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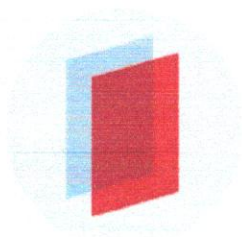
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## The Ability of Lyzenga's Algorithm for Seagrass Mapping using Sentinel-2A Imagery on Small Island, Spermonde Archipelago, Indonesia

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**Abstract.** The existence of the value of depth variation in the study area is also a requirement in the application of this algorithm. The purpose of this study is to determine the ability of the use of algorithms in the mapping of seagrass by comparing the results of classification between imagery using the Lyzenga's algorithm with imagery without using the Lyzenga's algorithm. The result of imagery classification applying the Lyzenga's algorithm shows the visibility of baseline water objects that are more easily recognizable using Depth Invariant Index (DII) value format as evidenced by the increase of 2 classes of seagrass cover. In this study there are five seagrass cover classes of shallow water in Pajenekang Island, Spermonde-Indonesia Islands using Lyzenga's algorithm, namely class are 1) Very good: > 75%; 2) Good: 50,5-75,4%; 3) Rather Good: 25,5-50,4%; 4) Bad: 5,5-25,4%; and 5) Very Bad: <5,5%.

### 1. Introduction

The availability of spatial information of coastal aquatic benthic becomes very important as awareness of environment-based management. Various methods have been undertaken and developed to obtain coastal aquatic benthic information, one of which is the application of the Lyzenga's algorithm.

Based on its Morphology, the Seagrass consists of leaves, rhizomes that have roots, flowering and seeds, and to obtain energy through photosynthesis process. Seagrass are also defined as flowering aquatic plants (*angiospermae*). However, this plant species is different from strong plants in general, owned stems are used to overcome the force of gravity on the substrate habitat to remain upright. It also has an air cavity used to create buoyancy under flexible conditions when exposed to current waves [1].

As one of the coastal and marine ecosystems, seagrass beds have an irreplaceable ecological function. The ecological functions of the seagrass ecosystem include, as a residence for juvenile and adult biota, as a shelter, feeding ground, nursery ground, and spawning ground. In addition, the seagrass ecosystem also becomes important because as a balance factor of marine ecosystem. The total area of seagrass beds in Indonesia was originally estimated at 30.000 km<sup>2</sup>, but is now estimated to have decreased by 30-40% due to human activities. So that the seagrass getting less attention to its existence [2].



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Indonesia as a tropical region has seagrass species that generally grow together, forming mixed meadows consist of 2-8 species. While in temperate, seagrass beds are often dominated by only one single species [3].

That the Spermonde-Pangkep archipelago, mainly in Sabangko Island, the condition of the seagrass ecosystem is spread on several sides of the island under varying conditions and has a seagrass ecosystem with medium-term categorical condiments Braun-Blanquet [4]. One of the islands is also found in the islands of Spermonde-Pangkep is the island of Pajenekang. But the potential of this island has not been revealed, especially the seagrass ecosystem. This is the reason to choose the research topic and research location.

Research on mapping and monitoring of shallow marine ecosystems (Coral, Mangrove and Seagrass) has been done using satellite imagery. Some researches have succeeded to map coastal aquatic using Landsat satellite imagery on small Island-Spermonde archipelago [5-8]. As for the type of imagery ALOS AVNIR [9,10].

The use of *Advanced Land Observing Satellite* (ALOS) satellite imagery with 10 m spatial resolution was used to perform multispectral classification in coral and seagrass mapping on small island-Spermonde archipelago of Indonesia. In this study also used the method of Depth Invariant Index stating that DII value is not significantly different with radian value [10].

The spatial resolution of the 10-meter ALOS imagery is similar to that of Sentinel-2 which has a multispectral instrument with 13 spectral channels of visible light channels, near infrared, as well as shortwaveinfrared. The planned satellite lasts for 7 years, has 4 spectral bands at 10 meter spatial resolution, 6 bands at 20 meter spatial resolution (four for vegetation spectral) and 3 spectral bands at 60 meter spatial resolution [11]. So that Sentinel-2 imagery allows to be used in the classification of seagrass cover, since 4 bands can be used for spectral vegetation.

Various studies have proven that the Lyzenga's method is often used to map the basic shallow water base closure material. One is to lower the Lyzenga's algorithm for mapping the shallow seagrass closure material (<20 m) with the research method which is used for merging operation of two visible channels TM1 and TM2 that can penetrate into the water body up to a certain depth, so it can be used to identify the object in shallow marine waters<sup>[12]</sup>. Meanwhile implemented the Lyzenga's algorithm for the imagery that gives clearer appearance of the picture of the basic types of waters [9]. Another study was also conducted by Jaelani who used high resolution imagery to be used in the method of extracting seagrass information using the Lyzenga's algorithm and without algorithm [13].

