Determining the location of rubber plantation locations in Merauke district based on AHP Topsis

N Patawaran¹, T A Darsono¹, I Wayangkau¹ and Saiful Mangngenre²

¹Department of Information Engineering Faculty of Engineering, Universitas Musamus, Merauke, Indonesia
²Department of Industrial Engineering, Faculty of Engineering, Universitas Hasanuddin, Makassar, Indonesia

E-mail: nilfred@unmus.ac.id

Abstract. AHP TOPSIS is a decision support method to find the closest alternative by showing the value of the ideal positive alternative solution and negative ideal solution to get the best alternative, where the AHP method is used to give the weight value of the criteria and TOPSIS to get the ranking from each alternative. This study conducted the best alternative selection using the application of the AHP method integrated with TOPSIS to assess eight criteria and six alternatives in determining the ideal location of rubber plantations in Merauke Regency. The results provide recommendations to the relevant Dinas and developers to choose the ideal location and invest in the rubber plantation business.

1. Introduction
Rubber is an important ingredient as a significant strategic reserve in the economic and political fields, this is due to the increasing demand for global economic conditions for rubber production so that rubber plantation expansion is still very much needed [1]. The choice of a rubber plantation location has the influence and social benefits to expand the rubber plantation community. Determining the right location is very important to achieve optimal land productivity and to ensure the growth of sustainable rubber land so that it requires effective information in decision making [2].

The decision support system is a computer-based system that is intended to assist in decision making using data and certain models to solve problems that are semi-structured [3]. At present the use of decision support systems has been used in various fields, namely: in the field of determination of conformity [4], optimization [1], search for a location [5,6] and forecasting [7].

AHP is a decision support method that describes complex multi-criteria problems into a hierarchy to calculate the weight of each criterion and to measure the ranking of each proposed alternative [8,9]. TOPSIS is defined as a description of a complex problem to find the closest alternative to the positive ideal solution value and the farthest from the negative ideal solution value as an optimal choice, but its application requires input criteria data to calculate the weighting criteria used in TOPSIS [10]. The advantage of the AHP TOPSIS method is that it can solve complex and unstructured problems, the measurement scale used considers logical consistency in the assessment to determine priorities.

Research related to the AHP TOPSIS method such as the application of security assessments in the communication network control system [11]. Evaluating urban intersection traffic jams [12]. Decision-making techniques for ICT infrastructure project portfolios [13]. Decision making for route selection of
the monorail transportation system in Angkara [14]. AHP method is integrated with TOPSIS in a foreign trade company in Turkey for the selection of Content Management System (CMS) information technology projects[15].

The research conducted has differences with previous studies. The difference lies in the object in the study is the suitability of the location of the rubber plantation, other differences exist in the analysis process designed and the output of the system. This study uses 8 criteria, namely rainfall, altitude, soil type, sunlight, slope, soil pH, temperature and relative humidity, to provide information on calculations and ranking of each criterion and alternative locations that can be recommended. Based on the above problems, a decision support system is needed based on the AHP TOPSIS method that can provide information in the form of a dashboard in the form of an alternative location suitable for rubber plantations. It is hoped that it can be used as a material consideration for decision making for the government and rubber plantation developers in Merauke Regency.

2. Methods

2.1. Research materials

The research materials used in this research process are data relating to the determination of the ideal location of rubber plantations, data got through an interview process with experts from the Merauke Regency Forestry and Plantation Service to determine the criteria used. While for determining the value of each criterion using a questionnaire, then analyzed through an information system. The criteria used are shown in table 1.

| Criteria       | Description |
|---------------|-------------|
| Rainfall      | C1          |
| Height        | C2          |
| Type of soil  | C3          |
| Sunlight      | C4          |
| Slope         | C5          |
| Soil pH       | C6          |
| Temperature   | C7          |
| Relative humidity | C8   |

2.2. Research tools

In building this system hardware is needed with the specifications of the Acer Aspireone D255 Notebook (Atomic IntelR TMN550 Processor, 1.5GHz, 320GB Hard Drive, 2GB Memory) and software namely the PHP Program language and MySQL database.

