the soil, then decomposed by macro and micro organisms so that it becomes the constituent material of soil and produces medium and large pores. Organic material, is physically useful as a medium of introduction and water storage in the soil.

Soil and climatic conditions in the area of clove plants, especially the physical properties of soil, rainfall, evaporation is the source of water availability so that knowledge and information about its properties and potential is expected to answer the problems and Management for the drought treatment of clove plants. Hydrological factors, particularly surface flows measured in the event of rain, and the rate of infiltration measured before and after the rain will provide additional knowledge of the magnitude of the ability of the soil to drain rainwater and It in the ground. Soil properties are measured among other textures, weight of contents, density, poricity, saturated hydraulic conductivities, soil laxatives and organic materials to know the level of lengas available and physical properties of the soil affect the availability of water. While the measurement of rainfall, evaporation, infiltration and surface flow to power the potential availability of water in the soil so that it can be done in the management of Clove plantation land on Ternate Island.

II. METHODS

The research was conducted in January in Clove Plantation land located on the north slope of Ternate Island. Pre Survey and mapping locations to determine the location of research and sampling. Soil sampling is done on the land of the clove plant is not dry, somewhat dry and dry/dead physiologically found in the village of Tobololo on slope of 8-15%. Soil samples for the observation of the soil properties in the form of samples are terlucinated and not affected in each layer of soil profile, namely at depths of 0-20, 20-40, and 40-60 cm.. Soil samples for soil texture and organic material observation, while soil samples were not used using the ring SAMPE (iron/Paralon pipe) for the analysis of soil content weight, soil type weight, saturated hydraulic conductivity, and groundwater content (pF 2.5 and 4.2)

Daily rainfall observations conducted on 3 research locations The daily rainfall is measured using artificial umbrometer. The rainfall measurement uses a modified manual rain tool by using a measuring glass of 100 ml above it using a glass funnel with a diameter of 9 cm, as the mouth of the root. The appliance is mounted on an open (unshaded) floor as high as 1.2 meters from the ground by using wooden beams as a support and bucket as a protector so as not to fall easily. Rainfall observations

are conducted daily during the study, starting at 07.00 to 07.00 WIT for 24 hours.

Evaporation measurement is done starting from 07.00 am/d 17.00 pm on the day there is no rain using micro lysimeter. The observation of rainfall and evaporation for 1 month. Surface flow measurements using a Chinometer method with a 22 x 2 metre runoff tile size. Erosion plots are placed at 1 point/location of research, namely on a rather dry clove plant land. Observation of surface flow in the time of rain and measurement/sampling volume of water after rain. Measurement of infiltration using double ring infiltrometer, which is done 3 times/field observation point. Calculation of infiltration using method Horton [4]. The Data on the observation and field measurements are analyzed discretely. The Data obtained from the laboratories were analyzed using Microsoft Excel 2007 to find the average as well as correlation relationship and regression between the properties parameters with the available downturns. Plant water needs with the evapotranspiration approach (ET) Penman-Monteith equation [5], and Penman-Monteith method, to assess the reference Evapotranspirasi (ETo), Evapotranspirasi crop (ETc), and the need for irrigation water using CROPWAT-8 [6,2]. Calculation of water demand of clove plant using rainfall data, air temperature, humidity, wind and sun Illumination 10 years (2008-2018) BMKG station Babullah Ternate.

Table 1. Soil Analysis Method

Parameters	Analysis Method
Texture	Hydrometer
Weight of contents	Cylinder
Type weight	Pycnometers
Porosity	1-BI/BJ x 100%
Saturated hydraulic conductivities	Constan Head
Lengas available (pF 2.5 and 4.2)	Sand Box, Pressure Plate
C-Organic	Walklay and Black

III. RESULTS AND DISCUSSION

Soil physical Properties

Soil characteristics (table 2) shows the soil at the research site dominated by the dust fraction so that the soil is textured clay and dusty clay, with soil porosity above 60% and ground weight of < 1 g/cm³. The soil has a low (BI) weight range between 0.48 – 0.88 g/cm³ and high porosity, i.e. the average soil porosity on clove land is 68.3%. This is caused by soil formation process derived from volcanic ash materials of Gamalama volcano so that the land unit formed General Order Andisol. The land on the cloves land in Ternate Island is Typic Durudants, Ultic Hapludants, Typic Hapludants, Typic Udivitrands, and Humic Udivitrands, formed from pyroclastic materials of the main material that is taken by basalt andesite rocks after the eruption [7].

