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Land Suitability Evaluation for Patchouli Plant Cultivation (*Pogostemon cablin* Benth) in Dry Land Pontang District, Serang Regency, Banten Province

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***Abstract* – Patchouli was one of the industrial plants that has the potential to be developed as a regional superior commodity. The purpose of this study was to analyze the suitability of dry land in Pontang District, Serang Regency, Banten Province for the cultivation of patchouli plants. The research methods were: dry land suitability evaluation in Pontang Subdistrict, Serang Regency, Banten Province for cultivation of patchouli plants with descriptive analysis. The primary data needed were data on soil physical properties (texture, structure, BV, BJ) and soil chemical prop erties (pH, N, P, K, C-Organic). Whereas secondary data needed were land use maps, topographic maps, climate data (rainfall, temperature humidity, intensity of irradiation). Data collection methods were carried out by taking soil samples, laboratory tests, observations, and documentation. Data analysis method was done through map overlay and matching between land characteristics and quality in the study area with criteria for growing patchouli. Land and climate characteristics in the dry land area of Pontang Subdistrict, Serang Regency, Banten Province are suitable for patchouli cultivation. The results of the land suitability evaluation up to the sub-class level show the limiting factors in the S2, S3 and N sub-classes, which indicate the need for land management in land use efforts. The results of land evaluation show that there were several limiting factors (level of vulnerability) at the sub-class level where with this information limiting constraint can be directly addressed. There were 5 (five) limiting factors, namely: rainfall, temperature, drainage, C-organic content, K2O and P2O5 content. Efforts to evaluate land suitability need to be supported by the provision of technological inputs, among others by irrigation aplikation, making drainage, and fertilizing to obtain optimal patchouli results.**

Keywords: patchouli, land evaluation, dry land, Pontang District

I. INTRODUCTION

Patchouli is an essential oil-producing plant that has been included in the superior crop group of National Plantations since 2010. Patchouli oil is one of the essential oils that has a large market prospect, both at home and abroad. The demand for patchouli oil is increasing along with the increasing variety of perfume / cosmetics products, the increasing need for the pharmaceutical industry and the lack of development of essential oil substitutions that are binding (fixation) in the perfume / cosmetics industry [9].

Demand for patchouli oil both from domestic and foreign countries is increasing, but the increasing quantity of production of patchouli raw material is still not optimal. Increased production of patchouli plants can be achieved by extensification of patchouli cultivation on marginal / dry land. Therefore, it is necessary to study land suitability evaluation for patchouli cultivation in various regions in Indonesia, including in dry land of Pontang District, Serang Regency, Banten Province.

Dry land is a stretch of land that has never been flooded or flooded for most of the year. The term dry land is often used for matching upland, dryland or unirrigated land. The last two terms indicate land use for rainfed agriculture. Upland shows land in a higher-lying area cultivated without water flooding such as wetland rice fields [6]. Dry land is an expanse of land that has neber been flooded or flooded most of the time of the year[2].

Land evaluation is considered important in agricultural land use, because the reality of each type of plant requires different requirements. In addition, land varies greatly in various factors such as topography, climate, geology, soil and vegetation. Optimal and sustainable productivity and the sustainability of land resources can be expected from the interpretation of the types of plants according to the quality of the land.

According to [4], land evaluation is part of the land use planning process. The essence of land evaluation is to compare the requirements requested by the type of land use to be used.

Land suitability is the suitability of a land for certain uses, for example land for irrigation, ponds, annual crop farming, or seasonal crops. More specifically, the suitability of the land is viewed from the physical properties of the environment, which consists of climate, soil, drainage, topography, hydrology and or drainage that are suitable for productive farming or certain commodities [10].

Land suitability evaluation is done by comparing the land quality of each land map unit with the land use requirements specified [4].

Patchouli plants can grow in the area of land between the lowest plains to a fairly high plateau, which is up to 2000 masl. The yield of oil produced in the highlands is relatively lower compared to plants grown in lowland areas. Patchouli plants need an ideal temperature between 22 - 28ºC or between 22 - 28 capacities of water vapor (g / m^3) with humidity above 75%. Patchouli plants need water availability at the beginning of planting until the growth process takes place to achieve optimal growth. Adequate sunlight at the age of more than 3 months until nearing the harvest is also needed [5].

Patchouli plants are plants that have shallow roots that are less drought resistant and sensitive to soil moisture deficits [8]. In general, patchouli plants are cultivated on dry land with irrigation that relies on rainfall. One of the obstacles in the cultivation of patchouli is the amount of rainfall that is very low. Areas with very low amounts of rainfall are categorized as less suitable for patchouli cultivation [7].

II. RESEARCH METHOD

This type of research is descriptive research. This research was carried out in Drylands in Pontang Subdistrict, North Serang Regency, Banten Province and in the Land and Agro-climate Laboratory of the Agriculture Faculty of Sultan Ageng Tirtayasa University in August to October 2018.

