

Utilization of Drones for Surveys, Mapping, in Determining the Feasibility of Oil Palm Plantation Land Using Applications of Geographic Information System (GIS)

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ABSTRACT

Banten has quite extensive potential for oil palm plantations. The area that has the potential for oil palm plantations is Banten Regency. This research was conducted on the suitability and potential of oil palm plantations in Banten Regency using a geographic information system. This research aims to analyze land suitability with parameters of rainfall, air temperature, soil type and topography for oil palm plantations in Banten Regency using a geographic information system and determine the potential of oil palm plantations in Banten Regency. The method used to analyze land suitability and potential for oil palm plantations is method *matching*. The results of data processing showed that the land suitability area in the suitable category (S1) was around 3.853,95 ha, quite suitable (S2) around 1.294,33 ha, marginally suitable (S3) around 258,40 ha and unsuitable (N) around 1,023,40 ha. The importance scale value from the AHP calculation results obtained an Eigen value of 5.425539 and a consistency index (CI) value of 0.106385, with a matrix size of 5 which has an index ratio (RI) value of 1.12, the consistency ratio (CR) obtained a value of 1.12. 0.094986. Decision making is based on a CR value ≤ 0.1 so that the results of the AHP analysis weighting are declared consistent.

Key word: Geographic Information Systems, Land Suitability, Methods *Matching*

1. INTRODUCTION

This invention relates to determining the suitability of oil palm plantation land by utilizing drone technology for more effective, fast and efficient survey activities. The stages of determining land suitability using drones include topographic and contour mapping through 3D photography; identification of vegetation and soil types with multispectral or infrared cameras mounted on drones; detecting areas affected by flooding or drought through regular aerial photography, analyzing the quality of drainage and irrigation, as well as monitoring plant health with drones equipped with plant stress detection sensors. The above activity stages can be carried out more quickly and accurately with the help of drones because they collect data automatically *real time* via aerial photography. Determining the suitability of land through topographic photos from drones is very useful for helping prepare land use for oil palm plantations on a large scale in accordance with suitability criteria. In the long term, drones can also be used to increase the productivity of oil palm plantations by taking pictures of the land to see where there are still empty spaces that can be planted.

2. RESULTS AND DISCUSSION

This oil palm land suitability analysis uses a matching method between land characteristics and oil palm plant growth requirements based on Technical Guidelines for Agriculture (Djaenudin, 2003). The suitability of this land is divided into four classes, namely suitable (S1), quite suitable (S2), marginally suitable (S3), and not suitable (N). This class classification is based on overlay data and data analysis using the matching method. Land suitability for oil palm plantations in Banten Province is prioritized for unused land such as moorland, open land and bushes. The results of data analysis showed that suitable land (S1) for oil palm plantations was mostly found in several sub-districts in Pandeglang and Lebak Regencies, with an area of 3,853.95 ha. However, it does not rule out the possibility that sub-districts in other districts also have the potential to be used as oil palm plantation areas in the future.

Suitable land (S1) to be used as an oil palm plantation includes parts of Wanasalam, Gunungkencana and Cijaku sub-districts in Lebak Regency as well as Sumur, Cibitung, Sobang, Munjul and Picung sub-districts in Pandeglang Regency. Sufficiently suitable land (S2) is found in parts of Banjarsari District in Lebak Regency and parts of Cimanggu, Cibaliung, Cikeusik, Angsana, Sindangresmi and Bojong Districts located in Pandeglang Regency. Marginally suitable land (S3) is found in Cihara, Cigemblong, Cileles, Bojongmanik, Cirinten, and Warunggunung subdistricts located in Lebak Regency as well as parts of Panimbang, Patia, Cimanuk, Banjar, Kaduhejo, Mekarjaya, Majasari, and Koroncong subdistricts in Pandeglang Regency. . Unsuitable land (N) is found in some of the 19 other sub-districts in Lebak Regency, such as Malingping, Panggarangan, Bayah, Ciligrang, and others. Meanwhile, unsuitable land (N) in Pandeglang Regency is found in parts of 16 other sub-districts, including Cigeulis, Saketi, Cisata, Pagelaran, and others.

Based on research results, Banten Province has land that can be used as plantation land. Land that is quite suitable (S2) and marginally suitable (S3) can also be used as plantation land, but the land must be improved to produce good oil palm plants. The area for each suitability class for oil palm land in Banten Province can be seen in Table 1.

Tabel 1. Suitable area for oil palm land

Class	Area (ha)
N	1.023,40
S1	3.853,95
S2	1294,33
S3	258,40

Source; Analysis Results, 2024



Figure 1, Suitability of Palm Oil Plantation Land

In the future, the need for palm oil will certainly increase. This is in line with the increase in the number of people who use palm oil in their daily lives. The potential for land use change to oil palm plantations is quite large. This process will occur when the existing oil palm plantation land is no longer able to meet market demand for palm oil so that other land is needed to be cleared to become an oil palm plantation. Several factors are driving the change in land cover to oil palm, including the increasing global demand for products that use palm oil, such as cosmetics, food and bioenergy.

