LAND SUITABILITY AND PROBLEMS ASSESSMENT FOR FOOD CROP DEVELOPMENT BASED ON PEDO-AGROCLIMATE AND RESOURCE MANAGEMENT

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Abstract

This study specifically aimed to: (i) identify of pedo-agroclimate characteristics, (ii) evaluate of potential avaibility land, suitability land and problems for food crops development, (iii) develop planting and land recource management. This study was conducted on the mainland Buton Regency, the used a spatial analysis method employing GIS. The study results showed that: (i) the mainland Buton regency had relatively varied characteristics of land biophysic. For climate aspects, the region had low and uneven distributed rainfall; (ii) potential land avaibility for food crops development in study area was : 74,664.64 ha, where the land suitability level of S2 of 5,096.52 ha, S3 of 44,521.38 ha, and the rest was N1 and N2. The Land suitability classes for crop plant in the study area were: S3 and N1 except for cassava, there were S2, S3, and N. Similar problems were found in almost all areas, i.e. high soil pH >7 - 8.5 or low 4 - 4.5, P2O5 content was very low, high air humidity > 90% or low < 30%, high erosion risk, high slope >15 - 25%, high level of surface rocks >40%, high level of surface layer >40%, very high erosion risk, very high slope >25%), shallow effective dept < 20 cm; (iii) the land resource management, suggested were improvements: i.e: drainage system, nutrient retention through liming and addition of organic matter for CEC and pH, nutrient availability through liming and fertilization, mechanization potency on slopy area, erosion risk level through reducing erosion rate, making terrace, parallel contour planting, cover crop planting, terrace construction for rice at slopes 3 - 8% and 8 - 15%, water availability through improvement of irrigation system.

Keywords: Land Suitability, Food Crop, Pedo-Agroclimate, Resource Management

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INTRODUCTION

Land is a key and limiting factor in an agriculture production system, and needs to be maintained to prevent from degradation. Land evaluation is required to determine the land suitability for plant growth. Rounsevell and Reay (2009) stated that uneffective land use is closely related to climate change and, vice versa, the wrongly use of land can cause climate change. Therefore, a wise plan is required to optimize land use, effectively and sustainably.

Djaenudin (2009) also mentioned that soil mapping and land evaluation are effective approaches to determine spatially land potential, including its limitations, as well as inputs, and management. Baja (2002, 20012a) stated that one of the alternatives to land suitability assessment through appropriate land use planning, by considering a number of factors especially biophysic characteristics using GIS technology.

Wirosoedarmo *et al* (2011) mentioned that GIS application has proven effective in determining the suitability of land and crops. Land evaluation is conducted based on the pedo-agroclimate, including information on soil conditions (physical, chemical, and soil microbiological properties), and climatic conditions (air temperature, air humidity, and rainfall). As noted in (Baja, 2001), one of the limiting factors in conducting agriculture development in a certain region such as Buton is the unavailability of data (especially spatial data), despite the fact that the region is actually potential to support sustainable crop production.

Based on the above information, the research on “Land suitability assessment of food crop based on pedo-agroclimate in dry climate region using spatial analysis method, especially in mainland Buton regency is important to be conducted. The objectives of this study were : (i) identify of pedo-agroclimate characteristics, (ii) evaluate of potential avaibility land, suitability land and problems for food crops development, (iii) develop planting and land resource management.

Study Area

The study area is the mainland Buton regency, situated in the southeast part of Sulawesi Island, Indonesia, and geographically located between 4.96^o and 6.25^o South Latitude and 120.0^o and 123.34^o East Longitude. This study was conducted on ten districts in the mainland Buton regency, including Batauga, Sampolawa, Lapandewa, Wabula, Pasarwajo, Wolowa, Siontapina, South Lasalimu, Lasalimu, and Kapontori [Figure 1].

