Utilization of the Geography Information System to Support Business Enterprises Site Planning of Defense Industry

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Abstract. Lampung Province especially Tanggamus District has been planned as the area for the development of Indonesia defense industry, namely Navy Shipyard Inc. (PT. PAL), Indonesian Aerospace Inc. (PT Dirgantara Indonesia), and Pindad Inc. Base on Indonesia national plan, Lampung Province also have a future planning as a Maritime Industrial Area. To support in deciding the site planning in the region, this study utilization the sensing technology by combining Geographic Information System (GIS) and remote sensing technique. Base on the archive spatial data, the suitability of land is analyzed and be used for the site planning of defense industry area. GIS application used to process spatial data that overlapped to produce a map of land suitability area. As a result, these studies find Indonesian Navy Shipyard Inc. (PT. PAL) and Pindad Inc. are suitable (S2) and Indonesian Aerospace Inc. is not suitable (N), for areas that are not suitable then it is recommended to other areas that are in Astra Kestra as the Air Force in Lampung Province.

Keyword: Defense Industry, Geographic Information System (GIS), land suitability

1. Introduction

Based on the guidance from the Ministry of Defense concerning the development plan of Indonesia defense industry, Navy Shipyard Inc. (here and after call as “PT. PAL”), Indonesian Aerospace Inc. (here and after call as “PT Dirgantara Indonesia” or “PT DI”), and Pindad Inc.to Tanggamus District of Lampung Province. Consideration of development areas to the outside of Java Island due to the increasingly crowded Java area and no longer possible for the development of the manufacture of defense equipment products. Reinforced by presidential directives that development is not Java-centric but Indonesia centric [1,2].

The main reason for the move is to unite the national defense industry in an industrial area. The development of the Indonesia defense industry area is also related to the development planning of Maritime Industrial Zone (MIZ) in Tanggamus District, based on the National Medium Term Development Plan (RPJMN) Lampung Province. Therefore, in the development of the region needs to be done land suitability assessment using sensing technology, one of them with the application of Geographic Information System (GIS).

This research focuses on Tanggamus District particularly on protected forest areas of registers 27 and 28. Protected Forest is a forest area that has a basic function as a protection of life buffer systems to regulate water governance, prevent floods, control erosion, prevent seawater intrusion, and maintain soil

fertility [2]. The Protected Forest area in Tanggamus District includes two registers namely "27 Pematangsullah" registers with an area of 8,740 hectares and "28 Pematangneba" registers with an area of 13,220 hectares. Register 28 is an area that will be more devoted to the study of Indonesia defense industry development plans.

2. Location

Geographically, Tanggamus District is located at 104° 18' - 105° 12' East Longitude and between 5° 05' - 5° 56' South Latitude. The western part of Tanggamus District continues north from Bukit Barisan Hills. The southern part is tapered and has a large bay, Semangka Bay. In Teluk Semangka there is a port which is a port and fish landing site.

The boundaries of the Tanggamus District administrative area are as follows:

a) North is bordered by West Lampung and Central Lampung Districts.
b) The South is bordered by the Indonesian Ocean.
c) Westside borders with West Lampung District.
d) Eastside borders Pringsewu District.