Where this study aims to determine the effect of the use of algorithms to mapping substrate baseline waters, especially seagrass by looking at the results of comparison of spatial accuracy between the image classification results Lyzenga algorithm and without Lyzenga image algorithm. So this method is expected to be done on the type of Sentinel-2A imagery as study material and research author.

## 2. Material and methods

This section discusses are the location of the research, the type of data used and how the data is processed.

### 2.1. Study area

The study was conducted in March-August 2017 in shallow waters of Pajenekang Island-Spermonde Islands of Pangkep, Indonesia with an area of 104.57 Ha geographically located at 119° 19'39.92 "E longitude and 4° 58'09, 42 "S (Figure. 1).

### 2.2. Data collection

The main data used in this study is Satellite Sentinel-2A Imagery acquisition 01-March-2017 which is downloaded on the link: <https://scihub.copernicus.eu/dhus/#/home>. As the specification of this imagery data can be viewed in Table 1. While for data processing mostly use ArcGIS 10.5 software.

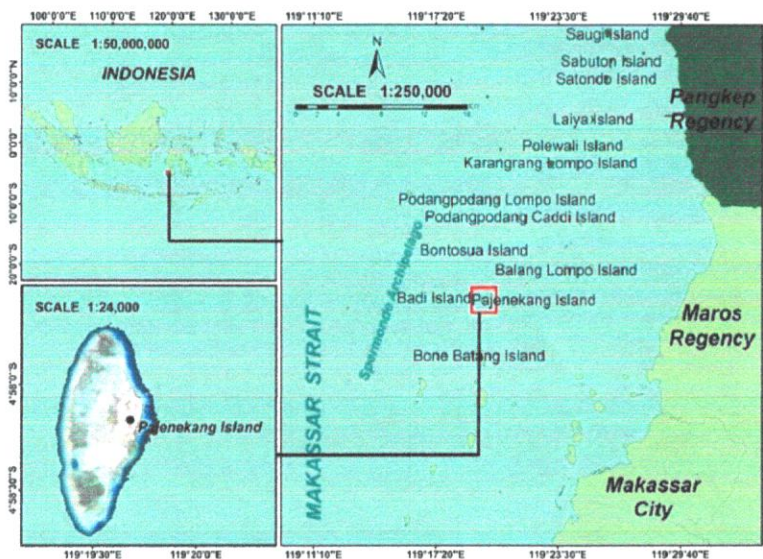
Other data used in the form of secondary data. The secondary data types are ocean watershed condition data from previous studies and prediction of tidal data obtained from tidal book prediction during 2017 published by DISHIDROS (Hydrographic-Oceanographic Service) of the Indonesian Navy.

**Table 1.** Data and imagery specification

Description	Specification
Multyspectral	Sentinel-2A
Spatial Resolution	10 meters
Temporal Resolution	5 days
Date of Acquisition	01 March 2017

**12. Processing Imagery**

Sentinel-2 Multi-Spectral Instrument (MSI) has 13 spectral bands from which are visible and Visible and Near Infrared (VNIR) to Short-Wave Infrared (SWIR), where this showing four spectral bands at 10 m are classic blue (490 nm), green (560 nm), red (665 nm) and near infrared (842 nm); six bands in 20 m are four bands in spectral vegetation (703 nm, 740 nm, 783 nm and 865 nm) and two large SWIR bands (1610 nm and 2190 nm); and three bands at 60 m spatial resolution that is dedicated to correction and cloud screening (443 nm for aerosol retrieval, 945 nm for moisture retrieval and 1380 nm for cirrus cloud detection). In the Sentinel-2a Imagery Level-1C for imagery geometric correction process is not done because this imagery data has a high resolution spectral that is 10 meters and not only has been corrected geometric but also has been corrected radiometric [11]. In this research, there are several steps, starting from pre-imagery processing, imagery processing to the result of comparison of seagrass distribution using algorithm and without Lyzenga's algorithm using high resolution imagery (Resolution 10 m).



**Figure 1.** Research site, red circle is Pajenekang Island, one of small Island on Spermonde Archipelago

2.3.1. Atmospheric correction. Broadly speaking the flow of this research is depicted in the flow diagram on Figure. 2. The first stage to perform is the imagery correction to eliminate atmospheric

effects on the imagery during recording. Corrections made by the Dark Object Subtraction (DOS) method. This correction is intended because every imagery that is processed always looks its visual been unclear, this atmospheric correction will clarify the appearance of the object, in order to facilitate to recognize the object when it was interpreted. The atmospheric correction is part of the pre-processing of imagery data which was used to eliminate radiance errors recorded on images as a result of atmospheric scattering (path radiance).

