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Plant Suitability Evaluation of Mangosteen Plant with Geoprocessing Model Approach Using Upland Soil Test Parameters

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Abstract
In 2015, national exports of annual fruits consistent of 20 fruit commodities. Therefore, total exports of Indonesia annual fruits were valued US$ 35.98 million in 2015. Mangosteen export from Indonesia has increased since 1999 export volume of 4,743,493 kg with export value $ 3,887,816 and In 2015, the volume of mangosteen export was 38.18 thousand tons, from all annual fruit, it gave the largest contribution to foreign exchange with the values of US$ 17,212,084. Most of mangosteen was exported to Thailand, Malaysia and Hongkong, to date demand growth increased on average 35.6%. The high contribution of Indonesian mangosteen fruit exports is due the mangosteen is a unique commodity and specific tropical areas, so that competitors in the international market is not much. Mangosteen fruit is often touted as the Queen of Fruits because of its exotic form that makes a special attraction.This becomes very contradictory when viewed from the proportion of mangosteen fruit production compared to the total national fruit production of 0.5%. The main obstacle facing the perpetrators of mangosteen commodity agricultural industry is less availability of information on land suitability and recommendations of nutritional needs on production land of mangosteen plant. In the research will take land samples in 3 villages (Cileuksa, Pasir Madang and Cisarua), Sukajaya District Bogor, coordinate: 106º24'00" - 106º30'00 " East longitude and 6º32'00 " - 6º43'00 " South latitude. With 25 points of upland soil test area (pH, P, K, C-Organic, and Lime) and fertilizer recommendation SP36 (kg / ha), Kalium (kg KCl/ ha) and Organic Material (t/ha) using upland soil test kit and Georeference identification using GPS. Upland soil test parameters and georeferences obtained are stored in spatial database and spatial analysis of buffering and overlay geoprocessing model using ArcGIS on geoprocessing extension. This research produces maps and land suitability geographic information system with category classes: 63% appropriate, 26% marginal and 11% Unsuitable and nutritional needs of mangosteen cropland unity survey.

Keywords: Mangosteen, Geoprocessing, Upland soil test

1. Introduction

Most of mangosteen was exported to Thailand, Malaysia and Hongkong, to date demand growth increased on average 35.6%.[1] The high contribution of Indonesian mangosteen fruit exports is due the mangosteen is a unique commodity and specific tropical areas, so that competitors in the international market is not much. Mangosteen fruit is often touted as the Queen of Fruits because of its exotic form that makes a special attraction, as in Table 1.

Table 1. Exports of annual fruits production Indonesia in 2015

No.	Kode HS / *HS Code*	Komoditi / *Commodity*	Berat *Net Weight* (Kg)	*Nilai FOB FOB Value Net Weight (US $)*
(1)	(2)	(3)	(4)	(5)
1	0804503000	Mangosteens, fresh or dried	38 177 338	17 212 084
2	0803100000	Plantains, fresh or dried	19 781 690	12 082 324
3	0804502000	Mangoes, fresh or dried	1 242 719	1 820 607
4	0810909100	Salacca (snake fruit), fresh	2 201 636	1 665 699
5	0803900000	Bananas, oth than plantains, fresh or dried	2 526 424	924 039
6	0810903000	Rambutan, fresh	801 954	828 651
7	0804300000	Pineapples, fresh or dried	873 674	653 637
8	0805500000	Lemons and limes, fresh or dried	1 258 814	506 074
9	0804501000	Guavas, fresh or dried	76 496	102 671
10	0808100000	Apples, fresh	47 337	58 378
11	0804400000	Avocados, fresh or dried	53 508	35 718
12	0807209000	Other papaws (papayas), fresh	15 394	32 326
13	0805101000	Oranges, fresh	23 238	24 509
14	0805900000	Other citrus fruit, fresh or dried	46 062	18 016
15	0810905000	Jackfruits (cempedak and nangka), fresh	4 426	11 653
16	0810600000	Durians, fresh	410	1 037
17	0810909300	Sapodilla (ciku fruit), fresh	335	835
18	0810904000	Langsat, starfruit, fresh	102	20
19	0806100000	Grapes, fresh	-	-
20	0807201000	Mardi backross solo (betik solo), fresh	-	-