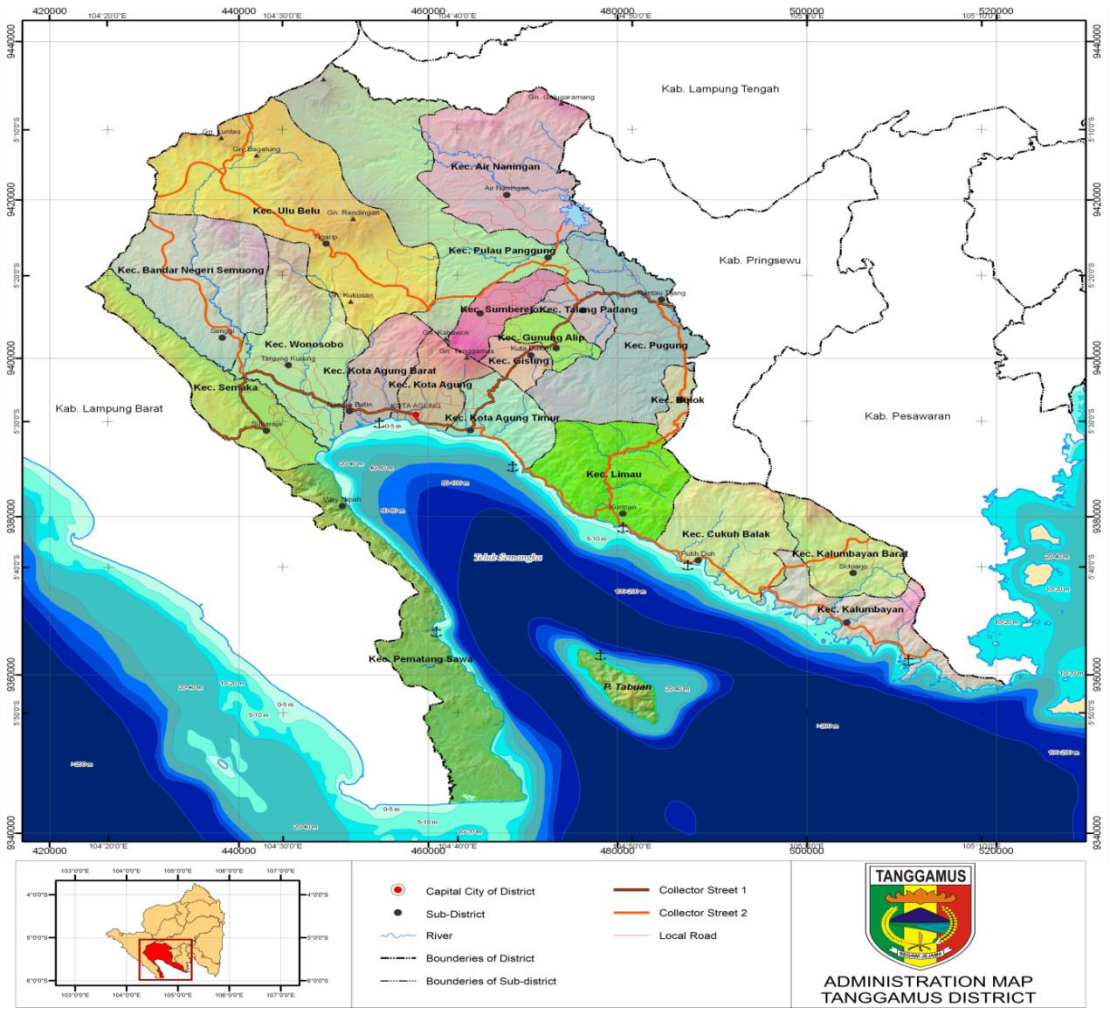

Figure 1. Administration Map of Tanggamus District

Tanggamus District has an area of 2855.46 Km² for land area and sea area covering 1799.50 Km² with a total area of 4654.98 Km², with the topography of the region varying between lowland and highland, some of which are hilly to mountainous areas, which is about 40% of all regions with altitudes from sea level between 0 and 2115 meters.

The natural resource potential of Tanggamus District is mostly used for agricultural activities. In addition, there are still several other natural resources that have the potential to be developed, among others: gold mining, minerals such as granite and marble or marble. Besides that, there are also hot and geothermal water sources that allow it to be developed into alternative electricity generation.

3. Research Methods

This study used several numbers of classes, three classes for suitable, namely: S1, S2, S3 and two classes for not suitable, namely: N1 and N2 [3]. A qualitative explanation of the definition in the class division is presented in Table 1.

Table 1. Suitability Class

Class	Description
S1 class	Highly Suitable is a land that does not have a heavy barrier for the use of sustainable or only has no limit and does not significantly affect the production and does not cause the increase in input given in general.
Grade S2	Moderately Suitable is a land that has a rather heavy barrier to maintain the level of management that must be done. Barriers will reduce productivity and profit, and increase the necessary input.
S3 Class	S3 or Marginal Suitable class is a land that has a very heavy barrier to maintain the level of management that must be done. Barriers will reduce productivity and profit. Enhanced input required.
Class N1	Currently Not Suitable class is a land that has more severe restrictions, but it is still possible to overcome, simply can not be fixed by the current level of knowledge at a rational cost. The limiting factors are so severe that they hinder the successful use of sustainable land in the long term.
Class N2	Permanently Not Suitable is a land that has a very heavy barrier, so it is not possible to use for a sustainable use.

