

Land Suitability and Direction of Strategic Agricultural Commodities in East Kalimantan to Support the Development of the New Nation's Capital of Republic of Indonesia

Kesesuaian Lahan dan Arahan Komoditas Pertanian Strategis di Kalimantan Timur Mendukung Pembangunan Ibu Kota Baru Republik Indonesia

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Abstract. The development of the new nation's capital in East Kalimantan must be supported with sufficient food supply. An Agricultural buffer zone must be provided as production area of food crops, horticulture, plantation, and livestock to suffice the food needs. The planning of land use arrangement in the area required land suitability assessment for various agricultural commodities. The purpose of this paper is to provide information of land suitability in East Kalimantan Province that support the development plan of the new capital of the Republic of Indonesia. Literature studies of the previous research in East Kalimantan Province are carried out by the Indonesian Center for Agricultural Land Resources Research and Development (ICALRRD), as well as other research institutions. Based on the researches by ICALRRD conducted between year 2016-2019, the land suitable for agriculture is quite extensive (7.7 million ha), mostly for dry land farming. It is classified as suitable (S) mainly for plantation, forage, dry land food, horticulture, and upland rice, especially rainfed paddy. Only a small part is suitable for swamp lowland paddy field or tidal paddy field. The efforts to develop the regions include: (1) the expansion of new areas called as extensification (E), and a little through intensification (I). Extensification is conducted by cultivating superior commodities on new opening land that were previously in the form of shrubs or swampy shrubs, and open area or pasture. The available area for extensification program in East Kalimantan is 2.728 million ha. (2) The intensification program is carried out through the development of commodities in the existing land by strengthening the application of land technology, water management, crops varieties selection and cultivation techniques covering 73.2 thousand ha.

Keywords: New nation's capital / East Kalimantan / Land suitability / Strategic agricultural commodities

Abstrak. Rencana pemindahan ibu kota negara ke Kalimantan Timur, perlu didukung oleh kawasan penyangga pertanian (tanaman pangan, hortikultura, perkebunan, dan peternakan) untuk memenuhi kebutuhan pangan masyarakat. Perencanaan penyusunan kawasan tersebut memerlukan data kesesuaian lahan berbagai komoditas pertanian. Tujuan dari tulisan ini adalah untuk memberikan informasi data tentang kesesuaian lahan di Provinsi Kalimantan Timur dalam mendukung rencana pembangunan ibukota baru Republik Indonesia. Metode yang digunakan dalam penulisan makalah ini adalah studi literatur dari hasil penelitian di Provinsi Kalimantan Timur, baik yang dilaksanakan oleh Balai Besar Litbang Sumberdaya Lahan Pertanian (BBSDLP), maupun lembaga penelitian lain. Berdasarkan data hasil penelitian BBSDLP antara tahun 2016-2019, lahan yang sesuai untuk pertanian cukup luas (7,7 juta ha), terutama untuk pertanian lahan kering. Lahan yang tergolong kelas sesuai (S) sebagian besar untuk tanaman perkebunan, pakan ternak, pertanian tanaman pangan lahan kering, hortikultura, dan padi sawah tadah hujan. Hanya sedikit yang sesuai untuk pertanian padi rawa lebak atau padi pasang surut. Upaya yang dapat ditempuh untuk membangun kawasan ini adalah: (1) melalui perluasan areal baru atau ekstensifikasi (E) tanaman perkebunan, pakan ternak, pertanian tanaman pangan lahan kering, hortikultura, dan padi sawah tadah hujan, pada lahan bukaan baru yang sebelumnya berupa semak belukar atau semak belukar rawa, lahan terbuka atau padang rumput seluas 2,728 juta ha. (2) melalui program intensifikasi (I) dilakukan melalui pengembangan komoditas di lahan sawah eksisting melalui penguatan aplikasi teknologi pengelolaan lahan, pengelolaan air, penggunaan varietas unggul, dan teknik budidaya, seluas 73,2 ribu ha.

Kata kunci: Ibu kota baru / Kalimantan Timur / Kesesuaian lahan / Komoditas pertanian strategis

INTRODUCTION

The Government of the Republic of Indonesia plans to move the national capital from Jakarta to the Province of East Kalimantan. President

Joko Widodo stated that the new capital city in East Kalimantan is located in two regencies, namely Kutai Kertanegara and North Penajam Paser. Determination of prospective locations for the country's capital was carried out through a thorough study (Setyawan 2019).

Regarding this plan, the Ministry of Agriculture is preparing food buffers for the new national capital through a cluster system of food crops, horticulture, livestock and plantations using modern agricultural technology so that all food needs are met independently without imports (Sulaiman 2019). The main locations of these clusters are regencies / cities in East Kalimantan Province.

Planning for that mentioned above requires land resources data on operational level, especially land suitability maps for agricultural crops. It is referred to a semi-detailed scale map (at a scale of 1:50,000) or larger that were generated from soil maps at a scale of 1:50,000 through land evaluation assessment. Land evaluation is the process of assessing land performance if it is used for a specific purpose (FAO 1976).

The land suitability map at a scale of 1: 50,000 contains information with sufficiently high accuracy, so that it can be used to support agricultural development planning at the regency / city level. The land suitability map is in the form of a thematic map, comprising a map of land suitability and directions for agricultural commodities, as well as recommendations for land management (BBSDLP 2018c). In line with the results of this study, it is hoped that it can be used as a basic data for planning clusters of food crops, horticulture, livestock and plantations in East Kalimantan.