Source: BPS statistic Indonesia, 2015

Fruit production in 2015 increased for all type fruits compared to 2014 except apple, orange, pamelo, manggo, pineapple, salacca and spodilla. Mangosteen production increased significanly by 88.348 tons or 76.98 percent [1]. In 2015, the first Quarter of the number of mangosteen plants that produce as much as 2237711 trees with production 123740000 kg and second quarter number of mangosteen plants that produce as much as 656848 trees with production of 20060000 kg. With a total production of 143800000 kg, exported 38177338 kg so that the unexported production of 105622662 kg or 26.5489 percent

is exported from the total production of mangosteen fruit. [1]

Mangosteen is one of Indonesia's primadona tropical fruit commodities exports. In 2015, the contribution of mangosteen exports to total national fruits exports is 37.4 percent, but contrary to the proportion of mangosteen fruit production to the total national fruit production of 0.5 percent. [1]

The main obstacles perpetrators of agricultural industry of mangosteen commodities is the lack of information availability on land suitability and recommendations of nutritional needs on mangosteen crop production.

The fundamentally of mangosteen plants productivity is dependent on: land suitability and nutritional needs on upland soil.

Reality issues: (1) Mangosteen plants are the result of garden crops used land without land suitability evaluated and (2) The garden are generally grown in upland soil which is still a forest plant that has not identified the nutritional needs of the land well.

Science and Technology Innovation of Geographic Information Systems: Development of Digital Mapping Science in geoprosessing model engineering with spatial analysis of the suitability and nutritional needs of mangosteen crop on the identified georeference region. Farming industry actors: The existence of appropriate regional standard assurance and nutritional needs on productive mangosteen crop fields export class Retail: The existence of mangosteen fruit production center, so it can determine supply System. Government: facilitated in regulation, policy and supervision of production center and trading chain of mangosteen fruit. Processed industry: The availability of mangosteen fruit supply with mapping mangosteen production center.

2. Theori

The taksooonomy of mangosteen plants is Kingdom: Plantae, Division: permato- phyta, Subdivision: Angiosper-mae, Class: Dicotyledonaceae, Order: Guttiferales, Family: Guttiferae, Genus: Garcinia, Species: Garcinia mangostana L. [2].

Mangosteen is a suitable plant living in dry tropical dry land area, Grows well in the lowlands to an altitude of 800 m above sea level (dpl), the optimal temperature ranges from 22-32 Celsius degrees with rainfall 1,500-2,500 mm / year and 80 percent humidity. The ideal soil type is latosol and andosol, well drained, has a pH of 5.0-7.0 with a depth of tillage of 50-200 cm [2].

For local consumption of mangosteen fruit in harvest after the age of 114 days since flowers bloom but for export consumption, usually the mangosteen fruit in the harvest at the age of 104-108 since the flowers bloom. Harvesting is done by picking / cutting the base of the fruit stalk with a sharp knife tool. In Indonesia mangosteen trees are harvested in November to March next year. [3]

Indonesia's agricultural development will increase if it has criteria: broad spectrum and involving small and medium-scale, market-oriented, participa-tive and decentralized and based on technological changes that help improve productivity of production factors and not damage the natural resource base and the environment. [4]

Geoprocessing of Buffer; serves to create an area with a certain distance from an object, as in Figure 1

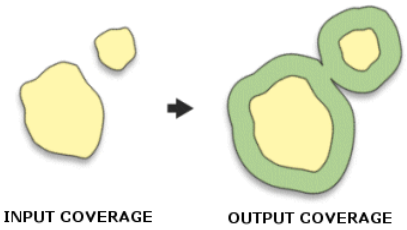

Figure 1. Map change due to buffer deoprocessing

Geoprocessing of Clip is used to cut a theme of type point, line or polygon by taking part in and dispose of the outside with the help of a theme of another polygon. The cutting theme must be of type polygon, as in Figure 2

First, confirm that you have the correct template for your paper size. This template has been tailored for output on the A4 paper size. If you are using US letter-sized paper, please close this file and download the file "MSW_USltr_format".

