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Reevaluation of Land Suitability for Soybean Plants in North Sumatra, Indonesia

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Abstract. This study was designed to reevaluate the adjustment of land suitability classes. This study was conducted in North Sumatra Province, precisely in 4 regencies, namely Simalungun, Langkat, Deli Serdang, and Serdang Bedagai Regencies. The study used land suitability classes. Related to rooting media and nutrient retention parameters, the results of a semi-detailed land suitability study for soybean plants in Deli Serdang, Serdang Bedagai, and Langkat Regencies showed that the land was only marginally suitable (S3 rc, nr). In Simalungun Regency, efforts were made to increase the suitability of potential land to a marginally suitable class with the rooting media factor (S3 rc) and the water availability and nutrient retention factor (S3 wa, nr). This was done by attempting to increase the adaptability of potential land to a marginal suitability class with a water availability factor (S3 wa). The land suitability class in the research area for soybean plants includes the marginal suitability class (S3), so planting soybean commodities results in less than maximum production with limiting factors of rainfall and nutrition retention. To improve nutrient retention by adding organic materials, the limiting factor of rainfall is relatively high by creating drainage channels.

Keywords: adaptability; limiting factors; marginal suitability; maximum production

INTRODUCTION

Indonesia has a large area of agricultural land, both dry and wet, making it one of the largest agricultural countries in the world (Saputra & Syaifuddin, 2023). Indonesia's Gross Domestic Product (GDP) data is sourced from the Central Statistics Agency (BPS, 2022). With a contribution of 14.48 per cent in the second quarter, the agricultural sector continues to play a significant role in Indonesia's economic growth. In addition, the agricultural sector is very valuable economically and plays a role in preventing economic crises. This is due to the fact that agriculture is closely related to the basic needs of the community (Rusdiana & Talib, 2020) and because agriculture is a very important sector for maintaining food security, or food resilience, during economic crises (Yusuf et al., 2020).

Land use alterations have significantly impacted ecosystem stability in many regions and introduced challenges that necessitate a comprehensive assessment framework (Kong et al., 2021; Song et al., 2018). Land evaluation is a method to assess the potential of land resources. The results of the land evaluation will provide information and/or instructions on land use. The expected and estimated production value will be determined by the results of the land evaluation (Sudjud, 2018). Physical land suitability evaluation can be carried out using matching and scoring methods to determine the suitability of plants to grow and develop in an area. Suitability research with a higher level of evaluation is needed to achieve better production results (Naibaho, 2019).

Agricultural land in one area is not the same as in other areas based on the level of soil fertility and other attributes. Land production is influenced by soil fertility (Parjono, 2019). However, the suitability of the land for certain commodities must be known first to obtain optimal productivity. Increasing land productivity is very important, especially in the agricultural sector. One effort that can be made is to evaluate land characteristics to obtain relevant information about the development of agricultural commodities in an area. This

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is done by evaluating land suitability to determine the characteristics and quality of the land so that appropriate alternative crop commodities can be developed (Suryawan et al., 2020).

Evaluation of the suitability of food cropland can also add economic value to increase farmers' income and find limiting factors in developing land management systems to increase land productivity. Farmers cannot achieve optimal production levels because they lack data and information. Lack of data and information impacts the behavior of farmers who manage agricultural land, which may not or may not be by crop growth requirements. Lack of data also causes a lack of information on land use based on capability classes. In agricultural development, providing a database is very important (Manalu et al., 2020; Oktafianti et al., 2021; Suarjaya et al., 2017).

Organic matter content, soil pH, and nutrient content determine soil quality. Organic matter content ranges from very low to high, while soil pH tends to be slightly acidic to neutral. Total nitrogen and phosphorus content ranges from very low to very high, while potassium content ranges from very low to very high (Sidabutar et al., 2021).

