Land Suitability for Horticultural (Fruit) Crops Development in Mukomuko District, Bengkulu Province

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ABSTRACT

Horticulture commodity is one of important commodities to develop in Indonesia considering climate in Indonesia is appropriate for it. Fruits were one of high valued-commodity of hortilculture that could be souce of revenue for small scale, medium scale and big scale farmers due to its high value, land resources availability, and potential market uptake from domestic and international market. The objective of this study was to evaluate the land suitability for fruits (mango, durian, rambutan, papaya, banana, pineapple, and mangosteen) development and its limiting factors. This study was done in four stages: 1). Spatial analysis for landform; 2). Evaluation Survey; 3). Laboratory Analysis, and 4). Compilation and Data interpretation. Land suitability analysis using *Sistem Penilaian Kesesuaian Lahan* (SPKL) or expert system of land suitability from Center for Research and Development of Agricultural Land Resources in Bogor. Results showed that the suitability of land for development of fruits can be classified according to altitude with criteria of marginal (S3), the limiting factors for fruits development were water and oxygen availability, nutrient retention, erosion hazard, and temperature.

Keywords: land suitability expert system, Mukomuko district.

INTRODUCTION

Indonesia as a tropical country has a comparative advantage to produce a wide range variety of tropical agricultural products that can not be produced by non-tropical countries. Among the typical tropical agricultural commodities potential to be developed are horticultural commodities, especially vegetables and fruits. Both commodities are classified as commercial high value commodity, so it must be produced efficiently to compete in the marketplace. From the aspect of production, the potential for development of horticultural commodities can be improved in terms of aspects of land availability and the increased technology adoption.

Horticultural commodities, especially fruits have a major role in nutrition and health. As a source of vitamins and minerals fruits able to meet the needs of carbohydrates 4.38%, 1.70% protein and 98.20% of the total production of food minerals (Sukaryorini, 2006). This important role has not been fully exploited because of the system of cultivation is done not maximizely. Horticultural crops are usually grown as a garden or plant interlocutory, not managed properly.

Soil data, climate and the physical properties of the environment that influence plant growth and management aspects need to be identified and characterized through the survey and mapping of land resources. Generated data, subsequently interpreted for the purposes of a specific use. Land evaluation is an approach for assessing the potential of land or soil resources that provide information about the direction of land use.

This study aimed to evaluate the suitability of land for horticultural crops in Mukomuko regency to provide an overview of land use in the mapped region.

MATERIALS AND METHODS

The study was conducted in Mukomuko regency of Bengkulu province. The study was conducted through four stages: 1). Spatial analysis for landform; 2). Evaluation survey; 3). Laboratory analysis, and 4). Compilation and data interpretation.

Analysis spasial for landform

This phase is done by computer through a GIS (geographic information system) for the preparation of a map of land units. Spatial analysis such as the delineation of land units map scale 1:

250,000 corrected into scale 1: 50,000. This process is done by overlaying several maps support, such as contour maps, DEM, geology, and satellite imagery.

Evaluation Survey

This activity is performed to evaluate soil map units that has been arranged with field conditions. Furthermore, to complement soil data, identification and characterization of the soil units. Soil sampling is done through the creation of the soil profile, minipit and using a drill ground based representative system. The selected soil samples were analyzed in laboratorum. Climate data collected from local weather stations such as: rainfall (mm), temperature (° C) and humidity (%)

Laboratory Analysis

Soil samples were analyzed in soil laboratories of AIAT Bengkulu. Analysis conducted were Texture (Pipette (SCS, 1984), pH H2O (pH meter), C-Organic (Walkley and Black), CEC (NH4OAc 1 N pH 7 titration), bases cations: Ca^{2+}, Mg^{2+}, K^{+} , Na^{+} (NH4OAc 1 N pH 7 titration) which K^{+} and Na^{+} using flamefotometer, N-Total (Kjedahl), P-available (Bray), exchangeable Al and H (N KCl, titration) and base saturation.

Compilation and Data Interpretation

Data collected for land suitability evaluation process consists of soil data, climate, land use, and development plans commodities. All data intepreted based on the concept of land evaluation is the matching process between the characteristics of the land as a parameter with the requirements of land use which has been prepared based on land units to determine land suitability classes.

RESULTS AND DISCUSSION

Study Area

Research locations covering all administrative areas of Mukomuko. Astronomically Mukomuko regency lies in 101001'36 "-101051'08" East Longitude and 02016'06 "-03007'08" South Latitude. Annual average rainfall 2,634 mm with an annual average temperature 26,77 ° C, relative humidity ranges from 83.17% during the year with the achievement of maximum value in November and minimum occur in September. Distribution of monthly rainfall is almost evenly distributed rainfall throughout the year with a monthly average of 219.50 mm and a rainy day average of 14.92 days. (BPS, 2013)

Land Units

Map Land units scale of 1: 50,000 compiled based on the interpretation of Landsat imagery, geological maps, field observations and supported by data of laboratory analysis of soil samples. This map provides information about the distribution of the soil characteristics, including soil properties are closely related to the parameters for land evaluation. The compilation showed 33 units of the group lanform; alluvial land, marine, fluvio-marine, peat, volcan and miscellaneous group.