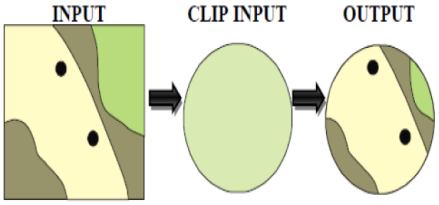

Figure 2. Map change due to merge geoprocessing

The Concept of Land Evaluation is a process of assessing land resources for a particular purpose with a tested approach or method. The results of the land evaluation will provide information or land use directives as needed. While the Land Conformity concept is the level of suitability of a plot of land for a particular use. The suitability of the land can be assessed for the current condition (land suitability of the actual land suitability classification structure) or after improvement (potential land suitability) . [5]

Upland soil test kit (PUTK) is designed to measure levels of P, K, C-organic, pH and lime requirements. The working principle of PUTK is to measure the nutrients of P, and K of soil contained in semi-quantitatively available form. Determination of P and pH by colorimetric method (staining). The results of P and K soil analysis are further used as the basis for determining the recommendation for the fertilization of site-specific P and K. [6]

Land suitability can be distinguished by level, ie the level of Order, Class, Subclass and Unit. Order is a state of land suitability globally. At the level of the order of land suitability is distinguished between suitable land (S = Suitable) and unsuitable land (N = Not Suitable). [7]

Class is a state of conformity in the order level. Based on the level of detail data available on each mapping scale, the class of land suitability is divided into: (1) For semi-detailed level mapping (scale 1: 25,000-1:50,000) at the class level, the land classified by corresponding (S) into three classes, namely: the land is very suitable (S1), quite appropriate (S2), and accordingly marginal (S3). While the land belonging to an unsuitable order (N) is not distinguished into classes. (2) For the mapping of the review level (scale 1: 100,000-1: 250,000) at the class level

differentiated to the corresponding Class (S), conditional (CS) and unsuitable (N).

Class S1 Suitable: Land does not have significant or apparent limiting factors on continuous use, or limiting factors are minor and will not have an effect on actual land productivity. Class S2 Sufficient: Land has a limiting factor, and this limiting factor will affect its bag-productivity, requiring additional input.

These barriers can usually be overcome by farmers themselves. S3 Class Correct Marginal: Land has a severe limiting factor, and this limiting factor will greatly affect the productivity, To overcome the limiting factor on S3 requires high capital, so that the need for assistance or intervention (intervention) government or private parties. Class N Not Suitable: Land is not appropriate because it has a limiting factor that is very heavy or difficult to restrict.

3. Method

Materials: (1) Basic map and adminis-trative boundary map of scale 1: 25.000 UTM projections 48S zone with WGS 84 datum, BIG. (2) Chemicals for soil analysis in the laboratory include: H2O2, K2Cr2O7, NH4OAc.

Tools: PC set, ArcGIS 10., Garmin GPS Map 76csx, Dried Land Test Kit, Abney level, ground drill, meter, field blade, pH stick ground color book (Munsell soil color chart), altimeter, plastic bag, etc.