The government has released many superior soybean varieties, but not many of these varieties have been adopted by farmers (Rozi, 2012). These superior varieties have a variety of yield potentials, harvest ages, seed sizes, seed colour, and adaptation areas. Generally, these varieties have high yields, are early maturing, have many branches, sturdy stems (do not fall over), pods will not break in hot weather, seeds are quite large (13 g 100 seeds) and round (Arsyad & Kuswantoro, 2017). Given the diversity of crop agroecology, these superior varieties need to be introduced and adapted to determine varieties that are suitable for development in the local environment and community and supported by a synergistic technology package.

Soybeans have become increasingly vital in residents' daily lives, as well as in food industry development and food security strategies, reaching a point where they are deemed irreplaceable (Siamabele, 2021). After joining the WTO in 2001, China's soybean market has progressively liberalized, leading to a continuous rise in imports. Currently, China stands as the largest consumer and trader of soybeans worldwide. In recent years, Chinese soybean imports have stabilized at around 100 million tons annually, with a foreign dependence rate exceeding 85%. The United States and Brazil account for about 85% of these imports, which has been posing considerable challenges to achieving national food security strategic objectives (Fu et al., 2021; Zhu et al., 2023).

Indonesia's soybean production is very volatile and shows a downward trend. Based on data from the National Food Authority from January to December 2023, domestic soybean production only reached approximately 355 thousand tons, while market demand and needs reached 2.7 million tons. As a result, soybeans are one of the foods the government must pay attention to to achieve food self-sufficiency.

Although the primary commodities cultivated in tidal areas are food crops such as corn and rice, cultivating soybeans in tidal swamps can be very profitable for farmers and the soybean industry in Indonesia if appropriately managed. However, the prospects for cultivating soybeans (*Glycine max* L.) in tidal swamps also have (Faadhilah et al., 2024).

Indonesia imported 2.49 million tons of soybeans, with a value of US$ 1.48 billion in 2021. The Central Statistics Agency in 2022 stated that the development of soybean production over the past ten years (2013-2021) fluctuated, with the area of soybean harvests decreasing from 2015 to 2021. Farmers are incentivised to plant soybeans because domestic soybean prices cannot compete with foreign soybean prices, which causes a decline in harvested areas. A very

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high level of soybean consumption is seen in Indonesia.

This is not expected, considering that soybeans are used to make two of the country's most popular foods, tofu and tempeh 3 million tons of soybeans must be distributed locally regularly. Domestic soybean production and supply estimate is 500–750 tons per year. At that time, public experts made a major contribution to solving social problems. In fact, the amount of imported soybeans has recently increased. Soybean imports amounted to 2.58 million tons in 2018 and 2.67 million tons in 2019. Between January and October 2020, Indonesia will import soybeans from the United States. The transaction value equivalent to 1.92 million tons is US$ 762 million or almost Rp 10.6 trillion.

