



Land Arrangement for Citronella (*Cymbopogon nardus*) and Arabica Coffee in the Cultivation Area in Gayo Lues District, Aceh Province Indonesia: A Land Suitability Approach

Abubakar Karim^{1,2,*}, Sugianto Sugianto^{1,2}, Muhammad Rusdi^{1,2}, Manfarizah^{1,2},
Yulia Dewi Fazlina^{1,2}, Hifnalisa^{1,2}

¹Department of Soil Science, Faculty of Agriculture, Syiah Kuala University;

²Aceh Cacao and Coffee Research Center, Institute for Research and Community Services,
Syiah Kuala University, Indonesia;

*Corresponding author email: karim.abubakar@unsyiah.ac.id

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Abstract – Gayo Lues District is known as Citronella and Arabica coffee producer in Aceh province, Indonesia. This paper aims to manage Citronella and Arabica coffee's land arrangement in the Gayo Lues District's cultivated area. This implementation is aimed at maintaining the peculiarities of citronella products and Arabica coffee. Thus, the two commodities must be separated in terms of allocated sites. The altitude for the area is 200-2,000 meters above sea level, consisting of ten classes, and the type of soils are Entisols, Oxisols, Inceptisols, and Ultisols. The area's slope between 0- to 40% (4 classes) was used to delineate the land units. There are 49 land units observed within the cultivated area of 160,017.17 ha. The guidelines for land suitability classification by the Ministry of Agriculture for Citronella and Center for Coffee and Cocoa Research, Jember for Arabica coffee were utilized. The results showed that 58,275.5 hectares of land were suitable for citronella, and 13,765.75 ha has been planted. The actual land suitability of citronella inside the area of 58,275.5 ha is suitable (S2 class) and marginally suitable (S3-class) and not suitable (N-class) with limiting factors are temperature, water availability, erosion hazard, and nutrient retention. This land suitability can be improved by providing inputs to increase the level of suitability with temperature, water availability, and erosion hazard (slope) limiting factors. Also, 48,765.3 hectares can be developed for Arabica coffee, and 4,653.5 ha has been planted. The actual land suitability for Arabica coffee is Suitable, Marginal Suitable, and Not Suitable, limiting the soil's physical properties (adequate soil depth), slope, and chemical properties of the soil. Once repaired, the land's suitability becomes Suitable (S1-class) (without limiting factor), Suitable, and marginal suitable with the slope as a limiting factor. There is an area of 44,509.75 hectares of land at 200-1,400 m above sea level within the cultivation area developed with a Citronella. There is an area of 44,111.8 ha at the height of 800-2,000 m above sea level, potentially for Arabica coffee.

Keywords: land arrangement, land suitability, Citronella, Arabica coffee.

Introduction

Cultivation land has been allocated an area of 160,017.17 ha from Gayo Lues District 554,991.19 ha. Previous research (Karim et al., 2018a) found that this cultivation area is sufficient for around 89,500 people in Gayo Lues District. However, this cultivated land is not well distributed per district, so that the subdistricts of Kuta Panjang, Blang Pegayon, and Blangkejeren have an inadequate allocation of cultivated land. Other findings from the study of Karim et al. (2018a; 2019) display ten plantation commodities, three food commodities, and seven horticultural and vegetable commodities developed by farmers in Gayo Lues District.

Based on the findings, only two superior commodities were compiled in this follow-up study, namely citronella and arabica coffee. It is based on; (1) the potential land and area of existing citronella and arabica coffee plantations are relatively more expansive, (2) more and more family heads are trying to produce Arabica

coffee and with more labor absorption from upstream to downstream, (3) policies local governments that continue to encourage the development of citronella and arabica coffee, (4) relatively open markets with relatively stable prices, (5) wider use for end products and other uses. This study aims to arrange the land for citronella and arabica coffee based on the land suitability approach.

It is unknown how much potential area can be cultivated for citronella, arabica coffee, and other crops to develop existing cultivation areas. However, the existing arabica coffee plantation area is 3,653.5 ha (2.28% of the cultivated area) (Karim et al., 2018b). The location of existing citronella is 15,116.22 ha (9.45% of the cultivated area), including land, an area of 1,350 ha in protected areas (Karim et al., 2018c). Land arrangement for citronella and arabica coffee has not been based on land suitability classes. Thus it has not been able to produce optimally. The land arrangement is thought to be caused; (1) farmers do not know which land is suitable for each commodity cultivated, (2) farmers have not been able to utilize agricultural cultivation areas to support optimal land productivity properly, and (3) planted the adoption of location-specific technology packages has not followed commodities.