Based on Regulation of the Minister of Industry **"***Permenperin 40/M-ind /Per/6/2016***:** Concerning Technical Guidelines for Industrial Area Development**"**, regarding the criteria for site selection for industrial estate development such as distance of industrial location of city centre, distance to settlement, land transportation network, energy and electricity network, telecommunication network, seaport, frozen water source, condition of the land [1]. The criteria for choosing the location of industrial estate development are summarized in Table 2.

Table 2. The criteria for choosing the location of industrial estate development

No.	Criteria	Description
1	Distance to city center	Minimum 10 km
2	Distance to settlement	Minimal 2 km
3	Land transportation distance	There is a primary arterial road or rail network
4	Energy and electrical networks	Available
5	Telecommunication networks	Available
6	Transportation Infrastructure	A seaport for smooth transportation of goods logistics and export/import outlets is available
7	Source of raw water	Available surface water source (river, lake, reservoir, or sea) with sufficient discharge
8	Land conditions	• Topography up to 15% • Land carrying capacity of soil sigma: 0.7-1.0 kg / cm2 • Soil fertility is relatively infertile (non-technical irrigation) • Patterns of land use: non-agricultural, non-residential, and non-conservation • Availability of land at least 50 Hectare

The method used in this study is done by hierarchy analysis of spatial data in accordance with the parameters of each Indonesia defense industry using Arc GIS 10.4 application, resulting in the output of a land suitability map for PT. PAL, PT DI, and Pindad Inc.

Analytical hierarchy process (AHP) was performed on GIS applications by scoring spatial data [4]. A flexible model that provides an opportunity for individuals or groups to build ideas and define issues by making their own assumptions and obtaining desired solutions but still refers to FAO land suitability theory [5]. Using the AHP, a problem to be solved in an organized mindset, allowing it to be expressed to make effective decisions on the issue.

The data used in this research are base map, Land Cover Map, Height Map, Slope Map, Disaster Prone Map, Bathymetry Map, Geological Map Map Road, and transportation network. Spatial data is then analyzed using the hierarchy concept in Arc GIS application 10.4 [6]. So as to obtain the land suitability map with appropriate land criteria (S1), according (S2), according to marginal (S3), and not appropriate (N) for the three Indonesia defense industry.

4. Results and Discussion

4.1.Land Suitability for PT. PAL

PT. PAL is one of the strategic industries that produce the main tool of the Indonesia defense system, especially for the sea dimension. Its main business activities are producing warships and commercial vessels, providing ship repair and maintenance services, and general engineering with specific specifications based on customer requirements. PT. PAL that will be planned in registers 27 and 28 Tanggamus District Lampung Province, it is necessary to study the land suitability in determining the location of the industrial development. Here are the parameters used in determining the location of land suitability for PT. PAL: 1. Have adequate sea depth; 2. Have adequate port facilities; 3. Lowland

with 0-2% slope; 4. The area is relatively safe from earthquakes, landslides, and floods; 5. Have adequate transportation; 6. Away from residential areas; 7. Included in the Maritime Industrial Zone

The above parameters are used in qualitative analysis and sorted by hierarchy where parameter number 1 shows the level of parameters that most influence on the level of land suitability for PT. PAL. The Land suitability maps obtained from the Land suitability Map were obtained from the hierarchy of Land Cover data analysis, Bathymetry, Slope, Disaster Risk, Geological Map, Road, and Transport Network. Thus, land suitability maps are obtained for PT. PAL (Figure 2).