This paper provides information and discussion on the land suitability for strategic commodities (rice, maize, soybeans, chillies, shallots, sugarcane, cacao, oil palm and forage / king grass) as well as recommendations for land management in ten regencies / cities throughout East Kalimantan Province.

BIOPHYSICAL CHARACTERISTICS OF EAST KALIMANTAN PROVINCE

Geography

East Kalimantan Province covers an area of 127,346.92 km², geographically located between 113°35'31" and 119°12'48" East Longitude, and between 2°34'23" North Latitude and 2°44'14" South Latitude (Figure 1). East Kalimantan Province consists of 7 regencies and 3 cities, namely: 1. Paser Regency, 2. West Kutai Regency, 3. Kutai Kartanegara Regency, 4. East Kutai Regency, 5. Berau Regency, 6. North Penajam Paser Regency, and 7 Mahakam Ulu Regency. The three cities are: 1. City of Balikpapan, 2. City of Samarinda, 3. City of Bontang.

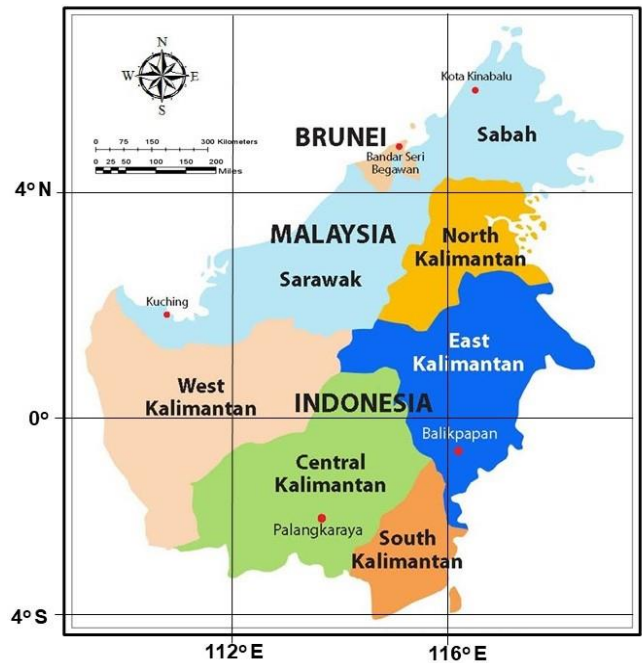


Figure 1. The location and administration map of East Kalimantan Province (BPS Kalimantan Timur 2020)

Gambar 1. Peta lokasi dan administrasi Provinsi Kalimantan Timur (BPS Kalimantan Timur 2020)

Climate

Rainfall data is collected from some climate observations, i.e. station in Balikpapan representing a wet climate, stations from Bontang and Tanjung Redeb representing a humid climate according to the agro-climatic zone of Oldeman *et al.* (1980). The average annual rainfall in Balikpapan is 2,811 mm, in Bontang is 2,013 mm and Tanjung Redeb is 1,881 mm. The annual average air temperature in the city of Balikpapan is 27.6°C, Bontang is 27.4°C, and Tanjung Redeb is 27.1°C (BBSDLP 2016g, 2018a, 2018b). Based on the rainfall data, Balikpapan has C1 agro-climatic zone, while Bontang and Tanjung Redeb have E1 agro-climatic zone. C1 zone is an agro-climatic zone characterized by the presence of 5 consecutive wet months without dry month. E1 zone is an agro-climatic zone characterized by the presence of 2 consecutive wet months with less than 2 wet months (Oldeman *et al.* 1980).

Based on the Agro-climatic Map of Kalimantan (Oldeman *et al.* 1980), East Kalimantan Province is divided into 9 agro-climatic zones, namely: A, B1, B2, C1, C2, D1, D2, E1, and E2. Agro-climatic zone A is an area having more than 9 consecutive wet months

without dry month. Agro-climatic zone of B1 is an area having 7-9 consecutive wet months without dry month. B2 agro-climatic zone is an area having 7-9 consecutive wet months with 2-3 dry months. Meanwhile, the driest agro-climatic zone (E2) is the agro-climatic zone having less than 3 consecutive wet months with 2-3 dry months.

The climatic conditions, especially rainfall and air temperature as discussed above, show that the East Kalimantan Province is mostly suitable (S) to support the growth of food crops, horticulture, plantations and forage crops (Taslim 2016).

Topography/ Relief

Topography or relief in East Kalimantan Province is mostly dominated by hilly areas (slopes, > 25-40%) and mountainous areas (slopes, > 40%), covering an area of 2,687,668 ha (21.33%) and 2,461,039 ha (19.54%) respectively. Meanwhile, the flat areas (slopes 0-3%) and undulating (slopes 3-8%) are 2,065,059 ha (16.39%), and 1,463,012 ha (11.61%), respectively (Table 1).