The soil type weight (BJ) ranges between 2.00 – 2.34 g/cm³ which indicates the density or low type of weight. Generally the soil has a type of weight 2.6 g/cm³ [4].

Saturated hydraulic conductivities (KHJ) soils on each layer rapidly, i.e. an average of 86.02 cm/h KHJ in the upper layer (topsoil) rapidly but increasingly decreased in the layer of the power between the ground to low water. Soil organic matter content in clove plant land ranges from

8.06 – 0.45%. The highest concentration of organic matter on the top layer, but the deeper into the lower layer (40 – 60 cm), soil organic matter tends to be lower, which is 0.45%.

Table 2. Soil characteristics at research site

Soil properties	Land of clove Plant								
	Dry/Off			Moderately dry			Not dry		
	0-20 cm	20-40 cm	40-60 cm	0-20 cm	20-40 cm	40-60 cm	0-20 cm	20-40 cm	40-60 cm
Texture (%)									
a. Sand	38	20	20	36	31	67	33	25	15
b. Dust	45	53	75	43	61	26	22	55	64
c. Clay	17	27	5	21	8	7	45	20	21
BI (g/cm ³)	0.88	0.69	0.81	0.48	0.67	0.52	0.87	0.79	0.61
BJ (g/cm ³)	2.29	2.22	2.14	2.00	2.06	2.12	2.29	2.23	2.34
KHJ (cm/jam)	63.20	11.00	10.60	154.80	115.00	370.90	26.80	13.80	8.10
Porosity (%)	61.60	69.20	62.00	75.91	67.26	75.67	62.13	64.45	74.07
Organic matter (%)	3.66	5.43	0.45	6.11	4.31	2.91	8.06	5.08	5.99

Description: KHJ (saturated hydraulic conductivity); BI (content weight); BJ (weight type).

Table 3. Soil Lengas available at research site

Ground Moisture content	Land of clove Plant								
	Dry/Off			Moderately dry			Not dry		
	0-20 cm	20-40 cm	40-60 cm	0-20 cm	20-40 cm	40-60 cm	0-20 cm	20-40 cm	40-60 cm
pF 2.5	0.39	0.42	0.5	0.23	0.4	0.26	0.44	0.51	0.53
pF 4.2	0.22	0.3	0.18	0.14	0.21	0.14	0.25	0.29	0.3
Lengas available (cm ³ /cm ³)	0.17	0.12	0.32	0.09	0.19	0.12	0.19	0.22	0.23