One way to arrange the land of citronella and arabica coffee can use land suitability classification through land evaluation. Land evaluation is the process of estimating the potential of land resources to be divided by use (Beek, 1978; Kater, 1982; Khan et al., 2014; Marbun et al., 2016; Marbun et al., 2020). The fundamental essence of land suitability classification activities is to compare the requirements required by the type of land use specified with the characteristics or quality of land owned by the land to be used (Beek, 1978; Kater, 1982; Pujiyanto, 1991; Khan et al., 2014; Marbun et al., 2020). The results of land assessments will provide information and directions for land use according to needs (Pujiyanto, 1991; Lukito and Muhammad, 2012; Marbun et al., 2020). Specifically, this study aims to regulate land use for citronella and arabica coffee in cultivated areas and develop their potential based on land suitability. The resulting land suitability class for citronella and arabica coffee, respectively, can be used to separate their cultivation sites, which are then referred to as land arrangement.

Materials and Method

The study was conducted in Gayo Lues Regency, Aceh Province, from March 2018 till November 2019. Soil analysis was carried out at the Soil Fertility Laboratory. Spatial data analysis was carried out at the Remote Sensing and Cartography Laboratory at the Faculty of Agriculture, Syiah Kuala University. The materials used in the implementation of this study are the spatial planning map of Gayo Lues Regency (Qanun No. 15, 2013), plans of cultivation areas (Karim et al., 2018a), slope maps, maps of altitude, and maps of soil types, scale 1: 50,000 (Qanun No. 15, 2013), rainfall data, and service reports related to research. Simultaneously, the tools used in this research are global positioning system (GPS), Arc GIS 10.4 computer software, printers, and other writing stationery.

The method used in this research is the survey method with descriptive analysis. The data used include primary data and secondary data. Preliminary data were obtained through field surveys, while secondary data were obtained from related institutions and literature studies. Land mapping units (LMU) of the observation site are formed within the cultivation area, based on a map of altitude, slopes, soil types (Karim, et al, 2018b; Karim, et al, 2018c), each consisting of several classes, namely; (1) altitude, consisting of 10 classes, namely 200-400; 400-600; 600-800; 800-1,000; 1,000-1,200; 1,200-1,400; 1,400-1,600; 1,600-1,800; 1,800-2,000 and > 2,000 m asl; (2) soil types, consisting of 4 classes, namely soil types Entisols, Oxisols, Inceptisols, and Ultisols, and (3) slopes, consisting of 5 classes, namely 0-8, 8-15, 15-25, 25-40, and > 40%. The three stacking maps of the map were obtained by 49 LMU, namely 23 SMU with the potential to be citronella and 26 LMU with Arabica coffee potential based on the altitude class (Figure 1). The method used in this study was the survey method with descriptive analysis. The data used include primary data and secondary data. Primary data were obtained through field surveys, while secondary data were obtained from related institutions and literature studies.

To achieve this study's objectives, all landforms were formed to collect land characteristics, namely rainfall data, temperature, dry month, slope, the effective depth of soil, soil drainage, rock surface soil, and genotypes citronella and cultivated Arabica coffee. Soil samples were analyzed and observed soil texture, pH, C-organic, cation exchange capacity, base saturation, exchangeable cations (K, Ca, Mg, Al, etc.), N, P, and K nutrients, according to the needs of conformity analysis citronella and arabica coffee.