Table 1. Topography/relief in East Kalimantan Province

Tabel 1. Bentuk wilayah/relief di Provinsi Kalimantan Timur

Topography/Relief	Slopes	Amplitudes	Acreage	
	%	m	ha	%
Flat and nearly flat	0-3	<2	2,065,059	16.39
Undulating	>3-8	2-10	1,463,012	11.61
Rolling	>8-15	10-50	2,246,413	17.83
Hillocky	>15-25	10-50	1,450,215	11.51
Hilly	>25-40	50-300	2,687,668	21.33
Mountainous	>40	>300	2,461,039	19.54
Escarpment	>60	-	24,546	0.19
Minings	-	-	29,608	0.24
Settlements	-	-	21,177	0.22
Small islands	-	-	4,045	0.03
Water body (Lakes, Rivers)	-	-	139,385	1.11
Total			12,598,167	100.00

Source: Processed data from BBSDLP (BBSDLP 2016a, 2016b, 2016c, 2016d, 2016e, 2016f, 2016g, 2016h, 2018a, 2018b)

Sumber: Diolah dari BBSDLP (BBSDLP 2016a, 2016b, 2016c, 2016d, 2016e, 2016f, 2016g, 2016h, 2018a, 2018b)

SOIL CHARACTERISTICS IN EAST KALIMANTAN

Soil characteristics and properties are the parameters used as the basis for assessing land

suitability for agricultural commodities. Based on the results of land identification and mapping at the semi-detailed level (scale of 1:50,000) by the Indonesian Center for Agricultural Land Resources Research and Development (BBSDLP 2016a, 2016b, 2016c, 2016d, 2016e, 2016f, 2016g, 2016h, 2018a, 2018b), the soils found in this province, the classification is according to National Soil Classification (Subardja *et al.* 2016), consists of 11 soil great groups, namely Organosol, Alluvial, Regosol, Kambisol, Gleisol, Podsolik, Mediteran, Nitosol, Latosol, Oksisol, and Podsol. These eleven soil great groups are then generated into 33 soil sub-groups.

In general, soils in East Kalimantan can be divided into 2 main groups: (1) soil in Wetlands and (2) soil in Dry land. Soil in wetlands consists of Organosol (peat), soils in lowland swamps (Gleisol Eutrik, Gleisol Distrik, and Aluvial Fluvik), and soils in tidal swamps (Gleisol Sulfik, Gleisol Sulfidik, and Aluvial Sulfidik). Soils in dry land have soil drainage ranging from somewhat poor to excessive. It is generally having topography flat (0-1%) to mountainous slopes (>40%).

Soil Characteristics in Wetlands

Wetlands are occupied by Organosol, Gleisol, and Aluvial Sulfidik soils. The characteristic of these soils, that can be the main limiting factor for dryland plants, is very poorly drained (BBSDLP 2016a, 2016b, 2016c, 2016d, 2016e, 2016f, 2016g, 2016h, 2018a, 2018b).

Special for Organosol soils, the peat depth is one of the limiting factors. Organosol having a peat thickness of > 300 cm becomes the main limiting factor for cultivating rice, food crops and plantation crops, although the land has been drained (Ritung *et al.* 2011). The results of the research by Supriyo *et al.* (1991) in South Kalimantan found that the thicker the peat, the lower the productivity of rice crops.

Other soil characteristics that become limiting factors of plant growth in wetlands are nutrient retention, namely low cation exchange capacity (CEC) and nutrient availability, especially low P and K content in the soil. Soil acidity is one of the characteristics of Organosol and sulfate in tidal soils. In acid sulfate soils, acidity occurs due to the oxidation of pyrite compounds that produce sulfate compounds. In peatlands, the acidity is caused by the presence of organic acids due to the decomposition of organic matter. In addition, according to Anwar (2015), in

peatlands and tidal swamplands, there is often a deficiency of micro elements, especially Cu and Zn.

In tidal areas, the presence of sea water intrusion is indicated by the high salinity value. High and low salinity is often related to the seasonal conditions. During the rainy season, the sea water concentration decrease so that the salinity value will also decreases. On the other hand, in the dry season, the intrusion of sea water is higher and farther inland. Therefore, the salinity value in tidal land will be higher and interfere plant growth which then ultimately reduces plant productivity (Anwar 2015).

Soil Characteristics in Dry Land

According to Hidayanto and Nastiti (2015), in East Kalimantan Province, dry land is the main land resource for agricultural development in realizing sustainable food security and self-sufficiency. The characteristics of this soil, both from positive and negative sides in supporting plant growth in general, are divided into sandy, acid and non-acid soils (BBSDLP 2016a, 2016b, 2016c, 2016d, 2016e, 2016f, 2016g, 2016h, 2018a, 2018b).

Soil characteristics on dry land in East Kalimantan are rooting media in the form of coarse texture, nutrient retention, namely low cation exchange capacity, low to very low base saturation, low C-organic and acid soil pH. This is in line with the research results by Shanti (2020) which states that dry land in East Kalimantan is dominated by Ultisols or Podsolik soils. These soils have low N, P, K nutrients and low organic matter, and especially very acid to acid soil, accompanied by low cation exchange capacity and base saturation. One of the biophysical characteristics of dry land in East Kalimantan is that most of the lands have slope more than 8 percent, covering an area of 8.845 million ha or 70.21% of the mainland of East Kalimantan (Table 1).