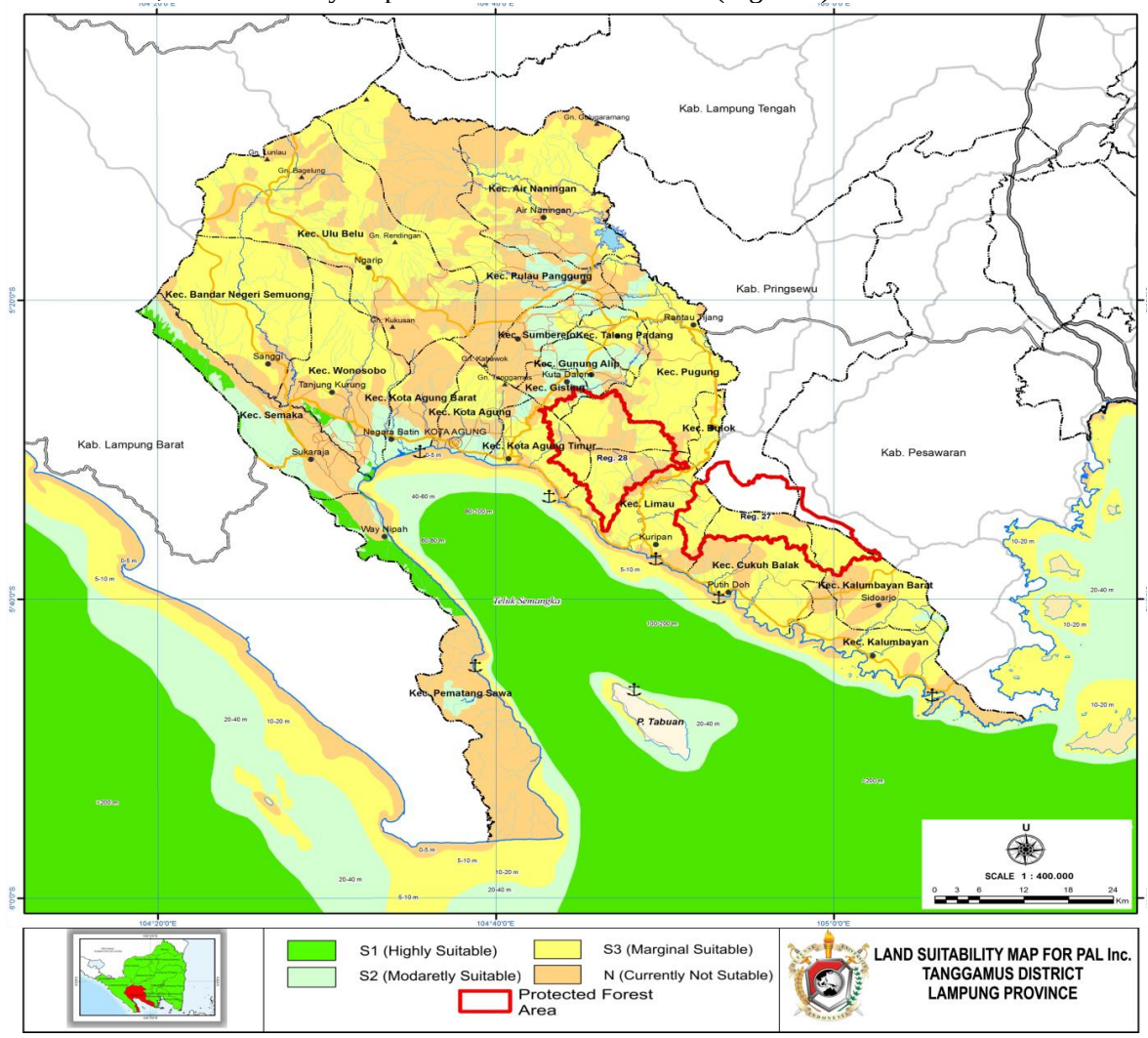

Figure 2. Land Conformity Map PT. PAL (Source: Analysis Results)

Based on the Land Conformity Map PT. PAL, it can be seen that the land suitability for the development of PT. PAL in register 28 is categorized accordingly. This is because of the parameters that determine the appropriate or inappropriate area to be developed for PT. PAL is from the depth of the sea in the region. Can be known from the map above the depth of the sea to 28 registers to reach 200 meters. In addition to the above factors, other excellence factors are register 28 near the port, Maritime Industrial Zone, and the ALKI line. With the port will benefit PT. PAL in loading and unloading of goods or distribution of goods. In addition, the location close to the Maritime Industrial Zone will support Navy Shipyard Inc. (PT. PAL) in improving the shipping industry, and the existence of the ALKI line will benefit PT. PAL in the distribution of goods and services of maintenance or repair of foreign ships as it passes through the ALKI. These three things can support the development of PT. PAL is for the better.