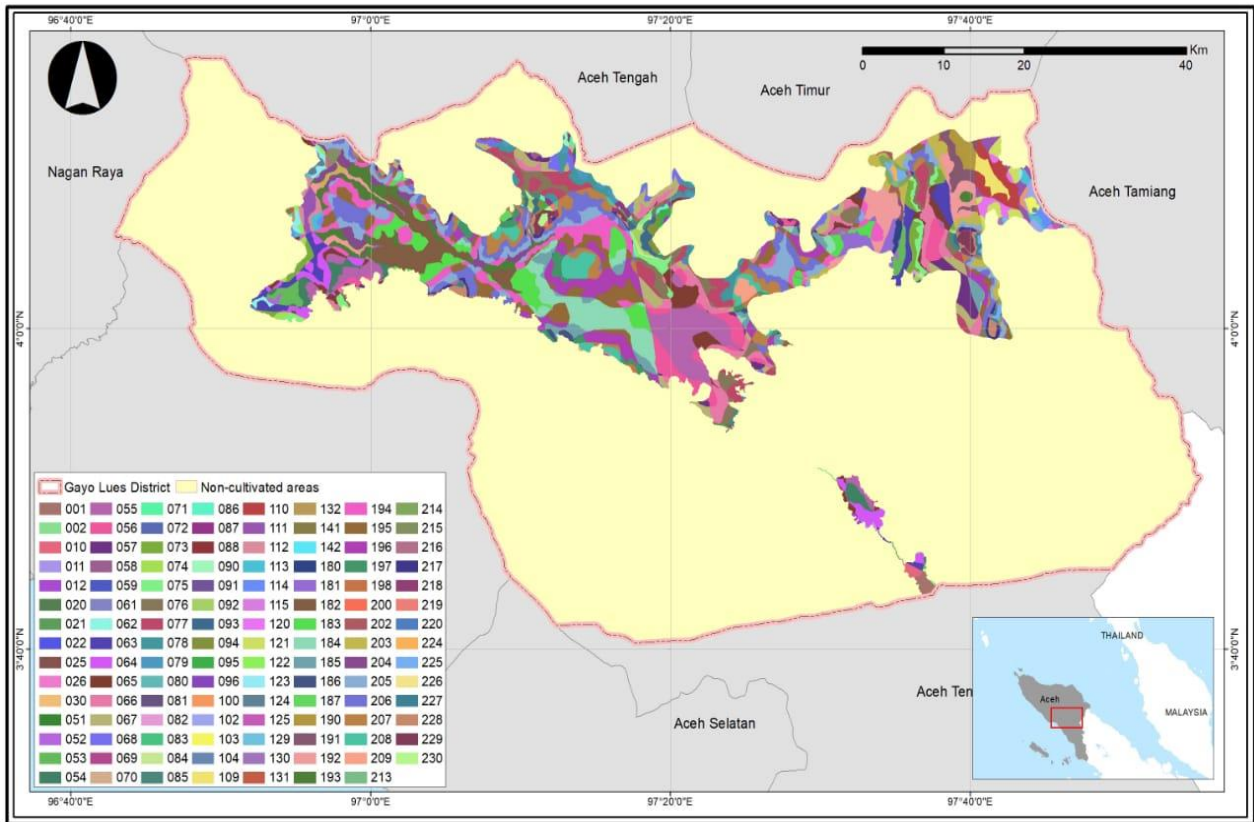


Figure 1. Land mapping unit of classifications land suitability for citronella and arabica coffee.

All the characteristics of the land are processed and arranged according to needs, then compared to the requirements for growing plants (citronella and arabica coffee) (Figure 2) regarding the framework of land suitability classification for citronella (Departemen Pertanian, 1997) and arabica coffee (Pujianto, 1991). For areas that can be developed by these two commodities, commodities with the highest land suitability are selected in each land; unless the ground is overgrown with pine trees, it is allocated for fragrant commodities. This arabica coffee and citronella land map are overlapped with a map of existing Citronella and Arabica coffee gardens in the next step. An area that can be developed by Citronella and Arabica coffee can be obtained.

