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Full Length Research Paper

Potential of land suitability in Seputih Surabaya and Bandar Surabaya Districts Central Lampung regency for developing soybean

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Seputih Surabaya district covers 13 villages having 8,566 ha agricultural land consisted of 928 ha rainfed lowland and 7,638 ha dry land. Bandar Surabaya district covers 9 villages having 6,727 ha agricultural land consisted of 1,363 ha rainfed lowland and 5,364 ha dry land. The objective of this research is to identify potential of land suitability for soy bean. The research was done in May – September 2006, using purposive soil sampling. There were five point of boring site in every village and to be composed. Soil chemical analysis was done in laboratory. Soil fertility was vary between village. This area can be classified into two groups, these are suitable (S-2) and moderate suitable for soy bean (S-3). The level of land suitability for soy bean can be upgraded by : deeping soil tillage, apply soil ameliorant (dolomite, zeolite), applying organic and inorganic fertilizers. Seputih Surabaya and Bandar Surabaya have suitable agricultural land to develope soy bean. Developing soy bean in rainfed lowland with cropping pattern rice – soybean – other secondary crops or rainfed upland with cropping pattern Maize – Soybean + others, or multiple cropping system between Cassava + Maize and Soybean with planting cassava arranged into double rows.

Key words: Land suitability, soybean, Seputih Surabaya, Bandar Surabaya, Lampung

INTRODUCTION

Upland area in Indonesia is quite broad, more than 70 million ha, thus providing a significant opportunity for expansion of crops, especially for soybeans and corn (Abdurachman, et al., 1998). Soil fertility of dry land is vary refers to the topo-geographical diversity. Upland acid soils with the characteristics of Ultisol and Oxisol which are mostly found in Sumatra, Kalimantan, and Irian Jaya has a productivity problem in the form of high acidity, Al-ex (Aluminum can be exchanged) and the levels of free iron (Fe) is very high that poison plants, low organic matter content, nutrient levels are generally low, the degree of base saturation (V) is low, low cation exchange capacity, low soil buffering capacity, and low water holding capacity. Taufiq et al. (2004) reported that the main problem in the dry lands of Central Lampung and Tulang Bawang regencies for soybean cultivation is low pH (<5), high Al saturation (12.0 to 40.1%) in Central Lampung and from 18.4 to 47.6 % in Tulang Bawang, Fe is high (41.30 to 73.43 ppm), the P and K status is low. Tolerance of soybean to Al saturation was 20% (Hartatik and Adiningsih, 1987).

Based on the above description of the production constraints, it can be understood that the performance of commodity production is still very large refers to its agroecology. Thus it is logic that productivity of soybean in upland acid soils is low. The use of agricultural lime in

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the form of CaCO3 and Dolomite and organic material to increase the productivity of acid soil has long been recommended and done (Kamprath, 1972, Mengel et al., 1987). Liming can be effective if the saturation of acidity (Al + H)> 10% and soil pH <5 (Wade et al., 1986).

Biophysical characterization of land that become the target development of soybean production systems in upland acid soils become very important in order to generate or synthesizing of site-specific farming technology. Biophysical characterization will be the reference basis for the land by way of raw agricultural development application based on prescription farming or precision farming (Shibusawa, 2002). Basic data of this area will illustrate the potential possessed by the territory, either directly on the potential for significant wealth that can be exploited and the potential issue or problem to be solved in order to increase the power of that territory in order to provide added value for the benefit of society. With a description of the potential of this region will greatly assist planners prepare Regional Development Plans (RDP), both at the village level (RDV), an administrative district as well as demarcation of the wider region (Sudaryono, 1994).

Agroecological upland acid soils characterized by Ultisol, Oxisol, and Entisol represents the widest area of soybean planting. Characterization of soil characteristics, diagnostic status and nutrient requirements of soybean in Ultisol, Oxisol and Entisol a basic data set of land management recommendations and optimum nutrient requirements in accordance soybean soil test. Disclosure (illustration) nutrient dynamics in a cropping system provides a reference of certain agroecological sustainability, stability of fertility, soybean productivity, and ensure sustainable production systems.

Principal considerations that underlie this activity is the target outcome of activities such basic information in order to empowerment and efficient management of upland acid soils for the use of material inputs, particularly soil ameliorant, organic fertilizer, nutrients P, K, S, Ca, Mg and micro nutrients. Detail survey of the region are generally designed to obtain data on land and land for regional development programs covering aspects of agricultural and other programs that are not also closed for a research program in the land of farmers (research farm) to identify the description of land specification in certain areas and to investigate the variety of characters of soil in the plot of land that represent (Landon, 1984). Basic information is meant to be (a) the total volume of physical assets that describe areas that can be developed for agricultural development, especially the development of food crops, (2) the physical description area that illustrates the potential productivity in agriculture as well as physical problem of land that must be solved to facilitate agricultural development process, (3) descriptions of biological assets or biological region that describes the potential and diversity of biological resources that provide a benefit for the development of agriculture, (4) description of institutional and institutional development opportunities to support the development of agriculture in local areas, and (5) location-specific technology as a material recommendations that must be prepared in accordance with the biophysical characteristics of land to develop agricultural production systems, especially food crops. Output expected from this activity is biophysical description of Seputih Surabaya and Bandar Surabaya districts and land suitability determination of soybean, to recommend soybean technology for soybean production system and further programs development.

RESEARCH METHOD

The study was conducted in May-September 2006 in the Districts of Seputih Surabaya and Bandar Surabaya, Central Lampung Regency (Table 3; Figure. 1). Operational activities in the field were conducted with a purposive method. Soil sampling was done by boring at five points in each village. Observations were made directly on the ground each drilling location. Carried on soil profile description representing the village area with detailed descriptions. Depth of approximately 75-100 cm soil profile.

These research activities can be detailed as follows: (1) the physical description area or land (land) includes altitude, climate (temperature and precipitation), physiography (slope), drainage pattern (drainage patterns), the degree of erosion of land and cropping pattern (cropping pattern and crop rotation) and (2) diagnostic studies include the characterization of land and soil physical and chemical properties such as thickness of soil solum, soil color, soil texture, soil organic matter content, pH, CEC, organic C, N, P, K , S, Ca, Na, Mg and Al.