LAND SUITABILITY FOR STRATEGIC AGRICULTURAL COMMODITIES

Results of Land Suitability Assessment

The land suitability for strategic commodities assessed is the actual land suitability that is assessed under current conditions. The strategic commodities are: dry land food crops (upland rice, maize and soybean), non-swamp rice (irrigated and rainfed), swamp rice crops (tidal and lowland), horticultural crops (red chilli and shallots), plantation crops (oil

palm, cacao and sugarcane) and king grass. The results of land suitability assessment for strategic commodities per regency/city in East Kalimantan Province are presented in Table 2. One example of land suitability map for maize crops in Kutai Kartanegara Regency is presented in Figure 2.

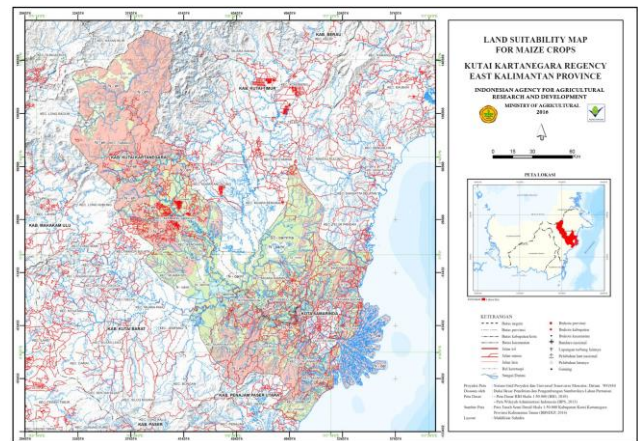


Figure 2. Land suitability map for maize crops in Kutai Kartanegara Regency, East Kalimantan Province (Source: BBSDLP 2016a)

Gambar 2. Peta kesesuaian lahan untuk tanaman jagung di Kabupaten Kutai Kartanegara, Provinsi Kalimantan Timur (Sumber: BBSDLP 2016a)

Dry Land Food Crops (Upland Rice, Maize, and Soybeans)

Land suitability for upland rice consists of moderately suitable (S2) and marginally suitable (S3), reaching 5.428 million ha or 43.09% of the province's area. The rest is not suitable (N) and land that is not assessed (td) covering an area of 6.897 million ha. The land not assessed (td) was mostly residential areas, mining land, very steep sloping land and protected forest. The largest moderately suitable land (S2) for upland rice is in Mahakam Ulu and Berau regencies, covering area of 51.4 thousand ha and 23.3 thousand ha respectively (Table 3).

The suitable land for maize is 4.638 million ha or 36.82% of the province's area. Most of the suitable lands consist of marginally suitable (S3), only 26 thousand ha are classified as moderately suitable (S2). Not suitable land (N) is around 4.582 million ha. Marginally suitable land for maize is mostly found in East Kutai and Kutai Kartanegara regencies, 1.688 million ha and 1.174 million ha respectively (Table 3).

Table 2. Land suitability assessment for strategic commodities in every regency/city in East Kalimantan Province

Tabel 2. Hasil penilaian kesesuaian lahan untuk komoditas strategis per kabupaten/kota se Provinsi Kalimantan Timur

Regency/ City	Acreage (x 1.000 ha)														
	Paser			West Kutai			Kutai Kartanegara			East Kutai			Berau		
Commodity	S2	S3	N	S2	S3	N	S2	S3	N	S3	N	S2	S3	N	
Irrigated rice	23.7	88.3	907.5	81.1	308.0	887.2	0	593.8	1,608.1	975.1	1,988.1	8.8	311.6	1,771.9	
Rainfed rice	23.7	382.6	613.1	81.1	727.2	468.0	0	968.9	1,233.0	1,162.1	1,801.0	23.3	640.1	1,428.8	
Swamp lowland rice	0	0	0	0	25.9	17.4	0	245.0	0	109.5	0	0	12.2	0	
Upland rice	0	527.6	491.9	0	834.1	485.3	0	1,234.2	1,237.0	1,293.3	1,815.4	23.3	728.2	1,428.8	
Tidal rice	71.0	50.3	0	0	0	0	0	20.2	0	21.7	14.4	0	75.9	0	
Maize	0	363.6	655.8	0	939.8	379.7	0	1,173.6	1,297.5	1,687.9	1,420.9	0	1,178.2	1,002.1	
Soybean	0	117.6	901.8	0	715.4	604.1	0	1,173.6	1,297.5	1,687.9	1,420.9	0	673.6	1,498.0	
Shallots	0	363.6	655.8	0	834.1	485.3	0	1,173.6	1,297.5	1,687.9	1,420.9	23.3	659.0	1,498.0	
Red chilli	0	363.6	655.8	0	715.4	604.1	0	1,173.6	1,297.5	1,687.9	1,420.9	23.3	728.2	1,428.8	
Oil palm	6.1	549.0	464.4	140.1	918.4	260.9	46.7	1,507.6	916.8	614.9	2,493.9	8.8	1,169.5	1,002.1	
Cacao	0	555.1	464.4	0	1,146.7	172.8	0	1,076.2	1,394.9	614.9	2,493.9	8.8	1,169.5	1,002.1	
Sugarcane	0	363.6	655.8	0	715.3	684.1	0	1,025.0	1,446.1	1,243.7	1,865.0	8.8	586.3	1,585.3	
Forage	0	555.1	464.4	0	939.8	379.7	0	1,554.3	916.8	2,505.4	603.4	29.7	1,148.7	1,002.1	

Table 2. (continued)