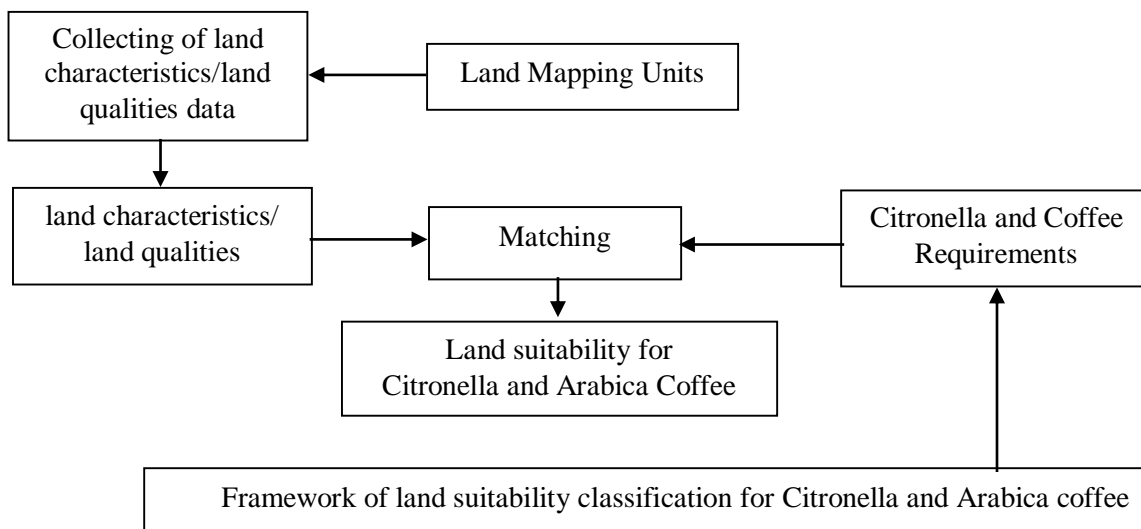


Figure 2. Illustration Concepts for Land Suitability of Citronella and Arabica Coffee

Results

The Gayo Lues District area is 554,991.08 ha, and 160,017.17 ha (28.83%) of cultivated areas. Inside the cultivation area is used for various activities ranging from dwelling, public facilities, social facilities, business places, farming places, etc. Citronella and Arabica coffee plants grow and produce well at altitudes of 200-1,400 m asl and 800-2,000 m asl, and slopes $\leq 40\%$, while soil types are not explicitly required.

Land Unit Determination

The land mapping units (LMU-figure 1) as an observation site is formed based on overlaps of altitude variables, soil types, and slopes. In theory, 160 units of observation site were obtained. The field check results in the cultivation area were only 49 LMU, consisting of 23 LMU areas developed by Citronella and 26 LMU, generated by Arabica coffee.

Based on this 23 LMU, citronellas can be cultivated in an area of 58,275.50 ha (altitude of 200-1,400 m asl, slopes $<40\%$), and Arabica coffee can be developed on an area of 48,465.3 ha (altitude of 800-2,000 m asl, slope $<40\%$). This area has been issued; use for settlements, public facilities, social facilities, other plants, other uses, areas with elevations below 200 m above sea level and above 2,000 m above sea level, and slopes $> 40\%$. Also, from these areas, there is an arsenic area that can be planted with citronellas. At the same time, they can be cultivated for arabica coffee, especially at an altitude of 800-1,400 m above sea level, with an area of about 21,120.9 ha. The entire shaded area is allocated entirely for citronella. This area is considered because almost all of the shading area is under the stands of pine trees. Of these two plants, only citronella lemongrass can associate well with pine trees.

From each of the LMU citronellas and Arabica coffee, not all of them were taken from soil samples and analyzed. This is done considering that not all of these LMU can be cultivated with Citronella and Arabica coffee. The observed LMU and soil samples were taken in the form of LMU free of other uses. The analysis is carried out only for land units cultivated in citronella and arabica coffee. From each LMU citronella and Arabica coffee, not all soil samples are taken and analyzed. This is done considering that not all of these LMU can be cultivated with citronellas and arabica coffee. The observed SL and soil samples were taken in LMU, which are free of other uses. The analysis is carried out only for land units cultivated for citronella and arabica coffee.

