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Mapping of actual and potential land suitability for oil palm in several land unit using geographic information system

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Abstract. The suitability land of oil palm in North Sumatra Province is important, especially in the lands that are often planted by the community. This study aimed to map the actual and potential suitability of the land for oil palm in Sei Bingai Subdistrict, Langkat, North Sumatra, Indonesia under the different land unit. This research was conducted from March to June 2018. The survey method was conducted to collect soil samples in the field. Land suitability classification (LSC) was evaluated based on the matching method. The Geographic Information System (SIG) was used to map the land suitability classes. The results showed that the land suitability classes for oil palm were marginally suitable (S3) on all land unit. There were no suitable (S1), moderately suitable (S2), and not suitable (N) classes were found in all land unit. There were several limiting factors in land suitability evaluation in the area, namely: the availability of water, erosion hazard, and root zone medium. The water availability (wa) was the dominant limiting factor in this area.

1. Introduction

Land evaluation is defined as the process of assessing the potential of land for certain uses [1-4]. Land evaluation results are used as a basis for land use planning so that the land can be used optimally and sustainably [5].

The process of land evaluation is comparing the requirements requested by the type of land use that will be applied to the properties of the land that is owned by the land to be used. Land suitability evaluation needs to be done to be a basis for consideration in land use decision making [6]. Further, [7-8, 2] distinguishes land suitability classes into two, namely: actual and potential land suitability classes.

Land evaluation results can be described in the form of maps using Geographic Information System (GIS) technology. Geographical Information System has been widely applied in various fields, including forestry and agriculture. One application of GIS in the field of forestry and agriculture is mapping the results of the land evaluation and presenting the results in the form of maps [9-13].

Geographical Information System is used for data collection, storage, analysis and manipulation of geographic references. The function of the map is to show the spatial distribution of geographical phenomena and also the characteristics that correspond to those seen on the surface of the earth [14]. Based



on the description above, this study aimed to evaluate and map the actual and potential land suitability classes for oil palm in Sei Bingai Subdistrict, Langkat District, North Sumatra Province.

2. Materials and methods

This research was conducted in four villages, namely: Kuta Buluh, Rumah Galuh, Telagah, and Gunung Ambat Village, Sei Bingai Subdistrict, Langkat District, North Sumatra Province. This research was conducted from March to June 2018.

The survey method was conducted to collect soil samples in the field. Land suitability classification (LSC) was evaluated based on the matching method [15]. The reference and criteria were adopted from the Land Suitability for Agricultural Plants by the Centre for Soil and Agroclimatic Research, Bogor-Indonesia [5, 16]. The Geographic Information System (SIG) was used to map the land suitability classes.

The results of the assessment of the actual and potential land suitability classes were presented in the form of tables and maps that provide a class description of the land suitability of oil palm for each land unit assessed. The assessment and presentation of land suitability class results were based on FAO (1976) [17-18], namely: Highly suitable (S1), Moderately suitable (S2), marginal suitable (S3), and not suitable (N).

The land unit was then used as a basis to determine land unit in this study, as agree with [19, 12] in analysing the suitability of eucalyptus and durian land as agroforestry crops in Karo District, North Sumatera Province.

3. Results and discussion

The results showed that the land unit consists of 10 classes (Table 1) with different areas. The widest land unit was land unit 9 covering approximately 4,372.35 ha (38.82% from the total area) and land unit 8 was the smallest with an area of approximately 11.19 ha (0.1% from the total area).

