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SELECTION OF THE LOCATION OF UNMANNED AERIAL VEHICLES LAND BASE FOR SUPPORTING THE TASK OF THE INDONESIAN NAVY

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ABSTRACT

The Indonesian Archipelagic Sea Lanes (ALKI) which connects the Indian Ocean region with the Pacific Ocean and East Asia with Australia, has enormous consequences for efforts to implement its safeguards. An alternative is needed to optimize the current detection system. One of them is by utilizing the latest technological developments through the use of Unmanned Aerial Vehicles (UAV). The UAV capability for security and defense purposes at sea needs to be developed as an Integrated Fleet Weapon System (SSAT) to fulfill the functions of tactical reconnaissance and maritime surveillance (Surveillance). The use of the UAV can also increase strength and complement the needs of maritime patrol aircraft (Maritime Patrol Aircraft / MPA) which so far have not been fulfilled quantitatively in covering all Indonesian national jurisdiction waters. The ALKI I area is in the working area of Fleet Command I (Koarmada I). In order to optimize the placement of the ScanEagle UAV in the ALKI I area, it is very important to know the criteria for determining its location. This is also due to the limited number of ScanEagle UAVs and the large area that must be covered by these UAVs. By obtaining the location criteria for the ScanEagle UAV Landbase, it is hoped that it will make it easier to map ScanEagle placement locations at Indonesian Navy bases in the ALKI I area. ANP and TOPSIS methods. The criteria for determining the location of the UAV consist of geographical location, weather conditions, vulnerability and security as well as logistical facilities and support, with sub-criteria mountains, tall buildings, plains, sunny cloudy, rain, territorial violations, piracy crimes, smuggling, SAR, airport, ports, spare parts, maintenance, fuel and electricity availability. Based on the results of the analysis and discussion of determining the location of the selected UAV Batam Naval Base.

Keywords**:** *UAV, SSAT, Surveillance, ScanEagle, ANP, TOPSIS*

1. INTRODUCTION

The Indonesian archipelagic sea lane which connects the Indian Ocean with the Pacific Ocean and East Asia with Australia. Of course, this brings huge consequences to the efforts to implement the security so that the continuity of national development can be maintained. The naval battle strategy using aircraft as a warship weapon system has shown the ability that naval battle tactics will be more effective in destroying the enemy if carried out with aircraft power according to their function. In carrying out the defense function, almost all defense equipment owned by the Indonesian Navy currently require a detection tool in the form of radar as a remote sensing system or as an early warning system, the use of Unmanned Aerial Vehicle (UAV) is an alternative. The use of the UAV can also increase strength and complement the need for maritime patrol aircraft (MPA), which so far have not been met quantitatively in covering all waters of Indonesia's national jurisdiction.

Ketut Buda Artana, Masroeri, et al (Artana, K.B., et al. 2012). *Implementation of intelligent control for Optimization of fleet placement TNI-AL ships using genetic algorithm. Academic Research International, Vol. 2, No. 3, May 2012 di SAVAP International.* Duan & Zhang (Duan & Zhang, 2014), Research on Application of UAV for Maritime Supervision (2014). Custers (Custers, 2016), The Future of Drone Use, in this journal discusses the opportunities and challenges of using UAV. Novia Faradila (Faradila et al., 2016), Utilization of Unmanned Vehicles in Disaster Reporting and Management.

2. MATERIALS AND METHODOLOGY

2.1. Research Approach

In this study the authors use a quantitative

research approach where in the implementation the data is taken from the measurement results and based on existing variables. In addition, data collection was also carried out using instruments in the form of questionnaires and interviews.

2.2. Data Sources, Subjects and Objects

This research also aims to develop a new approach in solving problems by applying directly to the real world where the type of data collected is in the form of quantitative data consisting of primary data and secondary data.

