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ANALYSIS OF LAND SUITABILITY FOR CINNAMON PLANTS (CINNAMOMUN BURMANII) IN BATIPUH DISTRICT, TANAH DATAR DISTRICT

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ABSTRACT

This research was conducted in Batipuh District, Tanah Datar Regency, aiming to determine the characteristics of the land and the land suitability level of cinnamon. The method used for the analysis of land characteristics is a descriptive method and for the analysis of land suitability levels using a scoring method with a parametric approach. The data used are primary and secondary data with data processing using RStudio. This research was conducted according to the land evaluation guidelines for semi-detailed land analysis. The research variables are soil, climate, and topography with indicators based on the Center for Research and Development on Land Resources. The results of this study indicate that Batipuh District has a temperature of 150C – 270C, dominant rainfall of 2000 – 2500 mm per year, and a high topography dominated by a slope class of >15% because it is in the Barisan Hill route, and the dominant soil condition is under the conditions for growing cinnamon. . Based on the parametric approach using RStudio, there are 2 levels of land suitability for cinnamon in Batipuh District, namely 84.5% for S1 areas and 15.5% for Masters areas

INDEX TERMS ***Cinnamon, Land Characteristic, Land Suitability***

I. INTRODUCTION

1.1. Background

Batipuh sub-district is one of the sub-districts that produces various types of plants, one of which is cinnamon. The highest cinnamon production in Batipuh in the last 10 years was in 2014 as much as 166.10 tons which then decreased every year to the lowest in 2017 which was 6.25 tons[5]. In 2018 it increased to 73.79 tonnes, and fell again in 2019 to 57 tonnes or a decrease of 22.75%, then rose again in 2020 to 74 tonnes or an increase of 29.8% (BPS Batipuh District) [7]. In addition, the average production of cinnamon in Batipuh District is below the minimum average production. The average cinnamon production in Batipuh District for the last 2 years was 0.11 and 0.21 tons/ha, while the average minimum production that should have been achieved was 0.66 tons/ha (Idris, H & Mayura, E, 2019) [10].

Decline and instability and low productivity of a type of plant can be caused by biotic and abiotic factors. Biotic factors are usually in the form of pests, microbes, and others, while abiotic factors are in the form of climate, soil, and topography. The reality that occurs in the field is that abiotic factors are the main cause of the loss of agricultural yields of up to 50% of agricultural yields (BPTP South Sumatra, 2021)[8]. In this case, it is necessary to have knowledge and understanding of environmental factors that can affect plants before directing land use. Guidance on land use is obtained through an analysis of the level of land suitability.

Land suitability analysis can be carried out with the help of various software including RStudio by taking into account the land suitability provisions issued by the Research and Development Center for Agricultural Land Resources of the Republic of Indonesia. RStudio is a data analysis software by utilizing various commands through coding or programming, which is capable of processing statistical data and spatial data.

The purpose of using RStudio is as a research tool for faster data analysis. RStudio provides a nice interface for importing and viewing files, installing packages, and exporting graphics)[2]. One of the advantages of RStudio that can help process spatial data compared to other mapping applications is that R can directly access or download spatial data such as administrative boundary data, elevation data, climate, rainfall, and others, and process them in the same software as processing faster data just by entering a certain command, this is proven in the

research of Asaad, et al, one of the R packages, namely the use of ALUES to calculate suitability scores and land unit classes is very efficient. The data frame consists of 2,980 rows (land units) and only takes about 3,267 milliseconds or 0.05 minutes to process (Asaad et.al, 2016)[3]. Based on the problems that have been described, this research is entitled **"Analysis of Land Suitability for Cinnamomun Burmanii Plants in Batipuh District, Tanah Datar District".**

II. METHODE

The research was conducted in one of the sub-districts in Tanah Datar Regency, namely Batipuh District. The method used for the analysis of land characteristics is the descriptive method and for land suitability level analysis using the scoring method. The scoring method is a method of assigning a rating with predetermined limits (Tristandi, et al, 2016) [16]. The scoring is done using the following formula.

Range = Max Value. – Min Value.
Max Value. = Harkat Max. x ΣParameter
Min Value. = Harkat Min. x ΣParameter
Interval = $\frac{\text{range}}{Total\ of\ Class}$

Source: Tristandi, et al. 2016

This research was conducted according to the land evaluation guidelines for semi-detailed land analysis. The characteristics of the land that will be identified in this study are characteristics that are closely related to evaluating the level of land suitability in the form of soil conditions, climate and topography (Aji, 2019)[1]. Land suitability analysis in this study is in the form of actual land suitability analysis. Actual land suitability is land suitability carried out under current land use conditions, without input improvements [13].