The rationale in the "Dark Object Subtraction (DOS)" method is that the number of pixels drawn from the deep water and the Digital Number (DN) value is then subtracted with each band. The formula can be seen in Equation.1[14].

Atmospherically corrected radiance :

$$L_i - L_{si} \quad (1)$$

Where  $L_i$  is the pixel of the tire radiance  $i$  and  $L_{si}$  is the average value of  $L_{i18}$  for the water column in band  $i$ . But if atmospheric correction has taken place then the pixel value has been converted to a surface reflectance or surface value. The value of this reflectance is the value that when the wave is about and / or leaving the object, assuming that the information delivered from the aquatic object to be treated is free of the atmospheric effect. So the value of this surface becomes an initial data to perform data entry to the Lyzenga's algorithm but firstly separates the shore and ocean region so that the processing focuses on the ocean area only (as the seagrass habitat).

But before doing the necessary cutting of images for the study area of research. Cropping imagery or commonly called cropping which is a process of image processing used to minimize the area of observation of a study. It aims to minimize the capacity of the files to be processed and speed up the processes in the processing software used when compared with processing a full-scene data. At this scene PajeneKang Island is located at  $4^\circ 55'41.22''$ LS and  $119^\circ 19'14.63''$  BT.

2.3.2. *Composite band*. The composite imagery in the image without using the Lyzenga's algorithm used is combining 3 natural bands (RGB: 432) from band 4 (red), band 3 (green) and band 2 (blue) for Sentinel-2A imagery data. Then conducting unsupervised classification (Unsupervised-K\_Means).

2.3.3. *Depth Invariant Index (DII)*. The next method is water column correction using the method of "Depth Invariant Index (DII)" [15]:

$$X_i = \ln(L_i) \quad (2)$$

$$\ln(L_i) = -[(k_i/k_j) \ln(l_j)] \quad (3)$$

Where:

$L_i$  dan  $L_j$  : the reflectance value of the  $i$  and  $j$  bands.

$K_i/K_j$  : the attenuation coefficient ratio from the  $i$  and  $j$  bands

While to find the value of coefficient attenuation ( $K_i / K_j$ ) is:

$$K_i/K_j = a + a\sqrt{a^2 + 1} \quad (4)$$

$$a = \frac{(\text{var}X_i - \text{var}X_j)}{2 \text{cov}X_iX_j} \quad (5)$$

Where:

$X_i$  : The variance of band  $i$ ,

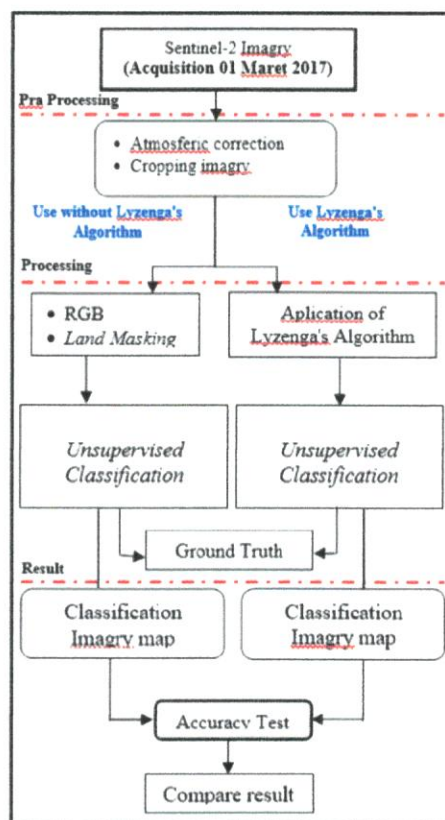
$X_j$  : Variant of band  $j$  and

$X_iX_j$  : Covariance from band  $ij$ .

In Equation (2) is used to find the reflection relationship with exponential attenuation for each depth. Therefore we need the value of two spectral data channel data to get attenuation coefficient value ( $K_i / K_j$ ) (In equation 4). The value is the attenuation coefficient ratio of the blue channel (490 nm) and the green channel (560 nm). The algorithm calculation is influenced by channel pair  $i$  (blue

channel) and j (green channel) used. According to Suwargana [16], the value of the wavelength for the channel used has an influence on how deep a channel is in detecting a watershed, so the blue channel and the green channel have the wavelength with the best penetration among other channels that is good to use.