The tools that will be used in this research are hoe, plastic, sample ring, oven, desiccator, sitting balance, ruler, stationery, tray, clamping pliers, petri dish, Dry Soil Test Device (PUTK), analytic balance, digestion tube and block digestion, boiling 250 ml pumpkin, 100 ml erlenmeyer, 10 ml or 5 ml burette, 25 ml measuring cup, magnetic stirrer, test tube, dis tillation device or spectrophotometer, GPS, and 4 in 1 soil survey instrument.

The material used is primary data such as soil physical properties data (texture, structure, BV, BJ) and soil chemical properties (pH, N, P, K, C- Organic), secondary data, namely land use maps, topographic maps, climate data (rainfall, temperature, humidity, irradiation intensity), concentrated sulfuric acid (95-97%), selenium, 1% boric acid, 40% sodium hydroxide (NaOH), Conway pointer and 0.05 N. H2SO4 Data collection methods are carried out by taking soil samples, laboratory tests, observations, and documentation. Data analysis method is done through map overlay and matching between land characteristics and quality in the study area with criteria for growing patchouli.

TABLE 1
CHARACTERISTICS AND SUITABILITY OF LAND FOR PATCHOULI PLANTS

Parameter	Suitability			
	Very Suitable (S1)	In Accordance (S2)	Inappropriate (S3)	Not Appropriate (N)
Field condition (s) Slope (%)	0-2	2-8	8-15	>15
Altitude (masl)	100-400	0-100 or 400-700	>700	>700
Type of soil	Andosol, latosol	Regosol, podsolik	others	others
Temperature (tc) Average temperature (ºC)	24-26	22-24 or 26-28	20-22 or 28-33	18-20 or >33
Humidity (%)	80-90	70-80	<60	<50
Light intensity	75-100	-		-
availability of water (wa) Rainfall (mm)	2300-3000	1750-2300 or 3000-3500	1200-1750 or >3500	<1200 or >3500
Rainy Day / year	190-200	170-180	<100	-

Wet month / year	10-11	9-10	<9	<8
Rooting media (rc) Texture	Sandy sand, quartz sandy clay	Other clay and sandy clays	others	Sand
Drainage	Good	A bit good	A bit bad	Bad
Soil depth (cm)	>100 cm	75-100 cm	50-75 cm	<50 cm
Hara Retention Acidity((pH)	Somewhat sour until neutral (5,5-7)	A little sour (5 – 5,5)	Sour until very sour (4,5-5)	Very sour or alkaline (<4,5)
C organic (%)	2-3	3-5	<2	-
KTK (me/100gr)	>17	5-16	<5	-
Nutrient Availability (n) K_2O (me/100g)	>10	0,6-10	0,2-0,6	-
P_2O_5 (ppm)	16-25	10-15	>25	-

Source: Rosman et al. (199

III. Results and Discussion

Geographically, Serang Regency is at located coordinates 50 50 '- 60 21' South Latitude and 1050 0 '- 1060 22' East Longitude. The longest distance in a straight line from north to south is around 60 Km and the longest distance from west to east is around 90 Km, with an area of 1,467.35 Km^2. Administratively, Serang Regency consists of 29 Districts and 326 Villages. Serang Regency has a variety of landscapes ranging from plains to steep hills. Judging from the land morphology unit, Serang Regency is located at an altitude of 0 - 1,778 masl (meters above sea level) and is generally classified as a terrain and undulating topography class. In general, (> 97.5%). Serang Regency is at an average height of 25.66 meters above sea level. Lowland areas are scattered on the north coast and are limited to the west coast and along major river flows such as the Ciujung River and Cidurian. Administratively, this lowland distribution covers the Tirtayasa, Pontang, Carenang, Ciruas, and Kramatwatu sub-districts. [13].

Pontang sub-district is directly adjacent to other districts / districts as follows: in the north bordering the Java Sea, in the south bordering Ciruas District, in the west bordering the Kasemen District, in the west bordering Tirtayasa Regency. Rice fields in Pontang Sub-district consist of: technical irrigated rice fields, semi-technical rice fields, rain-fed rice fields. Dry land in Pontang District consists of: tegal land and garden land. Area of Land According to Use in Pontang Subdistrict as follows: rice field area 4,868 Ha, area of yard and settlement 368 Ha, land area of tegal / garden: 63 Ha, area of pond: 6 Ha, area of other land: 19 Ha, amount of land all 7,223 Ha. The characteristics of the land and climate of Pontang Subdistrict are as follows: soil acidity (pH) is slightly acidic between 4 - 7, soil slope 0 - 8%, height of the place, namely the heat temperature regime. Peat conditions are around 90 cm with moderate drainage conditions. The origin (formation) of land is not of volcanic ash, wet month rainfall between 3-6 months and dry months also between 3-6 months. [12].