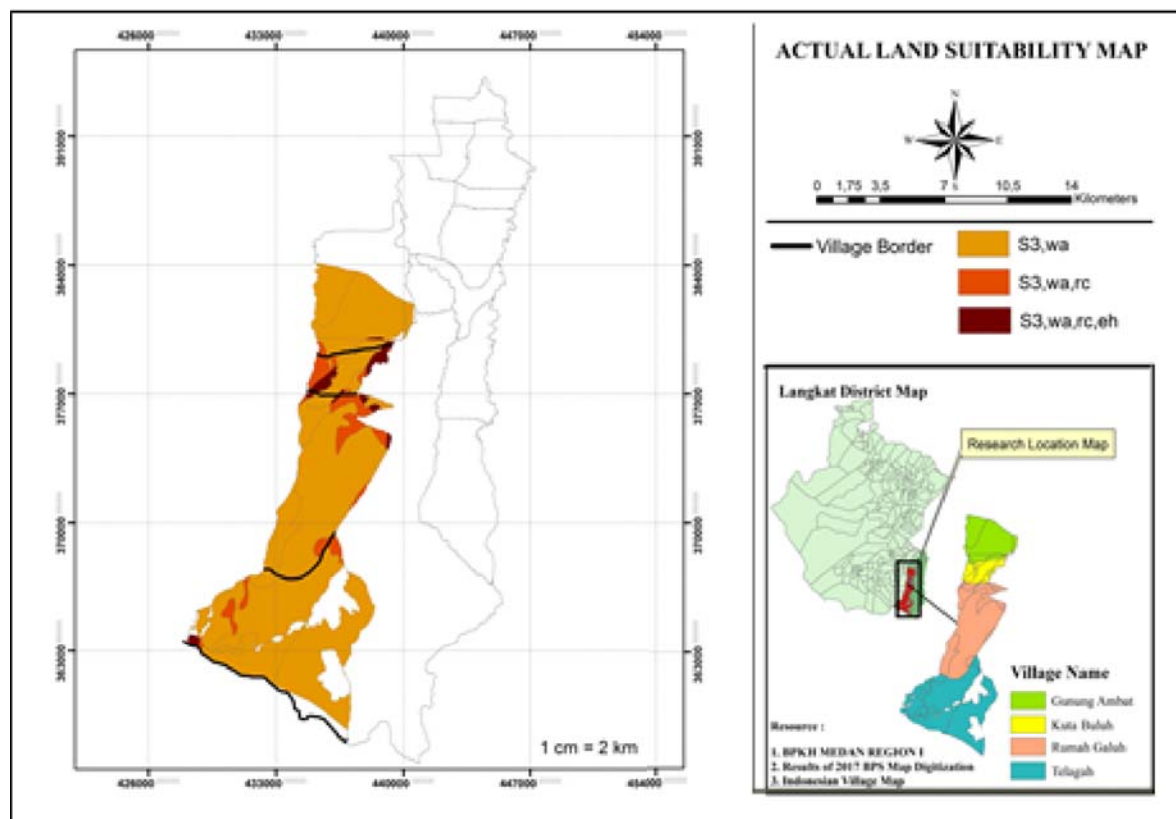
Table 1. Land unit area in Sei Bingai District

Land Unit	Area	
	(Ha)	(%)
1	2,422.70	21.51
2	836.65	7.43
3	307.84	2.73
4	986.62	8.76
5	514.01	4.56
6	571.88	5.07
7	1,152.67	10.23
8	11.19	0.10
9	4,372.35	38.82
10	89.33	0.80
	11,265.29	100.00

The land suitability classes for oil palm were marginally suitable (S3) on all land unit (Table 2). There were no suitable (S1), moderately suitable (S2), and not suitable (N) classes were found in all land unit. According to [17-18], Class S3 (marginal suitable) means that the land has very severe limitations for the continuous application of certain uses. There were several limiting factors, namely: the availability of water, erosion hazard, and root zone medium. The water availability (wa) was the dominant limiting factor in this area. Land suitability classification (actual and potential land suitability class of oil palm under the different land unit) in Sei Bingai Subdistrict was listed in Table 2 and delineated in Figure 1 and Figure 2.

