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LAND SUITABILITY EVALUATION FOR SUGARCANE IN SEGOROMULYO VILLAGE, PAMOTAN SUBDISTRICT, REMBANG REGENCY

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ABSTRACT

Sugarcane planting in Pamotan Subdistrict, Rembang Regency took place before 2000, but in recent years farmers have complained of declining yields. Data from the Central Statistics Agency for Rembang Regency shows that the productivity of sugarcane in Pamotan Subdistrict in 2011 produced 6,000 kg/ha, 2014 produced 4,597 kg/ha, and 2017 produced 4,200 kg/ha. This study aims to determine the characteristics of the land and land suitability class for sugar cane in Segoromulyo Village. The method used is the matching method, the determination of sample points is carried out using a purposive method based on the land system which is determined from the overlay of soil type maps, slope maps, and land use maps. The parameters measured include average temperature, water availability/rainfall, drainage, texture, coarse material, soil depth, soil CEC, base saturation, pH, C-organic, salinity, erosion hazard, slope, flood/puddle hazard, rock on the surface, and rock outcrops. The results showed that Segoromulyo Village has several land suitability classes for sugar cane, namely S2 with a limiting factor of water availability and oxygen availability of 198.08 ha or around 32.84%, S2 with a limiting factor of water availability, oxygen availability and salinity of 207 .77 ha or around 34.44%, and S3 with a salinity limiting factor of 197.41 ha or around 32.72%.

Keywords: *land suitability, matching method, productivity, sugarcane*

INTRODUCTION

Land evaluation is one of the instruments commonly used in assessing the suitability of land for various agricultural commodities in an area. Land can be classified as suitable for the development of certain commodities if it is suitable biophysically or socio-economically. Evaluation of land suitability is also a process of assessing land resources for a particular purpose using an approach or method that has been tested. The results of land evaluation will provide information and/or directions for land use as needed (FAO, 1976).

Sugarcane planting in Pamotan District, Rembang Regency has been going on for a long time. The majority of farmers who have moor fields in Pamotan District cultivate sugar cane as a source of income, but in recent years the farmers have complained that their yields have begun to decline. Data from the Central Bureau of Statistics for Rembang Regency shows that the productivity of sugar cane in

Pamotan District in 2011 produced 6,000 kg/ha (Rembang Regency in Figures, 2012). Then in 2014 it produced 4,597 kg/Ha (Rembang Regency in Figures, 2015). And in 2017 it produced 4,200 kg/ha (Rembang Regency in Figures, 2018).

Based on these data, it shows a decrease in the productivity of sugar cane in Pamotan District, and at the research location the soil has never been examined whether the land in the area is suitable or not for sugar cane. The research aims to determine the characteristics of the land and to analyze the land suitability of sugar cane in Segoromulyo Village, Pamotan District, Rembang Regency.

LITERATURE REVIEW

Land evaluation is the process of assessing the appearance or performance of land for certain uses, through the implementation and interpretation of surveys and studies of land forms, soils, vegetation, climate, and other land aspects, so that various land uses that may be developed can be identified and compared. FAO, 1976). The land being evaluated can be conversion forest, abandoned or unproductive land, or agricultural land whose productivity is unsatisfactory but it is still possible to increase it if the commodity is replaced with more suitable crops (Ritung et al, 2007).

Growth requirements or land use requirements required by each commodity have a minimum, optimum, and maximum range for each land characteristic. The optimum land quality for crop needs or land use is the limit for the most suitable land suitability class (S1). Meanwhile, land quality that is below optimum is a land suitability class boundary between moderately suitable (S2) and/or marginally suitable (S3) classes. Outside these limits are lands that are physically classified as unsuitable (N) (Djaenuddin et al., 2011)

There are several ways to assess land suitability, including by multiplying parameters, adding them, or using the minimum law, namely matching. The comparison method is a method of evaluating land suitability by matching and negotiating between land characteristics. In order to obtain the potential of each particular land. Several aspects that need to be considered in the matching process include: land quality in each land mapping unit, land quality for each land use, and land use rating (Khadiyanto, 2005). The structure of land suitability classification can be distinguished according to its level, namely the level of Order, Class, Sub-class and Unit. Order is the state of global land suitability. At the level of land suitability order, it is distinguished between land that is classified as suitable (S=Suitable) and land that is not suitable (N=Not Suitable).1. Order S: Suitable (suitable).