There are eight factors which includes 11 elements considered in assessing the suitability of land for soybean (Table 1), ie temperature, water availability (dry months, rainfall), the root environment (drainage, soil texture above layer, solum thickness and depth of soil), nutrient retention (CEC, pH), nutrient availability (N concentration, P, K), salinity (soil layer below), land slope and percent saturation of Al (CSR-FAO, 1983; Landon, 1984). Suitability criteria for soybean farming divided by four, namely: very suitable (S1), suitable (S2), is less suitable (S3), and is not suitable (N), each expressed with a value score of 4, 3, 2, and 1 (Table 1).

Criteria of suitability of land for farming soybeans divided by four, namely : very suitable (S1), suitable (S2), is less (moderate) suitable (S3), and is not suitable (N), each expressed as score 4, 3, 2, and 1 (Table 1), and successively weighs 100, 75, 50, and 25%. Point value of land suitability for soybean determined by the following Table 2a and 2b.

RESULTS AND DISCUSSION

Physical description of Seputih Surabaya and Bandar Surabaya Districts

Seputih Surabaya and Bandar Surabaya are the result of the expansion (pemekaran) of the Seputih Surabaya District. Characterization and soil sampling of Seputih

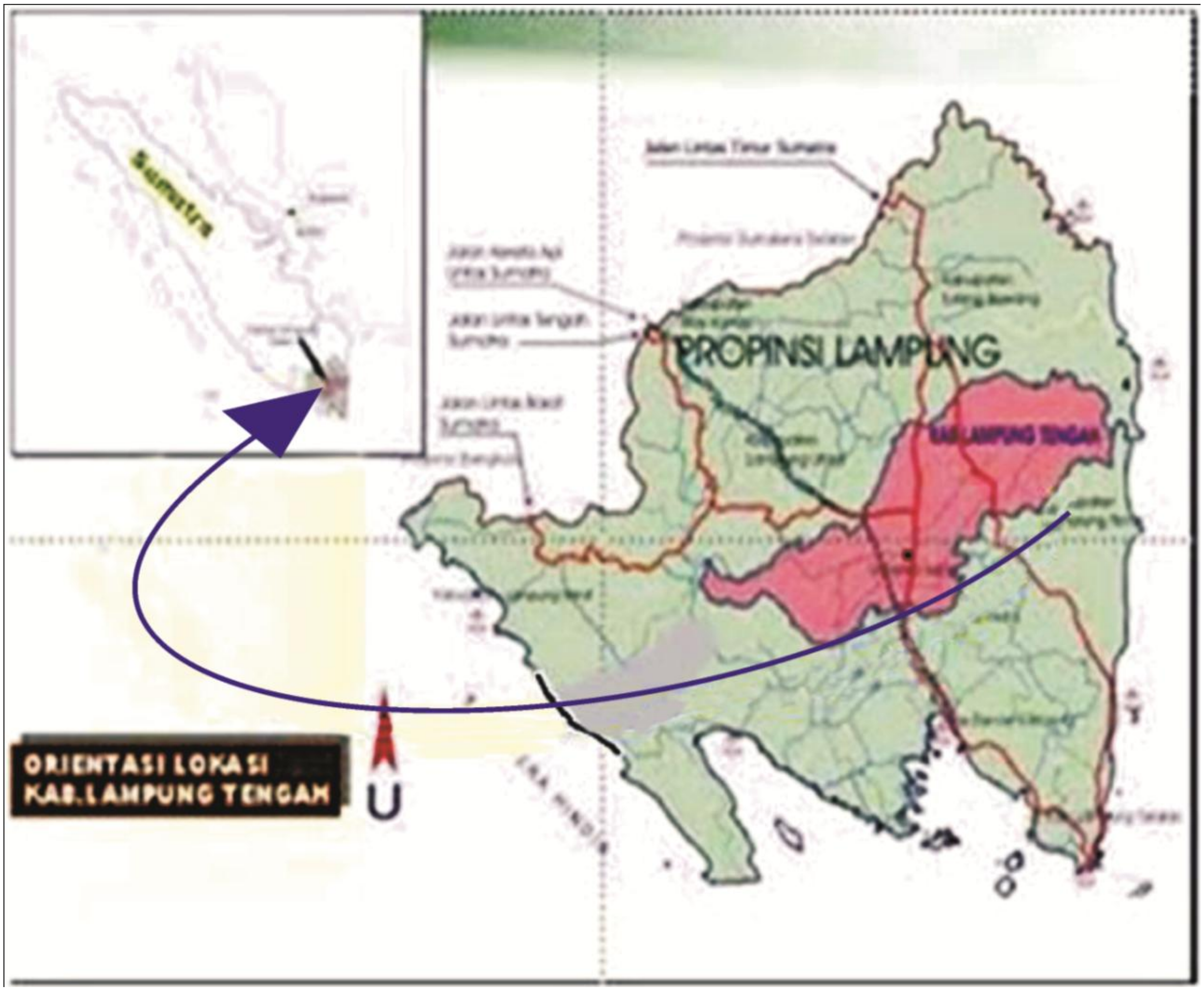

Figure 1. Map of Lampung Tengah Regency, Lampung Province.

Surabaya district was conducted from the dry land all over the village. Seputih Surabaya district consists of 13 villages, the village of Sumber Katon, Sri Katon, Baya Baru (GB I), GB II, GB III, IV, GB, GB VI, VII GB , GB VIII, Rawa Betik, Srimulyo Jaya, Kenangasari, and Mataram Ilir. This district has an area of 8566 ha of agricultural land consisting of 928 ha of rainfed land and 7638 ha dry land or "tegal land" (CBS, 2004).

Bandar Surabaya district consists of nine villages, namely Subang Jaya, Surabaya Ilir, Beringin Jaya, Gaya Baru 5, Rajawali, Sumberagung, Cabang, Sidodadi and Cempaka Putih. The land area in this districtis is 6727 ha consists of 1.363 ha lowland rainfed and 5364 ha tegal land (CBS, 2004).