2.3. Research procedure

In this study, there are steps in the research procedure which are arranged in a research framework through stages, as in figure 1.
The data collection:
(Rainfall, Height, Type of soil, Sunlight, Slope, Soil pH, 
Temperature and Relative humidity)

Figure 1. Research procedure

The proposed research model comprises the following stages:

2.3.1. Data collection. Research data collection is looking for field data that will answer research problems. Data collection is done by observing, interviewing and studying literature related to data collection research from the Merauke Regency Forestry and Plantation Service.

2.3.2. Processing data. Processing the data in this study using the AHP and TOPSIS analysis method as a parameter for determining the suitability of suitable locations in the selection of rubber plantations.

The stages of the AHP TOPSIS method in this study are:
1) Criteria data. Criteria data comprises 8 criteria, namely: rainfall, altitude, soil type, sunlight, slope, soil pH, temperature and relative humidity.
2) Alternative data. Alternative data comprises 6 alternatives, namely: Tanah Miring District, Sota District, Ullin District, Muting District, Elikobel District and Jagebob District.
3) Matrix weight data. Weight matrix data is used to determine the level of importance for the developer of each criterion.
4) Paired matrix data between criteria. Paired matrix data between each criterion is used to determine the priority weights of the criteria.
5) Decision matrix data. Decision matrix data is used to determine the relationship between alternatives and criteria.
6) Criteria weighting data.

Data weighting criteria are used in the TOPSIS process resulting from calculations in AHP. The process carried out in the analysis comprises two processes, namely the analysis process and calculation process to find the best alternative using AHP and TOPSIS methods, AHP is used to calculate the criteria weight and then TOPSIS is used to calculate and rank each alternative to determine the best solution.

2.3.3. Alternative results. The alternative results of the suitability of the location suitable for rubber plantations are in the form of visualization images and the results of the analysis of the assessment of the suitable location suitable for rubber plantations in the form of dashboards.

2.3.4. Implementation. At this stage is the process of making a decision support system application based on AHP TOPSIS to determine the ideal location of rubber plantations.

2.3.5. System testing. At this stage the system testing process is carried out by assessing the system designed as expected.

2.3.6. The system framework proposed in this study is shown in Figure 2. System Framework

| Input | Process | Output |
|-------|---------|--------|
| Criteria Data  
  • Rainfall  
  • Altitude  
  • Type of soil  
  • Sunlight  
  • Slope  
  • Soil pH  
  • Temperature  
  • Relative humidity  
| Database | Analysis method with AHP TOPSIS | Visualization of the results of the analysis |
| Alternative Data  
  • Location | DASHBOARD Alternative suitability of a location suitable for rubber plantations |

Figure 2. System Framework

In this study, there are 2 input data, namely criteria and alternative data. Criteria data comprise rainfall data, altitude, soil type, sunlight, slope, soil pH, temperature, and relative humidity while Alternative data is in the form of information on the area to be used as a basis for assessing the location of suitable rubber plantations.
In this study, which is part of the process of the system framework, namely the process of storing criteria data and alternative data and the process of analyzing alternative assessments of the suitability of locations suitable for rubber plantations using the AHP TOPSIS method. The output of this research is in the form of visualization and the results of the analysis of the assessment of the suitable location suitable for rubber plantations in the form of dashboards that can be used as a basis for decision making for rubber plantation developers.

2.4. Data flow diagram
Data Flow Diagrams (DFD) are one of the important model tools or modeling tools and are used to describe the flow of data in a new system, the source and destination of data, the process that processes the data and also stores data.

a. Data flow diagram level 0 describes the overall system along with the flow of data input, assessors and ranking in the decision support system to determine the ideal location of rubber plantations shown in Figure 3.

![Data flow diagram level 0](image)

**Figure 3.** Data flow diagram level 0

3. Results and discussion
3.1. Result
The results of this study are a program display that provides information about determining the ideal location of rubber plantations by applying the AHP TOPSIS method, so that an alternative location for rubber plantations can be got. The results of AHP data processing are the criteria weights that will carry out the TOPSIS process, by comparing criteria one with other criteria namely rainfall, altitude, soil type, sunlight, slope, soil pH, temperature, and relative humidity.
The data processing process starts with making a list of criteria and alternatives proposed then made in the form of a questionnaire and given to experts or experts to fill the assessment by choosing the level of importance. Weighting the pair-wise comparison matrix results in normalization values and each column and eigenvalues of each row average value to calculate the consistency of the test results of the weight values that will be used for the TOPSIS process.