Tabel 2. (lanjutan)

Regency/ City	Acreage (x 1.000 HA)													
	North Penajam Paser			Mahakam Ulu			Balikpapan		Samarinda		Bontang			
Commodity	S2	S3	N	S2	S3	N	S3	N	S3	N	S3	N	S3	N
Irrigated rice	0	53.9	209.1	32.0	247.3	1,515.0	13.1	24.7	14.7	50.5	6.9	5.9		
Rainfed paddy	6.2	148.3	108.5	32.0	488.2	1,273.6	34.1	3.7	24.7	40.4	7.1	4.7		
Padi rawa lebak/ Swamp lowland rice	0	0	0	0	18.8	0	0	0	3.1	0	0	0		
Upland rice	6.2	163.0	122.0	51.4	490.7	1,271.9	34.1	3.7	28.7	36.5	7.1	4.7		
Tidal rice	0	14.7	13.6	0	0	0	0.6	0	3.1	0	0	0		
Maize	6.2	216.7	68.4	13.1	663.0	1,137.0	37.7	0	26.3	39.9	11.8	0		
Soybean	6.2	163.5	122.0	0.5	490.7	1,321.9	34.1	3.7	26.3	39.9	7.1	4.7		
Shallots	6.2	154.8	130.3	51.4	490.7	1,271.9	34.1	3.7	26.3	39.9	7.1	4.7		
Red chilli	6.2	163.0	122.0	0.5	490.7	1,321.9	34.1	3.7	26.3	39.9	7.1	4.7		
Oil palm	6.2	208.4	76.7	13.1	706.5	1,093.5	37.8	0	54.7	10.5	11.8	0		
Cacao	6.2	244.8	40.3	13.1	895.7	904.3	37.8	0	54.5	10.7	11.8	0		
Sugarcane	6.2	154.8	130.3	14.4	554.3	1,244.5	34.1	3.7	25.0	40.1	7.1	4.7		
Forage	6.2	216.7	68.4	13.1	663.0	1,137.0	37.8	0	54.7	10.5	11.8	0		

Source: Processed data from the Strategic Commodity Atlas of the Ministry of Agriculture for 10 Regencies / Cities in East Kalimantan (BBSDLDP 2016i, 2016j, 2016k, 2016l, 2016m, 2016n, 2016o, 2016p, 2018c, 2018d)

Sumber: Diolah dari data Atlas Kesesuaian Lahan Komoditas Strategis Kementerian Pertanian 10 Kabupaten/Kota se Kalimantan Timur (BBSDLDP 2016i, 2016j, 2016k, 2016l, 2016m, 2016n, 2016o, 2016p, 2018c, 2018d)

The suitable land for soybeans classified as marginally suitable (S3) is about 5.102 million ha or 40.50% of the province's area. Not suitable land (N) is around 6.403 million ha. The largest area of marginally suitable land for maize crop is found in East Kutai and Kutai Kartanegara regencies, 1.688 million ha and 1.174 million ha respectively (Table 3).

The Ministry of Agriculture has to prepare food buffering to support the plan to move the national capital to East Kalimantan. Regarding to the land suitability assessment for food crops, the suitable lands

for dry land food crops is approximately 5.438 million ha (Table 3). This area is suitable for horticultural, plantation and forage crops. By the assumption that one-fifth of which can be used for the development of dry land food crops, it is predicted that one million ha can be used for dry land food crops including upland rice, maize and soybeans.

The main food crop commodity cultivated in East Kalimantan is maize. The research by Salelua and Maryam (2018) found that one of the reasons for farmers in Samarinda, East Kalimantan to cultivate

Table 3. An assessment of land suitability sub-classes/classes in East Kalimantan Province

Tabel 3. Hasil penilaian sub kelas/kelas kesesuaian lahan se Provinsi Kalimantan Timur

Commodity	Land Suitability Class / Sub-class (x 1.000 ha)							
	S2	%	S3	%	S	%	N	%
	Forage							
King Grass	55	0.44	7,687	61.02	7,742	61.45	4,582	36.37
	Estate Crops							
Oil Palm	227	1.80	5,778	45.87	6,006	47.67	6,319	50.16
Cacao	34	0.27	5,807	46.09	5,841	46.36	6,483	51.46
Sugarcane	36	0.28	4,709	37.38	4,745	37.66	7,660	60.80
	Horticulture							
Shallots	87	0.69	5,431	43.11	5,518	43.80	6,809	54.04
Red chilli	36	0.29	5,390	42.78	5,426	43.07	6,899	54.76
	Dry land food crops							
Upland rice	87	0.69	5,341	42.40	5,428	43.09	6,897	54.75
Soybean	13	0.10	5,089	40.40	5,102	40.50	6,403	50.82
Maize	26	0.20	4,612	36.61	4,638	36.82	4,582	36.37
	Rice							
Rainfed paddy	173	1.37	4,583	36.38	4,756	37.75	6,975	55.36
Irrigated rice	146	1.16	2,332	18.51	2,478	19.67	8,968	71.18
	Swamp rice							
Swamp lowland rice	0	0	415	3.29	415	3.29	17	0.14
Tidal rice	71	0.56	186	1.48	257	2.04	28	0.22

Source: Processed data from the Strategic Commodity Atlas of the Ministry of Agriculture for 10 Regencies / Cities in East Kalimantan (BBSDLP 2016i, 2016j, 2016k, 2016l, 2016m, 2016n, 2016o, 2016p, 2018c, 2018d)

Sumber: Diolah dari data Atlas Kesesuaian Lahan Komoditas Strategis Kementerian Pertanian 10 Kabupaten/Kota se Kalimantan Timur (BBSDLP 2016i, 2016j, 2016k, 2016l, 2016m, 2016n, 2016o, 2016p, 2018c, 2018d)

maize is easy to cultivate, low failure rate, little capital expenditure, and high demand. Furthermore, the demand for maize farming needs to be managed by implementing an intensification program. It is hoped that the extension agents could help to implement the program.

