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 properties (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 application, making drainage, and fertilizing to obtain optimal patchouli results.

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

1. 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 most 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 - 28°C or between 22 - 28 capacities of water vapor (g / m³) 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.

| Parameter                  | Field condition (s) | Altitude (masl) | Type of soil       | Temperature (tc) | Humidity (%) | Light intensity | availability of water (wa) | Rainfall (mm) | Rainy Day / year |
|----------------------------|---------------------|-----------------|--------------------|------------------|---------------|-----------------|--------------------------|--------------|-----------------|
| Slope (%)                  | 0-2                 | 100-400         | Andosol, latosol   | 24-26            | 80-90         | 75-100          | 2300-3000                | 190-200      |                 |
| (%)                        | 2-8                 | 0-100 or 400-700| Regosol, podsolik  | 22-24 or 26-28   | 70-80         | -               | 1750-2300 or 3000-3500   | 170-180      |                 |
|                             | 8-15                | >700            | others             | 20-22 or 28-33   | <60           |                | 1200-1750 or >3500       | <100         |                 |
|                             | >15                 | >700            | others             | 18-20 or >33     | <50           |                | <1200 or >3500           | -            |                 |
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 Km². 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 27.50°C, 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

| 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
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 Schmidt 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:

| 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) |

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

| 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) |

Based on Table 4, Soil texture in the study area both for moor, mixed gardens, and 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.

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Source: Primary Data (2018)
F. Soil acidity (pH)

| No. | Land Use  | Soil acidity (pH) | Suitability |
|-----|-----------|------------------|-------------|
|     |           | KCL | H2O  |
| 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 H2O 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 patchouli plants.

G. 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

| No | Land use | K2O Content | Suitability | Limiting factor |
|----|----------|-------------|-------------|-----------------|
| 1  | Moor     | Tinggi      | Very suitable (S1) |               |

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)

| No | Land Use | P2O5 Content (ppm) | Suitability | Limiting Factor |
|----|----------|---------------------|-------------|----------------|
| 1  | Moor     | 70.73               | Kurang Sesuai (S3) | K2O Content is a non-permanent 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, P2O5 content in the use of dry land and mixed gardens is less suitable (S3), while the vacant land includes Not Compliant (N). P2O5 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).

P2O5 content in dry land in Pontang sub- district is too low for patchouli cultivation. P2O5 content can be improved by adding fertilizer containing P and compound fertilizers containing 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, K2O content, P2O5 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 compost to increase C-organic content, fertilizing with fertilizers containing P and K elements to improve nutrient availability P2O5 and K2O, making channels to improve drainage.

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