The Suitability of Seaweed Cultivation with Geographic Information Systems on Lembeh Island

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Abstract. The purpose of this study is to find the suitability of seaweed cultivation land on Lembeh Island and its surroundings. The data collection technique in this study was divided into several events, namely primary data collection, where the implementation was carried out in the field such as conducting a ground check from the results of the analysis. In addition, there are also secondary data that generally come from local government data related to this study. In this study, the type of data used was data related to seaweed cultivation such as: protection, basic substrate, temperature, pH, current, depth, MPT, DO, salinity, phosphates, and nitrates. Based on these data, interpolation will be carried out which aims to predict grid values that are not represented by sample points. The interpolation used is Inverse Distance Weighting (IDW). The percentage of suitability of seaweed cultivation in the waters of Lembeh Island and Bitung City has 2 categories. The Unsuitable (N) has a percentage of 41%, and for the Category Suitable (S1), which is a highly recommended zone for seaweed cultivation, has a percentage of 59%. The percentage of this very suitable area is an area that is still classified as safe from sea transportation activities in Bitung City.

Keywords. Seaweed, Cultivation, Lembeh, Bitung

1 Introduction

The development of the maritime industry in Bitung City has a direct and indirect impact on the surrounding environment, including Lembeh Island [1]–[3]. Bitung City has been declared as a Special Economic Zone for Capture Fisheries [2], [4], although there has not been a significant development in the construction of the Hub Port, supporting facilities and infrastructure such as the Manado - Bitung toll road have been completed [2][5]. Optimistic about the development of Capture Fisheries, of course, it is also necessary to have other supporting products, namely aquaculture around the industrial development site [5]. One of the focuses in this study is to look at the condition of the waters around Lembeh island that can be used for seaweed cultivation [2]. One of the techniques to find out the location suitable for the development of this cultivation is spatial analysis [2]. This study uses satellite remote sensing technology, geographic information systems (GIS) and field surveys to map and evaluate the existing location of seaweed cultivation on Lembeh Island. Lembeh Island has a high fishery economic potential, this potential is the result of natural resources located in the Lembeh Island area. The potential fisheries capture on Lembeh Island in the form of skipjack tuna and tuna are greater, so that in maintaining the sustainability of marine resources, seaweed cultivation on Lembeh Island needs to be developed by looking for suitable locations. The purpose of this study is to evaluate the suitability status and usage patterns of seaweed cultivation space in the waters of Lembeh Island.

2 Research Methods

2.1 Research Location

This research is located on the coast of Bitung City and Lembeh Island. Lembeh Strait is a separator as well as a link for community activities in Bitung City, for details can be seen in the following picture.

Fig. 1. Map of Bitung City.
2.2 Research Tools and Materials

The equipment used in this study [2] is intended to facilitate data processing in the laboratory, tools such as the Global Positioning System RTK (GPS), Echosounder, and portable supporting equipment for measuring water quality. The satellite images used are sentinel satellite images 2A and 2B acquisition August 21, 2020 (https://scihub.copernicus.eu/) used to identify seaweed cultivation protected areas; Peta Lingkungan Pantai Indonesia (https://tanahair.indonesia.go.id/portal-web).

2.3 Data Collection Techniques

The data collection technique [2] in this research is divided into events, namely primary data collection, where the implementation is carried out in the field such as conducting a ground check from the results of the analysis [2]. In addition, there are also secondary data that generally come from local government data related to this study.

2.4 Data Analysis Techniques

In this study, the type of data used was data related to seaweed cultivation such as [6]: protection, bottom substrate, temperature, pH, current, depth, MPT, DO, salinity, phosphates and nitrates. Based on these data, interpolation will be made which aims to predicts grid values that are not represented by sample points. The interpolation used is Inverse Distance Weighting (IDW). This method makes the data is weighted during interpolation, so that the influence of one-point relative to other points and decrease as the distance to the grid nodes gets larger [2], [7]. Results from this polygon or coverage (layer) is used for the overlay process. To acquire an arrangement of the equal of agreement, a configuration matrix is made complete scoring and weighting on the preventive parameters of seaweed cultivation actions. In this study, each parameter was divided into three classes, namely unsuitable (N), suitable needs (S2) and suitable (S1) [8]. According to [2], quantitative investigation to control the suitability of Seaweed Cultivation uses the "assessment" method with the following approach [2]:

\[ Y = \sum ai . Xn \]  

(1)

where

- \( Y \) : Final value
- \( ai \) : Weighing value
- \( Xn \) : Value of land suitability level

To find a period of standards in each type is established created on the percentage value of the computation results in Table 1.

### Table 1. Total Scoring the suitability Seaweed Cultivation system.

<table>
<thead>
<tr>
<th>Overall Score</th>
<th>Suitable Quantities</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>247 - 255</td>
<td>Suitable (S1)</td>
<td>This field has the possible to be developed for Seaweed Cultivation.</td>
</tr>
<tr>
<td>244 - 247</td>
<td>Suitable needs (S2)</td>
<td>This space is quite helpful for developing the Seaweed Cultivation system. Nevertheless, this area has a limiting factor that requires exceptional treatment to improve its capabilities.</td>
</tr>
<tr>
<td>241 - 244</td>
<td>Unsuitable (N)</td>
<td>This Geographical zone that are integrated in this classification can’t be cultivated for Seaweed.</td>
</tr>
</tbody>
</table>

3 Results and Discussion

3.1 Parameters Seaweed Cultivation Analysis

The considerations that assistance in the suitability models seaweed cultivation system as pictured in the following maps (Figure 2).
3.2 Suitable Locations For Seaweed Cultivation

Determination of the location of seaweed cultivation is carried out by overlaying each variable that has been obtained. A map of land suitability is presented in Figure 3. The map is then carried out an analysis of the extent of each suitability using the Geographic Information System presented in Table 2.

Table 2. Data styles for a reference.

<table>
<thead>
<tr>
<th>No</th>
<th>Suitable Levels</th>
<th>Area (ha)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Suitable (S1)</td>
<td>835.58</td>
<td>59%</td>
</tr>
</tbody>
</table>

4 Conclusions

The results of this study show that Lembeh Island and its surroundings still have potential in the development of seaweed cultivation of 835.58 ha, even though the water conditions are already very dense by the traffic of industrial ships and transportation, this opportunity needs to be synergized with local government programs in the development of the fisheries industry.

References