The data used in this study are data on rainfall, temperature, topography and soil characteristics. Rainfall is sourced from the Meteorology, Climatology and Geophysics Agency (BMKG), temperature is sourced from Landsat 8 imagery, processing is carried out by analyzing bands 10 and 11 which are bands measuring air temperature, temperature data processing is carried out using the LST (Land Surface Temperature) method with data based on data from Landsat 8 imagery, the LST of the radiation transfer equation-based method using band 10 has the highest accuracy with an RMSE lower than 1 K[17]. Temperature calculation is done by the following formula:

LST = (BT / (1 + (0.00115 * BT / 1.4388) * Ln(ε))).

Topographical data is sourced from DEMNAS data and soil characteristics are sourced from semi-detailed soil maps from the Soil Research Institute. The determining variables in this study are land characteristics which are closely related to land suitability analysis in the form of climate, topography and soil with the following indicators:

Table 1
Land Suitability Analysis

Land Characteristics	Land Suitability Class			
	S1	S2	S3	N
Average Temperature	18-22	22-25	25-27	>27
		15-18		
Rainfall	2.000-2.500	1.300-2.000	1.000-1.300	<1000
		2.500-3.000	3.000-4.000	>4.000
Drainase	Good, average	Kinda hampered	hampered	Very hampered, quick
			Kinda Hampered	
Soil Texture	Soft	Average	Rough	Rough, Very Rough
Soil Depth (cm)	>100	75-100	50-75	<50
Soil Cation Exchange Capacity (cmol)	>16	5-16	<5	
Total N (%)	Average	Low	Very Low	-
Alkali Saturation (%)	>50	35-50	<35	
Soil Ph	5,3-6,0	6,0-6,5	>6,5	
		5,0-5,3	<5,3	
Slope (%)	<8	8-15	15-30	>30

Source : Balai Besar Litbang Sumberdaya Lahan Pertanian Kementrian RI (2011)

Spatial data analysis using R can be done by installing the package provided by the R software itself. There are many packages that can be used to analyze and visualize spatial data including:

1. *Rgdal* is a library that connects R with geospatial data
2. *Sp* is a package that contains class and method libraries for spatial data
3. *Maptools* contains various commands related to spatial data processing such as data.frame which functions to read and analyze table attributes, besides that it can also convert data to various formats (Bivand et.al, 2022) [4].
4. *Ggplot2* serves to visualize the results of processed data in the form of images, maps, graphs and others.

Processing uses some common commands on mappings such as:

a. ReadOGR is used to read Shapefile data sourced from outside R.
b. Proj4string functions to view, assign or retrieve projection attributes on spatial data classes.
c. Data.frame is a generic data object from R that is used to read and store tabular data.

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d. Cbind is a function whose job is to manipulate common data in R which involves combining two data frames

III. RESULTS AND DISCUSSION

Teritory Overview

Batipuh District is astronomically located between 0°23' 38" South Latitude - 0°34' 25" South Latitude and 100°22' 32" East Longitude and 100°30' 00" East Longitude (BPS Batipuh, 2020). Batipuh District is located in a row of hills, so it has a rough topography consisting of parts of Mount Marapi, hills and valleys which are crossed by 16 rivers with an altitude of between 564 – 1,019 meters above sea level. Administratively, Batipuh District has 8 Nagari and 49 jorong with the smallest area being Nagari Pitalah with an area of ± 4.8 Km², and the largest area being Nagari Batipuah Baruah with an area of ± 51.22 Km² (BPS Batipuh, 2020) [6].

Characteristic of Land in Batipuh District

The characteristics of the land in this study refer to the stipulations of the Center for Research and Development on Land Resources, where based on these stipulations, we know that the parameters that will be used to carry out land suitability analysis for cinnamon in general are soil, climate, and topography. The following are the characteristics of the Batipuh District land.

Table 2
Charasteristic of Land in Batipuh District

Land Characteristic		Class of Land Suitability			
		S1	S2	S3	N
Temperature	Factual Condition	18-22	22-25	25-27	-
	Surface Area (%)	65,9	33,6	0,5	
Rainfall	Factual Condition	2.000-2.500		3.000-4.000	>4.000
	Surface Area (%)	58,54		39,23	2,21
Drainase	Factual Condition	Good, Average		Hampered	
	Surface Area (%)	99,04		0,09	
Soil Texture	Factual Condition	Soft			
	Surface Area (%)	99,13			
Soil Depth	Factual Condition	>100	75-100		<50
	Surface Area (%)	37,24	49,27		12,62
Soil KTK	Factual Condition	>16	5-16		
	Surface Area (%)	66,56	32,57		
Alkali Saturation	Factual Condition	>20			
	Surface Area (%)	99,13			
Total N (%)	Factual Condition	Average	Low		
	Surface Area (%)	37,3	61,8		
Soil Ph	Factual Condition	5,3-6,0	6,0-6,5		
	Surface Area (%)	66,56	32,57		
Slope	Factual Condition	<8	8-15	15-40	>40
	Surface Area (%)	17,99	7,3	68,1	6,6

