

Land Suitability Evaluation of Maize Crop in Tilamuta Ditriect of Boalemo Regency

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Abstract

This study aims to determine the land suitability class and limiting factors for maize (Zea mays L.) in Tilamuta District, Boalemo Regency. The study will take place from August 2025 to September 2025 in Tilamuta District, Boalemo Regency. The method used in this study is the matching method, or matching between land characteristics and quality with the criteria for maize land suitability. The results of the analysis show that the actual land suitability for maize plants in Tilamuta District, Boalemo Regency, is in the marginal suitability class (S3) and is spread across all land units. This condition is influenced by several main limiting factors, namely low nutrient availability, rainfall, soil nutrient retention capacity, slope gradient, and erosion hazard levels. However, for potential land suitability, the application of various improvement efforts such as fertilization, liming, adding organic materials, implementing a planting system that follows the contour, and intensive terracing can increase the land suitability class to fairly suitable (S2).

Keywords : Land suitability, actual, potential, maize.

INTRODUCTION

Corn (Zea mays L.) is one of the world's most important food crops after wheat and rice. Corn has high economic value and development opportunities due to its role as a primary source of carbohydrates (Sulistyaningsih, 2019). Corn not only functions as a food source, but also as



animal feed and other industrial materials. (Fitria et al., 2017). In Indonesia, corn is a vital food source after rice. In some regions, this commodity is even a staple food. This is because, in addition to having almost the same calorie content as rice, corn also has a higher fat content. (Husain et al., 2006)

Boalemo Regency is one of the major corn-producing regions, with a harvested area of 29,224 hectares. Although Boalemo Regency is not known as a corn-producing region, it contributes to the economic growth of Gorontalo Province through this commodity. (Mohi et al., 2008). Tilamuta District is one of the districts in Boalemo Regency, Gorontalo Province, where the majority of the population works as farmers. This sub-district also has the smallest agricultural area compared to other sub-districts in Boalemo Regency. Tilamuta District only has dryland farming areas and no wetlands. Most farmers grow annual, seasonal, and horticultural crops on their 3,546.5 hectares of agricultural land. (Putri & Mustofiq, 2022).

Dryland agroecosystems have enormous potential for agricultural activities. (Nurdin, 2011). Boalemo Regency has 42.69% of its total area as dry land (Putri and Mustofiq, 2022). The increase in corn production at the national level has not been in line with the increase in corn productivity per unit of land, because corn is planted on land that does not meet quality standards. (Nurdin et al., 2021)

The corn production results obtained have not shown an optimal level of equality, even though the implementation of cultivation management is relatively uniform, resulting in an imbalance between corn production and the area of land cultivated. This condition is partly caused by the limited knowledge of farmers regarding the level of suitability of the land used, whether the land is suitable or not for corn cultivation, which ultimately affects the level of crop productivity. This study aims to determine the land suitability class and limiting factors for corn plants (*Zea mays* L.) in Tilamuta District, Boalemo Regency. Based on these problems, an analysis of land suitability for corn crops in Tilamuta District is needed to identify land suitability classes and limiting factors that have the potential to influence corn crop productivity.