The application of the Lyzenga's algorithm to find the coefficient of aquatic attenuation ( $k_i / k_j$ ) first needs to find the value, the value of  $a$  is obtained by looking at the digital values in the blue channel and the green channel at the same geographical position through the region-making process or the sample area training in the polygon form. In this study used sample area training as much as 35 regions taken in shallow water areas. Then calculated statistically to get the value of variety (variance) and covariance [15] the result of training of sample area on blue channel and green channel, so that the value of  $a$  and ratio of attenuation coefficient ( $k_i/k_j$ ) based on equation (4) and (5). Furthermore, the imagery is classified as Unsupervised refers to the data of the processed imagery while connected with the results of the observation when the field data retrieval with. The classification of satellite imagery in this way has been widely used to produce basic shallow terrestrial habitat maps [17].



**Figure 2.** Flow Chart of research methods

The results of the two were then compared from the results of the accuracy test. This test is important to know how big the map can be trusted. The accuracy test used is using matrix error (error matrix) by comparing the actual class of field observation with the result of imagery classification. Here is a flow chart of research that can be seen in Figure. 2.

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### 3. Results and discussion

This section discusses the atmospheric correction; the land masking; the result imagery classification without Lyzenga's algorithm and Lyzenga's algorithm; the type objects of the seagrass dominant species found in the field; and accuracy test.

#### 3.1. Atmospheric correction

The study was conducted in March-August 2017 in shallow waters of Pajenekang Island-Spermonde Islands of Pangkep, Indonesia with an area of 104.57 Ha geographically located at 119° 19'39.92 "E longitude and 4° 58'09, 42 "S (Figure. 1).

The result of atmospheric correction using "Dark Object Subtraction (DOS)" method can be seen from changing pixel value. The previous pixel value in the form of a reflectant value on a satellite is then converted to a reflectance value of the surface (surface reflectance). So the surface reflectance value with a range between 0-1. Where are according that the basic assumption<sup>5</sup> the picture of some complete shadow pixels and radiances received by satellites is also caused by atmospheric scattering (path radiance) [14]. This assumption is combined with the fact that very few targets on the surface of the earth are absolutely black, so it is assumed<sup>18</sup> that one percent of the minimum reflectance is better than zero percent. Band values of corrected band\_2, band\_3 and band\_4 can be seen in Table. 2.

**Table 2.** Tables of band values resulting from Dark Object Subtraction (DOS) correction

Band	Reflectance Value Minimum	Percent (%)
Band_2	0,000000	1
Band_3	0,000000	1
Band_4	0,000000	1

#### 3.2. Land Masking

The separation (masking) of land and sea boundaries needs to be done to facilitate during the transformation and classification process. The method used is the digitization of the mainland on the imagery. So that the sea area is allowed to continue to bring the reflectance value of the surface (surface reflectance), while the land area is left to have a value of 0 (null) so that when doing the transformation and classification there is no interference from the land value.

#### 3.3. Imagery classification without Lyzenga's algorithm

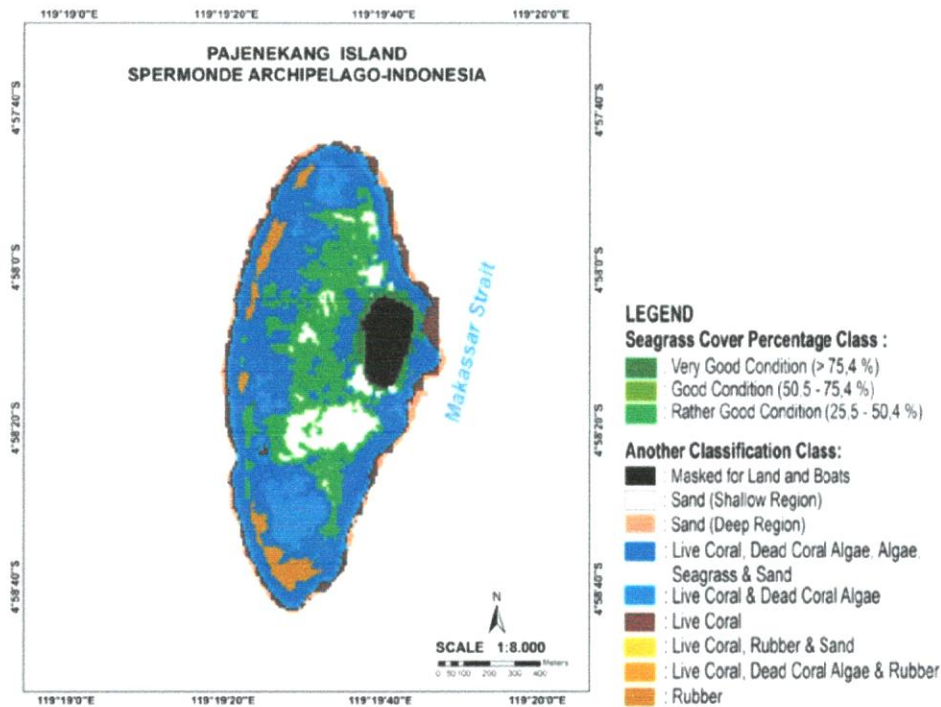
When compared to the composite imagery of Red-Green-Blue (RGB = 432), the Red-Green-Blue imagery composite is further classified by the same method of Unsupervised Classification-K\_Means. The classification results are shown in Figure .3.