Soybean import volume in the last 10 years

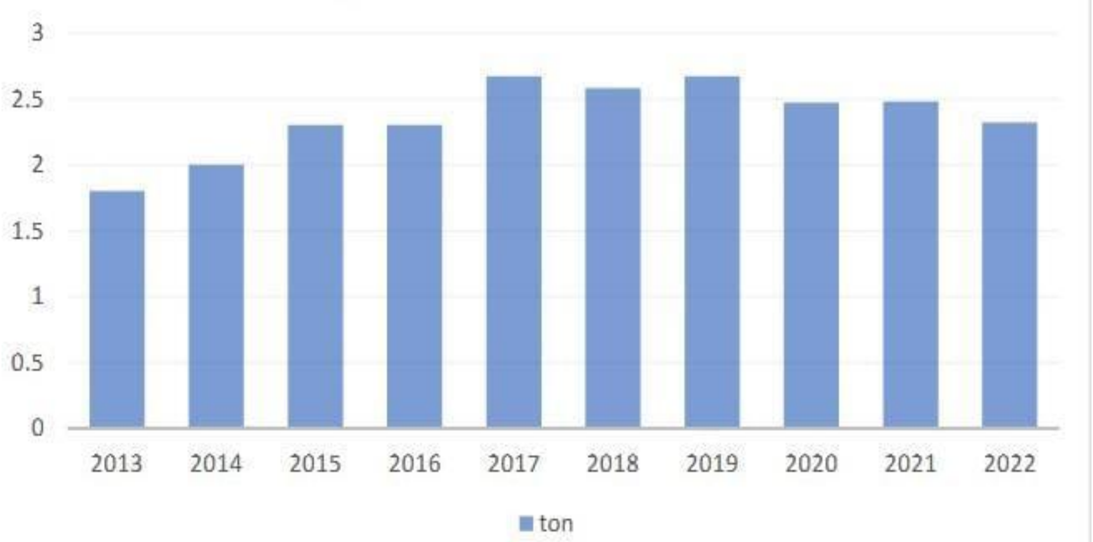

Figure 1. Soybean import volume in the last 10 years

The estimated decline in Indonesian soybean production in 2022 is 3.05% or 594.6 thousand tons. Since then, annual soybean production has decreased by 3.09% to 576.3 thousand tons. Since then, the amount of soybeans leaving Indonesia has decreased by 3.12% to 558.3 thousand tons in 2024.

Table 1. Soybean production in Indonesia

Number	Year	Production (tons)
1	2018	650.000
2	2019	424.189
3	2020	632.326
4	2021	613.318
5	2022	594.629
6	2023	576.278
7	2024	558.293

Source: BPS (2022)

In recent years, the value of soybeans imported into Indonesia has continued to change, depending on a certain direction. Although the total increased in 2021, the import value decreased compared to 2018 and 2020. It should be noted that Indonesia's soybean imports reached a record high in 2021. Soybean imports will reach their lowest point in 2022.

In addition to its many other uses, North Sumatra soybeans are the primary source of tofu, tempeh, soy sauce, tauco, and other snacks that have long been loved and favored by the local population. In North Sumatra, where the total amount of soybeans needed is 1.2-1.56 tons per hectare, the amount of soybeans available is still below standard. In addition, North Sumatra soybeans are of lower quality than imported soybeans, which affects their quality.

In addition to the fluctuating and low price of soybeans at the farmer level, which

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is the main cause of farmers' lack of interest in planting soybeans, the low production of soybeans in North Sumatra is also caused by low productivity at the farmer level, averaging only 13.78 quintals/ha. In fact, the production potential of several superior varieties can reach 20.00 to 35.00 quintals/ha because location-specific technology has not been implemented.

Another element that affects the availability of North Sumatra soybeans is the volume of imports; because the country is dependent on imports, global price changes significantly impact North Sumatra's supply. Since all retail soybeans are mostly imported from the United States, obtaining local soybeans is no longer possible, which also impacts the domestic market. Since Indonesia, a soybean-producing country, buys a lot of soybeans, this is the opposite. Ultimately, this leads people to believe that North Sumatra's inadequate soybean production is the reason for the imports.

The need for soybeans (*Glycine max* L) in Indonesia continues to increase from year to year along with population growth and improvements in per capita income. The fulfilment of soybean needs in Indonesia of 67.28% or 1.96 million tons must be imported from abroad. This is because domestic production is unable to meet the demand of domestic soybean-based food producers. Soybean production in Indonesia in the period 1980-2016 fluctuated and tended to increase with an average growth of 2.63% per year. Based on data from the BPS (2021), national soybean production from 2019 to 2021 was 687,151 tons per year.

Research conducted by (Sidabutar et al. 2021) found that through the analysis of land suitability for food crops in the research area, actual land suitability, potential land suitability, limiting factors, and improvements in each homogeneous land unit with each commodity evaluated. Limiting factors for all Homogeneous Land Units (SLH) in general include temperature, rock outcrops, erosion hazards, drainage, texture, slope, pH, total N, available P2O5, available K2O, surface rocks, base saturation, and rainfall. The limiting factors of temperature and texture cannot be improved because they are permanent limiting factors. Rainfall is improved by improving irrigation (for areas with rice field land use) and making reservoirs (for areas with non-rice field land use) (Heryani & Rejekiningrum, 2019). Drainage is improved by making drainage channels. Base saturation and acidity (pH) are improved by adding organic matter. Total N is improved by urea fertilization (Kogoya et al., 2018). Available P_2O_5 is improved by giving SP36 and TSP fertilizers (Sirait & Siahaan, 2019). Available K_2O is improved by KCl fertilization. Slopes are improved by making terracing (Erosion hazards are improved by planting parallel to the contour and planting land cover (Harahap et al., 2018).