2.2.1 Data Source

The data collected are:

a. Primary research data comes from data collected by the author himself from the first source or the place where the research object is carried out.

b. Secondary research data comes from data that has been previously collected by other researchers, agencies or other sources that have been tested/ valid.

2.2.2 Subject

Research subjects are people who are directly involved as resource persons or data providers, for example being interviewees, filling out questionnaires, or being participants in experiments conducted and observed.

2.2.2 Object

The object of research is generally material, already available before the research is carried out. The shape of the object of research is very diverse, ranging from writing or pictures (for example: transcripts of data and field notes that already exist, results of previous research, minutes of meetings, speeches, thesis details, main tasks and functions, maps, floor plans, charts, organigrams to in the form of objects, buildings, or land (for example: weapons, war vehicles, bunkers, munitions storage, battlefield training fields, and others.

2.3. Research design

Research design is a guideline in carrying out research stages from obtaining or collecting data, processing data, analyzing data and evaluating the data, testing data sensitivity to the final stage of interpreting research results. In this consider, information collection procedures were carried out through perception, interviews and documentation /literature ponders. The literature study was carried out by means of a literature review of several literatures that were correlated with the research theme. Field studies were conducted to obtain the data needed in this research.

2.3.1. Design

The selection of the ANP network model analysis is based on the reason that the purpose of this study is to choose the priority for selecting the Landbase Unmanned Aerial Vehicles (UAV) location in Indonesian archipelagic sea lane region. ANP has the advantage of generalizing the existing alternative options based on the weight of the comparative importance of each factor. . By using ANP it is hoped that the highest priority and lowest priority of the Landbase Unmanned Aerial Vehicles (UAV) locations in the ALKI I Region will be identified. The existing criteria are grouped into 4 clusters, namely Geography, Weather, Violations and Regional Security, Facilities and Logistics Support. The next stage is to rank priorities for alternative locations for determining the location of Landbase Unmanned Aerial Vehicles (UAV) in the Indonesian archipelagic sea lane region which is considered the most suitable. This research, use the TOPSIS method to rank priorities.

2.3.2. Research procedure

The steps taken at this stage include:

a. Define and formulate the problem.
b. Conduct literature study.
c. Determine the research design.
d. Processing and presenting information.
e. Analyze and interpret.
f. Results and conclusions.

3. RESULT AND DISCUSSION.

The limited number of ScanEagle UAVs on Intelligence, Surveillance, and Reconnaissance (ISR) tasks at Indonesian Navy bases in the Indonesian archipelagic sea lane region must be covered by UAVs, it is important to know the level of urgency and certain criteria in determining the location, so it is important to optimize . The optimization process is carried out based on the criteria for the ScanEagle UAV Landbase location. Most of the ALKI I area is in the working area of the Fleet Command I (Koarmada I) which consists of several Lantamal and Lanal under it. The ScanEagle UAV is tasked with carrying out location mapping activities in the Fleet I Command (Koarmada I) work area. In this study, to weight the criteria and sub-criteria used the ANP method. The criteria and sub-criteria that have been determined by the author are described as follows:

1. Geographical Location Criteria, Geographical location criteria are used as a basis for consideration of location selection, which includes mountains and land. The sub-criteria of the geographical location criteria are as follows

Table 1. Sub Criteria in Geographical Location Criteria

No	Sub Criteria	Parameter
1	Mountain	Relates to the planned position of the Landbase Unmanned Aerial Vehicles (UAV) location. The UAV will be able to operate properly if the location is not constrained by the presence of mountainous areas which will interfere with the transmission of the data link to the Ground Control Station.
2	Tall Buildings	Relates to the planned position of the Landbase Unmanned Aerial Vehicles (UAV) location. The UAV will be able to operate properly if the location is not constrained by the number of tall buildings that will interfere with the transmission of the data link to the Ground Control Station.
3	Land	Relates to the planned position of the Landbase Unmanned Aerial Vehicles (UAV) location. The UAV will be able to operate properly if the location is in the form of a lowland so as to minimize interference with sending data links to the Ground Control Station