Land Characteristics

The land morphology in the Citronella and Arabica coffee plantations, at ten altitude classes, four soil type classes, and four slope classes can be explained as follows; (1) soil color from dark brownish yellow (10YR 4/6, 10YR 4/4), yellowish-brown (10YR 5/6), dark brown (10YR 3/3), very dark brown (7.5YR 4/6), until very dark brown (10YR 2/2), (2) dusty clay texture, clay loam, dusty clay loam, the dusty loam, and sandy loam, (3) effective depth of 80 -> 100 cm, drainage is rather good and rather bad, stones are found $<15\%$, rainfall is around 2,000 mm / year, temperatures are everywhere 18-27 °C, and humidity is 70-86%. Judging from this land's morphological variables, it can be explained that the Citronella and Arabica coffee is relatively suitable to be cultivated in this region. This argument refers to the land suitability criteria for citronella and Arabica coffee (Departemen Pertanian, 1997; Pujianto, 1991). The development of these two commodities requires a comprehensive policy, bearing in mind that citronella can be developed and produce well at an altitude of 200-1,400 m above sea level. Arabica coffee at the height of 800-2,000 m above sea level. Therefore, for the Citronella and Arabica coffee development area to be available properly, it is necessary to separate these two commodities' development areas, except in the regions that cannot develop Arabica coffee, despite the ideal height due to pine trees. The soil profile and the ground drill point in the field show that each LMU does not have a layer of solids and rocks limiting factors for plant roots. Likewise, surface rocks and rock outcrops do not become a significant barrier to the growth process and Citronella and Arabica coffee plants' generative phase.

Soil color can be influenced by the condition of C-organic content in the soil. Dark black soils are relatively high in organic C, whereas the brighter the soil's color, there is the possibility of low organic C (Kater, 1982; Mc Vay et al., 2002). The soil analysis results in each selected LMU have varied C-organic values, namely low to very high. The highest C-organic value is obtained at LU at altitudes of 1,200-1,400 m above sea level or more. According to Hairiah et al. (2000), black soil has different soil properties that are too open to sunlight and infertile. The statement is by the Gayo Lues District condition, which ranges from 18-28 °C. The low

temperature of organic matter decomposes rather slowly, causing higher C-organic content (Dent, 1977; Wilson, 1985).

The soil's chemical properties analysis showed that soil pH ranged from 4.49-7.3 (acid to slightly alkaline). Acidic soil reactions dominate almost all SL, while acid soil reactions have only a few LMU. This condition explains, in acidic to slightly acidic soils, the plant has a P. nutrient deficiency. This is caused by the P element bound by Al and Fe's elements, thus also with micronutrient deficiencies such as Zn, B, and Mo (Hairiah et al. 2000). Soil acidity is influenced by parent material, precipitation, pine vegetation, plant growth, soil depth, and nitrogen fertilizer (Dent, 1977; Kater, 1982; Maro et al., 2014).

The CEC analysis results showed varying values, i.e., 10.0-65.4 cmol/kg soil (low to very high). High or low CEC is determined by the content of clay and organic matter in the soil. Low soil reaction, CEC is relatively low because clay micelles and organic matter absorb many H⁺ and Al³⁺ ions, cations in the form of nutrients are then dissolved in groundwater and absorbed by plants (Hairiah et al., 2000; Maro et al., 2014). The amount of soil CEC is caused by soil characteristics and characteristics such as pH, soil texture indicated by the amount of clay, types of clay minerals, organic matter, liming, and fertilization. The CEC content was followed by relatively good bases, namely 29.43-71.91% (low to very high), C-organic 0.81-7.29% (down to very high), N total 0.15-0.42% (low to moderate), P is deficient to very high, KK can be exchanged low to very high, a saturation of Al is not measurable to very low, and salinity is very low.

Table 1. Assessment of Actual and Potential Land Suitability of Citronella in Gayo Lues District

LMU	Actual Land suitability	Limiting Factor	Potential land Suitability	Area (ha)
072	S3e	Slope, erosion hazard	S2we	30.2
202	S3e	Slope, erosion hazard	S2we	318.8
001	S3n	CEC, Base saturation, pH	S2tw	538.7
010	S2twe	Temperature, water availability, slope	S2twe	279.6
100	S3n	CEC, Base saturation, pH	S2tw	180.0
181	S3n	CEC, Base saturation, pH	S2tw	1.410.8
192	S3e	Slope, erosion hazard	S2we	4.535.6
214	Ne	Slope, erosion hazard	S3e	522.9
002	S2tw	Temperature, water availability, CEC, pH	S2tw	23.4
011	S3n	CEC, Base saturation, pH	S2w	20.5
215	S3e	Slope, erosion hazard	S2twe	257.5
012	S3n	CEC, Base saturation, pH	S2w	69.5
123	S3e	Slope, erosion hazard	S2we	544.8
183	S3n	CEC, Base saturation, pH	S2w	6,070.0
020	S3e	Slope, erosion hazard	S2we	22.5
025	Ne	Slope, erosion hazard	S3e	21.1
076	S3e	Slope, erosion hazard	S2we	4.562.3
114	S3n	Slope, erosion hazard	S2w	432.4
195	S3e	Slope, erosion hazard	S2we	6,911.9
206	S3e	Slope, erosion hazard	S2we	7,578.6
021	S3en	Slope, erosion hazard, CEC, Base Saturation,	S2twe	48.8
026	S3e	Slope, erosion hazard	S2we	4.8
185	S2w	Water availability	S2w	2,770.1
Total			-	58,275.5