METHODS

Phase I research re-evaluates land suitability class modifications in North Sumatra Province, namely in 4 districts: Simalungun Regency (2°43'9.40"N, 98°59'46.78"E), Langkat Regency (3°42'38.49"N,98°25'55.67"E), Deli Serdang Regency (3°36'57.43"N, 98°53'19.20"E), and Serdang Bedagai Regency (3°33'11.96"N, 99°1'21.23"E). The research was conducted from May to July 2024.

The tools and materials utilized in this study are typical tools and materials for land surveys and laboratory work of the Department of Soil Science, University Sumatera Utara. The resources used include topographic maps, soil maps, land use maps, and other maps relevant to the inquiry. A GPS (Global Positioning System) is used to locate the research area and measure the elevation of the site; a soil drill is used to gather soil samples and measure effective soil depth in the field; an abney level is used to measure slope; and a set of instruments for soil analysis is used in the laboratory.

A five-stage investigation approach is used in this study: preparation, preliminary investigation, main investigation, laboratory

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soil analysis, and data processing. The five steps of the survey approach used in this study are preparation, pre-survey, main survey, laboratory soil analysis, and data processing**.** At this stage, the components of the selected land units are examined, and the accuracy of the information on land units and soils that are useful for determining land suitability is ensured. In general, observations include landforms, slope gradients, and land use.

The physical environment, or land features that affect its use, such as slope, vegetation, elevation, erosion, flooding, landforms, surface rocks and rock outcrops, and parameters in the land suitability class criteria for certain crops, are all included in field observations. The soil sampling is performed after observation on the ground. Soil sampling is performed by excavation in the selected area of the grounding unit. When the land use unit map displays the location of the land chosen unit. Soil excavation is used to determine the soil property values of soil samples at depths of 0-30 cm and 0-60 cm. In the laboratory, soil analysis is used to determine the chemical properties of soil.

The profile hole-making allows field studies of soil characteristics such as colour, drainage, effective depth, and erosion. Finding signs of water influence on the soil cross-section is the basis for field drainage observations based on differences in drainage classes. These signs include rusty, grey, or light-coloured spots. The effective depth indicator can be used to observe the effective depth. The effective depth of the soil layer is the depth to which roots can grow. Then each soil sample is air-dried and ground for analysis in the soil laboratory University Sumatera Utara

In the laboratory, soil samples were taken at 4 research locations, namely Pondok Buluh Village, Banyumas Village, Sidodadi Ramunia Village, Sungai Sei Sejenggi Village and analyzed to determine the following: (1) soil texture; (2) organic C analysis; (3) soil CEC analysis; (4) soil pH analysis; (5) available P analysis; and (6) total N analysis.

Information collected from field and laboratory analysis on geographical features in the study area is only arranged in tabular form. The land suitability classification system used is divided into several subclass levels. By using GIS software, the results of land suitability for soybean crop commodities are displayed in tabular form. In addition, potential and actual land suitability maps are also provided. Land suitability assessment uses a matching system to compare land characteristics with plant growth requirements set out in the Technical Instructions for Land Assessment for Agricultural Products. Plant growth requirements are the criteria for assessing land suitability.

RESULTS AND DISCUSSIONS

Land Characteristics of Deli Serdang Regency

Table 1 shows that the actual land suitability for soybean plants in Deli Serdang Regency, as determined through semi-detailed examination, is only marginally acceptable with regard to the rooting media and nutrient retention variables (S_3 rc, nr). The rooting media factor (S3 rc) is used to increase the potential for land adaptation to a marginally acceptable class.