Classification results without the use of algorithms for any reflection of aquatic benthic objects. In the shallow areas of Pajenekang Island the reflection of objects from every pixel is the result of various objects as well as some objects that are reflections of dominant objects such as: sand class, live coral, seagrass categories are very good, good and rather good. Objects mixed in one class such as dark blue pixels are the result of reflection from live coral mix with Dead Coral Algae (DCA), algae, seagrass & sand and the light blue image is the result of a reflection of live coral mix with DCA (Figure 3). Based on the search results without using the Lyzenga algorithm, the seagrass category only contained three classes: very good category: > 75%, good: 50,5-75,4% and rather good: 25,5-50,4%. From the results that this category very good (> 75%) consists of 96 pixels, the good category (50,5-75,4%) consists of 255 pixels and<sup>22</sup> other category (25,5-50,4%) of 1872 pixels. For seagrass cover in each category of seagrass cover can be seen in Table. 3.

**Table 3.** Percentage coverage of Seagrass area without Lyzenga's algorithm.

Percent Cover (%)	Coverage area (Ha)	Coverage area (%)
>75 %	0.96	4.32
50,5-75,4 %	2.55	11.47
25,5-50,4 %	18.72	84.21
Total	22.23	100.00

The extent value for each category of seagrass cover classification class in the above Table.3 is obtained from the multiplication of the number of pixels produced from each seagrass cover category with the imagery spatial resolution value used is  $10 \times 10$  m ( $100 \text{ m}^2$ ). Different area of each category produced is the result of imagery analysis that has been adjusted to the conditions in the field, the number shows the difference of cover area of each station. The total area of the seagrass is 22.23 Ha, this condition is obtained from the classification by calculating the classification area for each class on the imagery recording at low tide [18].

**Figure 3.** Classification Imagry without the Lyzenga's algorithm.

### 3.4 Imagery classification with Lyzenga's algorithm

In the process with using the Lyzenga's algorithm, the imagery used is a NIR-Green-Blue composite (RGB = 832). The composite imagery 421 shows better basic visibility, as of the NIR1, Green and Blue channels, has good spectral sensitivity to distinguish parameters in the ecosystem of a coastal waters [13]. The sample area training process carried out as many as 35 regions taken in shallow water areas with different depths for the bottom substrate of the waters. This is confirmed by Lyzenga [15] that in order to obtain the correct linear correlation value in the process of Depth Invariant Index (DII), then in the process of training sample on substrate of water base must be on homogeneous area and

have different depth. Where the channel chosen for the calculated ratio is the channel with the highest penetration of water depth, they are the blue and green channels. Based on the sample training, we get the value of  $k_i/k_j$  of 0.7656. Then apply the algorithm in the process of getting a new imagery. Furthermore, the imagery is classified by unsupervised classification-K\_Means method used to see the number of classes generated and perform the class naming based on ground truth.

Based on the results of classification by using the Lyzenga's algorithm visible color difference for each reflection of the basic object of the waters. In the shallow waters of Pajenekang Island the reflection of the objects of each pixel is the result of the reflection of several objects and also some other objects which are reflections of a dominant object such as: sand class, live coral, seagrass category very good, good, rather, etc. Mixed objects in one class such as yellow pixels show the result of the reflection of living coral mix with DCA and algae, seagrass and sand (Figure 9).