Geographically, these two districts have similar, most parts have a flat topography with a slope of less than 5%, and there are some small undulating with a slope between 8-15%, elevation ranges from 10-75 m above sea level, land drainage generally is a good (current), the top layer of soil texture is generally sandy loam (sandy loam), while the bottom layer of soil ranging from sandy loam to sandy clay loam, soil solum generally still enough in between 25-60 cm , soil reaction slightly acid to slightly acid soils (pH 4.0 to 5.5). Based on the average in the 10 th, climatic conditions in the two districts mentioned above has nine wet months and three dry months. Rain is distributed in every month throughout the year (CBS, 2004). Most of the population in these two districts have livelihoods as farmers with the main commodities of rice, corn, soybeans, peanuts, cassava, horticulture crops, and some plantation crops namely coconut, cacao and coffee. The main commodities at the moment are cassava and maize. The proportion of food crop area in the two districts is 4026 ha of lowland rice, upland rice 1910 ha, 4127 ha of maize, 656 ha of soybeans, and 10 235 ha of cassava. Moreover, because the land on the cropping pattern varies among others (1) Corn - / - Corn + Soybeans - / - Other Nuts, (2) Corn - / - Soybeans - / - Green Beans, (3) upland rice + maize - / - Other nuts, (4) Corn - / - cassava, and (5) Sesame - / - cassava

Table 1. Criteria of suitability of land for soybean plants

Characteristics	Level of land suitability			
	S1 Very suitable	**S2 Suitable**	**S3 Moderate suitable**	**N Not suitable**
Score	**4**	**3**	**2**	**1**
Temperature				
Average Temperature °C	23-28	29 - 30 22 – 20	31 - 32 19 – 18	> 32 < 18
Water Availability				
Dry Month (<75 mm) Average Rainfall (mm/yr)	3 -7.5 1000-1500	7.6 – 8.5 1500-2500 1000-700	8.6 – 9.5 2500-3500 700-500	> 9.5 > 3500 < 500
Root Environment				
Drainage	Moderate- Good	Excessive	Poor	Very poor
Texture top soil[x)]	L, S,CL, SiL, Si, CL, SiCL	SL, SC	LS,SiC, C	G,S, Mass.C
Soil Depth (cm)	> 50	30-49	15-29	< 15
Nutrient Retention				
CEC (me/100 g) pH (H_2O)	> 25 6.0 – 7.0	25 - 15 7.1 – 7.5 5.9 – 5.5	15 - 5 7.6 – 8.5 5.4 – 5.0	< 5 > 8.5 < 20
Nutrient Availability				
N total (%) P2O5 available (Bray 4) (ppm) P2O5 available (Olsen 3) (ppm)	> 1.0 – 0.5 > 50 > 15	0.5 - 0,2 50 - 15 15 - 5	0.2 – 0.1 < 15 < 5	< 0.1 < 5 < 2
K available (me/100 g)	0.8 – 0.4	0.4 – 0.2	0.2 -0.03	< 0.03
Salinity, mmhos/cm				
Sub soil	< 2.5	2.5 – 4	4 – 8	> 8
Slope of Land (%)	0 – 5	5 – 15	15 – 20	> 20
Al saturation (Al/CEC) %	< 20	20 – 30	30 – 40	> 40

Source: CSR-FAO, 1983; Landon, 1984
x) Texture: Clay ©; Clay loam (CL) ; Loam (L) ; Sandy clay loam (SCL); Sandy clay (SC); Sandy loam (SL) ; Silt (Si) ; Silty clay (SiC); Silt loam (SiL) ; Sand (S) ; Gravels (G); Massive clay (Mass.C)

Table 2a. Determine of point value of suitable land for soybean crop

Kelas kesesuaian	Score	Percentage (%)	Point value of suitability (*)
S-1 = very suitable	4	100	3.6 – 4.0
S-2 = Suitable	3	75	2.6 – 3.5
S-3 = moderate suitable	2	50	1.6 – 2.5
N = Not suitable	1	25	1.0 – 1.5

*) note : percentage interval is 25%, plus or minus point value of suitability is accounted by interval 12.5%.

(Anonymous, 2000).

Soil character in Seputih Surabaya and Bandar Surabaya Districts

Solum thickness land: Agricultural land in Seputih Surabaya district have an average thickness between 40-60 cm solum enough but there are several villages which have a rather shallow solum thickness between 20-30 cm, ie Sumberkaton, Sidodadi, Gaya Baru 5, and Subang Jaya. Soil solum can describe the range of effective volume of soybean roots. On the thick soil solum provides buffering capacity for stabilizing soil moisture conditions, supply nutrients, and reserves sufficient

Table 2b. Chemical character of soil in Seputih Surabaya district, Lampung Tengah Regency Year *2006*