By applying fertilizer according to the plant's needs, the limiting factor of total soil nitrogen can be improved with a simple level of management. The nitrogen availability in the soil during the study period was 0.12%, and the predicted total nitrogen requirement of soybean plants for a very acceptable standard was 0.51%, which is an additional contribution of 0.39%, i.e., 78 kg.ha-^{1} (N/ha-1) or 175.233 kg.ha-^{1} (urea/ha-^{1}), was required. To overcome the needs of microorganisms and the loss of N nutrients, the average amount of fertilizer needed for soybean plants in the area must be increased by 25%, which means an additional 96 kg.ha-^{1} (N/ha-^{1}) or 216.54 kg.ha-^{1} (urea/ha-^{1}) of fertilizer is needed. Therefore, from a very suitable class (S_2), the suitability for total N becomes very suitable (S_1).

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Table 1. Assessment of land suitability for soybean plants (*Glycine max*) in Deli Serdang Regency

Land Characteristics	Mark	Land Suitability Actual	The Greatest Limiting Factor	Repair Efforts		Land Suitability Potential
				Inp	TP	
Temperature Regime (tc)		**S2**	**Tc**			**S2**
Average Temperature (°C)	25.5	S2				
Water Availability (wa)		**S2**	**Wa**			**S1**
Rainfall During Growing Period (mm)	2066	S2		D	S	
Average Humidity(%)	72	S1				
Oxygen Availability (wa)		**S1**				
Drainage	Good	S1				
Rooting Media (rc)		**S3**	**rc**			**S3**
Soil Texture	A bit rough	S3				
Coarse Material (%)	30,2	S2				
Soil Depth (cm)	103	S1				
Nutrient retention (nr)		**S3**	**nr**			**S1**
KTK Land (me/100g)	27.50 (T)	S1				
Base Saturation (%)	42.50	S1				
pH H_2O	5.51	S1				
C-Organic (%)	0.53	S3		O	S	
Availability of Nutrients (na)		**S2**	**na**			**S1**
N-Total (%)	0.12 (R)	S2		P	S	
P_2O_5 Bray II (ppm P)	16.30 (ST)	S1				
K-Swap (me/ 100 g)	0.671 (T)	S1				
Erosion Danger (eh)		**S1**				
Slope (%)	< 2	S1				
Erosion Danger	SR	S1				
Flood Danger (fh)		**S1**				
Flood Period	F0	S1				
Land Preparation (lp)		**S1**				
Surface Rocks (%)	0	S1				
Rock Outcrop	0	S1				
Land Suitability Results		**S3 rc, nr**				**S_3 rc**

Information : S1 = Very Suitable TP = Management Level O = Organic Materials
S2 = Quite Appropriate S = Currently R = Low T = Tall
S3 = Quite Appropriate P = Fertilization Inp = Input D = Drainage

Providing organic matter can provide adequate control of the limiting factor of organic C. To achieve the estimated organic C requirement of 3% for soybean plants with very good criteria, an addition of 2.47% is required, or 45.3 tons of C/ha-^{1} or 81.6 tons of organic matter/ha-^{1}, because the amount of organic C in the soil during the study was 0.53%. Therefore, the criteria for the organic C land suitability class are now in the very suitable class (S_1) and not the fairly suitable class (S_3).

Land Characteristics in Serdang Bedagai Regency

Based on the results of a semi-detailed study of land suitability reevaluation for soybean plants in Serdang Bedagai Regency, it is known that land suitability is actually very suitable only for the rooting and nutrient retention limiting parameters (S_3 rc, nr). The rooting limiting factor (S_3 rc) is used to try to increase the adaptive capacity of the land to a marginally acceptable level.