**Table 4.** Percentage of Seagrass coverage area with Lyzenga's algorithm.

Percent Cover (%)	Coverage area (Ha)	Coverage area (%)
>75 %	6.44	20.02
50.5-75.4 %	12.17	37.84
25.5-50.4 %	8.77	27.27
5.5-25.4 %	3.21	9.98
<5.5 %	1.57	4.48
Total	32.16	100.00

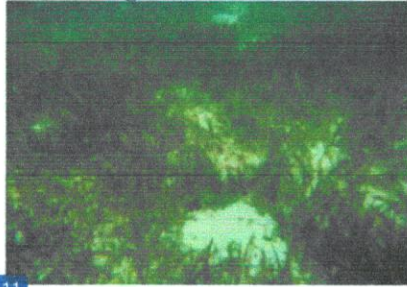
The value of the area for each seagrass objects of the 5 seagrass coverage area is obtained, is Very good: > 75%, Good: 50.5-75.4%, Rather Good: 25.5-50.4%, Bad: 5.5-25.4% and Very Bad: <5.5%. From the results it is known that the category > 75% consists of 644 pixels, the 50.5-75.4% category consists of 1217 pixels, the 25.5-50.4% category consists of 877 pixels, the categories 5.5-25.4 % consists of 321 pixels and the <5.5% category consists of 157 pixels. As for the value of seagrass cover in each category of seagrass cover can be seen in Table. 4 and Figure. 4-8.

Value of area for each class category of seagrass cover classification in the above Table. 4 is obtained from multiplication of pixel number resulting from each seagrass cover category with imagery spatial resolution value used is  $10 \times 10$  m ( $100 \text{ m}^2$ ). Different area of each category produced is the result of imagery analysis that has been adjusted to the conditions in the field, where the number shows the difference of cover area from each station. The total area of the seagrass is 32.16 Ha (Figure 9), this condition is obtained from the classification by calculating the classification area for each class on the imagery recording at low tide.

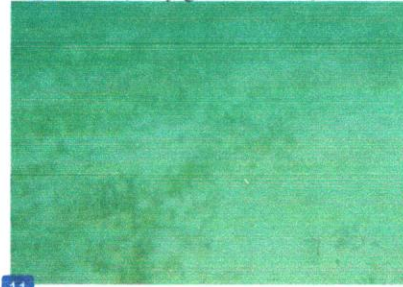
However, the difference is the increase of two classes for the seagrass cover category are very bad condition categories (<5.5%) and bad condition categories (5.5-25.5%), also live corals that are in the mixed class of objects from living corals and DCA more clearly show the existence of life coral pixels on with Lyzenga's algorithm (descriptions in Fig. 9 that the red square on the zoom in results in the mixed object class area of the living coral and DCA is to clarify the pixels for live corals not found in the imagery image without the Lyzenga algorithm). The loss of the two classes is due to the area of the object is close to the mainland so it gets anthropogenic disturbance causing the waters in the area becomes turbid and different depth variations as well. Turbidity and depth variation is what affects the use of the algorithm in correction of the water column. So the emergence of a new class for the seagrass cover category increasing from 3 classes to 5 classes on the classification results using the imagery of the Lyzenga algorithm. This is confirmed by [15] who said that correction of the water column needs to be done to improve the imagery quality by reducing the disturbance in the water column. Therefore, to get the basic object of good water, preferably in the process of imagery processing before the classification, its required to do a correction of the water column first.



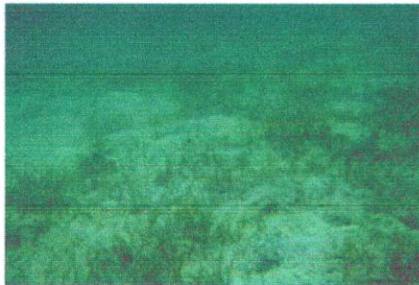
**Figure 4.** Percent cover of Seagrass on the field (Very good: > 75%)