No	Code	pH		CO	P2O	SO4	K	Na	Ca	Mg	*CEC*	*Al exch*	*H exch*	Fe	Zn
		H2	KCl	%	ppm			………………..		Me/100g	…………………..			ppm	
1	1SK3T	4.5	3.6	1.63	24.7	32.6	0.11	0.11	0.50	0.30	24.9	0.40	0.60	354	1.13
2	S	4.0	3.7	1.53	12.0	37.8	0.02	0.10	0.36	0.20	22.2	0.80	0.40	308	0.42
3	2GB7T	5.5	4.4	1.47	19.4	18.8	0.07	0.13	0.56	0.33	23.6	0.80	1.00	331	1.30
4	S	5.0	4.3	1.12	11.3	38.4	0.05	0.10	0.58	0.31	26.4	1.00	1.20	263	0.34
5	3GB6T	4.6	4.1	1.26	18.1	21.0	0.05	0.15	0.47	0.23	14.0	0.60	1.20	339	2.14
6	S	4.8	4.2	1.94	12.7	35.9	0.03	0.15	0.54	0.26	14.0	1.00	1.00	236	0.41
7	4RB-T	4.5	4.4	1.14	27.6	32.0	0.06	0.16	0.72	0.34	25.0	0.88	0.22	308	0.91
8	S	4.8	4.3	1.08	12.5	61.9	0.02	0.10	0.72	0.25	25.0	1.53	0.17	226	0.60
9	GB4T	4.8	4.2	2.30	21.1	41.3	0.07	0.18	0.51	0.28	8.42	1.40	0.40	318	1.49
10	S	4.7	4.2	1.71	12.9	49.6	0.03	0.16	0.47	0.25	19.6	1.00	0.40	243	0.33
11	7GB3T	4.9	4.2	2.08	42.3	30.8	0.05	0.15	0.56	0.29	22.2	0.80	0.40	225	0.66
12	S	4.9	4.4	1.03	13.9	68.3	0.04	0.13	0.41	0.23	22.2	1.00	0	182	0.72
13	6GB2T	5.2	4.4	1.61	44.1	25.1	0.05	0.11	1.06	0.31	22.2	0.80	0.40	228	1.48
14	S	5.1	4.4	1.56	15.4	42.1	0.03	0.11	0.62	0.29	25.0	1.00	0.20	238	0.39
15	5GB5	4.8	4.3	1.83	31.4	20.8	0.06	0.08	0.66	0.33	30.5	0.60	0.40	287	1.45
16	S	4.8	4.3	0.96	12.0	34.5	0.02	0.10	0.45	0.25	27.7	1.40	0	324	0.56
17	8SM T	4.6	4.0	1.53	46.0	49.9	0.03	0.13	0.89	0.28	24.9	1.40	0	299	1.71
18	S	4.2	3.6	1.05	24.1	85.2	0.02	0.13	0.4	0.22	22.2	1.60	0	188	0.41
19	GB1T	4.8	4.2	2.30	21.1	41.3	0.07	0.18	0.51	0.28	8.42	1.40	0.40	318	1.49
20	S	4.7	4.2	1.71	12.9	49.6	0.03	0.16	0.47	0.25	19.6	1.00	0.40	243	0.33
21	10MIT	4.5	4.3	1.99	43.4	19.9	0.07	0.16	0.69	0.30	25.0	1.20	0.40	326	1.23
22	S	4.4	4.3	1.29	15.0	38.8	0.04	0.15	0.49	0.25	16.6	1.50	0	295	0.50
23	GB8T	4.5	4.2	1.83	17.2	31.5	0.05	0.15	0.43	0.21	25.0	1.40	0.40	299	0.87
24	S	4.7	4.2	1.50	11.3	55.7	0.03	0.15	0.41	0.16	25.0	1.80	0	248	0.34
25	13SK T	4.4	4.0	1.28	67.7	25.0	0.08	0.16	1.06	0.29	22.2	0.60	0	347	2.53
26	S	4.2	3.7	1.22	12.4	32.2	0.03	0.15	0.73	0.23	33.2	0.80	0.20	282	1.22

Note : CEC = cation exchangeable capacity; Al exch or H exch = Al or H exchangeable
Queer number = above soil layer (0-20 cm); complete number = bellow soil layer (20-40 cm); GB1-8=Gaya Baru 1-8; SK=Srikaton; RB=Rawa Betik; SM=Sri Mulyo; KS=Karangsari; MI=Mataram Ilir; SK=Sumber Katon

carbon source for developing soil microbes. Areas that have a shallow solum commonly found on the slope area / side or the top of a small hill.

Soil Acidity. Top soil of agricultural land in the district of Seputih Surabaya generally is acid with a range of pH (H2O) 4.4 to 5.5, and the soil layer below is still a bit acid with a pH range of 4.0 to 5.1. Top soil of agricultural land district of Bandar Surabaya was still a bit acid with a pH range of 4.0 to 5.0 were classified on the bottom layer of soil with a pH range of 3.7 to 5.0 acidity. At soil pH <5 then a soluble Fe is very high so the potential to toxic the plants, however the availability of nutrients N, P, K, SO4, Ca, Mg, are low, so it caused the crops become deficiency. At pH 6.0 to 7.5 is an optimal condition for the availability of almost all elements of plant nutrients (Truog, 1973). High solubility of Fe in soil solution will be antagonism with Cu, K, Mn and P and at the same time will be against availability.

Cation Exchange Capacity (CEC), base cation content (K, Ca, Mg, Na): Cation exchange capacity value Ultisol soils are generally low (<15 me/100 g). Increasing the value of CEC can generally be shown by increased levels of C-organic soil or soil ameliorant (dolomite, zeolite, etc.).

Soil cation levels include K, Ca, Mg, Na and H + on district Seputih Surabaya has a very low status. K content in soil layers above means less than 0.1 me/100 g soil, especially soil layer on the bottom <0.05 me/100 g soil. Exchangeable Ca content in top soil is generally <1 me/100 g soil and the soil layer on the bottom of <0.5 g soil me/100. Similarly for Mg content, either on top or bottom layer of soil had higher levels of <0.05 me/100 g soil. K uptake would be severely hampered if the conditions of poor soil K, soil incompressible (solid), the excess water (water saturated), and less aeration. During rapid vegetative growth phase, soybean plants absorb K in large quantities. This absorption continues until 2-3

Table 3. Chemical character of soil in Bandar Surabaya district, Lampung Tengah Regency Year 2006

No	Code	pH		CO	P2O5	SO4	K	Na	Ca	Mg	CEC	Al exch	H exch	Fe	Zn
		H2	KCl	%	ppm		……………………	me/100g	…………………					ppm	
1	1SA-T	4.7	3.8	1.25	16.5	21.3	0.05	0.11	0.67	0.38	27.8	1.00	0.20	368	0.79
2	S	3.8	3.0	1.25	11.5	120	0.05	0.08	0.82	0.34	27.8	1.40	0	284	0.95
3	2SD-T	4.0	3.4	1.57	12.5	33.5	0.06	0.13	0.93	0.44	24.9	1.20	0.40	348	1.70
4	S	3.8	3.0	1.10	11.2	72.8	0.03	0.08	0.43	0.29	27.8	1.20	0	258	0.65
5	3CP-T	4.5	3.8	1.88	16.0	41.0	0.08	0.16	0.73	0.35	33.2	1.20	1.80	323	1.25
6	S	4.0	3.0	1.57	13.5	143	0.03	0.13	0.56	0.27	33.2	1.40	0	266	0.44
7	4BJ-T	4.4	4.3	1.85	22.1	21.0	0.05	0.16	0.65	0.33	22.1	1.80	0.20	331	1.74
8	S	4.4	4.3	1.56	15.2	41.3	0.04	0.13	0.41	0.27	19.4	2.00	0.20	321	0.64
9	5SPT	4.4	4.3	1.89	43.6	19.3	0.04	0.11	0.38	0.26	27.7	1.00	0.40	323	1.29
10	S	4.7	4.5	1.49	16.4	27.3	0.02	0.07	0.54	0.25	19.4	1.60	0	214	0.38
11	6S1-T	4.3	3.7	1.50	35.7	23.4	0.06	0.15	0.73	0.38	24.9	1.00	0	348	1.04
12	S	4.2	3.8	1.22	14.2	114	0.03	0.13	0.4	0.27	24.9	1.20	0.40	226	0.58
13	7RWT	5.0	4.4	1.50	20.2	40.6	0.06	0.13	0.54	0.28	38.9	1.75	0.35	317	2.49
14	S	5.0	4.4	1.24	10.2	91.0	0.04	0.15	0.56	0.30	31.9	1.86	0.24	237	0.44
15	8GB5T	4.8	4.1	1.41	33.7	20.7	0.06	0.13	0.61	0.29	14.0	1.20	0.40	327	0.75
16	S	4.8	4.2	0.96	11.7	37.2	0.03	0.11	0.48	0.26	14.0	2.40	0	226	0.40
17	9SJ T	3.9	3.3	1.44	22.5	33.8	0.03	0.16	0.50	0.25	27.8	1.20	0.40	348	1.69
18	S	3.7	3.2	1.45	11.2	149	0.08	0.15	0.54	0.31	24.9	1.20	0	364	0.78