3.2. Processing of AHP Method

Data processing using the AHP method includes hierarchy preparation, weighting criteria, pair-wise comparison matrices, and normalized weight matrices as weights in TOPSIS.

3.2.1. Hierarchical Structure. Compilation of hierarchies comprises 3 levels, namely: objectives, criteria, and alternatives. The objectives in this study were to determine the ideal location of rubber plantations, and the criteria used were: rainfall, altitude, soil type, sunlight, slope, soil pH, temperature and relative humidity, and alternatives used were the locations of the districts which is the ideal location for rubber plantations. The hierarchical structure of determining the ideal location of rubber plantations can be seen in figure 4.

![Hierarchical Structure](image)

Figure 4. The hierarchical structure of determining the ideal location of rubber plantations

3.2.2. Pairing Comparison Matrix. Comparisons are paired using a scale of 1 to 9 and filled by experts by assessing each criterion using an interest level questionnaire which the admin fills into a pair-wise comparison matrix, where each one criterion is compared with the other seven criteria. For example, comparing rainfall criteria with the other seven criteria, namely altitude, soil type, sunlight, slope, soil pH, temperature, relative humidity and so on other criteria compared. The results of the pair-wise comparison matrix can be seen in table 2.

|       | C1  | C2  | C3  | C4  | C5  | C6  | C7  | C8  |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| C1    | 1   | 1/3 | 1/5 | 1/3 | 1   | 1/5 | 1/3 | 3   |
| C2    | 3   | 1   | 1/3 | 3   | 1   | 1/3 | 1   | 5   |
| C3    | 5   | 3   | 1   | 5   | 3   | 1   | 3   | 5   |
| C4    | 3   | 1/3 | 1/5 | 1   | 1/3 | 1/5 | 1/3 | 3   |
| C5    | 1   | 1   | 1/3 | 1   | 1/3 | 1   | 3   | 5   |
| C6    | 5   | 3   | 1   | 5   | 3   | 1   | 3   | 5   |
| C7    | 3   | 1   | 1/3 | 3   | 1/3 | 1   | 1/3 | 3   |
| C8    | 1/3 | 1/5 | 1/5 | 1/5 | 1/5 | 1/3 | 1/3 | 1   |
3.2.3. Weighted Normalization Matrix

The weighted normalization matrix table results from the weight got by the number of rows divided by the value of each criterion. Then proceed by calculating the criteria, $\lambda_{\text{maks}}$, CI, and CR weights shown in Table 3.

**Table 3. Weighted normalization matrix**

|   | C1  | C2  | C3  | C4  | C5  | C6  | C7  | C8  | Number of Rows | Weight Value |
|---|-----|-----|-----|-----|-----|-----|-----|-----|---------------|--------------|
| C1 | 0.0469 | 0.0338 | 0.0556 | 0.0161 | 0.0938 | 0.0556 | 0.0333 | 0.1071 | 0.4421 | 0.0553 |
| C2 | 0.1406 | 0.1014 | 0.0926 | 0.1452 | 0.0938 | 0.0926 | 0.1000 | 0.1786 | 0.9446 | 0.1181 |
| C3 | 0.2344 | 0.3041 | 0.2778 | 0.2419 | 0.2813 | 0.2778 | 0.3000 | 0.1786 | 2.0957 | 0.262 |
| C4 | 0.1406 | 0.0338 | 0.0556 | 0.0484 | 0.0313 | 0.0556 | 0.0333 | 0.1071 | 0.5056 | 0.0632 |
| C5 | 0.0469 | 0.1014 | 0.0926 | 0.1452 | 0.0938 | 0.0926 | 0.1000 | 0.1786 | 0.7795 | 0.0974 |
| C6 | 0.2344 | 0.3041 | 0.2778 | 0.2419 | 0.2813 | 0.2778 | 0.3000 | 0.1786 | 2.0957 | 0.262 |
| C7 | 0.1406 | 0.1014 | 0.0926 | 0.1452 | 0.0938 | 0.0926 | 0.1000 | 0.1786 | 0.8732 | 0.1092 |
| C8 | 0.0156 | 0.0203 | 0.0556 | 0.0161 | 0.0313 | 0.0556 | 0.0333 | 0.0357 | 0.2634 | 0.0329 |

$\lambda_{\text{maks}} = (8.1983 + 8.6328 + 8.6076 + 8.5563 + 8.6518 + 8.6076 + 8.7356 + 8.1898) : 8$

$= 68.1801 : 8$

$= 8.5225$

$C_t = \frac{\lambda_{\text{maks}} - n}{n - 1} = \frac{8.5225 - 8}{8 - 1} = 0.0746$

$C_R = \frac{C_t}{I_R} = \frac{0.0746}{1.41} = 0.0529$

With several 8 criteria and $I_R$ values (Index Ratio) 1.41.