Serang and its surrounding climate data are: average air temperature of 27.50ºC, average air humidity of 81.23%, average monthly rainfall of 126.69 mm [3].

Dry land in Pontang Subdistrict, whose soil samples were observed and taken, included forms of dry land use, mixed gardens, and vacant land. Based on the results obtained from the primary data in the field and analysis in the laboratory, the following are the characteristics of dry land in Pontang District, Serang Regency, limiting factors for land suitability for patchouli cultivation, as well as recommendations for improving land conditions.

A. Place Height

T ABLE 2
LACE HEIGHT

No.	Land Use	Height of Place (msal)	Suitability
1	Moor	10	Appropriate (S2)
2	Mixed gardens	23	Appropriate (S2)
3	Vacant land	11	Appropriate (S2)

Source: Primary Data (2018)

The height of the place in the dry land of Pontang Subdistrict which was observed in the form of moor, mixed

garden, and vacant land was still classified as lowland (0-700 masl). Patchouli plants planted in the lowlands are suitable (S2), because having a higher percentage of oil yield and good alcohol content can still be obtained.

B. *Air Temperature (oC)*

T ABLE 3
AIR TEMPERATURE

N o.	Land Use	Air Temperature (oC)	Suitability	Limiting factor
1	Moor	28	Appropriate (S2)	Air temperature is a permanent
2	Mixed gardens	27	Appropriate (S2)	
3	Vacant land	30	Inadequate (S3)	

Source: Primary Data (2018)

The air temperature in the dry land of Pontang Subdistrict, which was observed in the form of moor and mixed gardens, was still in accordance (S2). Empty land is the highest air temperature because there is no high vegetation and evaporation, including less suitable (S3) for the cultivation of patchouli plants. Temperature affects the yield of patchouli plants. Temperature becomes a permanent limiting factor so that it becomes a heavy barrier for the cultivation of patchouli plants.

C. Water Availability

Water availability can be seen from the rainfall conditions of the study area. Based on the results of the calculation of the average rainfall, the rainfall conditions in the study area are around 126.69 mm / month or 1520.28 mm / year [3]. Based on the climate classification according to Schimdt Ferguson the number of wet months in Serang Regency is between 8-9 months, with 3 dry months. The availability of water from rainfall for patchouli plants on dry land in Pontang District, Serang Regency, is less suitable (S3).

Water content in the soil at the study site was also measured gravimetrically, the value as follows:

TABLE 5
MOIST URE CONT ENT (%)

No.	Land Use	Moisture content (%)	Suitability	Limiting factor
1	Moor	35,48	Appropriate (S2)	Moisture is a non-permanent limiting factor.
2	Mixed gardens	24,97	Appropriate (S2)	
3	Vacant land	11,22	Inadequate (S3)	

Source: Primary Data (2018)

Based on Table 3, the water content in the upland area is the highest (35.48%), while the mixed garden (24.97%) and vacant land (11.22%). Water content and rainfall are non-permanent limiting factors for the cultivation of patchouli plants, so improvements can be made to make it more suitable for the cultivation of patchouli plants.

The amount of rainfall in an area cannot be changed because the rainfall of a region is affected by its geographical location on the surface of the earth. Rainfall that is too much for the needs of a plant, can be overcome by making drainage channels on agricultural land. Rainfall which is too small for the needs of a plant especially during the dry season. can be overcome by irrigation techniques. Irrigation in Pontang District, Serang Regency can be done with water sources found on the surface of the land, namely the river.

D. Soil Texture

TABLE 4
SOIL TEXTURE

No.	Land Use	Soil Texture	Suitability
1	Moor	Clay loam	Appropriate (S2)
2	Mixed gardens	Sandy clay	Appropriate (S2)
3	Vacant land	Sandy clay	Appropriate (S2)

Source: Primary Data (2018)

Based on Table 4, Soil texture in the study area both for moor, mixed gardens, an d vacant land including appropriate (S2) with the condition of growing patchouli plants.

E. Drainage

The availability of oxygen for plants is affected by drainage conditions. Soil drainage is the speed of water transfer from a field of land either in the form of runoff or as infiltration of water into the soil. Slowly the water seeps in the soil determines the soil drainage class. Soil drainage data can be obtained from qualitative direct field observations on all soil profiles based on the presence of yellow, brown, or gray patches. Good drainage is characterized by no yellow, brown, or gray spots.

Drainage conditions in Pontang District, Serang Regency on dry land and mixed gardens are rather good (S2), while for vacant land, it is rather poor (S3) so that the water received by the land does not quickly pass down. Drainage conditions can be improved by making drainage channels.