4.2.Land Suitability for Pindad Inc

Pindad Inc is a company that provides and manufactures defense products such as light ammunition, heavy ammunition, anoa, tanks, missiles, and other military equipment. In addition to providing military equipment, Pindad Inc also manufactures commercial products such as machine tools, wrought products, air brake systems, and other items. In the production process of military or nonmilitary equipment, Pindad Inc requires suitable land to support the production process. In the development of Pindad Inc in registers 27 and 28 Tanggamus District, required several parameters. Here are the parameters used in determining the land suitability location for Pindad Inc: 1. Lowland with <15% slope; 2. The area is relatively safe from landslides, floods, and earthquakes; 3. Far from residential areas; 4. Have adequate transportation; 5. Have adequate port facilities; 6. There are areas for product trials; 7. The rocket launch trial is directed to the vast sea.

The above parameters are used in qualitative analysis and sorted by hierarchy where parameter number 1 shows the level of parameters that most influence on the level of land suitability for Pindad Inc. The Land suitability maps [7,8] are obtained from the hierarchy of Land Cover data analysis, Slope, Disaster Prone, Geological Map, Road, and Transport Network. Thus, a land suitability map for Pindad Inc (Figure 3).

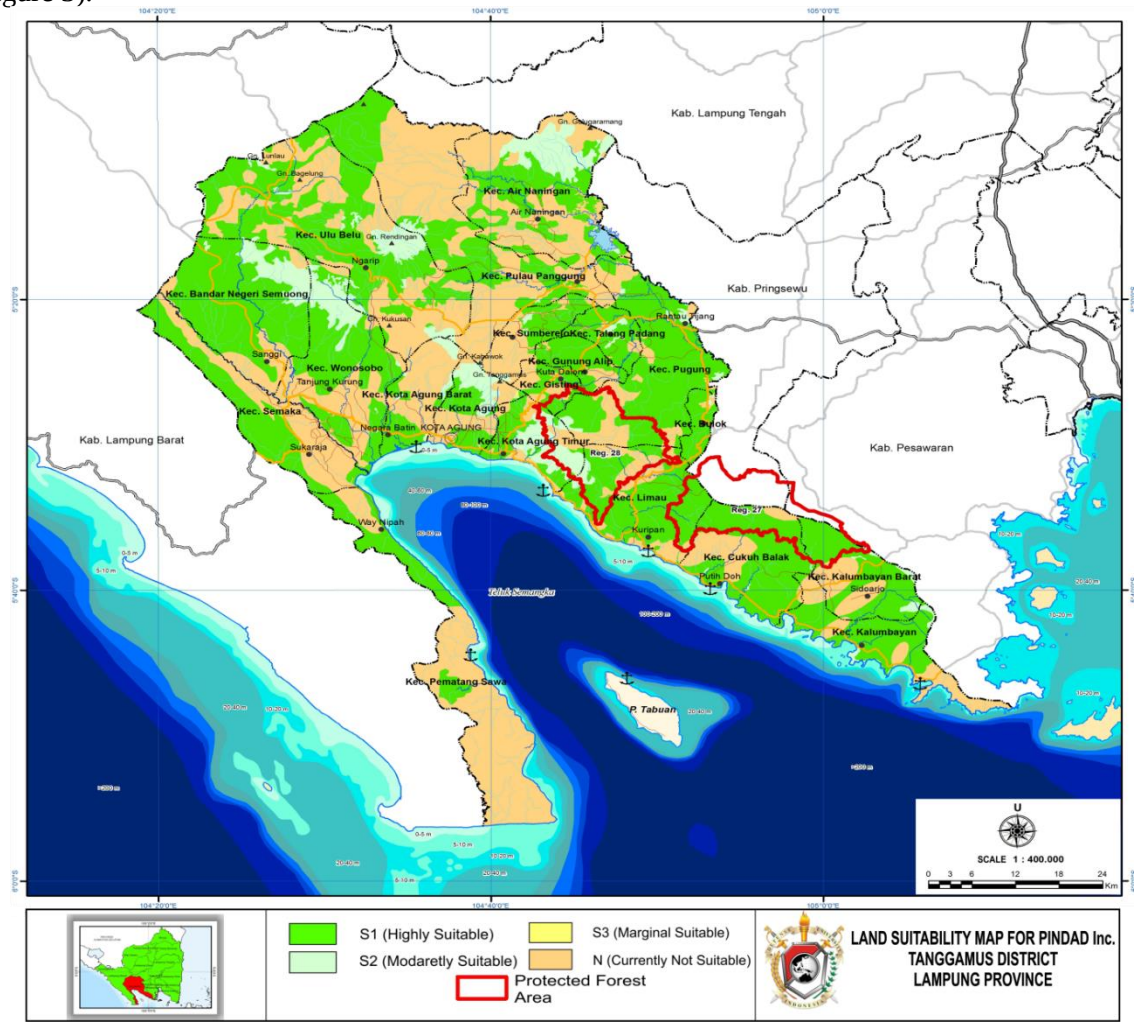

Figure 3. Land suitability Map Pindad Inc (Source: Analysis Results)

From the result of land suitability map above can be concluded that register 28 is suitable for developed industry Pindad Inc. However, this location is not sufficiently suited for rocket and artillery trials as they are relatively close to the settlements, and are at risk of being impacted by trials. Therefore, we recommend the launch of rockets and artillery in Way Batang, Semaka Subdistrict (border of Bengkulu Province and Lampung Province), due to: 1. The area is still Included in Lampung Province; 2. The area is far from residential areas; 3. Free from airplane traffic; 4. Free from ALKI path (Indonesian archipelagic sea lane); 5. Close to the high seas; 6. Slope flat, approximately 2%; *Land Suitability for PT DI*