MATERIALS AND METHODS

MATERIALS

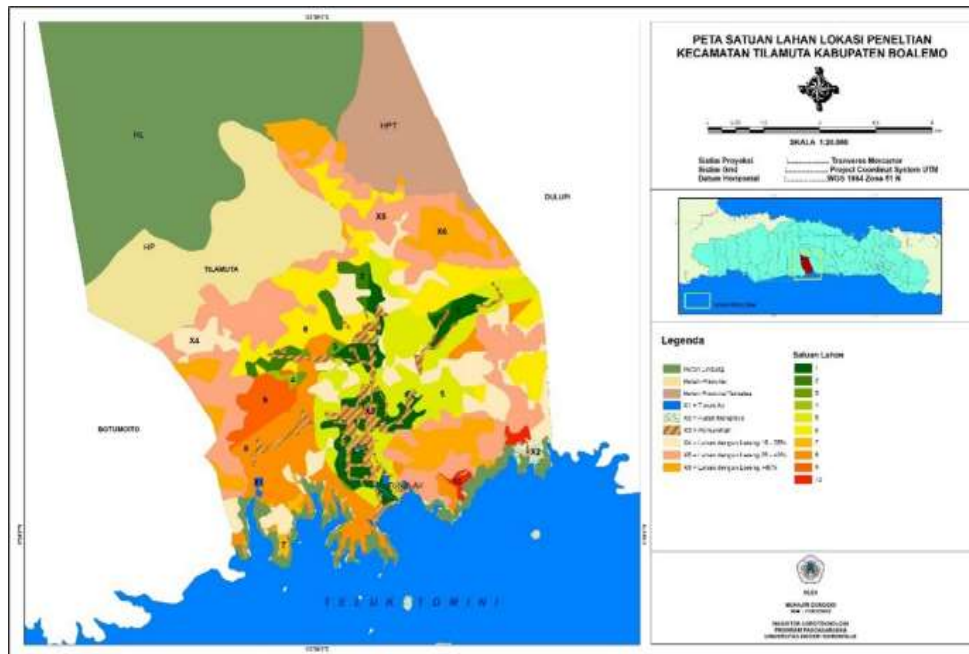


Figure 1. Land Unit Map at the Research Location

Metode

The research location has ten land units used for the comparison method, also known as matching. The land map units consist of overlapping geological maps, landforms, slopes, and dryland land use maps. Next, data collection took place. In this study, two types of data were collected: secondary data and primary data. Land suitability classes were analyzed using the matching method, which compares the results of the analysis of land characteristics and quality at the research location with the land suitability class criteria used as a reference, in this case the land suitability criteria of Ritung (2011). After the land suitability class for each land unit is determined, the next step is to identify limiting factors in corn cultivation, formulate efforts to eliminate or reduce these limiting factors, and determine the potential land suitability class.

Observed parameters included drainage, coarse material, soil depth, erosion hazard, soil CEC, base saturation, pH H₂O, salinity, alkali, surface rocks, and rock outcrops. Data analysis was then conducted to determine the characteristics and quality of the land at the location according to the Maximum Limiting Factor criteria used in the maize land suitability maize process. The criteria for land suitability for corn plants are listed in Table 1.

Table 1. Land Suitability Criteria for Corn (Zea mays L.)

Land characteristics	Land suitability class			
	S1	S2	S3	N
Temperature (tc)				
Average Temperature (°C)	20-26	26-30	16 -20 30-32	<16 >32
Water availability (wa)				
Annual rainfall (mm)	900-1200	1200-1600 500-900	>1600 300-500	<300
Humidity (%)	>42	36-42	30-36	<30
Oxygen availability (oa)				
Drainage	Good, Medium	Quite fast, somewhat hampered	Hampered	Very hampered, Very fast
Rooting media (rc)				
Texture	Smooth, Rather subtle, Medium	Smooth, Rather subtle, Medium	A bit rough	rough
Coarse material (%)	<15	15-35	35-55	>55
Soil depth (cm)	>60	40-60	25-40	<25
Nutrient retention (nr)				
Soil Cation Exchange Capacity (me 100g ⁻¹)	>16	5-16	<5	
Base saturation (%)	>50	35-50	<35	
pH H ₂ O	5,8-7,8	5,5-5,8 7,8-8,2	<5,5 >8,2	
C-organic	>1,2	0,8-1,2	<0,8	
Available Prices (na)*				
N total (%)	Medium	low	very low	
P ₂ O ₅ (mg 100 g ⁻¹)	light	Medium	low - very low	
K ₂ O (me 100g ⁻¹)	light	Medium	low - very low	
Danger of erosion (eh)				
Slope (%)	<3	3-8	8-15	>15
Danger of erosion	There isn't any	Very light	low - Medium	heavy - very heavy
Land preparation (ip)				
Rocks on the surface (%)	<5	5-15	15-40	>40
Rock outcrop (%)	<5	5-15	15-25	>25

Information; (Ritung *et al.*, (2011)


RESULTS AND DISCUSSION

Actual Land Suitability



Actual land suitability is an assessment of land characteristics before a survey is conducted and before improvements are made. This condition includes limiting factors that existed before land improvement actions to address deficiencies or weaknesses were taken, as well as their relationship to minimum growth criteria for crops.

Table 1. Land Suitability Class for Corn Commodities

SPL	KKLA	Limiting Factors	Improvement Efforts	KKLP	Area (ha)	Persentase (%)
1,2,3 dan 4	S3wa,nr,na	Rainfall Base saturation and pH Nutrients N and P	Irrigation system liming and addition of organic materials Fertilization of N and P elements	S2	492.7	16.23
9	S3wa,na,eh	Rainfall Nutrient P Slopes and erosion hazards	Irrigation system Fertilization with P elements Planting parallel to the contour and making terraces	S2	174.6	5.75
5,6,7,8,10	S3wa,nr,na,eh	Curah hujan Base saturation, pH, C- organic Nutrient P Slopes and erosion hazards	Irrigation system Liming and addition of organic matter Fertilization with P elements Planting parallel to the contour and making terraces	S2	2368.1	78.01
Total						100%