Land included in this order is land that can be used for a certain use in a sustainable manner, without or with little risk of damage to land resources. The expected profit from this result will exceed the input given. 2. Order N: Not suitable (not suitable) Land belonging to this order has boundaries in such a way as to prevent a sustainable use.

In Indonesia, sugar cane is cultivated in various types of soil, such as sandy soil, clay soil, acid soil and saline soil (beach sand) (Adisewojo 1971)

Erwin and Sastrosasmito (1995) state that the most suitable soil for sugar cane is well-drained alluvial soil, loamy texture (loamy loam). In contrast to Prawirosemadi (1991) that sugarcane does not require a special type of soil as long as it is physically suitable. The nature and condition of the soil greatly affect the growth and sugar content in sugarcane stalks.

According to Sudiatso (1982), a suitable soil texture for sugar cane is light to slightly heavy soil texture with sufficient water holding capacity. The depth (solum) of soil for the growth of sugarcane plants is at least 50 cm with no waterproof layer. The conditions for the topography of the sugarcane land are long, flat and sloping slopes. The shape of the land surface that is good for sugarcane growth is flat to undulating with a slope of 0-8%

MATERIALS AND METHODS

This research was carried out from September 2022 to May 2023 activities including field observations carried out in Segoromulyo Village, Pamotan District, Rembang Regency, Central Java. Analysis of chemical properties and physical properties was carried out at the soil chemistry and plant nutrition laboratory of UPN "Veteran" Yogyakarta.

The method used is the matching method, the determination of sample points is carried out using a purposive method based on the land system which is determined from the overlay of soil type maps, slope maps, and land use maps. From the land system map, 7 sample points were obtained as shown in Table 1 and Figure 1. The parameters measured included average temperature, water availability/rainfall, drainage, texture, coarse material, soil depth, soil CEC, base saturation, pH, C -organic, salinity, erosion hazard, slope, flood/inundation hazard, surface rocks, and rock outcrops.

Table 1. Sampling Points

Sample Points	Soil Type	Land Use	Slope	Coordinate	
				X (°)	**Y (°)**
1.	Vertisol	Moor	Flat (0 – 8 %)	111° 24' 13" E	6° 45' 39" S
2.	Vertisol	Moor	Flat (0 – 8 %)	111° 24' 35 " E	6° 45' 45" S
3.	Vertisol	Moor	Flat (0 – 8 %)	111° 24' 44" E	6° 46' 8" S
4.	Vertisol	Plantation	Flat (0 – 8 %)	111° 24' 36 " E	6° 46' 21" S
5.	Vertisol	Plantation	Flat (0 – 8 %)	111° 24' 52" E	6° 45' 48" S
6.	Vertisol	Plantation	Flat (0 – 8 %)	111° 24' 8. " E	6° 46' 10" S
7.	Vertisol	Ricefield	Flat (0 – 8 %)	111° 24' 12. " E	6° 46' 36" S

This study also required additional data as support, namely interviews with sugarcane farmers and measurements of salinity based on distance to the river, this was added to add supporting data as a reference for obtaining limiting factors in evaluating land suitability. Interviews were conducted with 10 farmers as respondents while salinity measurements based on distance to the river obtained 6 sample points with details in Table 2, as follows:

Table 2. Sampling Points for Salinity Levels

Sample Point	X	Y	Distance From River
1	111° 24' 56" E	6° 46' 12" S	45 m
2	111° 24' 53" E	6° 46' 12" S	120 m
3	111° 24' 50" E	6° 46' 11" S	225 m
4	111° 24' 47" E	6° 46' 10" S	330 m
5	111° 24' 43" E	6° 46' 9" S	450 m
6	111° 24' 40" E	6° 46' 8" S	560 m