Non Swamp Rice Crops (Irrigated Rice, and Rainfed Paddy)

Suitable land (Class S) for irrigated rice reaches 2.478 million ha or 19.67% of the province's area (Table 3). The suitable lands consist of moderately suitable land (S2) and marginally suitable (S3). Not suitable land (N) is around 8.968 ha or 71.18% of the province's area. The rest is not assessed (td), mostly are settlements, mining land and water bodies. The largest areas suitable for irrigated rice are found in the

regencies of East Kutai and Kutai Kartanegara, covering area of 975 thousand ha and 593.8 thousand ha respectively.

The land suitable for rainfed paddy is 4.756 million ha or 37.75% of the province's area (Table 3). It consists of moderately suitable (S2) and marginally suitable (S3). Not suitable land (N) is around 6.975 million ha. The largest areas suitable for rainfed paddy are in the regencies of East Kutai and Kutai Kartanegara, 1.162 million ha and 0.968 million ha respectively.

According to Irawan (2015), in Indonesia, irrigated rice fields are the main supplier of rice production regionally or nationally. Based on the data from Pusat Data dan Sistem Informasi Pertanian (2017), the area of irrigated rice fields in East

Kalimantan Province is 13,225 ha. This existing irrigated rice fields will not be able to support the needs of the population, if the capital is moved to East Kalimantan. Therefore, the development of irrigated rice fields in this province is a necessity.

In rainfed paddy fields, apart from water problems, the soil nutrient status is generally low. Nevertheless, the response to fertilization sometimes varies. The use of high yield potential rice varieties that are resistant to pests and diseases, and the anticipation of drought, are expected to have a positive effect on crop yields. According to Kasno *et al.* (2020), in rainfed paddy fields, integrated land management should be applied to increase rice yields. It is included water management, improving soil fertility through the provision of soil amendments, prevention of pests and diseases, crop rotation, management of soil organic matter, and fertilization that carried out in accordance with soil characteristics and crop needs.

Balai Besar Penelitian Tanaman Padi (2020) states that choosing varieties suitable for rainfed paddy agro-ecosystems is the main key to increase rice yields. Based on the typology of rainfed paddy field, several superior varieties that are suitable for areas having an altitude of less than 700 meters above sea level such as in East Kalimantan are: Inpari 10 Laeya, Inpari 11, Inpari 12, Inpari 13, Inpari 18, Inpari 19, Inpari 20, Inpari 33 HBD, Inpari 22, Inpari 38 Tadah Hujan, Agritan, Inpari 39 Tadah Hujan Agritan, Inpari 42 Agritan GSR, Inpari 43 Agritan GSR and Silugonggo. These varieties are suitable planted in wet months, while some varieties that are short-lived (less than 90 days), such as Dodokan, will be suitable for planting on rainfed paddy fields which fall into the dry month category. The use of superior short-lived rice is useful for avoiding water shortages when plants come into the generative phase.

Swamp Rice Crops (Tidal Swamp and Lowland Swamp)

The land suitable for tidal swamp rice reaches 257 thousand ha or 2.04% of the area of East Kalimantan Province (Table 3). This suitable land consists of moderately suitable (S2) and marginally suitable (S3). Not suitable land (N) is around 28 thousand ha, the rest is land that is not assessed (td), mostly is non-tidal land. The largest area of marginally suitable land for tidal rice is found in Paser and Berau regencies, 121.3 thousand ha and 75.9 million ha

respectively. The land suitable for tidal swamp rice have limiting factors of nutrient retention content (nr), nutrient availability (na) and rooting condition (rc).

Land suitable for swamp lowland rice only reaches 415 ha or 3.29% of the province's area (Table 3). It consists entirely of marginally suitable (S3). Not suitable land (N) is around 17 ha. The rest is not assessed (td) because it is not lowland swamp. The largest areas of land suitable for swamp lowland rice are found in Kartanegara and East Kutai regencies, i.e. 245 ha and 110 ha respectively (Table 3). Land suitable for swamp lowland rice in East Kalimantan have the limiting factors of nutrient retention (nr), and nutrient availability (na).

The results of research and studies conducted by Anwar (2015) found that the technological problem in dealing with swamps is in terms of water management. Proper water management and in accordance with the hydrological characteristics and land typology can prevent: (a) salt water intrusion, (b) drought, (c) flooding, (d) acidity, (e) toxicity of Fe, Al and H₂S, (f) subsidence and irreversibility as well as fire in peatlands and (g) increase the effectiveness of fertilization and the cropping index.