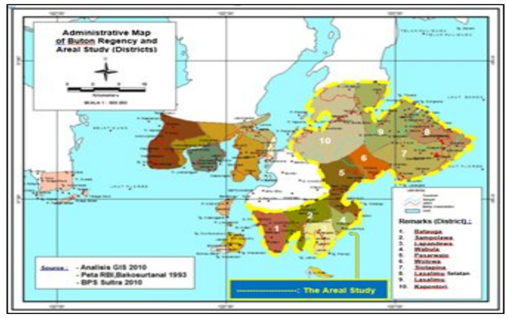

Figure 1. Administrative Map of Buton Regency and Location study

MATERIALS AND METHODS

This study utilizes primary and secondary data. Primary data collected were soil physical, morphological, and chemical properties on each site (mapping unit), analysed in the Soil Laboratory of Hasanuddin University, Makassar. Secondary data include: (a) soil map, with scale of 1 : 50,000, (b) land use map of Southeast Sulawesi, with scale of 1 : 25,000, (c) administrative map of Buton regency, and other thematic maps derived from satellite data, each with scale of 1 : 25.000, and (d) regional climatic data over the last ten years (2002-2011) from several climatic and rainfall stations in the region and surrounding areas (Bappeda Buton, 2010; Bakosurtana,2010 and BPS buton, 2012)

This study using a spatial analysis method, employes the ArcView GIS software. The study was conducted in three main: (i) survey, (ii) evaluation, and (iii) management (Djaenuddin et al., 2011; FAO, 1976). These three main steps were performed in five stages: (a) preparation, (b) collection of land biophysic data (physiography, land and climate), (c) input and data analysis, (d) interpretation for land evaluation, and (e) develop resource management.

RESULTS

Land Biophysic Characteristics

The identify results of land biophysic characteristics based on pedo-agroclimate in the study area are shown on Table 1.