The research procedure is divided into 4 stages that fit with research topic, that is: (1) Preparation; 1: 25.000 scale landscape map collection and satellite image of landsat 5. To digitize the administrative boundaries and borders of agriculture and non-agricultural areas into vector image of map with file shape extension in the spatial of Cileuksa Village, Pasir Madang Village and Cisarua Village in Sukajaya District with coordinates 106º24'00" - 106º30'00 " East Longitude and 6º32'00" - 6º43'00" South Latitude. (2) Survey; Activities to identify the georeferences of the point of the land area tested using Garmin GPS Map 76csx and the land unit activity was taken one soil sample and observation of land characteristic data in the field. The parameters observed in accordance with the characteristics and quality of land. Characteristics of land observed in the field include: soil drainage, soil texture, coarse material, effective depth, soil slope, erosion hazard, rock outcrop, surface rock, and flood hazard. As for the analysis of soil in the laboratory taken soil samples in the field approximately 0.25 kg. (3) Soil sample test; to find out the parameters of upland soil test (pH, P, K, C-Organic, and Lime) at each point of identified georeferences region, to know the nutritional requirement of upland soil test SP36 (kg/ha) Potassium (kg KCl / ha) and Organic Material (t/ha) at each point of the identified georeference region.

The soil sample test using the upland soil test kit is a tool for the analysis of soil nutrient content of dty soil, which can be used in the field quickly, easily, cheaply and accurately enough. As for PUTK as in Figure 3.

Figure 3. Materials and tools PUTK

(4) Obtain geoprosessing models; geoprocessing with spatial analysis of land suitability and nutrient requirements at each georeferenced area point; In the data analysis of land suitability used matching method to all physical parameters of land suitability for the determination of planting area. Prior to the matching, each parameter is made to the land suitability class. Grading of classes on each parameter, as in Table 2, Table 3, Table 4, Table 5 and Table 6.

Table 2. Landuse Class [8]

Parameter	land suitability class	
	suitable	Not suitable
Landuse	moor	Jungle
	Shrubs	Rice fields
	Meadow	Rice Fields Rain
	Plantation	Land Built

Table 3. Class C-organic [9]

Parameter	land suitability class			
	S1	S2	S3	N
C-organik (%)	> 0,4	≤ 0,4	-	-

Table 4. Posfor Grade [10]

Parameter	land suitability class			
	S1	S2	S3	N
Posfor	Very high	high	medium / low	Very low

Table 5. Kelas pH [9]

Parameter	land suitability class			
	S1	S2	S3	N
pH	5,8 - 7,8	5,5 - 5,8 / 7,8 - 8,2	< 5,5 / > 8,2	-

Table 6. Potassium Class [10]

Parameter	land suitability class			
	S1	S2	S3	N
Kalium	≥ medium	low	Very low	-

The flow of research implementation as in Figure 4.

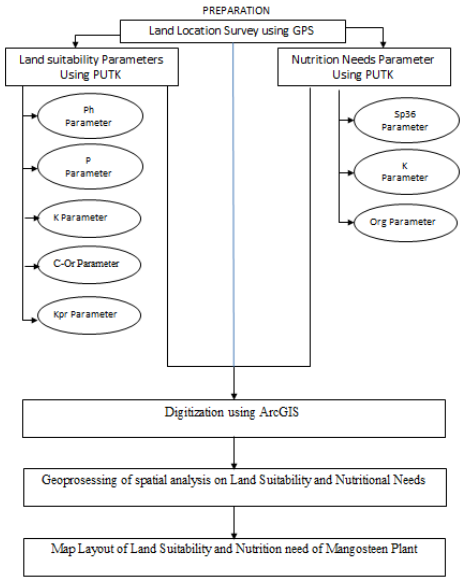

Figure 4. Flow of research implementation

4. Result and Discussion

Preparation is a step of map digitizing the landuse of agricultural land that shows the real state of landuse that can be used for agricultural areas such as moor, scrub, grassland and plantation and the area can not be used for agriculture such as: jungle forest, rice fields, rivers, lakes, puddles and others. The preparation stage produces a digital map of agricultural land (green) and non-agricultural land (red), as in Figure 5.