Land Suitability Analysis

Land suitability is done by matching the characteristics of the land on the condition of crops grown fruits (durian, banana, avocado, papaya, and pineapple). Land evaluation is computerized using the SPKL 1.0 program (Land Suitability Assessment System) developed by the Center for Environmental Resources Agriculture. Assessment of land suitability classes for fruit trees is done on land units generated various land suitability classes (Table 1).

Picture 1. Map of land unit in Mukomuko district

Table 1. Legends of Map land unit in Mukomuko regency for fruits development

No. Land unit	Symbol	Landform	Relief/slope (%)	Parent Material	Soil Clasification USDA, 2010
7	Au.214-r	Combined alluvial fan	Rolling (8-15)	Mixed sludge	Typic Dystrudepts Humic Dystrudepts
11	Mf.32-r	Terrace marine subresen	Rolling (8-15)	Clay sludge	Typic Kanhapludults Oxic Dystrudepts
15	Vad.113-h	Upper volcan slopes	Hilly (25-40)	Tuff andesit, liparite	Andic Dystrudepts Humic Dystrudepts
17	Va.115-r	Lower vulcan slopes	Rolling (8-15)	Tuff andesit	Typic Haplohumults Humic Dystrudepts
18	Vad.115-c	Lower vulcan slopes	Small hilly (15-25)	Tuff andesit, liparite	Andic Dystrudepts Humic Eutrudepts
19	Va.115-h	Lower vulcan slopes	Hilly (25-40)	Tuff andesit	Andic Dystrudepts Humic Dystrudepts
20	Va.31-u	Old volcanic plains	Wave (3-8)	Tuff andesit, liparite	Oxic Dystrudepts Typic Kanhapludults
22	Va.31-r	Old volcanic plains	Rolling (8-15)	Tuff andesit, liparite	Typic Kanhapludults Oxic Dystrudepts
23	Vad.31-r	Old volcanic plains	Rolling (8-15)	Tuff andesit, liparite	Typic Dystrudepts Typic Hapludults
24	Va.32-c	Old volcanic hills	Small hilly (15-25)	Tuff andesit	Oxic Dystrudepts Typic Kanhapludults
25	Vad.32-c	Old volcanic hills	Small hilly (15-25)	Tuff andesit, liparite	Typic Dystrudepts Typic Haplohumults
26	Va.32-h	Old volcanic hills	Hilly (25-40)	Tuff andesit	Typic Dystrudepts Typic Hapludults
27	Vad.32-h	Old volcanic hills	Hilly (25-40)	Tuff andesit, liparite	Typic Dystrudepts Typic Haplohumults
30	Vg.04-h	Volcan intrusion	Hilly (25-40)	Granit	Typic Hapludults Typic Udipsamments

Source: Primary data (processed), 2014

Table 2. Results of land suitability analysis

Commodity	Class	Sub-class	Limiting factor	Land unit	Wide	
					ha	%
Durian	**S3**	S3 – eh	erotion hazard	18	3.580	0.84
		S3 – nr	nutrient retention	7, 11, 20, 22, 23	97.821	22.97
		S3 – nr/ eh	nutrient retention, erotion hazard	24, 25	73.579	17.27
		S3 – tc/ eh	Temperature, erotion hazard	16	3.526	0.76
Banana	S3	S3 – nr	nutrient retention	7, 11, 20, 22, 23	97.821	22.97
		S3 – nr/ eh	nutrient retention, erotion hazard	24, 25	73.579	17.27
		S3 – tc	Temperature	17	1.773	0.42
		S3 – tc/ nr	Temperature, nutrient retention	7	2.181	0.51
		S3 – tc/ rc /eh	Temperature, rooting media availibility, erotion hazard	18	3.580	0.84
		S3 – tc/ rc /nr	Temperature, rooting media availibility, nutrient retention	20, 22, 23	89.839	21.1
Avocado	S3	S3 – tc/ rc /nr /eh	Temperature, rooting media availibility, nutrient retention, erotion hazard	25	66.153	15.53
		S3 – tc/ rc /nr /nr	Temperature, rooting media availibility, nutrient retention, nutrient retention	11	5.799	1.36
		S3 – tc/ rc/ nr/ eh	Temperature, rooting media availibility, nutrient retention, erotion	24	7.426	1.74