2. Criteria for Weather Conditions Criteria for weather conditions are used as a basis for consideration of location selection, which includes sunny cloudy and rainy. The sub-criteria of the weather conditions criteria are as follows:

Table 2. Sub Criteria in Weather Condition Criteria

No	Sub Criteria	Parameter
1	Sunny cloudy	Cloudy sunny weather at the UAV Landbase location greatly affects flight operations to the maximum
2	Rain	When it rains, it has a big effect on the sensor sensitivity of the UAV

3. Criteria for Vulnerability and Security, Criteria for vulnerability and security are used as the basis for site selection considerations, which include territorial violations, crimes of piracy, smuggling and SAR Rescue. The sub-criteria of the vulnerability and safety criteria are:

Table 3. Vulnerability and Security Sub Criteria

No	Sub Criteria	Parameter
1	Territory violation	With the determination of the location plan that will be used as a UAV Landbase, all area violation activities will be monitored more quickly and action will be carried out faster
2	The crime of piracy	By determining the location plan that will be used as a UAV Landbase, the occurrence of piracy crimes at sea can be anticipated
3	Smuggling	By determining the location plan that will be used as a UAV Landbase, smuggling activities at sea can be anticipated
4	SAR Rescue	By determining the location plan that will be used as the UAV Landbase, it will make it easier to carry out SAR in the event of an accident in the area

4. Criteria for Facilities and Logistics Support, Criteria for Facilities and Logistics Support are used as the basis for site selection considerations, which include Airport, Port, Maintenance, Fuel and Electricity. The sub-criteria of the Facilities and Logistics Support criteria are as follows:

Table 4. Sub Criteria for Facilities and Logistics Support

No	Sub Criteria	Parameter
1	Airport	The area around the Landbase Unmanned Aerial Vehicles (UAV) location must have easy access to spare parts so as to ensure the continuity of the UAV's operation.

2	Harbor	The existence of a port close to the planned location for determining the Landbase Unmanned Aerial Vehicles (UAV) will make UAV delivery easier
3	Parts	The area around the Landbase Unmanned Aerial Vehicles (UAV) location must have easy access to spare parts so as to ensure the continuity of the UAV's operation.
4	Maintenance	The area around the Landbase Unmanned Aerial Vehicles (UAV) location must have the convenience of carrying out repairs so as to ensure the continuity of the UAV's operations.
5	Fuel	The ease of access to get fuel will greatly support the optimal operation of the UAV
6	Electric	The existence of electricity at the Landbase Unmanned Aerial Vehicles location, the operation of the UAV is guaranteed starting from the UAV unit itself, the Ground Control Station and crew personnel from the UAV

The structure of the ANP relationship consists of criteria in which there are sub-criteria and alternatives. The structure of this ANP relationship has a relationship between criteria, sub -criteria and each alternative inner dependence. This ANP linkage structure is a summary of all identifications of all related elements. This linkage structure is used as the basic pattern in entering the linkage pattern using the Super Decisions software