So that the value of 0.0529 is got, this shows that the value of the weight is consistent.

3.3. Results of processing the TOPSIS method

Processing data using the TOPSIS method is an advanced stage carried out after the weighting process on the AHP, the process carried out on TOPSIS includes: creating a TOPSIS matrix, normalizing the matrix, normalizing weighted matrices, determining positive ideal solutions and negative ideal solutions, calculating alternative distances with ideal solutions positive and negative ideal solutions, and calculate the preference value of each alternative.

3.3.1. TOPSIS matrix. The TOPSIS matrix uses a scale of 1 to 5 where each alternative in the table is filled by experts by giving an assessment of each alternative ideal location for rubber plantations can be seen in Table 4.

**Table 4. TOPSIS matrix**

|               | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 |
|---------------|----|----|----|----|----|----|----|----|
| Tanah Miring District | 5  | 5  | 5  | 4  | 4  | 5  | 5  | 4  |
| Jagebob District   | 4  | 5  | 4  | 4  | 4  | 5  | 4  | 4  |
| Sota District      | 5  | 4  | 5  | 5  | 5  | 5  | 5  | 3  |
| Muting District    | 4  | 4  | 5  | 4  | 5  | 5  | 4  | 3  |
| Elikobe District   | 5  | 5  | 5  | 5  | 4  | 5  | 5  | 5  |
| Ulilin District    | 5  | 5  | 4  | 5  | 5  | 5  | 4  | 4  |
3.3.2. **Normalization of Matrices.** Fill in the value in the matrix normalization table can be calculated using equation 3. The first step that must be done is to do the TOPSIS matrix squaring can be seen in table 5.

| Table 5. Calculating the TOPSIS matrix |
|--------------------------------------|
| C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 |
|---|---|---|---|---|---|---|---|
| Tanah Miring District | 25 | 25 | 25 | 16 | 16 | 25 | 25 | 16 |
| Jagebob District | 16 | 25 | 16 | 16 | 16 | 25 | 16 | 16 |
| Sota District | 25 | 16 | 25 | 25 | 25 | 25 | 9  |
| Muting District | 16 | 16 | 25 | 16 | 25 | 25 | 16 | 9  |
| Elikobe District | 25 | 25 | 25 | 25 | 25 | 16 | 16 | 16 |
| Ulilin District | 25 | 25 | 16 | 25 | 25 | 16 | 16 | 16 |
| Total | 132 | 132 | 132 | 123 | 132 | 141 | 123 | 91 |

The next stage that must be carried out for the process to normalize the matrix from the results of squaring can be seen in table 6.

| Table 6. Matrix normalization |
|-------------------------------|
| C1   | C2   | C3   | C4   | C5   | C6   | C7   | C8   |
|------|------|------|------|------|------|------|------|
| Tanah Miring District         | 0.4352 | 0.4352 | 0.4352 | 0.3607 | 0.4382 | 0.4211 | 0.4508 | 0.4193 |
| Jagebob District              | 0.4382 | 0.4382 | 0.4382 | 0.3607 | 0.4382 | 0.4211 | 0.4508 | 0.4193 |
| Sota District                 | 0.4352 | 0.4382 | 0.4352 | 0.4508 | 0.4352 | 0.4211 | 0.4508 | 0.3145 |
| Muting District               | 0.4352 | 0.4382 | 0.4352 | 0.3607 | 0.4352 | 0.4211 | 0.3607 | 0.3145 |
| Elikobe District              | 0.4352 | 0.4352 | 0.4352 | 0.4508 | 0.4352 | 0.3369 | 0.4508 | 0.5241 |
| Ulilin District               | 0.4352 | 0.4352 | 0.4382 | 0.4508 | 0.4352 | 0.4211 | 0.3607 | 0.4193 |

3.3.3. **Weighted matrix normalization.** Normalization of the weighted decision matrix is calculated in the AHP process resulting from the weighting of the criteria as in table 7.