Source: Analysis results, 2019, CEC = cation exchange capacity

Land suitability for citronella

Land suitability class for each land unit is obtained from matching the land characteristics with the condition for growing citronella using a classification system issued by the Departemen Pertanian (1997). The results of the matching are obtained in the form of actual land suitability classes, namely land suitability based on the

biophysical nature of the land and land resources before being given input for improvement and overcoming management constraints caused by limiting factors (Beek, 1978; Sys et al., 1991; Khan et al., 2014). The actual land suitability class for citronella development in Gayo Lues District is dominated by marginal suit class (S3), which is 54,658.40 ha (93.79%) with limiting factors of erosion hazard (slope; e) and nutrient retention (n), according (S2) covering an area of 3,307.2 (5.68%) with a limiting factor in temperature (t), water availability (w), nutrient retention (n), and unsuitable (N) area of 544.1 ha (0, 93%) with limiting factors for erosion (slope; e). The actual and potential land suitability classes are presented in Table 1.

The provision of input can be different in each class, depending on the needs and limiting factors. The provision of information must also be based on and in line with the conservation of land. After giving input, it is expected to improve land quality without causing other problems that adversely affect the ecosystem below ground level (Beek, 1978; Dent, 1977; Leonel et al., 2006). Nutrient retention (n), whether in the form of CEC, base saturation, or soil reaction, can be improved by applying agricultural lime, organic matter, etc. (Maro et al., 2014). The availability of oxygen (O) can be enhanced by tillage. The danger of erosion (slope; e) can be improved by making the terrace, forming terraces naturally or precisely made. Temperature (t) cannot be enhanced through technology unless it creates a micro-climate with various technologies. Simultaneously, the availability of water (w), rooting media (r), and preparation of the field can be relatively improved. However, it is costly, such as providing water in various ways, making planting holes, and mechanizing the soil treatment (Leonel et al., 2006).

To be developed optimally, limiting factors in land must be given input to improve and support the land's quality following the limiting and designation factors. Information can improve the actual land suitability, thereby producing a potential land suitability class. Providing input to the ground that has limiting factors with changeable and non-permanent properties, such as nutrient retention (n), oxygen availability (O), and erosion hazard, slope (e). At the same time, the permanent limiting factors, such as temperature (t), water availability (w), rooting media (r), and field preparation (lp), are relatively irreparable.

Potential land suitability classes are sufficiently suitable (S2) with temperature limiting factors (t), water availability (w), and erosion hazard (slope; e), except LMU 214 and LMU 025 are marginal appropriate (S3) with erosion limiting factors (slope, e). Potentially suitable land suitability classes (S2, with various limiting factors) were recorded at 99.07% of the total area, and marginal according (S3, with erosion limiting factors) were recorded at 0.93%.

Table 1 shows that of the total area of the citronella area of 58,275.5 ha, it can still be developed around 44,509.8 ha (76.38% of the total land area). This area has been issued a variety of uses, such as settlements, public facilities, social facilities, other plants, slopes > 40%, altitude < 200 m asl and > 1,400 m asl, slopes > 40%, and land that has been planted in the cultivation area covering an area of 13,765.75 ha, etc.

Such citronella in the Gayo Lues District has begun to develop in other districts, such as Central Aceh District, Bener Meriah, Aceh Jaya, etc. The area of the existing citronella in the Gayo Lues District is 15,156.21 ha. The largest existing grains were in the Rikit Gaib subdistrict, and the narrowest was in the Putri Betung subdistrict. Of the 15,116.21 ha, there is around 1,350.60 ha located in protected areas (non-cultivation). There is in the area of cultivation covering an area of 13,765.75 ha. A place of 13,765.75 ha, even there is around 2,000 ha located at an altitude of > 1,400 m above sea level.