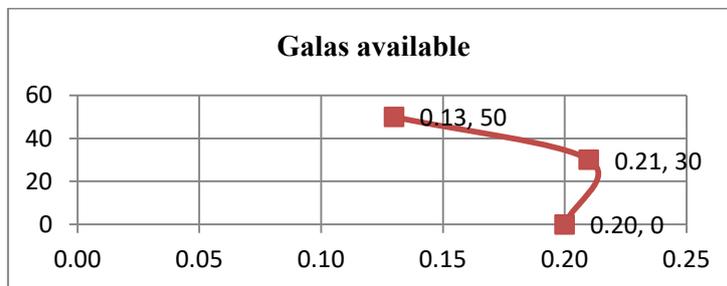


Figure 1. The spread of the soil is available

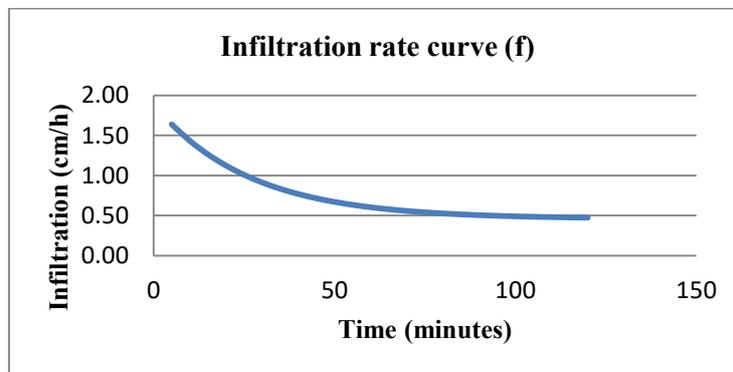


Figure 2. Infiltration Rate curve

Water availability on clove plantation land

Lengas available

Based on the results of ground analysis of pF 2.5 (roomy capacity) and pF 4.2 (permanent point of Wither) (table 3), the ground level of dirt ranged from 0.09 – 0.32 cm³/cm³. Lengas available average perlayer is 0.20 cm³/cm³ at a layer of 0-20 cm, then increased to 0.21 cm³/cm³ on layer 20-40 and then decreased to 0.13 cm³/cm³ at 40-60 cm layer. Low and increased Lengas available on land in clove plant land influenced by soil properties and the intensity of rainfall occurring [7]. Increased lengthe is available on the layer 20-40 cm caused by the texture of dusty clay soil and the increase of soil organic matter. Soil texture and organic material will affect directly for storing and maintaining the available lengthen in the ground [8]. Furthermore, according to [9], The addition of clay and organic materials can increase water content is available. The ability of the soil to drain water will increase the infiltration and minimize surface flow. The rugged surface gives the rain water an opportunity to infiltration more so that it will increase the soil water content and lower the surface flow [10].

The level of in-ground water availability of each layer indicates that the lower ground layer is increasingly low. It is directly proportional to the concentration of organic matter which is getting lower to the bottom layer in the soil. The addition of soil organic to the layer of rooting in addition to increased availability of nutrients also enhances the ability of the soil in storing and improving the available Lengas [11].

Rainfall and evaporation

Rainfall will increase water availability while evaporation is water loss resulting in reduced water availability. The amount of rainfall and evaporation rate occurring in the long time period will affect the available lengthen. This is because the needs of plants for the physiology process In addition will also occur due to transpiration water balancing. The plant absorbs the groundwater of the root zone to meet the needs of evapotranspiration [2]. Based on the results of the rainfall intensity measurement (table 4), showing that the amount of rainfall in January is 113.2 mm The evaporation amount is occurring at 13.9 mm. The amount of rainfall will thus be the source of water and the potential for water availability on farmland crops [12].

Infiltration and surface flow

The rate of infiltration in clove plant land ranges from 2.60 to 0.46 cm/min, where constant infiltration rate is reached at 105 minutes or 1.45 hours with the amount of infiltration rate of 0.46 cm/min. The speed of the infiltration in the first hour is due to the soil in dry conditions and low ground dirt. Soil with higher moisture content causes the rate of infiltration to be slow, conversely low groundwater content speeds up the rate of infiltration [13].

The amount of water flowing above the ground and the surface of the erosion plot in the event of rain is surface flow water. The amount of surface flow that occurs in the

Clove plantation land in January amounted to 14.10 mm (table 4), where the surface flow occurs in the event of rain for 10 days (decade) 3 namely the amount of 86.8 mm. Surface flow occurs when the soil has been saturated and/or caused the ability of the soil to drain water into the soil (infiltration) so that the magnitude of the surface flow will show the amount of rain water lost on the land of clove plants. The largest surface flow occurred in the 3rd decade, and did not occur in the 1st and 2nd decades. This is due to the occurrence of rain in the past, namely the rain in the decade of 1 and 2, as a result some pores of the soil have been filled with water. The amount of water that becomes the surface flow depends on the intensity of the rain, the state of the closure, slope slope, soil type and groundwater content before the rain [14].