Table 1. Land Biophysic Characteristics Based on Pedo-Agroclimate

No	Satuan lahan dan Karakteristiknya	Satuan lahan dan Karakteristik lahan yang dominan di Wilayah Penelitian									
		Batauga	Sampolawa	Lapandewa	Wabula	Pasarwajo	Wolowa	Siotapina	Lasalimu Sel	Lasalimu	Kapontori
1	Satuan lahan :										
	a. Jumlah satuan lahan (329 unit)	28	20	12	10	31	14	24	52	65	73
	b. Luas lahan potensial (74,664.64 ha)	7,120.29	3,473.56	8,472.45	4,872.97	12,615.67	3,081.27	4,422.33	8,709.94	9,436.40	12,458.86
2	Zona agroekologi	Iax2, IIax2	Iax2, Max1	Iax2	Iax2	Iax2	Iax2, Iay2	Iay2, Iax2	IIay2, Iay2	Iay2, IIay2, May2	Iax2, Max1, Max2
3	Komponen Fisio-topografis :										
	a. Bentuk lahan (landform)	Sis perbukitan	Sis perbukitan	Terumbu karang	Sis perbukitan	Sis perbukitan	Sis perbukitan	Dat piedmont	Sis perbukitan	Sis perbukitan	Sis perbukitan
	b. Geologi tanah	Wapulaka	Sampolakosa	Wapulaka	Wapulaka	Wapulaka	Tondo	Sampolakosa	Wapulaka	Tondo	Wapulaka
	c. Kelerengan (%)	26-40 (Berlereng)	41-60 (agak curam)	41-60 (agak curam)	41-60 (agak curam)	41-60 (agak curam)	41-60 (agak curam)	16-25 (agak berlereng)	9-15 (landai)	41-60 (berlereng)	41-60 (berlereng)
4	Komponen Tanah :										
	a. Jenis tanah	Rendolls	Rendolls	Rendolls	Rendolls	Rendolls	Rendolls	Tropudalfs	Tropudalfs	Dystropepts	Rendolls
	b. Tekstur tanah	Lempung berpasir	Liat berdebu	Lem liat berpsir	Lem liat berdebu	Lem Liat Berpsir	Lempung berpasir	Lempung	Lempung	Lempung berpasir	Lempung
	c. Struktur tanah	Gumpal membulat	Gumpal bersudut	Gumpal bersudut	Gumpal bersudut	Gumpal bersudut	Remah	Gumpal bersudut	Gumpal bersudut	Gumpal bersudut	Gumpal bersudut
	d. Kedalaman efektif (cm)	20-50 (dangkal)	>60-75 (agak dalam)	20-50 (dangkal)	20-50 (dangkal)	20-50 (dangkal)	20-50 (dangkal)	>75-100 (dalam)	20-50 (dangkal)	20-50 (dangkal)	20-50 (dangkal)
	e. Batuan permukaan (%)	>60-90 (A.S berbatu)	>3-15 (C. berbatu)	>15-50 (S. berbatu)	>3-15 (C. berbatu)	>60-90 (A.S berbatu)	>15-50 (S. berbatu)	>3-15 (C. berbatu)	>0.01-0.1 (sedikit berbatu)	>3-15 (C. berbatu)	>15-50 (S. berbatu)
	f. Singkapan batuan permukaan (%)	>60-90 (A.S berbatu)	>2-25 (C berbatu)	>25-50 (S. berbatu)	>0.1-2 (A berbaatu)	>2-25 (C berbatu)	>2-25 (C berbatu)	>0.1-2 (A berbatu)	>0.01-0.1 (sedikit berbatu)	>2-25 (C berbatu)	>2-25 (C berbatu)
	g. Tingkat bahaya erosi	sedang	berat	sedang	sedang	sedang	sedang	sangat ringan	sedang	sedang	sedang
	h. Konsistensi tanah	Lekt Basah Kering	Lekt Basah Kering	Lekt Basah Kering	Lekt Basah Kering	Lekt Basah Kering	Bash Jenuh Kering	Lekt Basah Kering	Lekt Basah Kering	Lekt Basah Kering	Lekt Basah Kering
	i. Kapasitas tukar kation (cmol(+)kg-1	25-40 (tinggi)	17-24 (sedang)	25-40 (tinggi)	25-40 (tinggi)	25-40 (tinggi)	25-40 (tinggi)	17-24 (sedang)	25-40 (tinggi)	25-40 (tinggi)	25-40 (tinggi)
	j. pH	6.6-7.5 (netral)	6.6-7.5 (netral)	7.6-8.5 (agak alkalis)	7.6-8.5 (agak alkalis)	7.6-8.5 (agak alkalis)	7.6-8.5 (agak alkalis)	7.6-8.5 (agak alkalis)	6.6-7.5 (netral)	6.6-7.5 (netral)	6.6-7.5 (netral)
	k. Kejenuhan basa (%)	>70 (sangat tinggi)	51-70 (tinggi)	>70 (sangat tinggi)	51-70 (tinggi)	51-70 (tinggi)	51-70 (tinggi)	51-70 (tinggi)	51-70 (tinggi)	51-70 (tinggi)	51-70 (tinggi)
	l. Kandungan C-organik (%)	<1 (sangat rendah)	1-2 (rendah)	>2-3 (sedang)	>2-3 (sedang)	>2-3 (sedang)	>3-5 (tinggi)	>3-5 (tinggi)	>3-5 (tinggi)	1-2 (rendah)	>3-5 (tinggi)
	m. Kandungan N-total (%)	0.51-0.75 (tinggi)	0.21-0.50 (sedang)	0.51-0.75 (tinggi)	0.51-0.75 (tinggi)	0.51-0.75 (tinggi)	0.51-0.75 (tinggi)	0.21-0.50 (sedang)	0.21-0.50 (sedang)	0.51-0.75 (tinggi)	0.51-0.75 (tinggi)
	n. Kandungan Phosfor (ppm)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)
	o.. Kandungan Kalium (K-dd, ppm)	41-60 (tinggi)	41-60 (tinggi)	21-40 (sedang)	41-60 (tinggi)	21-40 (sedang)	21-40 (sedang)	41-60 (tinggi)	41-60 (tinggi)	41-60 (tinggi)	41-60 (tinggi)
	p. C/N ratio (%)	<5 (sangat rendah)	<5 (sangat rendah)	<5 (sangat rendah)	<5 (sangat rendah)	<5 (sangat rendah)	5-10 (rendah)	5-10 (rendah)	5-10 (rendah)	5-10 (rendah)	5-10 (rendah)
	q. Kejenuhan Al (%)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)	<10 (sangat rendah)
	r. Status kesuburan	sedang	sedang	sedang	sedang	sedang	sedang	sedang	sedang	sedang	sedang
5	Komponen Iklim:										
	a. Suhu udara (oC)	26-28	26-28	26-28	26-28	26-28	28.1-30	28.1-30	28.1-30	28.1-30	28.1-30
	b. Kelembaban udara (%)	82	94	94	94	94	87	87	87	87	83
	c. Curah hujan tahunan (mm th-1)	1989.70	1747.20	1747.20	1,747.20	1646.50	1464.50	1464.50	1464.50	1464.50	1552.40
	d. Tipe Iklim Oldeman	C3	C3	C3	C3	C3, E3	C3, E3	D3	D3	D3, E3	C3
6	Neraca Air Lahan										
	a. Periode defisit	Jul-Nov	Jul-Okt	Jul-Okt	Jul-Okt	Jul-Nov	Jul-Okt, Nov	Jul-Jan	Jul-Nov	Jul-Nov	Jul-Nov
	b. Periode surlus	Des-Apr	Nov-Apr	Nov-Apr	Nov-Apr	Des-Apr	Nov, Des-Apr	Feb-Jun	Des-Apr; Feb-Jun	Des-Apr; Feb-Jun	Des-Apr
7	Komponen hidrologi :										
	a. Kapasitas drainase	Baik	Baik	Baik	Baik	Baik	Baik	Baik	Baik	Baik	Baik
	b. Tingkat bahaya banjir	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)	Tanpa banjir (F0)
8	Komponen Penggalahan	PLK, SB	SB	SB	HLKS, SB	PLKCS	PLKCS	PLKCS	PLK, PLKCS	PLKCS	HLKS