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Table 2. Assessment of land suitability for soybean plants (*Glycine max*) in Serdang Bedagai Regency

Land Characteristics	Mark	Land Suitability Actual	The Greatest Limiting Factor	Repair Efforts		Land Suitability Potential
				Inp	TP	
Temperature Regime (tc)		S2	tc			S2
Average Temperature (°C)	25.2	S2				
Water Availability (wa)		S1				
Rainfall During Growing Period (mm)	1440	S2				
Average Humidity(%)	73.5	S1				
Oxygen Availability (wa)		S1				
Drainage	Good	S1				
Rooting Media (rc)		S3	rc			S3
Soil Texture	A bit rough	S3				
Coarse Material (%)	25	S2				
Soil Depth (cm)	102	S1				
Nutrient retention (nr)		S3	nr			S1
KTK Land (me/100g)	17.44 (S)	S1				
Base Saturation (%)	35.47	S1				
pH H_2O	5.72	S1				
C-Organic (%)	0.48	S3		O	S	
Availability of Nutrients (na)		S2	na			S1
N-Total (%)	0.18 (R)	S2		P	S	
P_2O_5 Bray II (ppm P)	13.20 (T)	S1				
K-Swap (me/ 100 g)	0.543 (S)	S1				
Bahaya erosi (eh)		S1				
Slope (%)	< 2	S1				
Erosion Danger	SR	S1				
Flood Danger (fh)		S1				
Flood Period	F0	S1				
Land Preparation (lp)		S1				
Surface Rocks (%)	0	S1				
Rock Outcrop	0	S1				
Land Suitability Results		**S3 rc, nr**				**S_3 rc**

Information: S1 = Very Suitable, S2 = Quite Appropriate, S3 = Quite Appropriate; TP = Management Level, S = Currently, P = Fertilization; R = Low, Inp = Input; O = Organic Materials, T = Tall, D = Drainage

A simple level of management can increase the total limiting factor of N in the soil by applying fertiliser based on plant needs. A supplement of 0.33%, or 66 kg.ha-1 (N/ha-1) or 142.10 kg.ha-1 (urea/ha-1), is necessary because the total N availability in the soil during the study was 0.18%. In contrast, the total N requirement predicted for soybean plants based on very good criteria is 0.51%. An additional 82 kg.ha-1 (N/ha-1), or 186.11 kg.ha-1 (Urea/ha-1), is needed to meet the needs of microorganisms and N nutrient losses, which requires an average addition of 25% of the total fertilizer needed for soybean plants in the area. Therefore, from a fairly suitable class (S_2), the suitability for total N becomes very suitable (S_1).

Land Characteristics in Simalungun Regency

Marginal suitability with water availability and nutrient retention variables (S_3 wa, nr) is part of the results of a semi-detailed land suitability study for soybean plants in Simalungun Regency. The water availability factor (S_3 wa), by trying to increase the suitability of prospective land to a marginal suitability class. Fertilization in accordance with the needs of plants, a simple

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level of control can increase the limiting coefficient of the soil N-Total.

Since the availability of a total in the soil during the study was 0.15% and the estimated total requirement of nys for the very acceptable criteria was 0.51%, the addition of 0.36% or 66 kg.ha-[1] of n/ha-1 or 132.33 kg.ha-[1] of urea/ha-[1] was necessary. To compensate for microbial needs and nutrient losses, an additional input of 82 kg.ha-[1] (N/ha-[1]) or 172.18 kg.ha-1 (urea/ha-[1]) was required, which was an average of 25% of the total fertilizer required for soybean plants in the area, thus moving the general N suitability class from very suitable to very suitable (S_1).

Table 3. Assessment of land suitability for soybean plants (*Glycine max*) in Simalungun Regency

Land Characteristics	Mark	Land Suitability Actual	The Greatest Limiting Factor	Repair Efforts		Land Suitability Potential
				Inp	TP	
Temperature Regime (tc)		**S2**	**tc**			**S2**
Average Temperature (°C)	21.3	S2				
Water Availability (wa)		**S3**	**wa**			**S3**
Rainfall During Growing Period (mm)	1870	S3		D	S	
Average Humidity (%)	88	S3				
Oxygen Availability (wa)		**S1**				
Drainage	Good	S1				
Rooting Media (rc)		**S1**				
Soil Texture	A bit rough	S1				
Coarse Material (%)	9	S1				
Soil Depth (cm)	102	S1				
Nutrient retention (nr)		**S3**	**nr**			**S1**
KTK Land (me/100g)	25.23 (S)	S1				
Base Saturation (%)	36.2	S1				
pH H_2O	4.33	S3		K	S	
C-Organic (%)	0.71	S3		O	S	
Availability of Nutrients (na)		**S2**	**na**			**S1**
N-Total (%)	0.15 (R)	S2		P	S	
P_2O_5 Bray II (ppm P)	10.31 (S)	S2		P	S	
K-Swap (me/ 100 g)	0.553 (S)	S1				
Erosion Danger (eh)		**S1**				
Slope (%)	< 2	S1				
Erosion Danger	SR	S1				
Flood Danger (fh)		**S1**				
Flood Period	F0	S1				
Land Preparation (lp)		**S1**				
Surface Rocks (%)	0	S1				
Rock Outcrop	0	S1				
Land Suitability Results		**S3 wa, nr**				**S_3 wa**