Note : CEC = cation exchangeable capacity; Al exch or H exch = Al or H exchangeable
Queer number = above soil layer (0-20 cm); complete number = bellow soil layer (20-40 cm);
SA=Sumber Katon; SD=Sidodadi; CP=Cempaka Putih; BJ=Beringin Jaya; SP=Spontan; SI=Surabaya Ilir; RW=Raja Wali; GB5=Gaya Baru5; Subang Jaya

weeks before the seeds mature. Most K is absorbed through the movement of moisture diffusion through the coating on soil particles. Ratio K: CEC <2 is a lower limit to prevent deficiency K. Ca and Mg cations on the acid soils generally become limiting growth due to low levels. Soil analysis results in two districts mentioned above showed Ca levels <1% and the concentration of Mg was < 0.05 me%. Deficiency of Ca generally occurs at pH <5.5 and / or pH > 8 when the high nitrogen content. As a nutrient, the plant will be responsive Ca when the concentration of exchangeable Ca <0.2 me% (Landon, 1984). Deficiency of Mg in soil and plants are not only related to low levels, but also associated with a number of other cations, especially Ca and K. Ratio of Ca: Mg more than 5 : 1 causes Mg is not available to plants. Ratio Ca: Mg between 3: 1 to 4: 1 is the optimal range for almost all plants in the field (Landon, 1984). Two districts Seputih Surabaya and Bandar Surabaya have low content of alkaline cations. Therefore, additional nutrients through fertilization or combined with materials as well as land ameliorant very obliged to obtain the performance of plant growth and optimal results. The use of organic fertilizer and soil ameliorant should be recommended for the two districts. Organic fertilizers do not have to come from cattle wastes manure (chicken, goats, cows, buffalo) but can also be derived from organic compost, litter remaining agricultural byproducts factory farming (agro-industries) such as starch plant.

C-organic Carbon Content of Soil. In general, levels of C-soil organic layer on top is still relatively low (<2%). Levels of C-organic layer on the bottom is generally lower than in the layer above.

Nutrient Content of N, P, K, S, Ca, Mg and Micro Nutrients in the Soil. Total soil N concentration is generally very low (<0.1%). Total N concentration in the soil layer above the relatively high compared with the bottom layer. Fertilizer N can not be abandoned or reduced to obtain the optimum performance of growth and yield. Nitrogen antagonism with B, Cu, K, Zn, and encourage the availability of Ca, Mg, Mo, and P. P in soil nutrient levels in the two districts Seputih Surabaya and Bandar Surabaya varied from low to very high. P in the nutrient content of top soil are generally higher than at lower soil layers. P element antagonism with compounds of Ca, Cu, Fe, K, Mn, N, and Zn and are encouraging the availability of Mg, Mo, and S. Compounds of zinc (Zn) antagonism of Cu, Fe, Mg, Mo, P, and S. K nutrient levels on agricultural land in the area Seputih Surabaya and Bandar Surabaya at both soil layers above and below the soil layer has the availability of low to very low. K deficiency symptoms appeared on almost all food crops. K nutrient has many roles and activities in soil and in plants, both as a nutrient, antagonism cations, and activator cation, and a catalyst in various chemical, biochemical and physiological process in membrane cell.

Potassium antagonism with nutrient B, Ca, Mg, Mo, N (NH4 +), and Na. K nutrient can promote Fe and Mn uptake by plants.

Nutrient content of sulfur (S). S content in soil in two districts Seputih Surabaya Bandar Surabaya and is generally quite high (> 20 ppm), there is even a very high> 100 ppm. This gives a good indication of the aspects of S in soil fertility. Top soil layer generally had higher levels of SO4 = is higher than the bottom layer of soil (sub soil).

Aluminium content of exchangeable and Al saturation. According to analysis results ,effective cations and Al cations in the effective exchange complex of soil at the top soil of agricultural land in the region Seputih Surabaya and Bandar Surabaya have percent base saturation > 20%. Soybean plants have a tolerance limit of 20% Al saturation (Hartatik et al., 1987). Therefore, the amelioration of land in agricultural areas in the district of Seputih Surabaya and Bandar Surabaya have to pay attention to lower percent base saturation to below the threshold of tolerance, so that cultivation medium in the two regions it becomes optimal for the growth of soybean crops.

Land suitability for soybeans

Based on the assessment of land suitability for soybean plants can be seen that in districts of Seputih Surabaya as there were 10 villages have appropriate class (S 2), namely the village of Kenanga Sari, Gaya Baru 1, 2, 3,5,6,7, Rawa Betik, Sri Mulyo , and Sumber Katon, and third class villages have less suitable (S 3), the village of Gaya Baru 4 and 8, and Mataram Ilir (Table 4).