Table 1 showed that the ten study areas had different potential land areas, comprised of 74,664.64 ha area or 35.55% of total areas of Buton Regency main area (210,030.00 ha). The study areas had diversed land biophysics, including phyisio-topography, soil and climate condition, all had influences on the type and land suitability assessment for food crops, and their development covered area.

The climate condition especially rainfall [Figure 2] and analysis results on general land-water balance [Figure 3], showed that there were four categories based on information of rainfall and potential evapotranspiration in the study area and surrounding areas, namely: Betoambari, Kaisabu, Lawele, and Kapontori stations.

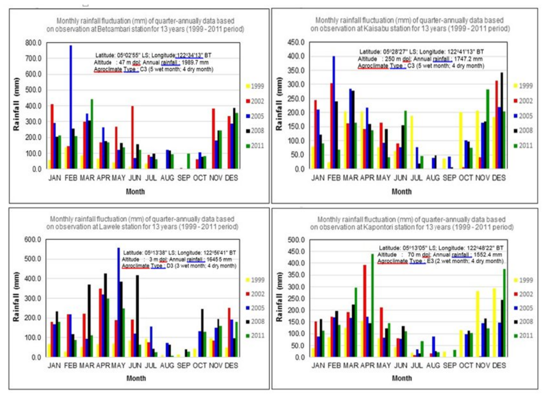

Figure 2. Monthly rainfall fluctuation in study area (4 stations)

Figure 2 showed that monthly rainfall of quarter-annually data for the last 13 years in Buton regency was very fluctuative each year. This had implication on spatial use, plan for farming type, determination of cropping pattern and planting date, and productivity of crop.

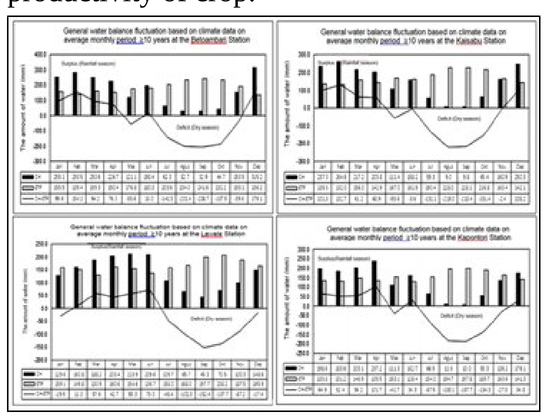

Figure 3. General water balance based on climate condition in study area

Figure 3 showed that research area around Betoambari station, i.e. Batauga district, had six wet months (dec, jan, feb, mar, apr, jun), and four dry months (jul-oct.). Around the Kaisabu station, i.e. Pasarwajo, Wabula, Lapandewa, Sampolawa districts, and part of Wolowa and Kapontori districts had fife wet months (dec, jan, feb, mar, apr), fife dry months (may, jul-nov), and moist months (jun and nov.). Around the Kapontori station, i.e. Kapontori district, and part of sub districts, Wolowa, Lasalimu, and Pasarwajo, had each fife wet and dry months, i.e. dec, jan, feb, mar, and apr (wet months), and may, jul-nov (dry months), and two moist months (jun and nov). In around Lawele station, included districts Lasalimu, South Lasalimu, Siotapina, and part of Wolowa district, showed that there were each fife rainy and fife drought seasons; feb, mar, apr, may, jun for rainy seasons, jul-nov for drought seasons, and two moist months (dec and jan).