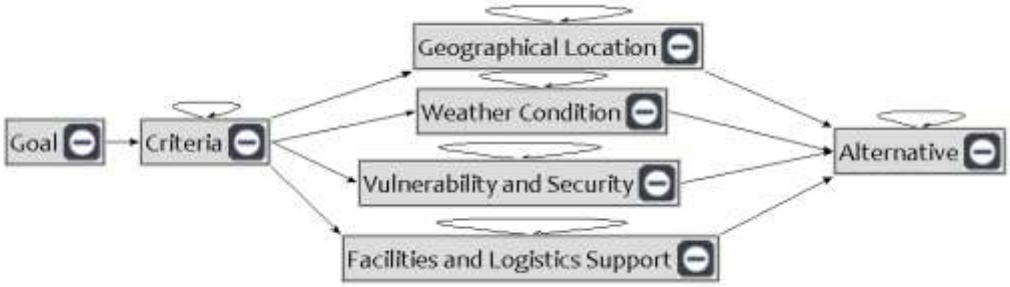

Figure 1. ANP Relationship Structure

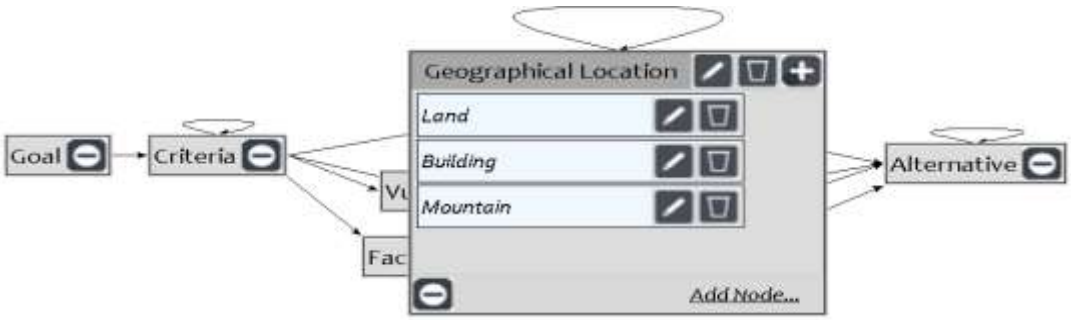

Figure 2. Geographical Location Sub-Criteria

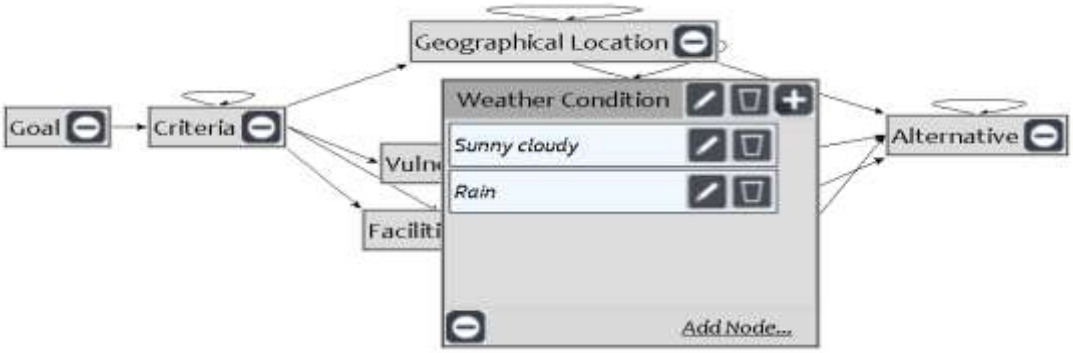

Figure 3. Weather Condition Sub-Criteria

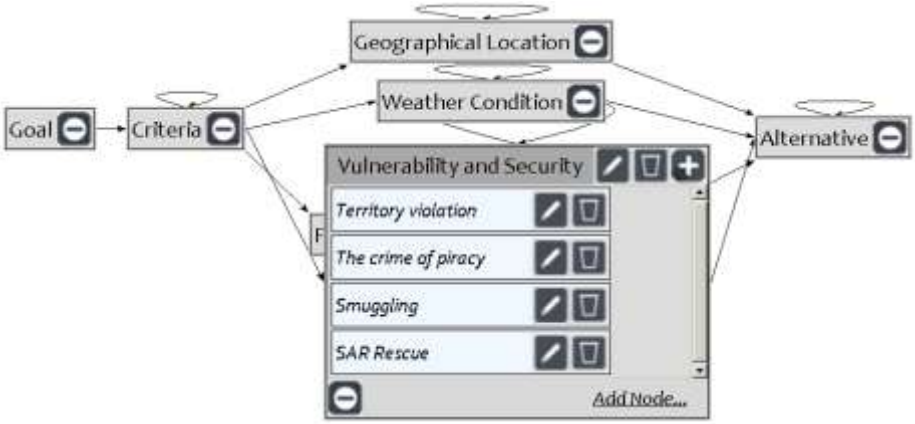

Figure 13. Vulnerability and Security Criteria

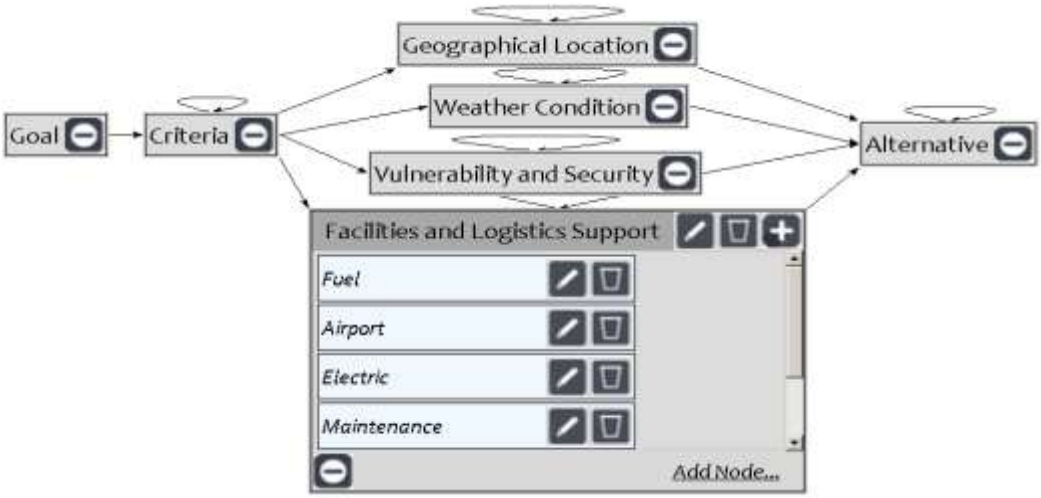

Figure 14. Facilities and Logistical Support Sub-Creteria

The results of the assessment of criteria and sub-criteria that have been carried out by 6 respondents can be summarized in a table that explains the results of weighting criteria and sub-criteria using ANP.

Table 5. Table of Weighting Results Criteria and Sub-criteria Using ANP

Criteria	Weight	Sub criteria	Weight
Geography position	0.494	Mountains	0.359
		Tall building	0.171
		Mainland	0.469
Weather Conditions	0.167	Sunny Cloudy	0.724
		Rain	0.276
Vulnerability and Security	0.105	Territorial violation	0.573
		Piracy Crime	0.220
		Smuggling	0.135
		SAR Rescue	0.072
Logistics Facilities and Support	0.234	Airport	0.395
		Harbor	0.174
		Maintenance	0.167
		Fuel	0.093
		Parts	0.091
		Electricity	0.080

The basic principle of the TOPSIS method is to choose an alternative that has the smallest distance from the positive ideal solution and has the farthest distance from the negative ideal solution. All data are entered into the table of alternative assessment frameworks of landbase UAV locations in ALKI Region I, then combined into one with the weights that have been obtained. Based on the weight of the criteria and sub-criteria, an alternative assessment framework for the location of the Landbase UAV in the ALKI Region I was prepared. The alternative assessment framework for the location of the Landbase UAV in ALKI Region I is as follows:

Table 6. Assessment of Land base Locations of UAV Alternative in Batam

No	Criteria	Weight	Subcriteria	Weight	Score					
					R1	R2	R3	R4	R5	R6
1	Geography position	0.494	Mountains	0,359	2	2	2	2	2	3
			Tall building	0,171	2	2	2	2	2	2
			Mainland	0,469	4	3	4	4	3	1
2	Weather Conditions	0.167	Sunny Cloudy	0,724	3	3	3	4	4	2
			Rain	0,276	3	3	3	3	2	3
3	Vulnerability and Security	0.105	Territorial violation	0,573	3	3	3	3	4	4
			Piracy Crime	0,220	3	3	3	3	2	3
			Smuggling	0,135	4	3	3	4	2	3
			SAR Rescue	0,072	3	3	3	3	4	3
4	Logistics Facilities and Support	0.234	Airport	0,395	4	3	3	3	2	3
			Harbor	0,174	4	3	3	3	2	3
			Maintenance	0,167	4	2	2	2	3	2
			Fuel	0,093	4	2	2	2	2	2
			Parts	0,091	3	2	2	2	3	3
			Electricity	0,080	3	2	3	3	2	2

The assessment results from experts are calculated using the geometric mean equation to obtain one value in the assessment of alternative UAV Landbase locations in ALKI Region I which will be included in the decision matrix, shown in Table 3.

Table 7. Assessment of UAV Landbase Locations Alternative

No	Criteria	Weight	Subcriteria	Geo mean score			
				BATAM	RANAI	TAREMPA	KARIMUN
1	Geography position	0.494	Mountains	2.14	2.376	2.402	2.798
			Tall building	2	3.141	2.798	2.798
			Mainland	2.884	2.884	1.906	2.33
2	Weather Conditions	0.167	Sunny Cloudy	3.086	3.175	2.621	2.854
			Rain	2.804	2.621	2.14	2.33
3	Vulnerability and Security	0.105	Territorial violation	3.302	2.33	3.295	2.376
			Piracy Crime	2.804	2	3.295	2.493
			Smuggling	3.086	2	3.295	2.493
			SAR Rescue	3.147	2.942	2.798	2.221
4			Airport	2.942	2.696	2.182	2.376

	Logistics Facilities and Support	0.234	Harbor	2.942	2.994	2.14	2.33
			Maintenance	2.402	2.221	2.493	1.979
			Fuel	2.245	2.402	1.906	2.076
			Parts	2.449	2.942	2.182	1.648
			Electricity	2.449	2.449	1.414	1.849

Table 8. TOPSIS normalization results

Subcriteria	ALTERNATIVE				
	Weight	Batam	Ranai	Tarempa	Balai karimun
Mountains	0.36	0.44	0.49	0.49	0.57
Tall building	0.17	0.37	0.58	0.51	0.51
Mainland	0.47	0.56	0.56	0.37	0.46
Sunny Cloudy	0.72	0.52	0.53	0.44	0.48
Rain	0.28	0.56	0.52	0.43	0.47
Territorial violation	0.57	0.57	0.40	0.57	0.41
Piracy Crime	0.22	0.52	0.37	0.61	0.46
Smuggling	0.14	0.56	0.36	0.59	0.45
SAR Rescue	0.07	0.56	0.53	0.50	0.40
Airport	0.38	0.57	0.52	0.42	0.46
Harbor	0.25	0.56	0.57	0.41	0.44
Maintenance	0.15	0.52	0.48	0.54	0.43
Fuel	0.07	0.52	0.55	0.44	0.48
Parts	0.08	0.52	0.62	0.46	0.35
Electricity	0.07	0.59	0.59	0.34	0.44

Topsis-weighted normalization is shown in Table 5

Table 9. Weighted results of standardization

SubCriteria	ALTERNATIVE				
	Bobot	Batam	Ranai	Tarempa	Balai karimun
Mountains	0.36	0.158	0.069	0.030	0.013
Tall building	0.17	0.063	0.023	0.008	0.003
Mainland	0.47	0.265	0.149	0.084	0.047
Sunny Cloudy	0.72	0.376	0.195	0.101	0.053
Rain	0.28	0.155	0.087	0.049	0.027
Territorial violation	0.57	0.327	0.187	0.107	0.061
Piracy Crime	0.22	0.114	0.059	0.031	0.016
Smuggling	0.14	0.075	0.042	0.023	0.013
SAR Rescue	0.07	0.041	0.023	0.013	0.007
Airport	0.38	0.215	0.122	0.070	0.040
Harbor	0.25	0.139	0.077	0.043	0.024
Maintenance	0.15	0.081	0.042	0.022	0.012
Fuel	0.07	0.035	0.018	0.009	0.005
Parts	0.08	0.043	0.022	0.012	0.006
Electricity	0.07	0.040	0.024	0.014	0.008