Based on the assessment of land suitability for soybean crops can be seen that in districts of Bandar Surabaya there are six villages have the appropriate class (S2), namely the village of Sumber Katon, Cempaka Putih, Beringin Jaya, Spontan, Surabaya Ilir and Rajawali, and three villages have less appropriate class (S 3), the village Sidodadi, Gaya Baru 5 and Subang Jaya (Table 5). The unity of land suitability map for soybean in the Seputih Surabaya and Bandar Surabaya districts are presented in Figure 2.

Soybean Development

Soybean plants have growing requirements as follows (1) grows at an altitude of 0-1500 m asl (above sea level) but the optimum of about 650 m asl., (2) The optimum temperature of 29,4 ^{0}C, (3) shade tolerance of <40%, (4) able to adapt to climate squares; optimum climate type C1-2, D1-3, and E1-2, (5), soybean is a plant short day (<12 hrs / day), (6) water consumption of 64 - 75 cm / cropping season or commensurate with rainfall 200-300 mm / growing season, (7) soybean plant has broader adaptation to soil, but it has to be fertile and friable, the optimal pH of 6.2 to 7.0, Al saturation <20%, and (8) for each ton of soy beans removes nutrients about 66 kg N, 15.5 kg P, 39.7 kg K, 7.5 kg 7 kg Mg and S (Baharsjah, 1985; PPI, 1985; Halliday and Trenkel , 1992; Hartatik and Adiningsih, 1987; Widjaja-Adhi, 1985). Based on the nature and adaptability on the broad climate of soybean plants can grow well in the climate C, D, and E. In areas which have type B climate soybean plants can also grow well when the origin of cultivated crops fall in the dry season so no trouble for post-harvest processing (drying).

Soybeans can be developed on rainfed or on dry land (tegal) on district Seputih Surabaya and Bandar Surabaya. Soybean development in wetland areas that have major constraints excess water at planting, then water drainage technology is effective at the beginning of cropping period were key factors (entry point) of soybean growth. Irrigated land generally has a high fertility. Therefore, land management technologies that create air and soil moisture balance to match the key factor for the soybean plant nutrient availability for nutrient uptake by soybean plants can take place optimally. Another example, the development of dry land soybean in acid soils cannot be separated from the soil acidity constraints derived from aluminum (Al) and iron (Fe). Thus, land amelioration of technical measures will be part of the standard technology components to reduce the activity of Al and Fe in acid soils of dry land. Considering the mineral composition of upland acid soils dominated by one type of clay minerals 1: 1, hence the use of organic fertilizer is also a standard component in soybean cultivation in upland acid soils, thereby increasing levels of soil organic matter, improve soil moisture holding capacity, soil cation exchange capacity (CEC) , the amount of soil organic colloids that can chelate Al and Fe compounds that help to control acidity and toxicity of plants by Al and Fe. Components of fertilization, especially P and K nutrient additions to its attention since the availability of P and K genuine upland acid soils are generally low.

Development of soybean in upland has the main obstacles acidity caused by high aluminum saturation, cation content of K, Ca, and Mg are low, the fertility of low N and P, soil organic matter content is low. The main problems associated with acid soil, the major technology components recommended for soybean development consists of: the use of land ameliorant (dolomite, zeolites) as well as a source of Ca and Mg nutrients, organic fertilizers (manure or poultry manure ruminants), complete inorganic fertilizer (N, P, K).

CONCLUSION

Based on the results of biophysical characterization of

Table 4. Land suitability for soy bean crop of Seputih Surabaya district, Lampung Tengah Regency

No	Location	Temp °C	*Rainfall* (mm/th)	*Drainage*	Tex-ture	*Depth* (cm)	pH H_2O	*CEC* Me%	P_2O_5 Bray ppm	K_2O Me %	Slope %	*Al saturation* %	C-org %	*OM* %	*Score 1-11*	*Suitability class*
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	1SK3t	28-30	3198	B	L	0-20	4.5	24.9	24.7	0.11	5-10	19.80	1.63	2.80	31/11=2.82	S-2
2	1SK3s	28-30	3198	B	SiL	21-40	4.0	22.2	12.0	0.02	5-10	42.55	1.53	2.63	28/11=2.55	S-3
3	2GB7t	28-30	3198	B	L	0-20	5.5	23.6	19.4	0.07	5-10	27.68	1.47	2.52	31/11=2.82	S-2
4	2GB7s	28-30	3198	B	SiL	21-40	5.0	26.4	11.3	0.05	5-10	30.86	1.12	1.93	31/11=2.82	S-2
5	3GB6t	28-30	3198	B	L	0-20	4.6	14.0	18.1	0.05	5-10	22.22	1.26	2.17	30/11=2.73	S-2
6	3GB6s	28-30	3198	B	SiL	21-40	4.8	14.0	12.7	0.03	5-10	33.56	1.94	3.34	28/11=2.55	S-3
7	4RBt	28-30	3198	B	L	0-20	4.5	25.0	27.6	0.06	5-10	36.97	1.14	1.96	30/11=2.73	S-2
8	4RBs	28-30	3198	CB	SiL	21-40	4.8	25.0	12.5	0.02	5-10	54.84	1.08	1.86	28/11=2.55	S-3
9	GB4t	28-30	3198	CB	SiL	0-30	4.8	8.42	21.1	0.07	5-10	49.30	2.30	3.96	29/11=2.64	S-3
10	GB4s	28-30	3198	CB	SiL	31-60	4.7	19.6	12.9	0.03	5-10	43.29	1.71	2.44	29/11=2.64	S-3
11	7GB3t	28-30	3198	CB	SiL	0-30	4.9	22.2	42.3	0.05	5-10	35.56	2.08	3.58	31/11=2.82	S-2
12	7GB3s	28-30	3198	CB	SiL	31-60	4.9	22.2	13.9	0.04	5-10	55.25	1.03	1.77	29/11=2.64	S-3
13	6GB2t	28-30	3198	CB	SiL	0-30	5.2	22.2	44.1	0.05	5-10	29.30	1.61	2.08	32/11=2.91	S-2
14	6GB2s	28-30	3198	CB	SiL	31-60	5.1	25.0	15.4	0.03	5-10	44.44	1.56	2.77	30/11=2.73	S-2
15	5KSt	28-30	3198	B	L	0-25	4.8	30.5	31.4	0.06	5-10	44.61	1.83	2.43	31/11=2.82	S-2
16	5KSs	28-30	3198	CB	SiL	26-55	4.8	27.7	12.0	0.02	5-10	73.17	0.96	1.65	30/11=2.73	S-2
17	8SMt	28-30	3198	CB	SiL	0-30	4.6	24.9	46.0	0.03	5-10	51.28	1.53	2.63	30/11=2.73	S-2
18	8SMs	28-30	3198	CB	SiL	31-60	4.2	22.2	24.1	0.02	5-10	67.51	1.05	1.81	30/11=2.73	S-2
19	GB1t	28-30	3198	CB	L	0-25	4.5	25.0	17.2	0.05	5-10	53.03	2.30	2.98	30/11=2.73	S-2
20	GB1s	28-30	3198	CB	SiL	26-55	4.7	25,0	11.3	0.03	5-10	70.59	1.71	2.58	29/11=2.64	S-3
21	10MIt	28-30	3198	B	L	0-20	4.5	25.0	43.4	0.07	5-10	42.55	1.99	3.42	29/11=2.64	S-3
22	10MIs	28-30	3198	B	SiL	21-40	4.4	16.6	15.0	0.04	5-10	61.73	1.29	2.22	29/11=2.64	S-3
23	GB8t	28-30	3198	B	SL	0-15	4.5	25.0	17.2	0.05	5-10	53.03	1.83	2.98	29/11=2.64	S-3
24	GB8s	28-30	3198	B	L	16-30	4.7	25.0	11.3	0.03	5-10	70.59	1.50	2.58	28/11=2.55	S-3
25	13SKt	28-30	3198	B	SL	0-20	4.4	22.2	67.7	0.08	5-10	27.40	1.28	2.20	32/11=2.91	S-2