The stages of this research include research preparation such as literature studies to find out the existing problems and conduct a survey to the location that will be used as a place for conducting research to find out the condition of the location. Then a field survey was carried out, carried out by direct observation in the field and taking soil samples according to the coordinates of the sample points that had been determined using the help of a Garmin GPS tool. Disturbed soil samples at one sample point location were taken 3 soil samples around the sample point, each taken as much as 250 g/replication, and as much as 1 kg was taken for laboratory analysis purposes. Total samples taken amounted to 7 samples. After taking measurements in the field, samples were also taken from the location for further analysis in the laboratory. Some of the parameters measured were soil CEC, C-organic base saturation, toxicity levels. After the data is obtained, then data processing is carried out. Data processing was carried out with a matching system between land criteria in the field and a table of land suitability criteria for sugar cane based on Djaenuddin et al. (2011), by conducting a classification consisting of S1 (very suitable), S2 (quite suitable), S3 (marginally suitable)), and N (not suitable). Then, mapping of land suitability directions for sugar cane was carried out in Segoromulyo Village, Pamotan District, Rembang Regency.

Parameters observed were based on land suitability criteria for sugar cane by Djaenuddin et al. (2011) namely average temperature, rainfall, drainage, coarse material, soil depth, slope, erosion hazard, inundation, soil pH, surface rocks, rock outcrops, and texture. Secondary data collection such as climate and air temperature data were obtained from the Meteorology, Climatology and Geophysics Agency (BMKG) closest to the research location

RESULTS AND DISCUSSION

The results of the assessment of land suitability criteria for sugar cane in Segoromulyo Village, Pamotan District, Rembang Regency are shown in Table 3. Based on the results of the analysis that has been carried out as shown in Table 3, the research locations are in Segoromulyo Village, Pamotan District, Rembang Regency has land suitability for sugar cane, namely S3 (marginal fit), and S2 (quite suitable). In general, each location has different limiting factors, shown in Table 3.

Table 3. Assessment of Actual Land Suitability for Sugar Cane in Segoromulyo Village

No	Parameter		Sample 1		Sample 2		Sample 3		Sample 4		Sample 5		Sample 6		Sample 7	
			Data value	Class	Data value	Class	Data value	Class	Data value	Class	Data value	Class	Data value	Class	Data value	Class
Temperature		**tc**	**S1**		**S1**		**S1**		**S1**		**S1**		**S1**		**S1**	
1	Temperature (°C)		26.9	S1	26.9	S1	26.9	S1	26.9	S1	26.9	S1	26.9	S1	26.9	S1
Availability of water		**wa**	**S2**		**S2**		**S2**		**S2**		**S2**		**S2**		**S2**	
2	Rainfall (mm) Growth period		1354.2	S2	1354.2	S2	1354.2	S2	1354.2	S2	1354.2	S2	1354.2	S2	1354.2	S2
Oxygen Availability		**oa**	**S2**		**S2**		**S2**		**S2**		**S2**		**S2**		**S2**	
3	Drainage		somewhat hampered	S2	somewhat hampered	S2	somewhat hampered	S2	somewhat hampered t	S2	somewhat hampered	S2	somewhat hampered	S2	somewhat hampered	S2
Rooting Media		**rc**	**S1**		**S1**		**S1**		**S1**		**S1**		**S2**		**S2**	
4	Textur		clay	S1	clay	S1	clay	S1	clay	S1	clay	S1	clay	S1	clay	S1
5	Coarse Material (%)		<15	S1	<15	S1	<15	S1	<15	S1	<15	S1	<15	S1	<15	S1
6	Soil Depth (cm)		95	S1	83	S1	85	S1	102	S1	79	S1	63	S2	58	S2
Nutrient Retention		**nr**	**S1**		**S1**		**S1**		**S1**		**S1**		**S1**		**S1**	
7	Soil CEC (cmol/kg)		36.7	S1	34.2	S1	23.5	S1	27.7	S1	38.1	S1	26.8	S1	25.6	S1
8	Base Saturation (%)		56.3	S1	58.7	S1	59.4	S1	66.3	S1	68.5	S1	69.1	S1	55.8	S1
9	pH H2O		6.4	S1	6.5	S1	6.9	S1	6.9	S1	6.7	S1	7.1	S1	5.9	S1
10	C-Organic (%)		1.64	S1	1.82	S1	1.89	S1	2.17	S1	2.33	S1	2.53	S1	2.78	S1
Toksicity		**xc**	**S1**		**S2**		**S3**		**S3**		**S3**		**S2**		**S2**	
11	Salinity (dS/m)		4.75	S1	5.22	S2	8.31	S3	8.57	S3	9.1	S3	6.13	S2	6.34	S2
Erosion hazard		**eh**	**S1**		**S1**		**S1**		**S1**		**S1**		**S1**		**S1**	
12	Slope (%)		0	S1	0	S1	0	S1	0	S1	0	S1	0	S1	0	S1
13	Erosion hazard		Very low	S1	Very low	S1	Very low	S1	Very low	S1	Very low	S1	Very low	S1	Very low	S1
Flood hazard		**fh**	**S1**		**S1**		**S1**		**S1**		**S1**		**S1**		**S1**	
14	Puddle		F0	S1	F0	S1	F0	S1	F0	S1	F0	S1	F0	S1	F0	S1
Land Preparationon		**lp**	**S1**		**S1**		**S1**		**S1**		**S1**		**S1**		**S1**	
15	Rocks on the surface (%)		1	S1	1	S1	0	S1	0	S1	0	S1	0	S1	0	S1
16	Rocks outcrops (%)		1	S1	1	S1	0	S1	0	S1	0	S1	0	S1	0	S1
Actual sub class			**S2waoa**		**S2waoaxc**		**S3xc**		**S3xc**		**S3xc**		**S2waoaxc**		**S2waoaxc**	