Source: Researcher

Based on the physical properties of the soil in the form of drainage and texture, the conditions are suitable for cinnamon, while the depth of the soil, there are a few areas that are classified as shallow, making it unsuitable for cinnamon. Soil drainage conditions in Batipuh District are dominated by the good class which reaches 86.4% of the area, 12.62% for the rather good drainage class, 0.097% for the blocked drainage class which means it only covers a small part of the area, and the remaining 0. .86% is the crater area of Mount Merapi. According to Effendy (2011) [9], soil conditions which include soil moisture, transportation, nutrient effectiveness, soil erosion and various other things are strongly influenced by soil drainage conditions. in allotment of a land. Soil texture in Batipuh District is dominated by a rather fine texture class which covers 60.99% of the area, the remaining 38.15% with a fine texture. Soil depth in Batipuh District consists of very deep (> 100 cm), deep (75-100 cm), and shallow soil depth (25-50 cm).

Based on the soil chemistry, it is classified as very suitable and suitable, which means that the chemical conditions and organic content are suitable for the growth of cinnamon. The acidity level of the soil in Batipuh District consists of acid (pH 4.5-5.5) and slightly acidic (pH 5.6-6.5). Batipuh District has varying base saturation levels of low (20-35%), moderate (13-60%), high (61-80%) and very high (> 80%) levels, and has CEC of Batipuh District based on the

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classification consists of low (5-16 cmol/kg), moderate (17-24 cmol/kg) and high (25-40 cmol/kg) levels.
Based on the climate, Batipuh District has rainfall in the range of 2000-4500 mm per year which is dominated by total rainfall of 2000-2500 mm per year with an area of 58.54% of the area and has a temperature of 15-27°C which is dominated by temperatures of 18 -22°C with an area of 65.9%.

According to Rahman et al, 2017, climatic elements in the form of temperature and rainfall greatly affect crop yields, so indicators of temperature and rainfall are very important to consider in assessing the level of land suitability [15]. Based on topography, Batipuh District has an altitude between 564 – 1,019 meters above sea level with slopes dominated by slope classes >15% with an area of 74.7%.

Cinnamon Land Suitability Level Analysis
Analysis of land suitability level of cinnamon using scoring method. The scoring method is a method of giving grades and weights with a parametric approach so that the data obtained is more objective. Determination of the score is based on In this study the land suitability class to be used consists of 4 classes, namely S1, S2, S3, and N, so the score will be given a value of 1-4, in order based on the magnitude of the parameter's influence on the level of land suitability.

The following is the calculation of the scoring provisions :

- Max Value = Max Value x ΣParameter = 4 x 10 = 40
- Min Value = Min. x ΣParameters = 1 x 10 = 10
- Range = Max Value – Min Value = 40-10 = 30
- Interval = range/(Number of Classes) = 30/4 = 7.5

Table 3
Class Value

No	Class	Value
1	N	≤17,5
2	S3	17,6-25
3	S2	26-32,5
4	S1	>32,5

Classification and determination of land suitability level is carried out with the help of RStudio using the following script:

```
> total<- hasil$scor_ler + hasil$skor +...n
> total
[1] 35 36 35 34 33 33 33 32 33 32 33 33 35 34 35 34 36 33
35 35 37 34 36 35 34 32
[27] 33 33 32 31 33 32 33 32 32 33 33 32 33 33 32 33 33
33 35 34 35 34 34 36 35 33
[53] 35 32 34 31 33
> for (i in 1:length(total)){
  if (total [i]>32) {keterangan [i]<-"S1"}
  else if (total [i]<= 32 & total [i]>25) {keterangan [i]<-
   "S2"}
  else if (total [i]<=25 & total [i]>17) {keterangan [i]<-
   "S3"}
  else {keterangan [i]<-"N"}
> keterangan
[1] "S1" "S1" "S1" "S1" "S1" "S1" "S1" "S2" "S1" "S2" "S1"
   "S1" "S1" "S1" "S1"
[16] "S1" "S1" "S1" "S1" "S1" "S1" "S1" "S1" "S1" "S1"
   "S2" "S1" "S1" "S2" "S2"
[31] "S1" "S2" "S1" "S2" "S2" "S1" "S1" "S2" "S1" "S1"
   "S2" "S1" "S1" "S1" "S1"
[46] "S1" "S1" "S1" "S1" "S1" "S1" "S1" "S1" "S2" "S1"
   "S2" "S1"
```