Table 4. Cont'd

26	13SKs	28-30	3198	B	L	21-50	4.2	33.2	12.4	0.03	5-10	37.38	1.22	2.10	31/11=2.82	S-2

Keterangan (*Note*) : *CEC = cation exchangeable capacity; OM =organic matter.*
Queer number = above soil layer (0-20 cm); complete number = bellow soil layer (20-40 cm);; Rain fall data year 2005; SL=sandy loam (geluh pasiran); L=loam (geluh); SiL=silt loam (gelum debuan); GB1-8=Gaya Baru1-8; SK3=Srikaton; RB=Rawa Betik; SM=Sri Mulyo; KS=Kenanga Sari; MI=Mataram Ilir; SK=Sumber Katon

Table 5. Land suitability for soy bean crop of Seputih Surabaya district, Lampung Tengah Regency

No	Location	*Temp* °C	*Rainfall (mm/th)*	*Drainage*	*Texture*	*Depth* (cm)	pH H_2O	*CEC* me%	P_2O_5 Bray ppm	K_2O me%	Slope %	*Al saturation %*	C-org %	*OM* %	Score 1-11	Suitability class
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1SAt	26-30	3198	B	L	0-20	4.7	27.8	16.5	0.05	5-10	41.49	1.25	2.15	30/11=2.73	S-2
2	1SAs	26-30	3198	B	SiL	21-35	3.8	27.8	11.5	0.05	5-10	52.04	1.25	2.15	29/11=2.64	S-3
3	2SDt	26-30	3198	B	L	0-15	4.0	24.9	12.5	0.06	5-10	37.97	1.57	2.70	28/11=2.55	S-3
4	2SDs	26-30	3198	B	SiL	16-30	3.8	27.8	11.2	0.03	5-10	59.11	1.10	1.89	29/11=2.64	S-3
5	3CPt	26-30	3198	ALmb	L	0-30	4.5	33.2	16.0	0.08	5-10	27.78	1.88	3.23	31/11=2.82	S-2
6	3CPs	26-30	3198	Lmb	SiL	31-50	4.0	33.2	13.5	0.03	5-10	58.58	1.57	2.70	30/11=2.73	S-2
7	4BJt	26-30	3198	B	L	0-20	4.4	22.1	22.1	0.05	5-10	56.43	1.85	3.18	30/11=2.73	S-2
8	4BJs	26-30	3198	B	SiL	21-40	4.4	19.4	15.2	0.04	5-10	65.57	1.56	2.68	30/11=2.73	S-2
9	5SPt	26-30	3198	B	L	0-20	4.4	27.7	43.6	0.04	5-10	45.66	1.89	3.25	31/11=2.82	S-2
10	5SPs	26-30	3198	B	SiL	21-50	4.7	19.4	16.4	0.02	5-10	64.52	1.49	2.56	30/11=2.73	S-2
11	6SIt	26-30	3198	CB	SiL	0-30	4.3	24.9	35.7	0.06	5-10	43.10	1.50	2.58	30/11=2.73	S-2
12	6Sis	26-30	3198	CB	SiCL	31-60	4.2	24.9	14.2	0.03	5-10	49.38	1.22	2.10	29/11=2.64	S-3
13	7RWt	26-30	3198	B	L	0-20	5.0	38.9	20.2	0.06	5-10	56.27	1.50	2.58	30/11=2.73	S-2
14	7RWs	26-30	3198	B	SiL	21-40	5.0	31.9	10.2	0.04	5-10	59.05	1.24	2.14	29/11=2.64	S-3
15	8GB5t	26-30	3198	B	L	0-15	4.8	14.0	33.7	0.06	5-10	44.61	1.41	2.43	28/11=2.55	S-3
16	8GB5s	26-30	3198	B	SiL	16-30	4.8	14.0	11.7	0.03	5-10	73.17	0.96	1.65	27/11=2.45	S-3
17	9SJt	26-30	3198	B	L	0-15	3.9	14.8	22.5	0.03	5-10	47.24	1.44	2.48	28/11=2.55	S-3
18	9SJs	26-30	3198	B	SiL	16-30	3.7	24.9	11.2	0.08	5-10	52.63	1.45	2.49	28/11=2.55	S-3

Note : CEC = cation exchangeable capacity, OM = organic matter
Queer number = above soil layer (0-20 cm); complete number = bellow soil layer (20-40 cm); Rain fall data was not available so was estimated same with Seputih Surabaya district; L=loam (geluh); SiL=silt loam (gelum debuan); SA=Sumber Katon; SD=Sidodadi; CP=Cempaka Putih; BJ=Beringin Jaya; SP=Spontan; SI=Surabaya Ilir; RW=Raja Wali; GB5=Gaya Baru5; SJ= Subang Jaya