PT DI is a company that produces, markets, sells and distributes aerospace, defense and security products, such as aircraft and helicopters, aircraft components, aircraft maintenance and modifications, weapons systems and technology services. In the development of PT DI which will be planned in registers 27 and 28 Tanggamus District of Lampung Province, it is necessary to study the land suitability in determining the location of the industrial development. Here are the parameters used in determining the land suitability location for PT DI: 1. Lowland with 0-2% slope; 2. A safe area from earthquakes, landslides, and floods; 3. 2 km of land is available for runaway production; 4. Free from obstacle to a radius of 15 km; 5. Have adequate transportation (close to the toll road and railway development plan); 6. Away from residential areas; 7. Low wind speed.

The above parameters are used in qualitative analysis and sorted by hierarchy where parameter number 1 shows the level of parameters that most influence on the level of land suitability for PT DI. Based on land suitability analysis map, it is known that land suitability for development of PT DI in registers 27 and 28, fall into S4 category (not appropriate). Factors affecting the non-conformance are one of the steep slopes of more than 15% (Figure 4). With the slope of the slope, ideally, it is not possible to construct a runway, where one of the requirements for the construction of an airport is a lowland with a slope of 2% and free of obstacles up to a radius of 15 km. Therefore, register regions 27 and 28 are not suitable for the development of PT DI. Land suitability map for PT DI is obtained from the hierarchy of data analysis of Land Cover, Slope, Disaster Prone, Geological Map, Road, and Transport Network. Thus, a land suitability map for PT DI (Figure 5).