			hazard			
		S3 – tc/ wa	Temperature, water availibility	17	1.773	0.42
Papaya	S3	S3 – wa	water availibility	24, 25	73.579	17.27
		S3 – wa/ eh	water availibility, erotion hazard	16, 18	7.106	1.6
		S3 – wa/ nr	water availibility, nutrient retention	7, 20, 23	79.073	18.57
		S3 – wa/ nr/ eh	water availibility, nutrient retention, erotion hazard	25	66.153	15.53
		S3 – wa/ nr/ nr	water availibility, nutrient retention, nutrient retention	22	12.948	3.04
		S3 – wa/ nr/ nr/ nr	water availibility, nutrient retention, nutrient retention, nutrient retention	11	5.799	1.36
		S3 – wa/ nr/ nr/ nr/ eh	water availibility, nutrient retention, nutrient retention, nutrient retention, erotion hazard	24	7.426	1.74
pineapple	S3	S3 – tc/ wa	Temperature, water availibility	17	1.773	0.42
		S3 – wa/ eh	water availibility, erotion hazard	16, 18	7.106	1.6
		S3 – wa/ nr	water availibility, nutrient retention	7, 20, 23	79.073	18.57
		S3 – wa/ nr/ eh	water availibility, nutrient retention, erotion hazard	25	66.153	15.53
		S3 – wa/ nr/ nr	water availibility, nutrient retention, nutrient retention	22	12.948	3.04
		S3 – wa/ nr/ nr/ nr	water availibility, nutrient retention, nutrient retention, nutrient retention	11	5.799	1.36
		S3 – wa/ nr/ nr/ nr/ eh	water availibility, nutrient retention, nutrient retention, nutrient retention, erotion hazard	24	7.426	1,74

Source : Primary data (processed) 2014. Notes:S1 = Very Appropriate, S2 = Quite Appropriate, S3 = Marginal Fit

Land suitability classes for major horticultural commodities in Mukomuko (durian, banana, avocado, papaya, and pineapple) are marginally suitable (S3). Durian can be developed in District of V Koto, Selagan Raya, Teras Terunjam, Air Dikit, Sungai Rumbai, Ipuh, Air Rami, Malin Deman, Teramang Jaya, Penarik, Teramang Jaya, Pondok Suguh, and Lubuk Pinang. Limiting factors were erosion, nutrient retention and temperature.

Banana can be developed in District of V Koto, Selagan Raya, Teras Terunjam, Air Dikit, Sungai Rumbai, Ipuh, Air Rami, Malin Deman, Teramang Jaya, Penarik, Teramang Jaya, Pondok Suguh, dan Lubuk Pinang. Limiting factors were erosion, nutrient retention and temperature.

Avocado can be developed in District of V Koto, Selagan Raya, Teras Terunjam, Air Dikit, Sungai Rumbai, Ipuh, Air Rami, Malin Deman, Teramang Jaya, Penarik, Teramang Jaya, Pondok Suguh, dan Lubuk Pinang. Limiting factors were erosion, nutrient retention, rooting media, and temperature.

Papaya can be developed in District of V Koto, Selagan Raya, Teras Terunjam, Air Dikit, Sungai Rumbai, Ipuh, Air Rami, Malin Deman, Teramang Jaya, Penarik, Teramang Jaya, Pondok Suguh, dan Lubuk Pinang. Limiting factors were erosion, nutrient retention, rooting medium, water availability, and temperature.

Pineapple can be developed in District of V Koto, Selagan Raya, Teras Terunjam, Air Dikit, Sungai Rumbai, Ipuh, Air Rami, Malin Deman, Teramang Jaya, Penarik, Teramang Jaya, Pondok Suguh, dan Lubuk Pinang. Limiting factors were, nutrient retention, rooting medium, water availability, and temperature.

Land management suitable for minimizing the requirement is needed in the existing limiting factors. For permanent limiting factor due to natural conditions difficult for minimized except by finding other alternatives for cultivated plants (Sukaryorini, 2006).

The limiting factor of erosion can be improved by the application of soil and water conservation techniques. The application of conservation techniques will be adapted to the environmental conditions of planting, as well technical requirements to build it, especially the slope factor. Land with slope <15% may be applied vegetative methods such as mulching, contour planting, planting strips and alley

cropping. Lands with slopes > 15% may be applied mechanical methods such as bench terraces. According Suripin (2000) general erosion will increase with increasing slope and slope length.

The limiting factor rooting media situation can be improved by means of processing the soil so that plant roots can move in absorbing nutrients and oxygen (Nurdin, 2011). For the limiting nutrient retention factor can be minimized by increasing the pH (calcification), inorganic and organic fertilizer to maintain soil fertility. (Sukaryorini, 2006). The addition of organic matter, such as the use of mulch (crop residues), green manure, manure and compost can improve soil nutrient content. (Indranada, 1986)

The water availability and temperature were fixed limiting factor. According to Indranada (1986) that plants productivity will grow normally and deliver good results if adequate water available. Provision of water to the plant should be in accordance with the amount of water needed by plants. If the lack of water, the plant will suffer dryness, if too excessive will result in the loss of nutrients dissolved. If the limiting factor for fruit development can be improved, it is expected that the future development of commodity fruits can be a main commodity of Mukomuko regency.

CONCLUSION

Mukomuko has potential land to be developed as a center for fruits with an area of 188.260,28 ha or 44,13%. Fruits suitable to be developed in Mukomuko are durian, banana, avocado, papaya and pineapple.

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