Central Lampung district can lead to some conclusions as following formula:
1. Seputih Surabaya and Bandar Surabaya have great potential for development of soybean.
2. Soil fertility has a large diversity between villages (farmer land) because of differences in the level of management and agribusiness.
3. Agricultural land in the subdistrict Seputih Surabaya and Bandar Surabaya have two classes of land suitability for soybean, namely S2 class (appropriate) and S3 classes (less fit).
4. Major commodities in these two districts are now more cassava and maize.
5. Development of soybean planting areas by shifting basic commodities will be difficult, so the opportunity is to approach the development of soybean-based intercropping

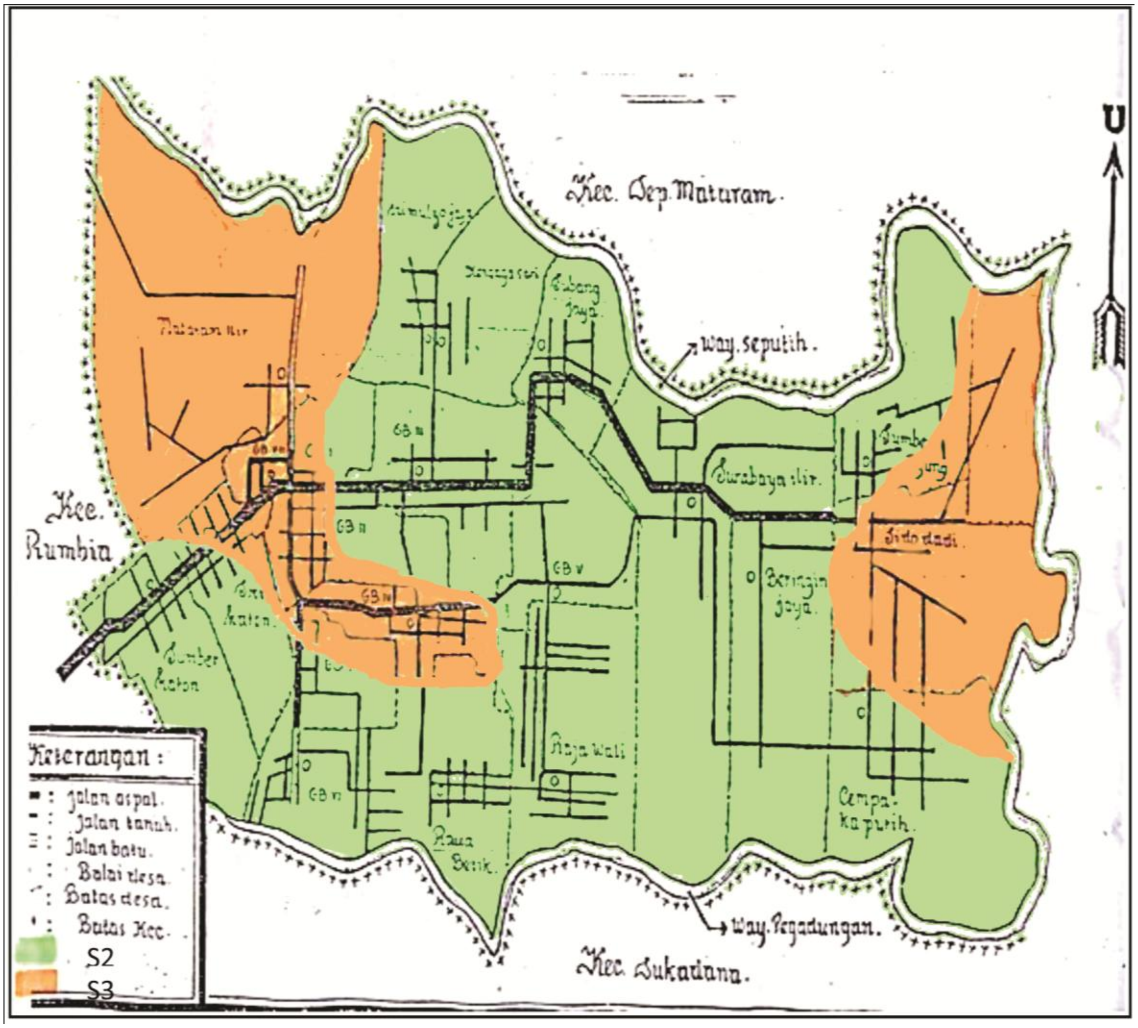

Figure 2. Map of land suitability for soybean in Seputih Surabaya and Bandar Surabaya Districs of LampungTengah Regency, Lampung Province.

cassava and / or corn.

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Appendix 1. Descriptions of soil profiles in the village of Rawa Betik, District Seputih Surabaya, Central Lampung Regency, August 25, 2006

Layer (Horizon) Character of soil (soil character)
A0: 0-17 cm Loamy sand soil texture, pH 4.95; soil crumb structure, dark brown soil color 10YR 3 / 3; Plenty of hair roots and branches
A1: 18-32 cm. Sandy loam soil texture, pH 7:25; crumb soil structure, soil color strong brown 7.5 YR 4 / 6, Plenty of hair roots.
A2: 33-65 cm. Sandy loam soil texture, pH 4.8, elluviation horizon, strong brown soil color 7.5 YR 4 / 6, Few hair roots.
Bt: 66 cm. Silty clay soil texture, pH 4.8, blocky soil structures, illuviation horizon, soil color red 2.5 YR 4 / 6.

Appendix 2. Descriptions of soil profiles in the village of Sumber Agung, Bandar Surabaya District, Central Lampung Regency, August 26, 2006

Layer (Horizon) Character soil (Soil Character)
A0: 0-25 cm. Loamy sand soil texture, pH 6.2, soil crumb structure, soil brwn color 10 YR 5 / 3, Penetrometer 0.25-0.5 kg / cm, many hair roots.
A1: 26 cm - 59 cm. Sandy loam soil texture, pH 6.6, lose soil structure, soil color Yellowish brown 10 YR 5 / 6.
Bt: 60 cm + Silty clay soil texture, pH 4.8, blocky soil structures, illuviation horizon, soil color red 2.5 YR 4 / 6.