Of the 44,509.8 ha land area that can be developed in the field of citronella in 11 sub-districts, including can be cultivated under the stands of pine trees, after being reduced by existing grains (excluding those planted in non-cultivation areas), and other uses in a narrow space and not displayed in this spatial data. The area of existing citronella in the cultivation area is 13,765.75 ha, spread almost in all subdistricts in Gayo Lues District. Based on the entire site, the potential suitability level in existing citronella land is very diverse. The most dominant suitability class is the moderately suitable class (S2), and a small proportion of the class is marginal (S3).

Land Suitability for Arabica Coffee

Land suitability of Arabica coffee is assessed based on the land's characteristics using the Coffee and Cocoa Research Center classification system, Jember (Pujianto, 1991) limiting factor method. The assessment results obtained are the actual land suitability class, limiting factor, limiting factor improvement, and potential land suitability class (Table 2).

Table 2 shows the actual land suitability class was assessed in the cultivation area with a height of 800-2,000 m asl. The existing land suitability analysis results showed that almost all LMU were suitable for Arabica coffee plants in class S2 and S3, except that LMU 079 was not suitable (Ns) with slope limiting factors.

Table 2. Assessment of Actual and Potential Land Suitability of Arabica Coffee in The Cultivation Area in Gayo Lues District.

LMU	Actual Land suitability	Limiting Factor	Potential Land suitability	Area (ha)
012	S2r	The effective depth of soil	S1	69.5
194	S2r	The effective depth of soil	S1	7,557.1
205	S2rn	The effective depth of soil, soil fertility	S1	6,533.2
216	S3sn	Slope, soil fertility	S2s	597.8
102	S2rn	The effective depth of soil, soil fertility	S1	521.5
113	S2rsn	The effective depth of soil, slope, soil fertility	S1	672.4
184	S2rn	The effective depth of soil, soil fertility	S1	6,393.1
217	S3sn	Slope soil fertility	S2s	750.3
103	S3n	Soil fertility	S1	240.3
124	S3n	Soil fertility	S1	302.7
057	S2rn	The effective depth of soil, soil fertility	S1	1,910.5
196	S2rsn	The effective depth of soil, slope, soil fertility	S1	6,628.0
207	S3n	Soil fertility	S1	4,249.7
079	Ns	Slope	S3s	845.2
115	S3n	Soil fertility	S1	32.0
067	S2rsn	Soil fertility	S1	4,095.9
197	S2sn	Soil fertility	S1	1,726.3
208	S3r	The effective depth of soil	S1	2,654.8
068	S2rsn	The effective depth of soil, slope, soil fertility	S1	2,376.8
209	S3n	Soil fertility	S1	608.1
Jumlah				48,765.3

Source: Analysis results, 2019

Discussion

The actual land suitability results show that 11 LMU classes suitable enough (S2), covering an area of 38,484.4 ha (78.92%) (Table 2) with the limiting factors soil physical properties (effective soil depth; r), slope (s), and soil chemical properties (CEC, base saturation, pH; (n), appropriate marginal class (S3) covering 9,435.7 ha (19.35%) with a slope limiting factor (s), soil chemical properties (CEC, base saturation, pH; (n), and physical properties of the soil (effective depth of soil; r). The limiting factors that can be corrected are soil chemical properties, namely pH, C-organic, CEC, base saturation, and nutrients. The effective depth and slope are relatively difficult to repair (Hairiah et al., 200; Maro et al., 2014). But with high input can be increased one level of land suitability class.

Table 2 also shows that almost all LMU has a very suitable land suitability class (S1), area of 46,571.1 ha (95.50%), except for LMU 216 and LMU 217, the potential land suitability class is quite suitable (S2) covering 1,348.0 ha (2.76%), slope limiting factor, and according to the marginal (S3) area of 845.2 ha (1.73%), slope limiting factor.