Information : S1 = Very Suitable; S2 = Quite Appropriate; S3 = Quite Appropriate; TP = Management Level; S = Currently; P = Fertilization; R = Low; Inp = Input; O = Organic Materials; T = Tall; D = Drainage

Land Characteristics of Langkat Regency

Marginal suitability with rooting media and nutrient retention factors (S_3 rc, nr) are presented in the table above presents the results of semi-detailed land suitability reevaluation for soybean plants in Langkat

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Regency against real land suitability. With efforts to increase prospective land suitability to marginal suitability class with root media characteristics (S_3 rc).

Fertilization, according to plant needs, can increase the limiting factor of total nitrogen in the soil at simple management levels (Parjono, 2019). Soil nitrogen availability during the study period was 0.12%, while soybean plants' predicted total nitrogen requirement was 0.51%, which is an excellent benchmark, so an additional 0.39% or 82 kg.ha-^{1} (N/ha-^{1}) or 186.31 kg.ha-^{1} (urea/ha-^{1}) was required.

Table 4. Assessment of land suitability for soybean plants (*Glycine max*) in Langkat Regency

Land Characteristics	Mark	Land Suitability Actual	The Greatest Limiting Factor	Repair Efforts		Land Suitability Potential
				Inp	TP	
Temperature Regime (tc)		**S2**	**tc**			**S2**
Average Temperature (°C)	25.2	S2				
Water Availability (wa)		**S2**	**Wa**			**S2**
Rainfall During Growing Period (mm)	1800	S3		D	S	
Average Humidity (%)	82	S2				
Oxygen Availability (wa)		**S1**				
Drainage	Good	S1				
Rooting Media (rc)		**S3**	**Rc**			**S3**
Soil Texture	A bit rough	S3				
Coarse Material (%)	24	S2				
Soil Depth (cm)	112	S1				
Nutrient retention (nr)		**S3**	**Nr**			**S1**
KTK Land (me/100g)	21.58 (S)	S1				
Base Saturation (%)	34.24	S1				
pH H_2O	6.55	S1				
C-Organic (%)	0.67	S3		O	S	
Availability of Nutrients (na)		**S2**	**Na**			**S1**
N-Total (%)	0.12 (R)	S2		P	S	
P_2O_5 Bray II (ppm P)	9.83 (S)	S2		P	S	
K-Swap (me/ 100 g)	0.671 (T)	S1				
Erosion Danger (eh)		**S1**				
Slope (%)	< 2	S1				
Erosion Danger	SR	S1				
Flood Danger (fh)		**S1**				
Flood Period	F0	S1				
Land Preparation (lp)		**S1**				
Surface Rocks (%)	0	S1				
Rock Outcrop	0	S1				
Land Suitability Results		**S3 rc, nr**				**S_3 rc**

Information : S1 = Very Suitable; S2 = Quite Appropriate; S3 = Quite Appropriate; TP = Management Level; S = Currently; P = Fertilization; R = Low; Inp = Input; O = Organic Materials; T = Tall; D = Drainage

To meet the microbial needs and losses of nutrient nitrogen, the total amount of fertilizer required for soybean plants at this location would have to be increased by an average of 25%. This would mean the addition of fertilizers of 110 kg.ha-^{1} (N/ha-^{1}) or 237.19 kg.ha-^{1}. Thus, from the very moderate class (S_2), the total nitrogen adequacy went to the very moderate class (S_1), and since the availability of organic carbon in the soil at the time of the study was 0.67%, "an additional 2.33% was required (the standard was very adequate, 3% was required)" corresponds to 49.6 tons of

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carbon/ha-[1] or 84.6 tons of organic matter/ha. Therefore, the land suitability class criteria for organic carbon moves from a low suitability class (S_3) to a very high suitability class (S_1).