**Figure 5.** Percent cover of Seagrass on the field (Good: 50,5-75,4%)



**Figure 6.** Percent cover of Seagrass on the field (Rather Good: 25,5-50,4%)

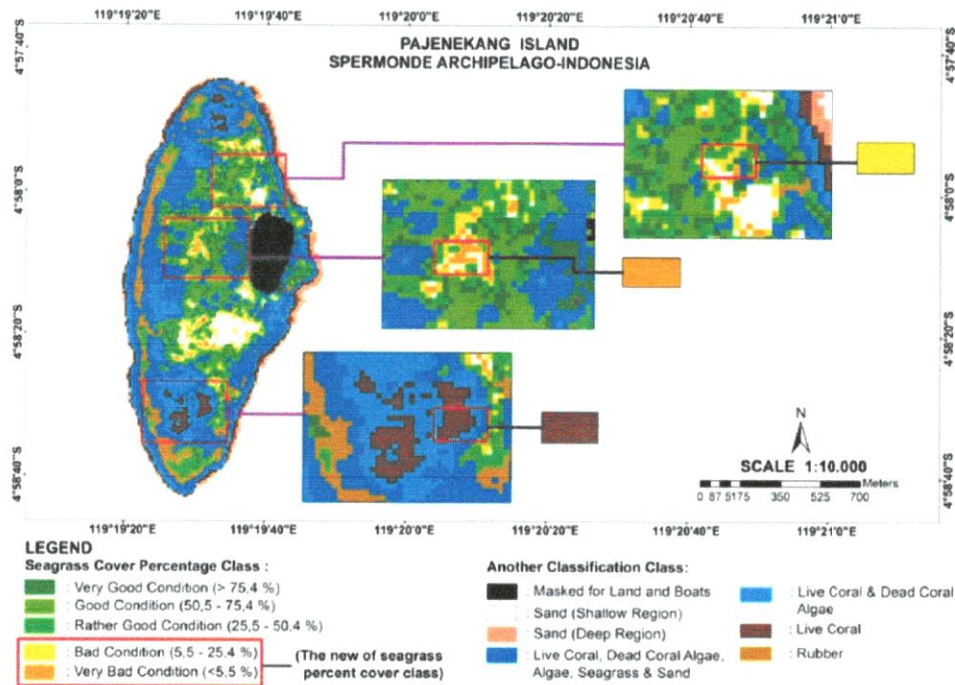


**Figure 7.** Percent cover of Seagrass on the field (Bad: 5,5-25,4%)



**Figure 8.** Percent cover of Seagrass on the field (Very Bad: <5.5%)

Classification result using the Lyzenga algorithm, the seagrass with the bad condition category has an area of 3,21 ha and with the very bad condition category has an area of 1,57 ha, also the live coral class mixed with DCA on the result of image classification using the Lyzenga's algorithm also shows a clearer live coral. The magnitude of the sand and the seagrass in the good category in the image without using the Lyzenga algorithm due to the absence of the influence of the water column in the spectral reflection process of sand and seagrass objects, so that the emergence of a new class for seagrass cover does not appear. This is different from the image of the result of the Lyzenga's algorithm to reduce the extent of the good category seagrass and there are two new classes for the seagrass cover category, which bad condition and very bad condition categories not found in the image classification result without the Lyzenga's algorithm, as shown in Figure. 9 on the legend marked with a red circle.



**Figure 9.** Result classification with the Lyzenga's algorithm. The description on the legend marked with a red square is a new class of seagrass percents cover class not found in the image classification result without the Lyzenga's algorithm

3.5. The type objects of seagrass dominant species found in the field

In tropical regions such as Indonesia, the types of seagrasses generally grow together, forming a mixed meadows community of 2-8 species. While in temperate, Seagrass beds are often dominated by only one single species [3]. Type objects of the seagrass are 5 species dominant namely *Cymodocea rotundata*, *Enhalus acoroides*, *Halodule uninervis*, *Syringodium isoetifolium* and *Thalassia hemprichii*. Types of dominant seagrass, as shown in Figure. 10-14. Another objects some basic classes of shallow water in Pajenekang Island, Spermonde-Indonesia Islands, namely class are Sand; Dead Corals Algae (DCA) mixed with life corals, seagrass and sand; life corals mixed Dead Corals Algae (DCA); life corals; and rubber.

3.6. Accuracy test

Based on the results of accuracy tests using matrix error on the results of the classification of different methods on both images where obtained a value that states that 85.29% of the classification using algorithm is in accordance with the data or conditions in the field (ground truth 68 point coordinate), then Sentinel-2A's imagery is eligible for this study.

Anderson says that the thoroughness results of the classification must have a minimum value of 85% [19]. The comparison of the classification results between the imagery and the Lyzenga's algorithm and the imagery without the Lyzenga's algorithm indicates that the imagery with the application of the algorithm has an effect on the process of detecting the appearance of the basal object in this case is better seagrass. Differences generated when the classification process by comparing the two results, it can be selected imagery classification results from the application of Lyzenga's algorithm. The imagery proved to provide a better baseline water substrate appearance with the addition of new classes for the category and seagrass slightly and very few of the 11 classes produced

are shallow sand classes in shallow water: deep sand; DCA with algae mixed with living corals, seagrass and sand; live corals mixed with DCA; live corals; rubber and some classes of seagrass cover (Very good: > 75%, Good: 50,5-75,4%, Rather Good: 25,5-50,4%, Bad: 5,5-25,4% and Very Bad: <5,5%).