Based on calculations of the potential for oil palm plantation development, there are several cities and districts in Banten Province that meet the parameter criteria. However, it is also necessary to consider that there are several places that are no longer suitable for development as oil palm land, even though in terms of parameters they are in the potential or feasible category. This is because several locations such as the cities of Tangerang, Serang and Cilegon are dominated by residential areas, making it impossible to function as oil palm plantations. Locations where it is still possible to expand oil palm are in Pandeglang and Lebak Regencies. The importance scale value from the AHP calculation results obtained an Eigen value of 5.425539 and a consistency index (CI) value of 0.106385, with a matrix size of 5 which has an index ratio (RI) value of 1.12, the consistency ratio (CR) obtained a value of 0.094986. Decision making is based on a CR value ≤ 0.1 so that the results of the AHP analysis weighting are declared consistent.

Table 2, Classification of Potential Land Suitability

No.	Priority Criteria	Importance	Scale Weights
1	Rainfall	0,49	9
2	Soil Texture	0,27	3
3	Land Slope	0,11	7
4	Soil Acidity	0,08	1
5	Dry Moon	0,06	5

Source: Survey results, 2024

The Final Result Map is a map of Oil Palm Land Feasibility in Banten Province on a scale of 1:1,000,000 using soil texture and pH data obtained from the digital world soil map from FAO (Digital Soil Map of the World) on a scale of 1:5,000,000. The types of soil on the digital world soil map from FAO (Digital Soil Map of the World) on a scale of 1:5,000,000 have criteria in the form of soil texture and pH in the table from <https://www.fao.org/4/y5749e/y5749e0m.htm> can see the soil pH for each type of soil then for soil texture can be seen in previous research (Djaenudin et al., 2003). Rainfall data is obtained from BMKG data which can be downloaded online from the data can be known the monthly average each year in each city/district in Banten Province. Rainfall data is used to find dry months. The map creation was then scored on each map as shown in table 3.

Table 3. Parameter Scores for oil palm land suitability

No	Classification	Parameters	Weight	Score	Value
1	Rainfall				
	<1.250	Very low	1	7	7
	1.250 – 1.450	Low	2	7	14
	1.450 – 1.700	Currently	3	7	21
	1.700 – 2.000	Tall	4	7	28
	2.000 – 3000	Very high	5	7	35
2	Soil Texture				
	Very Coarse	Very low	1	1	1
	Coarse	Low	2	1	2
	Medium	Currently	3	1	3
	Fine	Tall	4	1	4
	Very Fine	Very high	5	1	5
3	Land Slope				
	0 – 8 %	Very low	1	1	1
	8 – 15 %	Low	2	1	2
	15 – 25 %	Currently	3	1	3
	25 – 45 %	Tall	4	1	4
	>45 %	Very high	5	1	5
4	Soil acidity (pH)				
	>7,0	Very low	1	0,5	0,5
	<4,2	Low	2	0,5	1
	6,5 – 7,0	Currently	3	0,5	1,5
	4,2 – 5,0	Tall	4	0,5	2
	5,0 – 6,5	Very high	5	0,5	2,5
5	Dry Month (<100mm/monday)				
	>4	Very low	1	0,5	0,5
	4	Low	2	0,5	1
	3	Currently	3	0,5	1,5
	2	Tall	4	0,5	2
	<1	Very high	5	0,5	2,5

Source; analysis results, 2024.



Figure 2, Palm Oil Plantation Land Feasibility Map

Land suitability map creation using ArcMap software by providing rainfall and dry month attribute data on administrative maps obtained from the RBI Map from the Geospatial Information Agency. Soil texture and pH data are obtained from soil type maps issued by FAO, then land slope maps are obtained from the Geospatial Information Agency. Each map is then scored for each of the five parameters. After the assessment is carried out, overlay the five parameters, after overlaying enter the weight for each parameter contained in table 1. After that, calculate the total score for the final map in the form of a land suitability map of Banten Province on a scale of 1: 1,000,000 which is then classified based on table 4. After obtaining the classification results, the next step is to create symbology to make it easier for users to read the map and create a layout that contains map components that are in accordance with cartographic rules.

After calculating the AHP scoring results with secondary data available in each district in Banten Province, an overlay was carried out using GIS to produce an output map of the feasibility of oil palm land in Banten Province as in Figure 2.

Table 4. Land Suitability Classification

No	Total Skor	Classification
1	<20	Not Appropriate
2	20 – 30	Quite Appropriate
3	30 – 50	Appropriate
4	50	Very Appropriate

3. Conclusions

From the results of the Overlay analysis on the Geographic Information System Application:

1. Pandeglang Regency, Tangerang Regency and Tangerang City are feasible areas based on the specified indicators.
2. Meanwhile, Lebak Regency, Serang Regency and Cilegon City are areas included

in the feasible area. quite decent category.

3. Meanwhile, Serang City is an area that is less suitable.

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