Based on the results of field observations and supported by laboratory analysis data, the results of matching between land characteristics and plant growth requirements, land suitability assessment using the matching method based on land suitability criteria from Djaenuddin et al. (2011). The actual and potential land suitability assessment results are presented in Table 3 and Table 4.

Actual land suitability is land suitability in its natural state at present and has not considered improvement efforts (Hardjowigeno and Widiatmaka, 2007). Land suitability assessment in this study was made based on land suitability criteria for sugar cane according to the Center for Research and Development of Agricultural Land Resources (2011).

Table 4. Limiting Factors for Land Suitability

Lokation sample	Land map unit	Land suitability	Area (ha)	Area Percentage (%)	Limiting Factor
1	Tgl – dtr – gruklb	S2waoa	198,08	32,84	1. Water Availability 2. Oxigen Availibility
2	Tgl – dtr – gruklb	S2waoaxc	207,77	34,44	1. Water Availability

6	Kbn – dtr – gruklb				2. Oxigen Availibility
7	Swh – dtr – gruklb				3. Toxicity
3	Tgl – dtr – gruklb	S3xc	197,41	32,72	1. Toxicity
4	Kbn – dtr – gruklb				
5	Kbn – dtr – gruklb				
	Total		603.26	100	

Information:
LMU: Land Map Unit, Tgl: Moorland, Kbn: Garden, Swh: Paddy Field, Dtr: Flat
Gruklb: Grumosol Dark gray

Based on the results of the analysis that has been carried out as shown in Table 4, several land suitability class results were obtained. Location 1 (Tgl – dtr – gruklb) has a land suitability class of S2 or sufficient according to the limiting factors of water availability (wa) and oxygen availability (oa) covering an area of 198.08 ha or around 32.84%. Locations 2 (Tgl – dtr – gruklb), 6 (Kbn – dtr – gruklb), and 7 (Swh – dtr – gruklb) have land suitability class S2 or adequate according to the limiting factors of water availability (wa), oxygen availability (oa) , and toxicity (xc) covering an area of 207.77 ha or around 34.44%. Locations 3 (Dtr – dtr – gruklb), 4 (Kbn – dtr – gruklb), and 5 (Kbn – dtr – gruklb) have land suitability class S3 or marginal suitability with a limiting factor of availability of toxicity (xc) covering an area of 197.41 ha or about 32.7%.