The error of 25% in the classification results without using the algorithm is caused by the change of the type of bottom closure of the waters where the imagery is classified as a good seagrass category whereas the validation results in the field show different types of objects is the area there are still two new categories namely a bad and very bad category, because in shallow waters with high depth variations and turbid water conditions will result in various classes due to correction of the water column. But when the research area has a variation in the depth that is less diverse (not correction of water column) then the resulting class will be less. So the extent of the object is different. This is what underlies the different seagrass and sand of the two images. Therefore in this study, the Lyzenga's algorithm gives effect to the result of classification due to turbidity variation and depth at the research location.

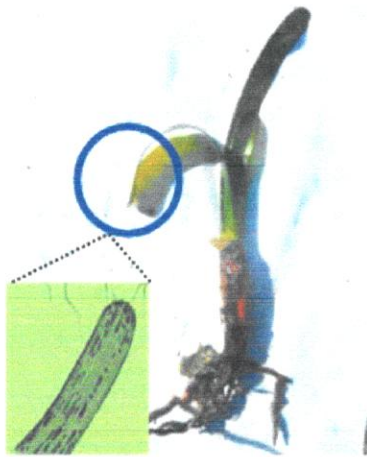


Figure 10. *Thalassia hemprichii*



Figure 11. *Enhalus acoroides*

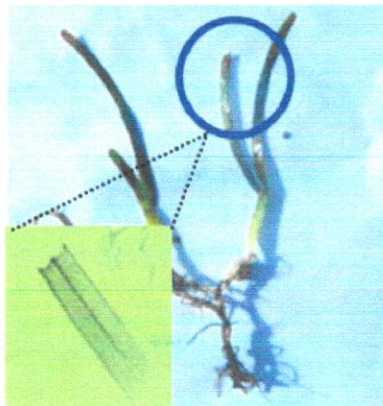


Figure 12. *Halodule uninervis*

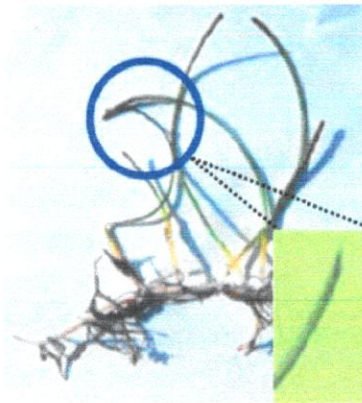
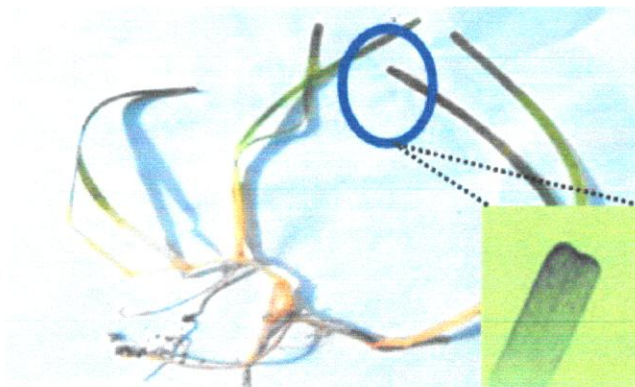


Figure 13. *Syringodium isoetifolium*



**Figure 14.** *Cymodocea rotundata*

#### 4. Conclusions

Based on the comparison of imagery classification results with the Lyzenga's algorithm and without the Lyzenga's algorithm indicates that with the use of the Lyzenga's algorithm has an influence in detecting better baseline water features. Classes resulting from this research that is the class of shallow sand waters; deep sand; DCA and algae mixed with living corals, seagrass and sand; live corals mixed with DCA; live corals; rubber and some classes of seagrass cover (Very good: > 75%, Good: 50,5-75,4%, Rather Good: 25,5-50,4%, Bad: 5,5-25,4% and Very Bad: <5.5%), where the seagrass cover area is 30,75%, and there are 4 types of dominant seagrass namely *Cymodocea rotundata*, *Enhalus acoroides*, *Halodule uninervis*, *Syringodium isoetifolium* and *Thalassia hemprichi*.

Obstacles faced when the research is done that is the lack of reference about the results of imagery processing using Sentinel-2A Imagery, especially for seagrass beds so that the image of the interpretation for this type of imagery is needed by the author.

For further research, it is advisable to deepen the processing of this imagery data type and it is expected to apply the Lyzenga's algorithm for guided classification, especially for other substrate type of waters such as corals and more specific study to observe the condition of substrate base in Pajenekang Island not only look at the species but rather the texture of sediments and other oceanographic conditions. And the condition of the extent of seagrass beds large enough to need further research on the development and improvement of ecosystem of the area. So there is always the latest information that is expected to be the next research material on this island.

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