TABLE6
DRAINAGE

No.	Land Use	Drainage	Suitability	Limiting factor
1	Moor	Rather Good	Appropriate (S2)	
2	Mixed gardens	Rather Good	Appropriate (S2)	
3	Vacant land	A little bad	Inadequate (S3)	Drainage is a non-Permanent limiting factor.

Source: Primary Data (2018)

F. Soil acidity (pH)

TABLE 7
SOIL ACIDITY

No.	Land Use	Soil acidity (pH)		Suitability
		KCL	H_2O	
1	Moor	5,68	6,02	Very suitable (S1)
2	Mixed gardens	5,54	6,39	Very suitable (S1)
3	Vacant land	5,39	6,38	Appropriate (S2)

Source: Primary Data (2018)

Based on soil acidity test (pH) in the laboratory, using either KCL or H_2O solvents, the use of dry land and mixed gardens has a slightly acidic to neutral soil pH (5.5 -7), meaning that the study location is very suitable (S1) for patchouli cultivation . Whereas for vacant land has a slightly acidic soil pH (5 - 5.5), meaning that the research location is suitable (S2) for the cultivation of patch ouli plants.

G. *C- Organik (%)*

TABLE 8
C – ORGANIK(%)

No.	Land Use	C- Organik (%)	Suitability	Limiting factor
1	Moor	0,24	Inadequate (S3)	C- Organik (%) is a non-permanent limiting factor.
2	Mixed gardens	0,19	Inadequate (S3)	
3	Vacant land	0,13	Inadequate (S3)	

Source: Primary Data (2018)

Based on the results of laboratory tests, the C-Organic content in the study location is either dry land use, mixed gardens, or vacant land including low, so that it is less suitable (S3) for patchouli cultivation. C-Organic content is a non- permanent limiting factor for the cultivation of patchouli plants, so improvements can be made to make it more suitable for the cultivation of patchouli plants

Organic C content in Pontang District, Serang Regency can be improved by fertilizing using manure, compost or green manure. Organic C content can also be improved by attempting to return the remaining plants to the soil.

H. K2O Content

TABLE 9
K2O CONT ENT

No	Land use	K_2O Content	Sustanbility	Limiting factor
1.	Moor	Tinggi	Very suitable (S1)	
2.	Mixed gardens	Rendah	Inadequate(S3)	K_2O Content is a non – permanent limiting factor.
3.	Vacant land	Rendah	Inadequate(S3)	

Source: Primary Data (2018)

Based on laboratory tests, K2O content in dry land use includes high and very suitable (S1) for the cultivation of patchouli plants. Whereas mixed gardens and vacant land are low so that they are not suitable (S3) for patchouli cultivation. K2O content is a non-permanent limiting factor, so that repairs can be done to make it more suitable for the cultivation of patchouli plants.

The K2O content that is suitable for the cultivation of patchouli plants is > 10 me / 100 gr. The K2O content in Pontang Subdistrict is too low for patchouli cultivation. The content of K2O can be improved by the addition of fertilizer containing K and compound fertilizer containing elements of P and K.

I. P2O5 Content (ppm)

TABLE 10
P_2O_5 CONTENT

No	Land Use	P_2O_5 Content (ppm)	Suitability	Limiting Factor
1.	Moor	70,73	Kurang Sesuai (S3)	K_2O Content is a non – permanet limiting factor
2.	Mixed Gardens	27,27	Kurang Sesuai(S3)	
3.	Vacant land	7,49	Tidak Sesuai (N)	

Source: Primary Data (2018)

Based on the laboratory test, P_2O_5 content in the use of dry land and mixed gardens is less suitable (S3), while the vacant land includes Not Compliant (N). P_2O_5 content is a non-permanent barrier, so that repairs can be done to make it more suitable for the cultivation of patchouli plants.

Phosphorus (P) is found in organic substances that are most important for plants, namely in nucleo proteins (protein nuclei). P is very helpful for the development of roots (AAK, 2002: 162 - 163).

P_2O_5 content in dry land in Pontang sub- district is too low for patchouli cultivation. P_2O_5 content can be improved by adding fertilizer containing P and compound fertilizers containin g elements of P and K

IV. CONCLUSION

1) Limiting factors for dry land suitability for patchouli cultivation in Pontang District: moor has a limiting

factor for land suitability in the form of C-organic, P2O5 content. Mixed gardens have limiting factors in the form of C-organic, K2O content, P2O5 content. Empty land has limiting factors in the form of air temperature, water content, drainage, C-organic, K_2O content, P_2O_5 content.

2) The level of land suitability for patchouli cultivation in Pontang Subdistrict: moor including suitable (S2), mixed gardens including less suitable (S3), vacant land including inappropriate (N).

3) Efforts to improve land to improve the nature of land constraints : irrigation application, fertilizing with manure or compos t to increase C-organic content, fertilizing with fertilizers containing P and K elements to improve nutrient availability P_2O5 and K_2O, making channels to improve drainage

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