Salinity measurements based on distance from the river were obtained by taking samples in the field and then analyzing them in the laboratory, as shown in Table 5:

Table 5. Salinity based on distance from the river in Segoromulyo Village

Sample Point	Distance From River	Salinity (dS/m)	Class
1	45 m	9.43	High
2	120 m	8.91	High
3	225 m	9.02	High
4	330 m	8.25	High
5	450 m	8.18	High
6	560 m	7.36	Medium

Based on Table 5, the salinity values from sample 1 to sample 6 show decreasing results. This is also illustrated in Figure which shows a descending line, which means that the farther the land is from the river, the smaller the salinity value will be. Sample 1 is closest to the river until sample 6 is farthest from the river. Salinity data based on distance from the river is also presented in graphical form presented in Figure.

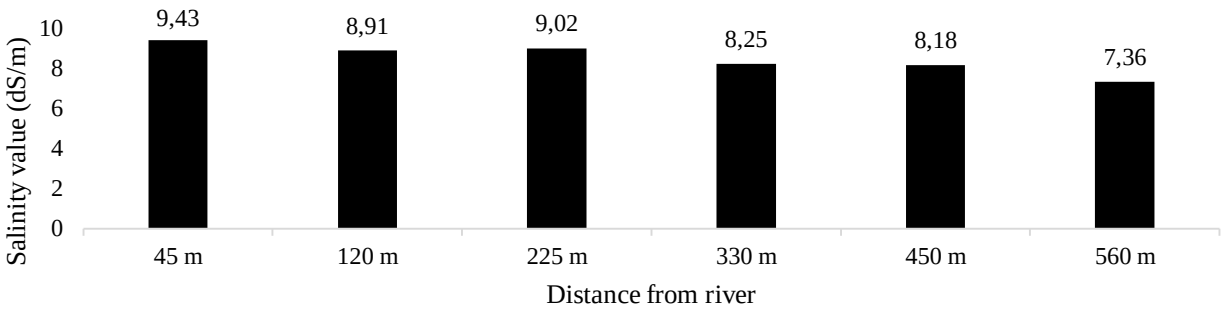

Figure. Soil Salinity Based on Distance From River

This can happen because the entry of seawater into the mainland can be through the land surface or through seepage (intrusion). The flow of sea water can pass through bodies of water and rocks, parent material and soil which is porous and has low hydrostatic pressure so it is unable to hold sea water (Sutono, 2015). entry of seawater into the mainland can be through the land surface or through seepage (intrusion). The flow of sea water can pass through bodies of water and rocks, parent material and soil which is porous and has low hydrostatic pressure so it is unable to hold sea water. Sutono (2015) notes that the increased amount of sodium in paddy fields is caused by (1) an imbalance in the discharge of river water or fresh water that enters the river channel with salt water from the sea, (2) the closer the source of salt water on the ground surface to the paddy fields, (3) it is suspected that subsurface salt water is increasingly protruding towards the mainland, and (4) factory waste containing sodium enters water bodies which are then used for irrigation of paddy fields.

Potential land suitability is land suitability that will be achieved after land improvement efforts have been carried out. Potential land suitability is the condition that is expected after being given input according to the appropriate level of management. To determine the types of improvement efforts that can be carried out, it must be considered the characteristics of the land incorporated in each land quality. Land characteristics can be divided into land characteristics that can be improved with proper management, and land characteristics that cannot be improved. Land map units that have land characteristics that cannot be improved will not experience a change in land suitability class, while those with land characteristics that can be improved, land suitability classes can improve better (Hardjowigeno and Widiatmaka, 2007).

Based on Table 6, it is known that there are several land suitability classes, namely S2waoa, S2waoaxc, and S3xc. S2waoa is a class that can be interpreted quite according to the limiting factors of water availability (rainfall) and oxygen availability (drainage). Availability of water (rainfall) and availability of oxygen (drainage) can be improved by constructing or repairing a drainage system so that excess rainwater can immediately drain from the land and not cause potential flooding. Land with a limiting factor for water availability (rainfall) includes a high level of management (Hardjowigeno and Widiatmaka, 2007).