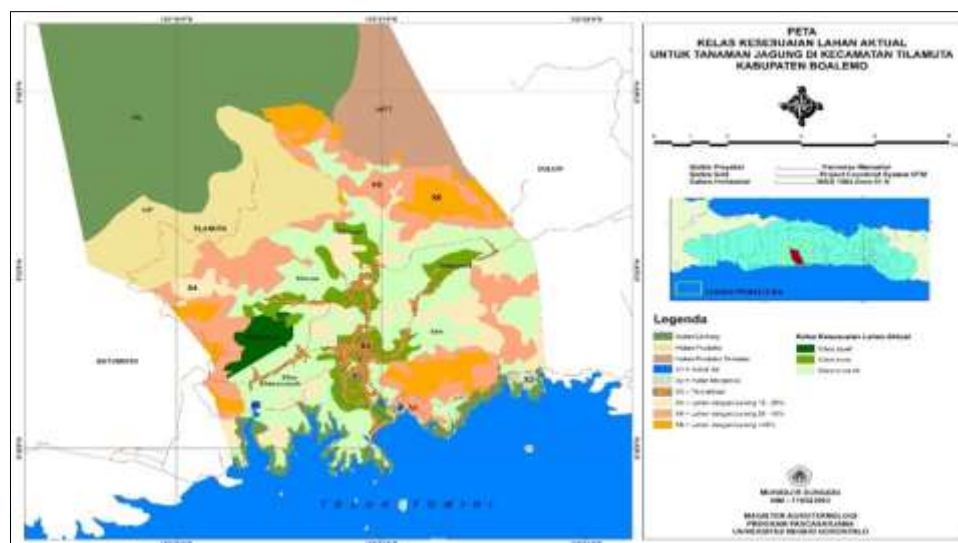


Figure 2. Actual Land Suitability Class Map for Corn Plants



Actual land suitability (S3) (marginally suitable) can be divided into three subclasses based on the following characteristics S3 (Marginally Suitable). The S3 subclass, with various limiting factors, is spread across a number of land units with different biophysical characteristics. Subclass S3 (wa, nr, na) is found in SPL 1, 2, 3, and 4, covering 492.7 ha, or approximately 16.23% of the total land units. This subclass is limited by high average annual rainfall of 2,061 mm, low base saturation, a soil reaction that tends to be slightly acidic, and very low nitrogen (N) and phosphorus (P) content. Furthermore, subclass S3 (wa, na, eh) is found in SPL 9, covering approximately 174.6 ha, or 5.75% of the total land units. The main limiting factors in this subclass include relatively high rainfall, very low P nutrient content, slightly sloping slope conditions, and a moderate level of erosion hazard. Meanwhile, subclass S3 (wa, nr, na, eh) is the most widely distributed subclass, covering SPL 5, 6, 7, 8, and 10 with a total area of 2,368.1 ha or approximately 78.01% of the total land unit. This subclass is influenced by a combination of various limiting factors, including an average annual rainfall of 2,061 mm, low base saturation, slightly acidic soil pH, very low organic C content, low N and P nutrients, slightly sloping slope conditions, and a moderate level of erosion hazard.

LIMITING FACTORS

Available Nutrients

In this study, the availability of nitrogen (N) and phosphorus (P) nutrients plays a crucial role in determining the suitability of the land for corn. Very low nutrient levels in certain soils can potentially inhibit plant growth, characterized by stunting, small leaves, and yellowing of the leaves. This condition can be addressed through appropriate fertilization. Fertilization generally aims to maintain or increase soil fertility, thereby supporting faster, more optimal, and healthier plant growth (Kriswantoro et al., 2016). Furthermore, Hartati et al. (2018) stated that the limiting factor of low nutrient availability (Na) can be minimized through the application of organic and inorganic fertilizers. The combination of inorganic and organic fertilizers, especially on sandy soils or areas experiencing high erosion, can reduce nutrient loss due to rainwater leaching and suppress erosion rates.

Rainfall.

The average rainfall in Tilamuta District, at 2,061.6 mm/year, falls into land suitability class S3 (marginally suitable), while the average length of dry months, at four months, falls into land suitability class S2. These limiting factors related to water requirements can be addressed through appropriate water management. Relatively high rainfall has the potential to cause





waterlogging in corn crops, which can then stunt plant growth and hinder the plants' ability to absorb nutrients optimally.

Addressing the limiting factor of rainfall is challenging because it depends heavily on farmers' knowledge and financial capacity. Furthermore, water availability, determined by annual rainfall and the length of dry months, is a factor whose improvement is heavily influenced by climate variability and change. An alternative improvement measure to address the limitations of rainfall and dry months is the development of an irrigation system with a moderate to high level of management.

Asnur (2020) stated that developing irrigation systems can be used to anticipate low rainfall conditions, while improving drainage systems plays a role in addressing excess rainfall. Furthermore, the creation of water absorption holes, including biopore absorption holes (LRB), can help reduce excess water caused by high rainfall. In general, corn plant growth is strongly influenced by climatic conditions, particularly rainfall and the duration of dry months.