Superior variety is one of the main components of technology which is proven can increase rice productivity and is quickly adopted by farmers because it is cheap and practically applied. Recommended quality seeds for tidal swamp land are 40 - 60 kg / ha for direct seed planting system (*tabela*) and 30-40 kg / ha for transplanting. The new specific superior varieties for tidal swamp are: Inpara 1, Inpara 2, Inpara 3, Inpara 6, Inpara 7, Inpara 8, Inpara 9, Inpara 10 and Purwa. Meanwhile, the rice varieties that are tolerant of flooding and Fe toxicity recommended for lowland swamps are Inpara 3, Inpara 4, Inpari 29 Rendaman, Inpari 30-Ciherang Sub1, Inpara 8 Agritan, Purwa and Inpara 10 BLB (Balai Besar Penelitian Tanaman Padi 2020).

Horticultural Crops (Red Chilli and Shallots).

The land suitable for red chilli crops reaches 5.426 million ha or 43.07% of the province's area (Table 3). Most of the suitable lands consist of marginally suitable (S3). Not suitable (N) is around 6.899 million ha. The rest is not assessed (td) in the form of settlements, ex-mining areas, and water bodies. The largest area of marginally suitable land for red chilli crops is found in East Kutai and Kutai Kartanegara

regencies, 1.688 million ha and 1.174 million ha respectively. For shallots, the suitable land covers 5,518 million ha or 43.80% of the province's area. It mostly belongs to marginally suitable (S3). The land which is classified as not suitable (N) reaches around 6.809 million ha. The largest area of marginally suitable land for shallots is found in East Kutai and Kutai Kartanegara regencies, 1.688 million ha and 1.174 million ha respectively.

The study by Sayaka (2018) found that vegetable farming can be carried out in the lowlands and highlands, both in wet and dry land. Generally, the scale of vegetable farming is relatively small. It is rare to find large companies conducting their own cultivation on a large scale. The companies are usually partnering with farmers or farmer groups. The scale of land ownership for vegetable farming is relatively small, especially in Java Island.

Based on the description above, it is necessary to state that in order to fit out a future capital city that will be inhabited by many people, the applied farming model must be on a large scale involving various companies and farmer groups. In addition, it is necessary for other parties to participate, such as marketing / processing companies and marketing NGOs. The Central and Local Governments as well as various supporting institutions, such as Indonesian Agency for Agricultural Research and Development (IAARD), must play a very active role in overcoming various obstacles and challenges to the development of vegetable farming on dry land. These obstacles include low soil fertility, lack of capital, the risk of farming, land ownership, and business permits that must be obtained. The challenges included good cultivation practices, controlling forest encroachment, and reducing the risk of farming.

Estate Crops (Oil Palm, Cacao, and Sugarcane)

The strategic commodities of estate crops are oil palm, cacao and sugarcane. The plantation sub-sector is one of the pillars driving the national economy, most of which is cultivated in smallholder plantations. In addition to exports, the potential plantation products in East Kalimantan have also to meet the needs of the future capital city. Most of the lands in East Kalimantan are classified as suitable (class S) for plantations. However, until now this potential land has not been optimally utilized.

Based on the results of the land suitability assessment for oil palm plants, the suitable land reached

6.006 million ha or 47.67% of the province's area (Table 3). Most of the suitable land belongs to marginally suitable (S3). The not- suitable land (N) is 6.319 million ha, with the main limiting factor of steep slopes. Marginally suitable land is largely found in Kutai Kartanegara and Berau regencies, covering an area of 1.553 million ha and of 1.678 million ha. The suitable land for cacao reaches 5.841 million ha or 46.36% of the province's area. Most of the suitable land belongs to marginally suitable (S3). Not suitable land (N) covers an area of 6.483 million ha with a limiting factor of steep slope.

For sugarcane, the suitable land reached 4.745 million ha or 37.66% of the province's area. Most of this suitable land consists of marginally suitable land (S3), Not suitable land (N) is around 7,660 million ha. The largest area of marginally suitable land for sugarcane plantation is found in East Kutai and Kutai Kartanegara regencies, 1.244 million ha and 1.025 million ha respectively.

King Grass

Land suitable for king grass in East Kalimantan covered an area of 7,742 million ha or 61.45% of the province's area (Table 3). Most of the land is marginally suitable land (S3). The others are classified as not suitable (N) covering 4.582 million ha. The largest area of marginally suitable land for king grass as forage is in East Kutai and Kutai Kartanegara regencies, 2.505 million ha and 1.554 million ha respectively. King grass (*Pennisetum purpureum*) has been chosen as animal feed because it has high productivity and properties to improve soil conditions and can grow in marginal lands. In addition, king grass is a forage which can be used as complete feed silage because it has a fairly high nutrient content (Syahrir and Novieta 2016).

In East Kalimantan, animal feed for ruminants is generally comes from grass and fodder grass. It is obtained from pasture or grazing areas which is gradually decreasing because there has been a function change from pasture to plantation and mining area (Alimin 2018). However, former coal mining land in East Kalimantan is often cultivated for growing forage crops.

DIRECTION OF COMMODITY DEVELOPMENT

The direction of commodities in each regency/city in East Kalimantan is determined by land suitability class of each commodity and other factors

such as superior or prioritised commodities, farming feasibility, farmer preferences, and local government programs at the central and regional levels (BBSDLP 2018e).