Table 4. Surface flow and soil erosion

Decade	Rainfall	Surface flow	Soil erosion
January	(mm)	(mm)	(kg/plot)
Decade 1	11,0	0	0
Decade 2	15,4	0	0
Decade 3	86,8	14.10	0.09
Amount	113,20	14.10	0.09

The relationship of soil with Lengas is available

The physical properties of soil affect the availability of soil lengthen. The influence of these soil properties can increase and decrease the lengthen available at the research site. This can be used as the basis for the management of increased water availability on the clove plantation land in Ternate Island. Based on the results of the correlation analysis (Table 5) and a simple regression (Figure 3), indicating the strength of the relationship (Koefiesen correlation), where the soil properties especially heavy content of strong effect of posetif, while porosity, and hydraulic conductivity saturated (KHJ) Negatively influential. Furthermore, the organic material and dust fraction are strong enough, while the fraction of sand and dust as a weak factor against the Lengas is available.

The result of a correlation analysis, a strong link between the weight of the contents with the available Downfill is R = 0.5519. The form of the relationship between the ground weight available with the soil weighs results in a single equation of $Y = 0,264x - 0.002$ which means that the increased content weight value of 0.264 g/cm³ will be followed by an increase in the amount available 1 cm³/cm³. The resulting R2 value of 0.304 indicates that the soil's content weight contributed 30.4% to the ground lengthen in the water availability system on clove plant land. According to [15], 54% of water content levels are affected by the content weight value.

The porosity relationship with the LLC is available with a value of R = 0.5769 resulting in a model of the equation $Y = -0.006x + 0644$ which means an increase in the value percent porosity by 0.006% will be followed by a decrease in the amount available for 1 cm³/cm³. The resulting R2 = 0.332 value indicates the influence of the porosity variable against the Lengas is available at 33.2%, while the

remainder is influenced by other factors outside the model. The sand fraction generates a single model of equation $Y = -0.002x + 0.256$ which means an increase in the percent value of the sand by 0,002% will be followed by a decrease in the available lengthe of 1 cm³/cm³. The resulting R2 value of 0.110 shows an 11% sand percent influence over the available downgrades.

Table 5. The value of the relationship strength between soil and Lengthe properties is available

Soil physical Properties	value r	Description
Weight of contents	0.5519	Strong
Type weight	0.2547	Very weak
Porosity	-0,5769	Strong
Saturated hydraulic conductivities	-0.5430	Strong
Organic matter	-0.4398	Strong enough
Fractions of sand	-0.3330	Weak
Dust fraction	0.4268	Strong enough
Clay fraction	-0.3335	Weak