Nutrient Retention

One of the main limiting factors in land suitability for corn is low nutrient retention capacity. This condition is reflected in the corn land suitability class, which is S3 (marginally suitable), with soil characteristics such as low organic carbon content, low base saturation, and an acidic soil reaction. Relatively high rainfall accelerates the leaching of soil bases, limiting the availability of base cations and dominating acid cations. Furthermore, low organic carbon content results in the soil having a low capacity to retain water and nutrients.

Slope and Erosion Hazards

Slope gradient is one of the limiting factors in land suitability for corn in this study, with a land suitability class of S3 (marginally suitable). Slope conditions, which are sloping to undulating, with gradients ranging from 8–15%, significantly impact the sustainability of land use for corn cultivation. Planting corn on land with gradients greater than 8%, has the potential to reduce productivity due to accelerated land degradation, particularly due to the increased risk of soil erosion.

Efforts to address the limiting factors of slope and erosion hazards can be implemented through the application of soil conservation techniques, such as terracing or contour-based cropping patterns. Like rainfall, slope gradient also plays a significant role in increasing the potential for soil erosion. Therefore, improvement efforts with a relatively high level of



management are required, including contour-aligned planting systems, which have proven effective in reducing erosion hazards, particularly on land units with marginally suitable slopes.

Sitepu et al. (2017) stated that the steeper the slope, the greater the risk of erosion and landslides, especially during high rainfall conditions. The implementation of cover crops, terracing, and contour-aligned planting systems can be solutions to reduce these risks. This aligns with Notohadiprawiro's (2006) opinion, which emphasizes that land use for conservation purposes can be achieved through the creation of terraces or ridges, contour-aligned planting, and the use of cover crops, all of which aim to improve soil structure and reduce surface runoff that can potentially cause erosion.

Potential Land Suitability

Potential land suitability is the level of land suitability that can be achieved after various improvement efforts are implemented to address existing limiting factors. Through the implementation of these management measures, a potential land suitability class is then obtained, reflecting the condition of the land after improvements are made (Pasaribu et al., 2018).

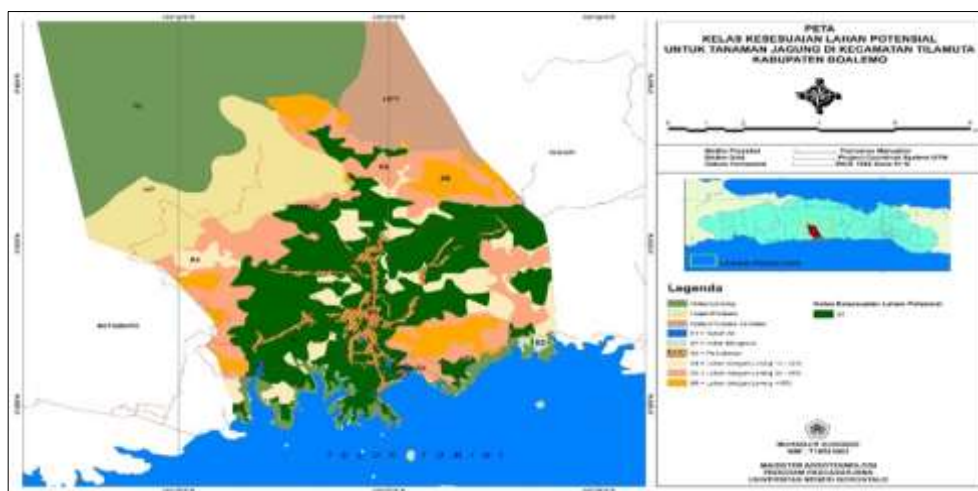


Figure 3. Map of Potential Land Suitability Classes for Corn Plants

Based on Table 1, all land units for corn cultivation in Talamuta District fall into the S3 (marginally suitable) land suitability class. However, after various efforts to improve limiting factors, the land showed development potential, indicated by an increase in suitability class to



S2 (moderately suitable). This potential S2 land suitability class is spread across all land units with a total area of 3,035.4 ha, or 100% of the total area.

CONCLUSION

Actual land suitability for corn in Tilamuta District, Boalemo Regency, is in the marginal suitability class (S3) and is spread across all land units. This condition is influenced by several main limiting factors, namely low nutrient availability, rainfall, soil nutrient retention capacity, slope gradient, and erosion hazard. However, for potential land suitability, the application of various improvement efforts such as fertilization, liming, organic matter addition, contour planting systems, and intensive terracing can improve the land suitability class to moderately suitable (S2).

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