Based on such data and information, the study area had yearly rainfall less than its potential evapo-transpiration, and was classified as dry climate area; therefore agriculture activities had to carefully consider the use of rainfall information for dry land agriculture, especially on determining the planting date and pattern, and plan for application of water irrigation and use of suitable variety. There were four different chategories of soil drainage capacity in the research areas, i.e. good, moderate, slightly bad, and bad. Likewise, the dominance of spatial use was differed for each region.

Land Suitability Assessment and Problems

Results of the land suitability analysis (actual and potential suitability) for food crops development in the study area (districts) are shown on Table 2.

Table 2 showed that based on ten evaluated food crops (cultivated and uncultivated), the highest suitability class was S2 (*moderately suitable*), followed by S3 class (*marginally suitable*), and the rest was N1 class (*temporarily not suitable*) and N2 class (*permanently not suitable*). Several food crops that were suitability and can be developed in the study area, i.e: paddy rice, upland rice, maize, cassava, sweet potato, peanut, soybean, peanut, mungbean, taro, and sorghum. The land suitability levels for crop plant in the study area were S3 and N1 except for cassava, there were land suitability classes of S2, S3, and N.

Table 2. The actual and potential land suitability classes for several food crops development

No.	The Study area (District)	The Actual Land Suitability Classes for Food Crop Development in the Study Area									
		Paddy rice	Upland rice	Maize	Cassava	Sweet Potato	Peanut	Soybean	Mungbean	Taro	Sorghum
1	Batauga	N2	N2	N2	S3 N	N2	N2	N2	N2	N2	N2
2	Sampolawa	S3 N2	S3 N2	N1N2	S2 S3 N	S3 N1N2	S3 N1N2	N1 N2	S3 N1 N2	S3 N1 N2	S3 N1N2
3	Lapandewa	S3 N2	S3 N2	N1N2	S3 N	N1 N2	S3 N2	N2	N1N2	N1 N2	S3 N2
4	Wabula	N2	N2	N2	N	N2	N2	N2	N2	N2	N2
5	Pasarwajo	N2	N2	N2	N	N2	N2	N2	N2	N2	N2
6	Wolowa	N2	N2	N2	N	N2	N2	N2	N2	N2	N2
7	Siotapina	S3 N1N2	N1N2	N1,N2	S2 S3 N	N1 N2	S3 N1N2	N1 N2	S3 N1 N2	S3 N1 N2	S3 N1N2
8	Lasalimu Selatan	S3 N1N2	N1 N2	N1N2	S2 S3 N	N1 N2	S3 N1N2	N1 N2	S3 N1 N2	S3 N1 N2	S3 N1N2
9	Lasalimu	S3 N1N2	N1 N2	N1N2	S2 S3 N	N1 N2	S3 N1N2	N1 N2	S3 N1 N2	S3 N1 N2	S3 N1N2
10	Kapontori	S3 N1N2	N1N2	S3 N1 N2	S2 S3 N	N1 N2	S3 N1N2	N1 N2	S2 S3 N1 N2	S3 N1 N2	S3 N1N2

No.	The Study area (District)	The Potential Land Suitability Classes for Food Crop Development in the Study Area									
		Paddy rice	Upland rice	Maize	Cassava	Sweet Potato	Peanut	Soybean	Mungbean	Taro	Sorghum
1	Batauga	N2	N2	N2	S3 N	N2	N2	N2	N2	N2	N2
2	Sampolawa	S2 N2	S3 N2	S3 N1 N2	S1 S2 N	S3 N1N2	S2 S3 N2	N1N2	S2 N1N2	S3 N2	S3 N1N2
3	Lapandewa	S2 N2	S3 N2	N1N2	S2 N	N1N2	S3 N2	N1N2	N1N2	S3 N2	S3 N2
4	Wabula	N2	N2	N2	N	N2	N2	N2	N2	N2	N2
5	Pasarwajo	N2	N2	N2	N	N2	N2	N2	N2	N2	N2
6	Wolowa	N2	N2	N2	N	N2	N2	N2	N2	N2	N2
7	Siotapina	S2 S3 N1N2	N1N2	N1,N2	S2 S3 N	N1N2	S3 N1N2	N1N2	S2 S3 N1N2	S3 N1 N2	S3 N1N2
8	Lasalimu Selatan	S2 S3 N1N2	N1 N2	N1N2	S1 S2 S3 N	N1N2	S2 S3 N1N2	S3 N1N2	S2 S3 N1N2	S3 N1 N2	S3 N1N2
9	Lasalimu	S2 S3 N1N2	N1 N2	N1N2	S2 S3 N	N1N2	S3 N1N2	S3 N1N2	S2 S3 N1N2	S3 N1 N2	S3 N1N2
10	Kapontori	S2 S3 N1N2	N1N2	S3 N1 N2	S2 S3 N	N1N2	S3 N2	N1N2	S2 S3 N1N2	S3 N1 N2	S3 N2