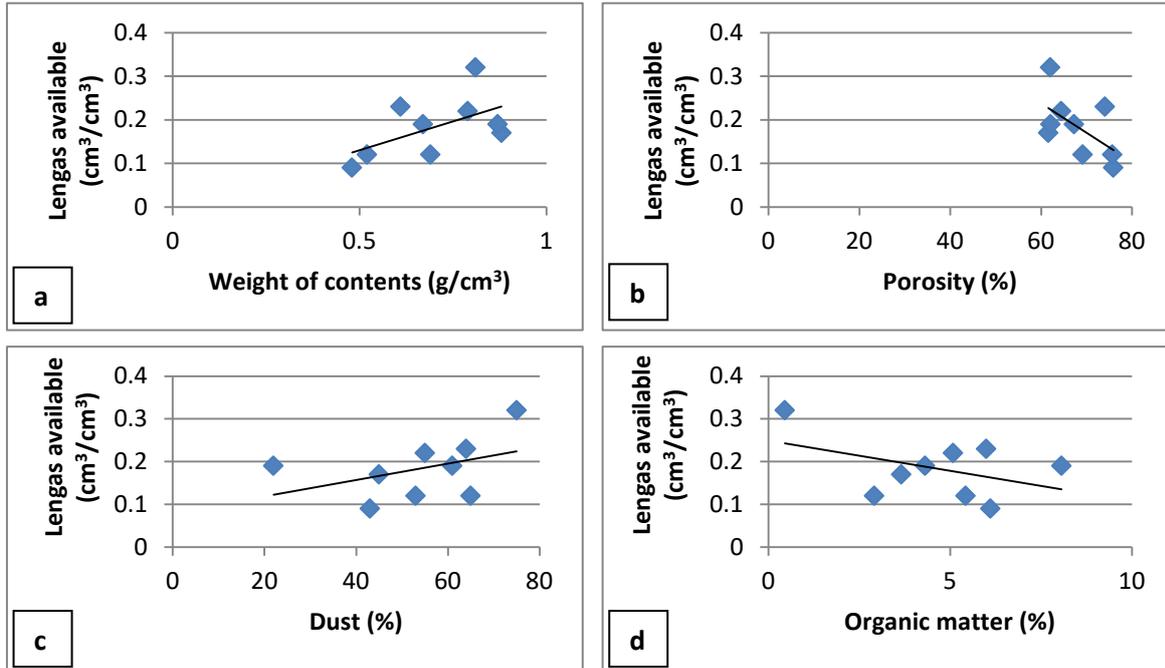


Figure 3. The relationship between the arm is available with the content weight (a); Porosity (b); Dust fraction (c); and organic materials (d).

The affected dust fraction of the posetif against the ground is available in the soil with a model of equation $Y = 0.001x + 0.0080$, i.e. an increase of 0.001% will increase the available lengthen of 1 cm³/cm³, with a coefficient of determination (R2) of 0.182 indicating the effect of dust fraction of the downsides available at 18.2%. While the organic material is negatively affected where the decline in the lower layer of material will lower the available lengthen, as in the relationship of the equation model $y = -0.014x + 0.249$ with $R^2 = 0.193$, indicating that 19.3% of the Lengas is available in soil influenced by organic material, and the value of $R = -0.4398$, namely the relationship with the Lengas is strong enough Organic material affects the water capacity available in the soil [3].

Water needs clove Plant

The water needs of clove plants are generally obtained from the rainfall that occurs so it is very dependent on the intensity of rainfall, water loss (evaporation) and the ability of the soil in storing water to meet these needs. Based on the results of the calculations using CROPWAT-8, the amount of rainfall occurring in Ternate island amounted to 2,307.3 mm/year and the evapotranspiration (ETc) of 1,288.2 mm/year.

Clove plant age production in Ternate Island requires water as much as 1,521.7 mm/year for the charging period (formation of shoots after harvest), the flowering period until the next harvest. Based on the evapotranspiration that occurs then the clove plant requires a water administration of 33.4 mm/year especially during the filling and flowering period. Amount of water needs each time growth of clove plant for 1 year on Table 5 and Figure 4.

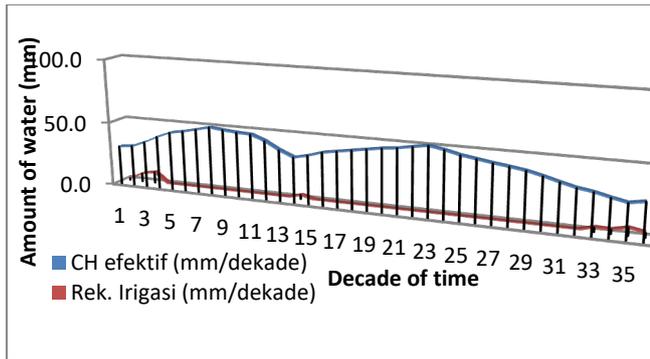


Figure 4. Water needs of clove plant each time growth

Figure 4, the irrigation of water in the initial period (formation of shoots) in oktober (decade 1 = 1,3 mm; decade 2 = 6,4 mm; decade 3 = 8,4 mm), bud development period in February (decade 2 = 2,8 mm), and final flowering period in August (decade 3 = 3,0 mm), and in September (decade 1 = 2,8 mm; decade 2 = 5,4 mm, dan decade 3 = 3,3 mm).

IV. CONCLUSION

The available Lengas of clove plant land ranges between 0.09 – 0.32 cm³/cm³, fluctuating and low to layer > 20 cm. Availability soil lengit is influenced by the weight of the contents of the soil, soil porosity, saturated hydraulic conductivity, organic material and dust fraction.

The amount of rainfall in Ternate is 2,307.3 mm/year and the evapotranspiration (ETc) of 1,288.2 mm/year. Clove plant age production requires water as much as 1,521.7 mm/year for the charging period (formation of shoots after harvest), the flowering until the harvest then carried out irrigation water administration of 33.4 mm/year.

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