S2waoaxc is a class that can be interpreted quite according to the limiting factors of water availability (rainfall), oxygen availability (drainage), and toxicity (salinity). Availability of water (rainfall) and availability of oxygen (drainage) can be improved by constructing or repairing a drainage system so that excess rainwater can immediately drain from the land and not cause potential flooding. Land with a limiting factor for water availability (rainfall) includes a high level of management (Hardjowigeno and Widiatmaka, 2007).

Overcoming salinity by using agricultural lime soil enhancer. According to FAO (2005) a method that can be used to improve salinity stress on agricultural land is by dredging the soil using a washing system with continuous flow of water.
The results of the Potential Land Suitability class for Sugar Cane are listed in table 6.

Table 6. Assessment of Potential Land Suitability for Sugar Cane in Segoromulyo Village

No	Parameter		Sample 1		Sample 2		Sample 3		Sample 4		Sample 5		Sample 6		Sample 7	
			A	P	A	P	A	P	A	P	A	P	A	P	A	P
Temperature		**tc**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**
1	Temperatue (°C)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Availability of water		**w**														
		a	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**
2	Rainfall (mm) Growth period		S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1
Oxygen Availability		**oa**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**
3	Drainage		S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1
Rooting Media		**rc**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S2**	**S1**	**S2**	**S1**
4	Texture		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
5	Coarse Material (%)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
6	Soil Depth (cm)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2	S1	S2	S1
Retensi Hara		**nr**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**
7	Soil CEC (cmol/kg)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
8	Base Saturation (%)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
9	pH H2O		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
10	C-Organic (%)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Toxicity		**xc**	**S1**	**S1**	**S2**	**S1**	**S3**	**S2**	**S3**	**S2**	**S3**	**S2**	**S2**	**S1**	**S2**	**S1**
11	Salinity (dS/m)		S1	S1	S2	S1	S3	S2	S3	S2	S3	S2	S2	S1	S2	S1
Erosion hazard		**eh**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**
12	Slope (%)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
13	Erosion hazard		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Flood hazard		**fh**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**
14	Puddle		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Land Preparationon		**lp**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**	**S1**
15	Rocks on the surface (%) (%)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
16	Rocks outcrops (%)		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Actual and potential sub Classes			**S2waoa**	**S1**	**S2waoaxc**	**S1**	**S3xc**	**S2xc**	**S3xc**	**S2xc**	**S3xc**	**S2xc**	**S2waoaxc**	**S1**	**S2waoaxc**	**S1**

Description: A: Actual, P: Potential

S3xc is a class that can be interpreted as marginal according to the limiting factor of toxicity (salinity). Overcoming salinity by using agricultural lime soil enhancer. According to FAO (2005) a method that can be used to improve salinity stress on agricultural land is by dredging the soil using a washing system with continuous flow of water.

CONCLUSION

The characteristics of the land in Segoromulyo Village are that it has a moderate average temperature, with quite a lot of rainfall, while the drainage is somewhat obstructed with a fine texture, a little coarse material with medium to deep soil depth, soil CEC and high base saturation with a slightly acidic to neutral pH. then it has high C-organic content, but for salinity from moderate to high, has flat slopes without erosion and flood hazards, then there are no rocks on the surface and rock outcrops.

The results of the land suitability evaluation in Segoromulyo Village have several suitability classes for sugarcane, namely at sample location 1 the S2waoa land suitability class is 198.08 ha or around 32.84%. Locations 2, 6 and 7 have land suitability class S2waoaxc with an area of 207.77 ha or around 34.44%. Sample locations 3, 4, and 5 (Kbn – dtr – gruklb) have land suitability class S3xc covering an area of 197.41 ha or around 32.72%.

SUGGESTION

The results showed that there were several land suitability classes with different limiting factors. To overcome these limiting factors, it is necessary to do:

1. Improvement by constructing or improving the drainage system for the limiting factors of water availability (rainfall) and oxygen availability (drainage).
2. Dredging the soil other than in the tilled layer and washing the soil with continuous flow of ground water at the limiting factor of toxicity (salinity)

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