Table 2. The area of actual and potential land suitability classes (LSC) for oil palm

Land Unit	Actual LSC	Potential LSC	Area	
			(Ha)	(%)
1	S3,wa	S3,wa	2,422.70	21.51
2	S3,wa,rc	S3,wa,rc	836.65	7.43
3	S3,wa,rc,eh	S3,wa,rc	307.84	2.73
4	S3,wa	S3,wa	986.62	8.75
5	S3,wa	S3,wa	514.01	4.56
6	S3,wa	S3,wa	571.88	5.07
7	S3,wa	S3,wa	1,152.67	10.23
8	S3,wa,rc,eh	S3,wa,rc	11.19	0.10
9	S3,wa	S3,wa	4,372.35	38.82
10	S3,wa	S3,wa	89.33	0.80
Total			11,265.29	100.00

**Figure 1.** Actual land suitability map in Sei Bingai Subdistrict, Langkat District, North Sumatra Province

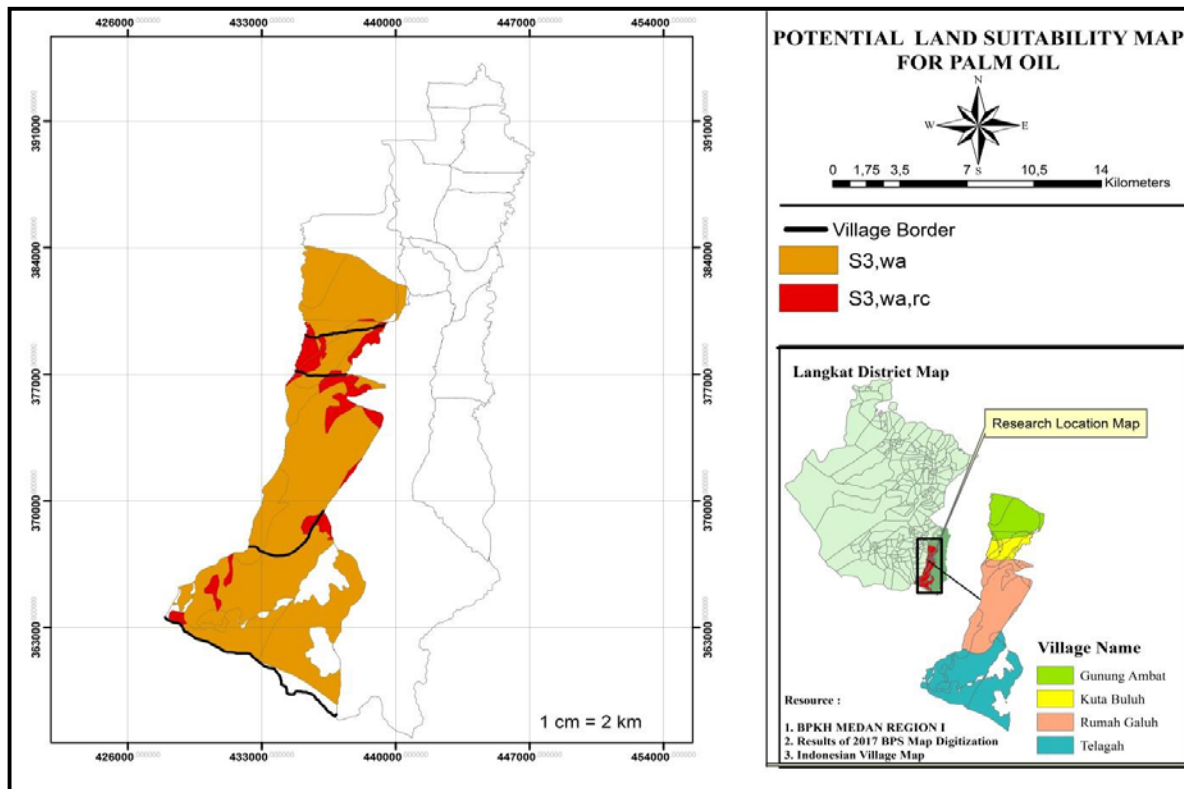


Figure 2. Potential land suitability map in Sei Bingai Subdistrict, Langkat District, North Sumatra Province

4. Conclusions

Land suitability classes for oil palm were marginally suitable (S3) on all land units. The water availability (wa) was the dominant limiting factor in this area. Land suitability classes for oil palm were marginally suitable (S3) distributed in four villages in Sei Bingai Subdistrict.

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