| Table 7. Weight criteria |
|--------------------------|
| No. | criteria | weight |
|-----|----------|--------|
| 1   | C1       | 0.0553 |
| 2   | C2       | 0.1181 |
| 3   | C3       | 0.262  |
| 4   | C4       | 0.0632 |
| 5   | C5       | 0.0974 |
| 6   | C6       | 0.262  |
| 7   | C7       | 0.1092 |
| 8   | C8       | 0.0329 |

The element of a weighted normalized matrix is the product of the multiplication of the criteria weight in AHP with the element r_ij in equation 3. The table normalization of the matrix can be seen in table 8.
Table 8. Normalization of weighted matrices

| Location          | C1   | C2   | C3   | C4   | C5   | C6   | C7   | C8   |
|-------------------|------|------|------|------|------|------|------|------|
| Tanah Miring District | 0.0241 | 0.0514 | 0.1140 | 0.0228 | 0.0339 | 0.1103 | 0.0492 | 0.0138 |
| Jagebob District   | 0.0192 | 0.0514 | 0.0912 | 0.0228 | 0.0339 | 0.1103 | 0.0492 | 0.0104 |
| Sota District      | 0.0241 | 0.0411 | 0.1140 | 0.0285 | 0.0424 | 0.1103 | 0.0492 | 0.0104 |
| Muting District    | 0.0192 | 0.0411 | 0.1140 | 0.0228 | 0.0424 | 0.1103 | 0.0394 | 0.0104 |
| Elikobe District   | 0.0241 | 0.0514 | 0.1140 | 0.0285 | 0.0424 | 0.0882 | 0.0492 | 0.0173 |
| Ulilin District    | 0.0241 | 0.0514 | 0.0912 | 0.0285 | 0.0424 | 0.1103 | 0.0394 | 0.0138 |

3.3.4. Determining Ideal Positive Solutions and Ideal Negative Solutions. Stages to determine the ideal positive solution (+) and the ideal negative (-) solution can be determined based on the weighted normalization matrix. The elements of the A* matrix in the table below are the maximum values of each column in the weighted matrix normalization table, while the elements of the A matrix in the table below are the minimum values of each column in the table of positive (+) ideal solutions and ideal solutions negative (-) based on formula 5 can be seen in table 12.

Table 9. Determine positive ideal solutions and negative ideal solutions

|          | C1   | C2   | C3   | C4   | C5   | C6   | C7   | C8   |
|----------|------|------|------|------|------|------|------|------|
| Ideal positif | 0.0241 | 0.0514 | 0.1140 | 0.0285 | 0.0424 | 0.1103 | 0.0492 | 0.0173 |
| Ideal negatif | 0.0192 | 0.0411 | 0.0912 | 0.0228 | 0.0339 | 0.0882 | 0.0394 | 0.0104 |

3.3.5. Determining the Distance of Alternatives with Ideal Positive and Ideal Negative Solutions. At this stage the distance determined is not only the closest distance, but the farthest distance can be calculated, so this step to determine the distance of each alternative to the positive ideal solution and the distance of each alternative to the negative ideal solution can be seen in table 13. Distance is alternative Ai with positive ideal solutions and with negative ideal solutions planned in equation 6.

Table 10. Calculate alternative distances with positive ideal solutions and negative ideal solutions.

| Location           | Positive Distance | Negative Distance |
|--------------------|-------------------|-------------------|
| Tanah Miring District | 0.0108            | 0.0353            |
| Jagebob District    | 0.0275            | 0.0246            |
| Sota District       | 0.0124            | 0.0351            |
| Muting District     | 0.0175            | 0.0328            |
| Elikobe District    | 0.0221            | 0.0300            |
| Ulilin District     | 0.0251            | 0.0271            |

3.3.6. Calculating Each Alternative Preference Value. This stage is the final stage to determine the TOPSIS ranking or known by calculating the preference value for each alternative. The preference value for each alternative (Vi) is the relative proximity of each alternative calculated based on the equation. 7. A larger Vi value shows that the Ai alternative is precisely selected can be seen in table 13.
### Table 1. Preference values

| Location       | Reference Value | Ranking |
|----------------|-----------------|---------|
| Tanah Miring District | 0.7658          | 1       |
| Sota District   | 0.7392          | 2       |
| Muting District | 0.6525          | 3       |
| Elikobe District | 0.5759         | 4       |
| Ulilin District | 0.5190          | 5       |
| Jagebob District | 0.4720          | 6       |

Based on the results of the discussion above, it can be seen that alternative priorities for determining the ideal location of rubber plantations, then compared with the results of implementing the system above, from the weighting for each criterion by each assessor calculated using the AHP method, until alternative priority calculations are calculated using the TOPSIS method. Each assessment of criteria and each alternative assessment will influence the results of determining the location of rubber plantations.