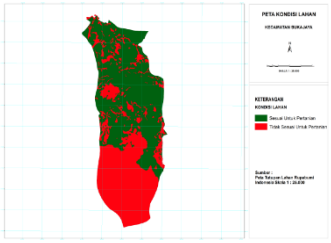

Figure 5. Map of landuse for agricultural and not agriculture.

Survey, soil sampling test and mapping content: pH, P, K, C-Organic and lime and fertilizer recommendation for mangosteen plants at each sample point. Most of the soil pH within a Sukajaya subdistrict is highly suitable (S1) with a soil acidity level of 5.0 to less than 6.0. The Map of soil acidity in mangosteen plants in Figure 6.

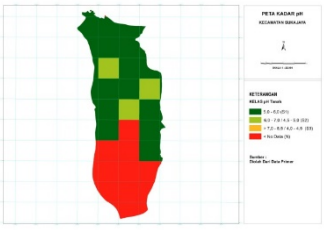

Figure 6. Maps of soil acidity suitability in mangosteen plants

Most lands posfor are class suitable (S2) with medium or low level. As for land posfor maps for mangosteen plants in Figure 7.

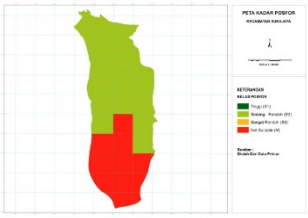

Figure 7. Maps of soil posfor suitability in mangosteen plants

Most of the soil potassium class is very suitable (S1). The soil potassium map for the mangosteen plant in Figure 8.

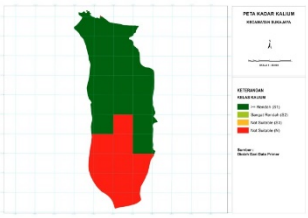

Figure 8. Map of soil potassium suitability in mangosteen plants

Most of C-organic soil class in accordance (S2) with soil level 0.4 or with soil level below 0.4. As for C-organic soil map for mangosteen plant in Figure 9.

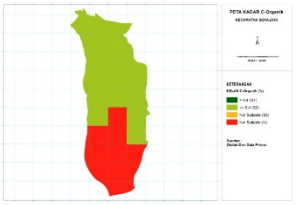

Figure 9. Map of C-organic soil suitabili-ty on mangosteen plants

Geoprocessing approach with parameters PUTK resulted that Sukajaya District land suitability level of mangosteen plant reach 63% (5928 Ha) quite suitable is land have limiting factor that will influence to its productivity, require additional input. These barriers can usually be overcome by farmers themselves. Achieving 26% (2432 Ha) as marginal is a land that has severe limiting factor that will greatly affect its productivity. To overcome these limiting factors require high capital, so that the need for assistance or intervention of government or private parties. Achieving 11% (1012Ha) Class N Not Suitable: Land is not suitable because it has a limiting factor that is very heavy or difficult to overcome. The geoprocessing result with PUTK parameters for land suitability level and nutrient requirement of mangosteen plant land as in Figure 10.

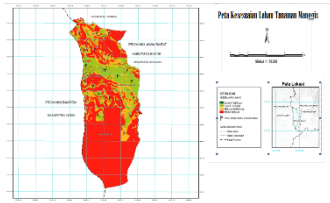

Figure 10. Map of suitability and nutrition-al needs of mangosteen croplands.

5. Conclusion

The land can be used for mangosteen plantations using PUTK parameters in Kecamatan Sukajaya included in the S1 class (very suitable) is pH and potassium. While S2 (appropriate) is phosphor and C-Organic.

Suitable and nutritional needs land in the sub district of Sukajaya for mangosteen plants are: (1) Sufficient according to 63% (5928 Ha) can be handled independently by farmers and low-cost, (2) according to marginal 26% (2432 Ha) can not be handled independently, large capital and required the role of government and investors, (3) unsuitable 11% (1012 Ha) has a limiting factor that is very heavy or difficult to overcome.

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