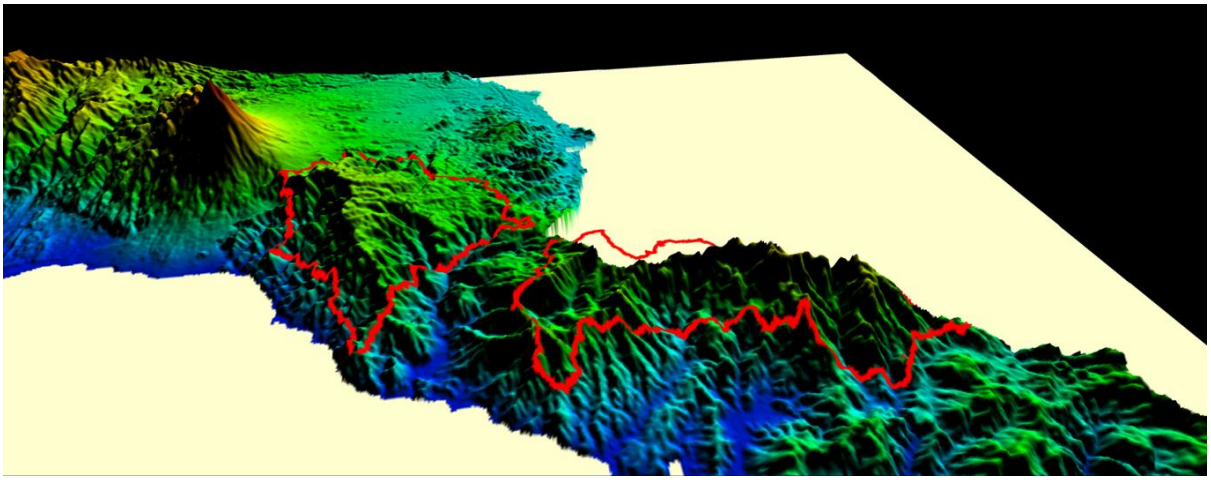

Figure 4. The slope of Registers 27 and 28 in 3D (Source: Analysis Results)