From 48,763.3 ha of land that can be planted with Arabica coffee in the cultivation area, various uses have been issued, such as settlements, social facilities, public facilities, other plants, rivers, borders, including pine tree stands, citronella, etc. Of this area, arabica coffee has been planted, covering an area of 4,653.5 ha (9.54%), so that the potential land for developing Arabica coffee is 44,111.8 ha. This area is spread across all districts, most

comprehensive in Pining District with a suboptimal altitude (800-1,000 m above sea level). It includes various limits on the significant depth of soil, slopes, and other chemical properties.

The results of the spatial analysis of the extensive Arabica coffee plantations that produce in Gayo Lues District are 1,724.41 ha, spread in 7 subdistricts, namely Blangjerango subdistrict (99.90 ha), Blangpegayon (61.24 ha), Pantan Cuaca Weather (644.57 ha), Pining (8.60 ha), Kuta Panjang (11.43 ha), Dabun Gelang (380.39 ha), and Blangkejeren (518.28 ha).

The terms of land suitability of Arabica coffee plants are the height and slope and the climate. Some essential climate elements are rainfall, temperature, humidity, and dry months. Arabica coffee plants prefer highlands or relatively low temperatures (18-24 °C) (Wilson, 1985). Furthermore, it is mentioned that the air temperature is calculated based on the height of the place from sea level; the higher the area, the lower the air temperature. Arabica coffee can grow and produce the best in rainfall 1,500-2,200 mm/year and three months dry month (Pujianto, 1991).

The land's morphological characteristics and the soil's physical properties affecting the Arabica coffee plants observed in each FFS are the altitudes, slope, rainfall, dry moon, texture, drainage, the effective depth of soil, surface, and exposed rocks. At the same time, the soil chemical properties that affect the Arabica coffee plant observed in each study LMU were soil pH, organic C, cation exchange capacity, base saturation, N-total, P-available, K-dd, salinity, Al saturation, etc. (Leonel et al., 2006; Hairiah et al., 2014).

Arabica coffee can grow well in rainfall 1,500-2,200 mm/year, dry month 1-3 months/year, altitude 800-2000 m above sea level, and slope <40%. In addition to the height of the hill and slope, Arabica coffee requirements also include an effective depth of > 60 cm, the texture of dusty loamy soils, dusty loamy loam, sandy loam, loamy sand, sandy loam, loamy loam, dust, and loam, the type of soil is not required. Other soil characteristics are unflooded, pH 5.0-8.0, C-organic 0.50-15%, cation exchange capacity (CEC) > 15 me / 100 g of soil, base saturation (KB) > 20%, the content of N, P, and K is very low to very high, poisoning due to salinity <4 mhos/cm, and Al poisoning <60% (Pujianto, 1991; Karim, 1996; Karim, 1998).

Conclusions

Land suitability for citronella for the existing area of citronella in the Gayo Lues District's cultivation area is 13,765.75 ha. There is potential land for the development of the citronella area of 44,509.4 ha. In general, citronella's actual land suitability in the Gayo Lues District is quite suitable (S2). In the marginal (S3) area of 57,731.3 (99.07%) with limiting factors are the danger of erosion (slope), temperature, water availability, and nutrient retention (CEC, base saturation, and soil reaction, and only two unsuitable (N) area of 544.1 ha with limiting factors for erosion (slope) hazards. Land suitability for Arabica coffee, the area of existing Arabica coffee in Gayo Lues District is 4,653.5 ha spread across seven subdistricts; there is potential land for developing Arabica coffee covering 44,111.8 ha. The actual land suitability of arabica coffee in Gayo Lues District is quite suitable (S2), and marginal (S3) area of 47,920.1 hectares with limiting factors are soil physical properties (effective depth), slope (s), and soil chemical properties (soil reaction, CEC, base saturation, and nutrients). Only LMU 079 covers 845.2 ha with an unsuitable limiting factor (s) (N).

Based on this study's results, it can be recommended that planting areas still need to be synchronized between Citronella, Arabica coffee, and other commodities in the area of cultivation. There is a need to do related research; citronella genotypes, soil management, fertilization, organic fertilizer sources, post-harvest handling, refined sere scent, and fuel innovation as energy sources. A good and efficient distillation device design is needed to increase the yield of citronella oil and develop Arabica coffee by adopting location-specific technology.

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