The following is a visualization of the results of the cinnamon land suitability analysis scoring method with a parametric approach using RStudio via the *ggplot2* function:

```
p<-ggplot()+
    geom_sf(data =LS , aes(x= long, y= lat, fill=
    Legenda))
p+ labs(title = "Kesesuaian Lahan Kayu Manis")
```

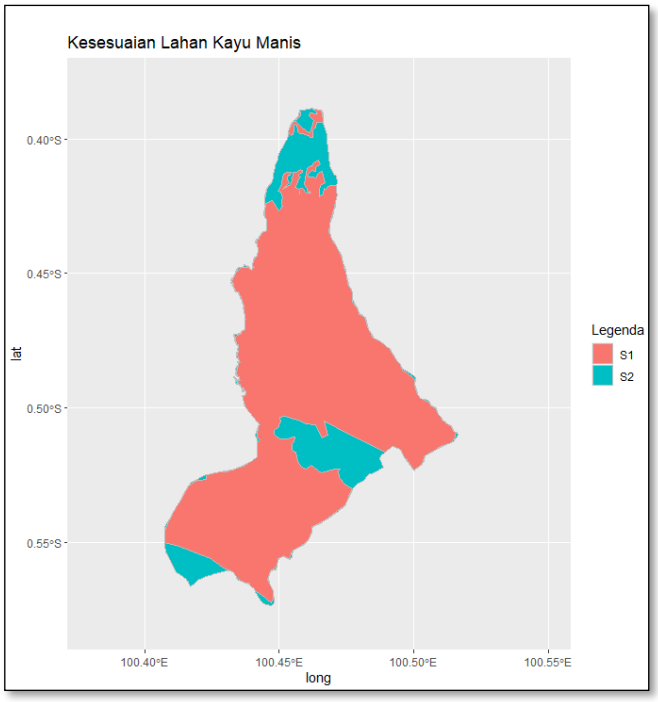

FIGURE 1.R Visualisation

The map of the results of the land suitability analysis is a map that is analyzed based on a parametric approach by providing the same assessment for each parameter so that the results obtained are more objective (Mustaman 2019)[12]. Based on the parametric approach in this area, there are only 2 levels of land suitability for cinnamon, namely in S1 and S2 classes, where S1 dominates more than S2, which means that almost the entire area of Batipuh District is very suitable for cinnamon cultivation. The area with a very suitable suitability level (S1) is 8120.9 hectares and the area with a suitable class land suitability level (S2) is 1490.2 hectares and it can be concluded that the area considered very suitable is around 84.5%.

The research area, namely the Batipuah sub-district, consists of 8 regencies, namely Andaleh, Sabu, Batipuah Ateh, Batipuah Baruah, Gunung Rajo, Pitalah, Bungo Tanjuang, Tanjuang Barulak, and Pitalah, land suitability classes are also spread across these various regencies, S1 with a very suitable level scattered throughout the Batipuah Ateh and Tanjuang Barulak districts, then also scattered in parts of Andaleh, Sabu, Pitalah, Bungo Tanjuang and Batipuah Baruah districts. Land suitability for class S2 is only found in a small part of the Batipuh District, namely in the northern part of Andaleh and Sabu districts. S3 classes are spread throughout Nagari Gunung Rajo and in parts of Batipuah Baruah, Bungo Tanjuang, and Pitalah districts and for N are spread out in parts of Andaleh, Sabu, and a small part in the southern part of Batipuah Baruah district.

Cinnamon Land Suitability Level Analysis

Karakteristik lahan di Kecamatan Batipuh dari sisi tanah, iklim dan topografi berupa jenis tanah terdapat 3 kategori yaitu tanah Andosol Humik, Andosol Vitrik, dan kambisol distrik, keberadaan tanah andosol dinilai sangat bagus untuk kesesuaian tanaman, untuk persebaran iklim Kecamatan Batipuh memiliki suhu 130C – 270C dengan rata-rata suhu 20°C yang dinilaicukup dingin karena bertopografi tinggi dan curah hujan dominan 2000 – 2500 mm per tahun dinilai normal seperti curah hujan wilayah Indonesia kebanyakan,sedangkan untuk topografi Kecamatan Batipuh didominasi oleh kelas kelerengan tinggi>15% karena berada dijalur bukit barisan dan wilayah gunung Marapi.

The land suitability level of cinnamon suitability in Batipuh District was analyzed with various approaches in the first land suitability analysis based on a parametric approach using RStudio, there were 2 land suitability levels of 84.5% for very suitable areas (S1) and 15.5% for suitable areas (S2).

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