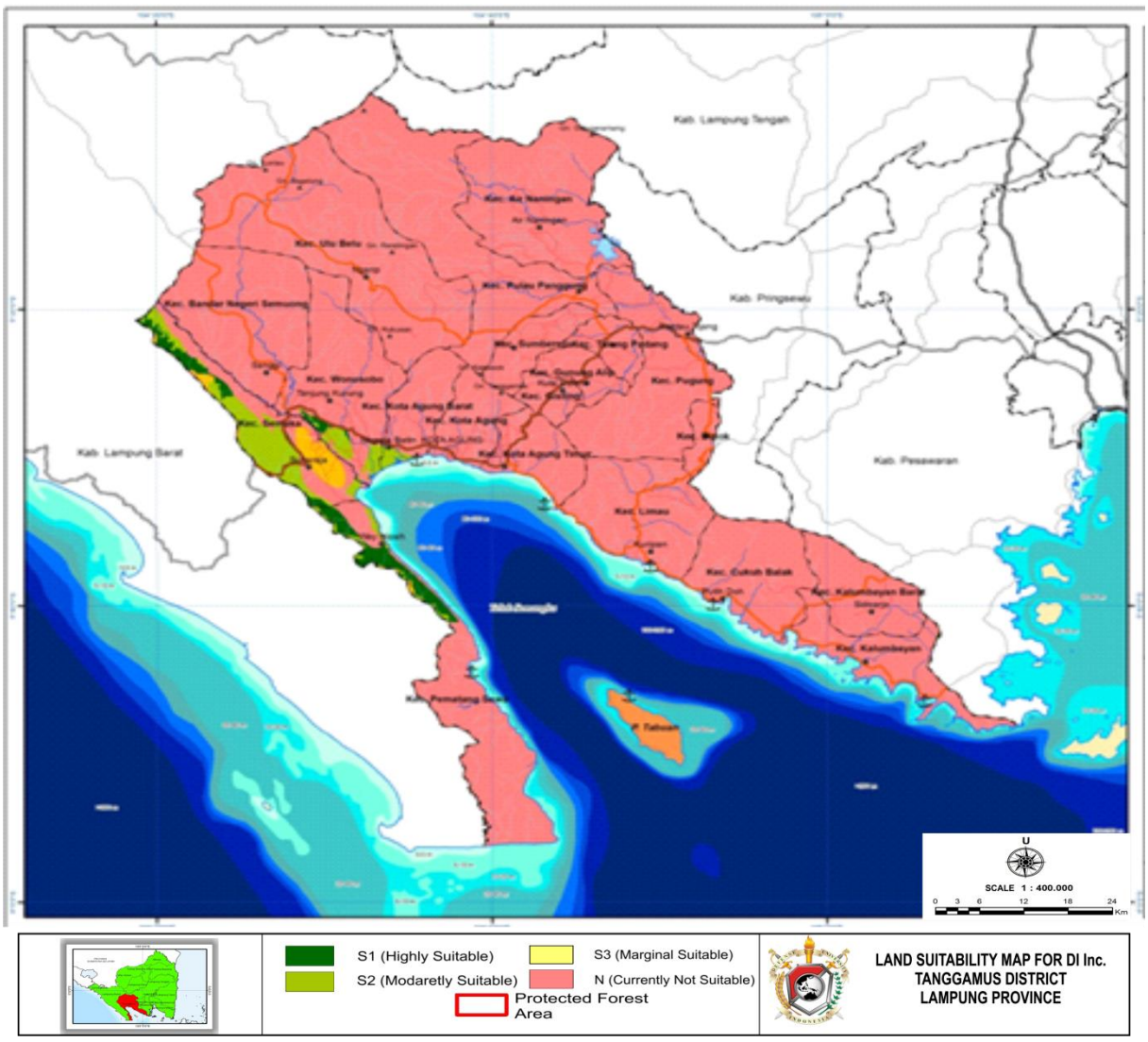

Figure 5. Land Conformity Map Indonesian Aerospace Inc. (PT DI) (Source: Analysis Results)

Based on the land suitability map above, Indonesian Aerospace Inc. (PT DI) is not recommended for development in register 28, so the authors recommend another location that is Astra Kestra region Tulang Bawang District, Lampung Province. Astra Kestra selected as the location for the development of Indonesian Aerospace Inc. (PT DI) due to: 1. The slope is less than 2%; 2. There is a Runway along approximately 2 km and free of the obstacle; 3. It still belongs to Lampung area and is Air Force Air Force (LANUD Astrakestra); 4. Close to the transportation route that is the plan of construction of toll road.

After obtaining the land suitability map for Navy Shipyard Inc. (PT. PAL), Indonesian Aerospace Inc. (PT DI), and Pindad Inc. The authors make recommendation maps for the three Indonesia defense industry using google earth 2016 image data (Figure 6). From Figure 6 above, Navy Shipyard Inc. (PT. PAL) and Pindad Inc are recommended to be developed in register 28 of Tanggamus District, but for testing Pindad Inc rocket launch is recommended in Way Batang region (border of Lampung Province and Bengkulu Province, while Indonesian Aerospace Inc. (PT DI) is recommended in LANUD Astra Kestra, Lampung Province.

Figure 6. Recommendation Map of Defense Industry (Source: Analysis Results)

5. Conclusions

Geographic Information System (GIS) is useful for determining the development of Indonesia defense industry area in Tanggamus District of Lampung Province, summarized as follows:

a) Land suitability for Navy Shipyard Inc. (PT. PAL) is suitable to be developed in register 28 because it is Included in KIM (Kawasan Industri Maritim) which has been set in the National Medium Term Development Plan (RPJMN).
b) Land suitability for Pindad Inc is suitable to be developed in register 28, while for the location of test launch rocket recommended in Way Batang region (border of Lampung Province and Bengkulu Province.
c) Land suitability for PT DI is not suitable to be developed in registers 27 and 28 of Tanggamus District due to the insufficient topographical conditions in runway production.

d) 1. PT DI could be built in areas that already have runways ie. LANUD Astra Kestra, Lampung Province.
e) 2. Require the role of National Air Defense System (Sishanudnas) in order to protect the national vital objects (Navy Shipyard Inc. (PT. PAL), Indonesian Aerospace Inc. (PT DI), and Pindad Inc) to be developed in Tanggamus District of Lampung Province.
f) 3. Further and specific studies are needed to support the development plans of the three Indonesia defense industry in Tanggamus.

6. References

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