Tanah Miring District with a value of 0.7658 is the best alternative priority on the location of rubber plantations later, Sota District with a value of 0.7392 is the second best alternative priority, Muting District with a value of 0.6525 is the third best alternative priority, Elikobe District with a value of 0.5759 is the fourth best alternative priority, Ulilin District with a value of 0.5190 is the fifth best alternative priority, and Jagebob District with a value of 0.4720 is the last alternative priority.

This indicates that Tanah Miring District is the main priority in determining the ideal location of rubber plantations and Jagebob District as the final priority assessment. The results of ranking the determination of the location of this rubber plantation can be used as a reference, where the information can be used as a recommendation to the relevant Office to determine the ideal location of rubber plantations and for developers who want to invest in the rubber plantation business.

#### 3.3.7. System Validation

The results of the system validation test include the results of manual calculation using Microsoft Excel and the results of system calculations and field data and results in a system. The calculation results are valid if the manual calculation is the same as the system calculation. From the results of manual calculation and testing of information, systems show that the system designed is under the system of determining the ideal location. So that it can be seen that the application of the AHP-TOPSIS method can be used to determine the ideal location of rubber plantations well, quickly and easily.

### Table 12. System validation

| No | District    | Reference Value | Ranking | Reference Value | Ranking |
|----|-------------|-----------------|---------|-----------------|---------|
| 1  | Tanah Miring| 0.7658          | 1       | 0.7658          | 1       |
| 2  | Sota        | 0.7392          | 2       | 0.7392          | 2       |
| 3  | Muting      | 0.6525          | 3       | 0.6525          | 3       |
| 4  | Elikobe     | 0.5759          | 4       | 0.5759          | 4       |
| 5  | Ulilin      | 0.5190          | 5       | 0.5190          | 5       |
| 6  | Jagebob     | 0.4720          | 6       | 0.4720          | 6       |

The results of system testing show that of the 6 alternative rubber plantation locations tested by the system, all ranking sequences in manual calculations have the same ranking sequence as the system calculation. From the results of manual calculation and testing of information, systems show that the system designed is under the system of determining the ideal location. So that it can be seen that the application of the AHP-TOPSIS method can be used to determine the ideal location of rubber plantations well, quickly and easily.
The next step is to test field data and system results. From the results of testing field data and results in a system different results were got. Field data and system results can be shown in table 1.

| No. | District       | size (km) | Production (ton) | Productivity (ton/ha) | Rangking | Reference Value | Rangking |
|-----|----------------|-----------|------------------|-----------------------|----------|-----------------|----------|
| 1   | Tanah Miring   | 112       | 38.89            | 0.3472                | 1        | 0.7658          | 1        |
| 2   | Sota           | 213       | 49.31            | 0.2268                | 2        | 0.7392          | 2        |
| 3   | Muting         | 960       | 37.18            | 0.0387                | 3        | 0.6525          | 3        |
| 4   | Elikobe        | 849       | 23.04            | 0.0271                | 4        | 0.5759          | 4        |
| 5   | Ulilin         | 835       | 30.04            | 0.0359                | 5        | 0.5190          | 5        |
| 6   | Jagebob        | 637       | 5.76             | 0.009                 | 6        | 0.4720          | 6        |

From the comparison of the results of the rooting data and the results of the system, it shows that of the 6 alternative rubber plantation locations there are differences in ranking results. The difference from the results of ranking in the field shows that the Elikobel District is ranked fourth and the Muting District is ranked five while the results of ranking systemically show that the Muting District is ranked fourth and the Elikobel District is rated five. This shows that the weight assessment using the AHP TOPSIS method of each criterion influences the results of ranking alternative locations to be determined as the ideal location of rubber plantations so that in the results of ranking alternative locations there are several differences between field data and system results.