Similar problems were found in almost all areas, i.e: high soil pH > 7 -

8.5 or low 4 - 4.5), P2O5 content was very low, high air humidity > 90% or low < 30%, high erosion risk, high slope >15 - 25%, high level of surface rocks >40%, high level of surface layer >40%, very high erosion risk, very high slope >25%, shallow effective depth < 20 cm. These result are similar to the criteria of Hardjowigeno and Widiatmaka (2007) and result of study by Kandari (2014).

Land Resource Management

Land resource management on each research area was based on the number of identified limiting factor. The study results showed that there were several limiting factor combinations on each study area, generally classified into seven factors: (i) slope condition (s), (ii) erosion risk level (e), (iii) water availability (w), (iv) surface rock (p), (v) media and root conditions (r), (vi) nutrient retension (f), and (vii) nutrient availability (n).

Based on the limiting factors, activities for land resource management were as follows:

a) land management based on the principles of soil and water conservations;
b) optimal use of water and climate resources;
c) management of forest vegetation, food, and animal feed;
d) wise education for human resources;
e) determination of commodity that is suitable with agroecology.

The land resource management on the study area, suggested were improvements: i.e: drainage system, nutrient retention through liming and addition of organic matter for CEC and pH, nutrient availability through liming and fertilization, mechanization potency on slopy area, erosion risk level through reducing erosion rate, making terrace, parallel contour planting, cover crop planting, terrace construction for rice at slopes 3 - 8% and 8 - 15%, water availability through improvement of irrigation system. These argument was similar to report and criteria of LREPP (1994) and result of study by Kandari (2014).

The use of organic matter was intended to improve water holding capacity of soil, to let fast infiltration, but slow the percolation, so that the water availability for crops was relatively maintained. Inclusion of plant wastes during soil cultivation was a very simple and specific technology, as an effort to increase and maintain soil organic matter content, to be able to produce humic material. If the mulch or crop waste is such a crop like *Leguminoceae*, this will ultimately add nitrogen nutrient and other mineral elements to the soil.

DISCUSSION

The study result showed that regional zonation using a spatial method applied with GIS could effectively determine the regional agroecology potency, and this eased the planning and determination of crop types and other relevant activities, based on the principles of usefulness and sustainability. Identify result of pedo-agroclimate characteristics on the mainland of Buton regency were relatively varied. These results are the same as those reported by Hezam *et al* (2011), Wirosoedarmo *et al* (2011), Baja [2012b). Kandari (2013, 2014), who stated that the spatial method using GIS could be used to evaluate land potential characteristics, so that we can easily make planning for crop development. Bobade *et al*. (2010) mentioned that research activities using land as general data source, can be efficiently integrated in planning for crop development in a certain area, using GIS.

In general, the research areas were dominated by sandy soil texture; where the soil capability to keep and fix water was relatively low so that soil easily dried. This condition became worst with low and uneven distribution of rainfall, making Buton regency especially in study area was frequently facing drought. Based on the method of Oldeman (1975, 1977), there were three climate types over the study area, i.e: C3, D3 and E3.

According to Mueller (2010), important natural factors as indicators for land characteristics in a certain region, in relation to plans for crop development were climate characteristics, such as radiation, temperature, evapo transpiration, and rainfall. Climate condition in the study area was dominated by dry climate condition; where the average of yearly rainfall rate was below 2000 mm. This showed that study area was chategorized as dry area with dry climate, which limited food crop productivity due to insufficient water for crops to optimally grow and produce. This argument was similar to the finding of Akdemir et.al (2011) that climate condition was the most influent agriculture production factor, especially at growth and seed-filling (production) stages. Awotoye and Matthew (2009) mentioned that climate changes and its variation, especially rainfall, affected crop production, particularly for gramineae, leguminoceae and vegetables. In addition, analysis of land resource potency was important, because it is possible that dominant area were not suitable for crop development, due to the interaction between land usage and climate change.