Positive ideal solutions and negative ideal solutions are shown in Tables 6 and 7.

Table 10. Matrix Positive Ideal Solution

Positive ideal solution	
Mountains	0.158
Tall building	0.063
Mainland	0.265
Sunny Cloudy	0.376
Rain	0.155
Territorial violation	0.327
Piracy Crime	0.114
Smuggling	0.075
SAR Rescue	0.041
Airport	0.215
Harbor	0.139
Maintenance	0.081
Fuel	0.035
Parts	0.043
Electricity	0.04

Table 11. Matris Of Negative Ideal Solutions

Negative ideal solution	
Mountains	0.0129
Tall building	0.0031
Mainland	0.0474
Sunny Cloudy	0.0526
Rain	0.0273
Territorial violation	0.061
Piracy Crime	0.016
Smuggling	0.013
SAR Rescue	0.0072
Airport	0.0396
Harbor	0.024
Maintenance	0.0116
Fuel	0.0049
Parts	0.0061
Electricity	0.0081

The distance values of the positive and negative ideal solutions are shown in Table 8. The preference value of each alternative that shows the weight value of each alternative.

Table 12. Alternative Distances To Positive Ideal Solutions And Negative Ideal Solutions

Alternative	Positive	Negative	Preferences
Batam	0.000	0.574	1.000
Ranai	0.315	0.260	0.453
Tarempa	0.483	0.092	0.159
Balai karimun	0.574	0.000	0.000

4. CONCLUSION

From the results of the analysis and discussion, the following conclusions can be drawn:

a. The criteria and sub-criteria in determining the location of Landbase Unmanned Aerial Vehicles (UAVs) in the ALKI I Region consist of 4 (four) criteria, namely Geographical Location, Weather Conditions, Vulnerability and Security as well as Logistics Facilities and Support, and 15 (fifteen) sub-criteria, namely: mountains, high-rise buildings, plains, sunny clouds, rain, regional violations, piracy crimes, smuggling, SAR, airports, ports, spare parts, maintenance, fuel and electricity.

b. From data processing with ANP (Analitic Network Process) can be determined the value of comparison in pairs in determining the weight of criteria and sub-criteria from the questionnaire of experts / exspert, where the assessment of expert respoden will be unified using the formulation of the Geometric mean. From the results of data processing, the results of weighting criteria were obtained, namely Geographic Location 0.494, Weather Conditions 0.167, Insecurity and Security 0.105 and Facilities and Logistics Support 0.234. The results of the weighting of the sub-criteria obtained results, namely Mountains 0.359, Tall Buildings 0.171, Land 0.469, Sunny Cloudy 0.724, Rain 0.276, Area violations 0.573, Crime of Piracy 0.220, Smuggling 0.135, SAR Rescue 0.072, Airport 0.377, Port 0.249, Maintenance 0.154, Fuel 0.068, Spare Parts 0.083 and Electricity 0.069

c. From the results of processing alternative priority data, determining the location of Landbase Unmanned Aerial Vehicles (UAV) in the ALKI I Region with the results of the ranking of the first rank with the largest weight value is Lanal Batam 1,000 then in order the priority alternative second rank Lanal Ranai 0.453 followed by the third rank is Lanal Tarempa 0.159 and as the last priority of the four existing alternatives is Lanal Balai Karimun 0.000.

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