From the comparison of the results of the rooting data and the results of the system, it shows that of the 6 alternative rubber plantation locations there are differences in ranking results. The difference from the results of ranking in the field shows that the Ulilin District is ranked fourth and the Elikobel District is ranked five while the results of the ranking system show that the Elikobel District is ranked fourth and the Ulilin District is rated five. This shows that the weight assessment using the AHP TOPSIS method of each criterion influences the results of ranking alternative locations to be determined as the ideal location of rubber plantations so that in the results of ranking alternative locations there are several differences between field data and system results.

4. Conclusion
The conclusion got from this study is that the application of the AHP method is integrated with the TOPSIS method for determining the ideal location of rubber plantations. AHP gives criteria weights and TOPSIS is used to give a ranking of each alternative. From the proposed method, criteria and alternatives are tested to represent complete information.
1) The results show that of the six alternative locations, Tanah Oblique District is the best location with a weight value of 0.7658 and Sota District with a value of 0.7392. This shows that the Tanah Miring District and Sota District are the most important priorities in determining the ideal location of rubber plantations in Merauke Regency.
2) The system created by applying the AHP TOPSIS method can be used as a recommendation to the relevant Dinas to be able to determine the ideal location of rubber plantations and for developers who want to invest in the rubber plantation business.
3) An assessment of the criteria weight can affect the ranking results of each alternative to determine the location of rubber plantations.
References

[1] Demesouka O E, Vavatsikos A P and Anagnostopoulos K P 2013 Suitability analysis for siting MSW landfills and its multicriteria spatial decision support system: method, implementation and case study Waste Manag. 33 1190–206

[2] Li H, Aide T M, Ma Y, Liu W and Cao M 2006 Demand for rubber is causing the loss of high diversity rain forest in SW China Plant Conservation and Biodiversity (Springer) pp 157–71

[3] Turban E, Aronson and Jay E. 2001 Decision Support Systems and Intelligent Systems. 6th edition (new Jersey: Prentice Hall: Upper Saddle River)

[4] Zabihi H, Ahmad A, Vogeler I, Said M N, Golmohammadi M, Golein B and Nilashi M 2015 Land suitability procedure for sustainable citrus planning using the application of the analytical network process approach and GIS Comput. Electron. Agric. 117 114–26

[5] Vatalis K and Manoliadis O 2002 A two-level multicriteria DSS for landfill site selection using GIS: case study in western Macedonia, Greece J. Geogr. Inf. Decis. Anal. 6 49–56

[6] Nas B, Cay T, Iscan F and Berktay A 2010 Selection of MSW landfill site for Konya, Turkey using GIS and multi-criteria evaluation Environ. Monit. Assess. 160 491

[7] FIATI R 2009 Sistem pendukung keputusan peramalan penjualan barang:: Studi kasus peramalan penjualan barang dan pemilihan daerah pemasaran pada TB. Andi Star Yogyakarta

[8] Saaty T L 1990 Decision making for leaders: the analytic hierarchy process for decisions in a complex world (RWS publications)

[9] Dirpan A 2018 Combining an Analytic Hierarchy Process and TOPSIS for Selecting Postharvest Technology Method for Selayar Citrus in Indonesia IOP Conf. Ser. Earth Environ. Sci. 156 12031

[10] Kusumadewi S, Hartati S, Harjoko A and Wardoyo R 2006 Fuzzy Multi-Attribute Decision Making (Fuzzy MADM) Yogyakarta Graha Ilmu 78–9

[11] Liu N, Zhang J, Zhang H and Liu W 2010 Security assessment for communication networks of power control systems using attack graph and MCDM IEEE Trans. Power Deliv. 25 1492–500

[12] Yu J, Wang L and Gong X 2013 Study on the status evaluation of urban road intersections traffic congestion base on AHP-TOPSIS modal Procedia-Social Behav. Sci. 96 609–16

[13] Angelou G N and Economides A A 2008 A decision analysis framework for prioritizing a portfolio of ICT infrastructure projects IEEE Trans. Eng. Manag. 55 479–95

[14] Hamurcu M and Eren T 2016 A multicriteria decision-making for monorail route selection in Ankara Int. J. Ind. Electron. Electr. Eng. 4 121–5

[15] Oztaysi B 2014 A decision model for information technology selection using AHP integrated TOPSIS-Grey: The case of content management systems Knowledge-Based Syst. 70 44–54