Soybean Plant Land Suitability Assessment

Figure 1 shows the percentage of C-Organic land suitability in several regencies is highest in Simalungun Regency with a value of 0.71% and the lowest is in Serdang Bedagai Regency with a value of 0.48% while the highest N-Total value is in Serdang Bedagai Regency 0.18% and the lowest in Langkat and Deli Serdang Regencies.

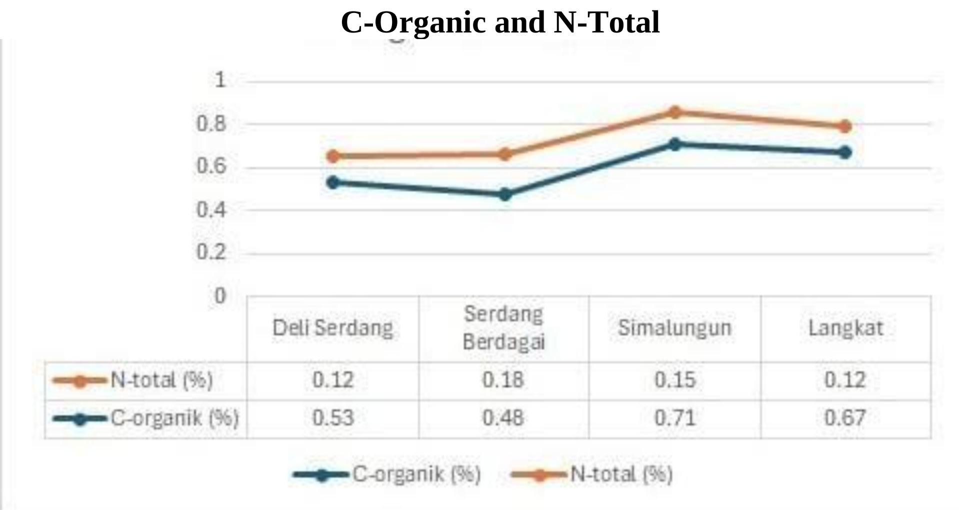

Figure 1. Graph of land suitability for organic-C and total-N

CONCLUSION

Reevaluation of land suitability regarding rooting media and nutrient retention elements for soybean plants in Deli Serdang, Serdang Bedagai and Langkat Regencies is still fairly suitable (S_3 rc, nr). Therefore, efforts have been made to improve potential land suitability. Reevaluation of land suitability in elements such as nutrient retention and water availability (S_3 wa, nr) for soybean plants is found in Simalungun Regency. Efforts to improve potential land suitability to a marginally suitable class with water availability factors (S_3 wa, nr). Reevaluation of marginal suitability class (S_3) includes land suitability class for soybean plants in the research area. Planting soybean commodities produces less production with limiting factors of rainfall and nutrient retention. The addition of organic matter can increase nutrient retention, and the creation of drainage channels can increase rainfall's limiting factor.

It is expected that the findings of this study can provide information to farmers about land suitability and various limiting factors for soybean plants so that they can be used as a reference for providing management recommendations to optimise soybean production in North Sumatra. In further research, soybean planting can be carried out on land that has been assessed for land suitability, and it is hoped that the local district government will assist in improvements in land characteristics. In several districts, limiting factors are classified as S3 (marginal suitable). This land is one that has quite severe limiting factors that have productivity, requiring additional input that is greater than land classified as S2. High capital is needed to overcome the limiting factors in S3, so it is necessary to provide assistance from government or private sector intervention because farmers cannot overcome it.

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