The direction of commodity development is based on agricultural development patterns, as follows: intensification pattern (I), diversification pattern (D), intercrop cultivation pattern (C), and extensification pattern (E) (Table 4). Intensification pattern (I) is the development of commodities in existing rice fields through strengthening applications of land technology, water, varieties and cultivation techniques. Apart from rice, food crops such as maize, soybeans, chillies, shallots and sugarcane can be directed as rotational crops in the second or third season. In East Kalimantan, the land that can be intensified in the existing rice fields is 73.2 thousand hectares, which cover 9 regencies / cities. Meanwhile, the tidal /

lowland swamps cover an area of 19.0 thousand ha, which spreads across 7 regencies / cities (Table 4).

The diversification pattern (D) is the development of new commodities on the same land, either through intercropping, multiple cropping or crop rotation. The types of land use for diversification are dry-field and mixed gardens. In both lands, the choice of commodity depends on the priorities and desires of the local government or local community. The area that can be used for a diversification pattern is 326.0 thousand ha, distributed in all regencies / cities in East Kalimantan (Table 4).

Cultivation of mixed cropping or pattern C is the development of shade-tolerant annual crops (intercropping) among young perennials. This system is directed at plantations or gardens with scarce canopy cover, such as oil palm or young rubber plantations, or tall coconut plantations that are already high so that the

Table 4. Agricultural commodity direction in East Kalimantan

Tabel 4. Arahana komoditas pertanian di Kalimantan Timur

Pattern	Description	Agricultural Commodity Direction	Regency/ City	Acreage (x 1000 ha)
I	- Intensification (I) development in existing rice fields	Rainfed paddy, maize, soybeans, red chillies, shallots and sugarcane.	Paser, West Kutai, Kutai Kartanegara, East Kutai, Berau, North Penajam Paser, Mahakam Ulu, Samarinda, Bontang	73.2
	- Intensification (I) development in swamp rice fields	Tidal swamp rice or swamp lowland rice	Paser, Kutai Kartanegara, East Kutai, Berau, North Penajam Paser, Samarinda	19.0
D	Diversification pattern (D) the addition of new commodities in dry-field / mixed gardens, intercropping, multiple cropping and crop rotation	Upland rice, maize, soybeans, red chillies, shallots, king grass.	Paser, West Kutai, Kutai Kartanegara, East Kutai, Berau, North Penajam Paser, Mahakam Ulu, Balikpapan, Samarinda, Bontang	326.0
C	Mixed Pattern (C), development of annual crops, which can tolerate shade among young perennials	Upland rice, maize, soybeans, shallots, red chillies, king grass	Paser, West Kutai, Kutai Kartanegara, East Kutai, Berau, North Penajam Paser.	89.2
E	Expansion of new areas or extensification (E), planting of strategic superior commodities on new opened land that was previously swamp shrubs or shrubs of open land or pasture	Rainfed paddy, upland rice, tidal swamp rice, maize, soybeans, shallots, red chillies, cacao, oil palm, sugarcane, king grass	Bontang, Paser, West Kutai, Kutai Kartanegara, East Kutai, Berau, North Penajam Paser, Mahakam Ulu, Samarinda	2,728.0

Source: Processed data from the Strategic Commodity Land Suitability Atlas of the Ministry of Agriculture in ten Regencies / Cities in East Kalimantan (BBSDLP 2016i, 2016j, 2016k, 2016l, 2016m, 2016n, 2016o, 2016p, 2018c, 2018d)

Sumber: Diolah dari Atlas Kesesuaian Lahan Komoditas Strategis Kementerian Pertanian di sepuluh Kabupaten/Kota se Kalimantan Timur (BBSDLP 2016i, 2016j, 2016k, 2016l, 2016m, 2016n, 2016o, 2016p, 2018c, 2018d)

sunlight is still sufficient for food crops. Most shade-resistant crops cultivated are upland rice, maize and soybeans, or upward climbing crops. The area of land that can be developed with the intercropping cultivation pattern (Pattern C) is 89.2 thousand ha, covering 6 regencies / cities in East Kalimantan (Table 4).

Expansion of new areas or extensification (E) is the planting of strategic superior commodities on new opened land that was previously shrubs or swampy shrubs, and open land or pasture. The area for extensification covers an area of 2.728 million ha distributed in 7 regencies and 1 city (Table 4).

CONCLUSION

Changes that will occur rapidly due to the plan to relocate the national capital to East Kalimantan Province, requires restructuring of the existing agricultural land use and planning for expansion of new agricultural areas. The relocation of the capital will be followed by an increase in population that requires adequate food supply and industrial raw materials as well as consolidation and reallocation of space for life.

The atlas of land suitability and recommendations for commodity development at a scale of 1: 50,000 and recommendations for land management prepared by the Indonesian Center for Agricultural Land Resources Research and Development are the data that can be used as a preliminary step in planning to benefit from land resources in a more productive and sustainable manner at an operational scale to support the development of new nation's capital.

In terms of area, the land for agricultural development, both intensification and extension, is still quite wide. It is required more thorough planning which is applied using modern technology to meet food needs and the provision of increasingly high quality food.

Based on the land suitability for irrigated / rainfed paddy, swamp rice, dry land food crops, estate/ plantation crops, horticultural crops, and forage crops, the land that can be developed in East Kalimantan Province is mostly for Extensification Pattern (Pattern E), covering an area of 2.728 million ha.

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