According to Lavale (2009), soil and climate significantly contribute to the plant growth process. Management for soil and water conservation is highly required for obtaining optimal production, anticipating erosion risk and water limitation at growth period, through surface water and rain management, such as drainage, planting pattern adjustment, build water dam, the use of soil organic matter, and the use of short-age plant variety. Joshi *et al* (2011), mentioned that the unsuitability of a certain area for cultivation of a certain plant commodity was closely related to its climate and land conditions.

Building land contour should to be considered in land conservation effort at slope over 15%. Several technologies that can be applied to control erosion were: vegetative, mechanic, and chemical approaches. Land management by vegetative technology such as: contour-based planting, planting of cover crop (for dry land), strip cropping, crop rotation, mulch usage. Hakim (2002) reported that conservation efforts for land with slopes of 20-50% and 18-40% (rainfall 1,434 mm year^{-1}) using alley cropping and *Leucaena* crop, proved to reduce soil erosion as much as 69 ton ha^{-1} and 15 ton ha^{-1}, and percolation level of 8 cm^3 ha^{-1} and 4.5 cm^3 ha^{-1} lower than that in agroforestry.

Crops will eventually not productive if they were forcely grown in an unsuitable location, except if improvements, including technology inputs, were made (Niggol et al, 2008). In agricultural context, finding optimal locations for crops can increase economic benefits, as well as reduce negative environmental consequences.

The effectiveness of agricultural interventions–improved cultivars, agronomic management practices, decision support system–depends on these factors. As pointed out in Rossiter (1994), the use of unsuitable land can decrease productivity, quality, and eventually its sustainable use. Similarly Rounselvell et al, (2009) previously also stated that suitability of agroecologic requirements is fundamental for crop cultivation; otherwise it causes not only economical and financial losses, but also generatis social costs, in forms of degradation of and declining in the quality of land resources.

Land management by mechanic technology included conservation tillage, contour cultivation, sewage, irrigation, checkdam, *etc*. (Arsyad, 2006). Land management by chemical technology included the use of chemical agents, such as low amount of synthetic chemical, to increase aggregate stability, improve soil properties, and avoid erosion. In an attempt to overcome the limiting factor of water availability in the study area, several specific technologies can be applied, i.e. (a) management of surface water, (b) adjustment of planting pattern, and (c) application of organic material into soil.

During drought season, a few ways could be done to overcome the water deficit, such as controlling surface water, collecting water, improvement of soil infiltration capacity, soil cultivation and the use of mulch, and building irrigation to maximize water potential in the rivers around research area. During rainy season, efforts that could be done to overcome water excess problem included making irrigation to collect excess water during rainy season (Hakim, 2002). Besides, making good drainage was an important thing to reduce the possibility of flood of farming land.

CONCLUSIONS

Based on results and discussion, it is concluded as follows:

a) The mainland Buton regency had relatively varied characteristics of land biophysic. For climate aspects, the region had low and uneven distributed rainfall. The region was classified as a dry climate region area with annual rainfall < 2000 mm, dominated by agroclimate types C3, D3, and E3;
b) Potential land avaibility for food crops development in study area was : 74,664.64 ha, where the land

suitability level of S2 (*moderately suitable*) of 5,096.52 ha, S3 (*marginally suitable*) of 44,521.38 ha, and the rest was N1 and N2. Several food crops that were suitability and can be developed in the study area, i.e: paddy rice, upland rice, maize, cassava, sweet potato, peanut, soybean, peanut, mungbean, taro, and sorghum. The land suitability levels for crop plant in the study area were S3 and N1 except for cassava, there were land suitability levels of S2, S3, and N.

c) Similar problems were found in almost all areas, i.e. high soil pH >7 - 8.5 or low 4 - 4.5, P2O5 content was very low, high air humidity > 90% or low < 30%, high erosion risk, high slope >15- 25%, high level of surface rocks >40%, high level of surface layer >40%, very high erosion risk, very high slope >25%), shallow effective depth < 20 cm;

d) The land recource management, i.e: suggested improvement types and technology inputs to solve the problems of crop development in the study areas were improvements of : drainage system, nutrient retention through liming and addition of organic matter for CEC and pH, nutrient availability through liming and and fertilization, mechanization potency on slopy area, erosion risk level through reducing erosion rate, making terrace, parallel contour planting, cover crop planting, terrace construction for rice at slopes 3 - 8% and 8 - 15%, water availability through improvement of irrigation system.

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