Volume 2, No. 6 June 2023 - (413-423)
p-ISSN 2980-4868 | e-ISSN 2980-4841
https://ajesh.ph/index.php/gp

SUITABILITY OF SEAWEED CULTIVATION LAND POST EARTHQUAKE AND TSUNAMI IN BANAWA SELATAN DISTRICT, DONGGALA DISTRICT

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ABSTRACT:
An earthquake measuring 7.7 on the Richter scale (SR) shook Donggala, Central Sulawesi (Central Sulawesi) causing disruption to the supply of electricity to the people in the region. The incident mentioned above caused thousands of buildings to collapse including power plants which disrupted lighting. The impact of the tsunami hit Parigi Regency and Palu City causing the economy to be totally paralyzed, especially the people who live in coastal areas. The specific objective of the research was to examine the physical and chemical suitability of the waters of the waters of the grass cultivation site after the earthquake and tsunami in Donggala District. Based on the results overlay then the land area used for (appropriate, less suitable and not suitable) cultivation activities is obtained Eucheuma cottonii or almost balanced cultivation area. In developing a cultivation business, it is necessary to consider the area of utilization, such as the flow of shipping traffic, the distance between ropes long line and for the protection of other ecosystems. Based on the percentage of land suitability covering 33.53% suitable areas, 44.26% less suitable and 19.84% not suitable. This shows that the condition of the seaweed cultivation area is less favorable in terms of water quality. Water quality parameters include physical, chemical and biological aspects. These three parameters are interrelated with one another. So that when one of the parameter elements is disturbed, it will automatically interfere with other elements.

Keywords: Physical, chemical, land suitability.

Article History

Received	: 20 May 2023
Revised	: 01 June 2023
Accepted	: 14 June 2023
DOI	: 10.xxxxx

INTRODUCTION

Seaweed (sea weed) is one of the fisheries commodities that can be used to encourage people's economic growth (Chen et al., 2020). Seaweed cultivation does not require high technology, investment tends to be low, absorbs quite a lot of labor and generates relatively large profits. The development of these businesses is expected to reduce the unemployment rate (pro job), increase people's income (pro growth) and in turn can reduce poverty (pro poor). Seaweed is one of the leading commodities that has a prospective market. The world's demand is quite high causing the production of products originating from nature to be insufficient, so cultivation efforts must be made. This target is carried out by developing 15,000 hectares of cultivated land by 2009 with a production target of 0.4 million tonnes for Gracilaria sp and 1.5 million wet tonnes for Eucheuma sp (Ya'la et al., 2022).

Total expected production of 1.9 million tons or equivalent to 186,332 dry tons, while exports are expected to be $ 111,501,000. The reality on the ground shows that seaweed cultivation activities have absorbed a lot of manpower, helped poverty alleviation efforts and in turn opened up opportunities for the community's economic growth. At least, the margin for this type of seaweed cultivation business Eucheuma sp ranges from IDR 20,500,000/KK/0.5 Ha/Year mean while Gracilaria sp ranges from IDR 24,700,000/KK/Ha/Year (Eyayu et al., 2023). This margin could increase if it is accompanied by an increase in production per unit area, area expansion, quality improvement and potential for increasing world demand (Popp et al., 2013).

The Province of Central Sulawesi, with a coast length of around 4,013 km covering Tomini Bay, Tolo Bay and Makassar Strait, has a potential area for developing seaweed commodities of around 65,426 ha. The dominant species cultivated is Eucheuma cottonii carrageenan phyte producers, while agarophyte producers such as Gracilaria verrucosa cultivated in ponds are being developed. In 2009 the development of seaweed cultivation in Central Sulawesi was predicted to reach an area of 7,851.12 Ha, in 2010 it could reach an area of 11,776.68 Ha, and in 2011 it could reach an area of 15,702.24 Ha (Sapitri & Cokrowati, 2016).

RESEARCH METHODS

1. Land Suitability Analysis

To determine the land suitability of a water area in the optimal and sustainable development of seaweed cultivation which guarantees coastal sustainability, analytical methods are used including (Mudeng et al., 2015).

a. Spatial Analysis

In conducting spatial analysis there are several steps that must be carried out, namely the preparation of a spatial database and the overlay technique (overlay).

1) Database Compilation

The preparation of a spatial database is intended to create digital thematic maps starting with a base map, data collection (data compilation) up to the final stage. Overlaying. In this study the types of data collected included ecological waters such as temperature, salinity, waves, tides, currents, brightness, dissolved oxygen, pH, CO2, nitrate, phosphate, TSS, TDS, protection, aquatic substrates and biological aspects. Based on these data, contours will be made for each criterion with assistance Extension Gird Conturso that the next contour is formed conver to polygon which generates the theme itself. The result of a polygon or coverage (layer) is used for processing overlay.

2) Patching Process

To determine the mapping of an area that is suitable and not suitable for the development of seaweed cultivation in the research area, an overlapping operation is carried out (overlay) of each theme used as a criterion, using Arc ArcView 3.2. Before the overlapping operation was carried out, each theme was assessed for its level of influence on determining land suitability. Giving value to each of these themes using weighting (weighting). Each theme is divided into several classes (which are adjusted to the conditions of the research area) given a score ranging from classes that have an effect on to classes that have no effect. Each class will get a final score which is the result of multiplying the class score by the weight of the theme in which the class is located. Determination of criteria, giving weights and scores is determined based on literature studies and competent justification in the field of fisheries. The process of giving weights and scores as above is carried out through an index approach overlay model to obtain the sequence of land suitability classes. This model requires each coverage weighted and each class in one coverage rated. The multiplication result between the weight and the score received by each coverage is adjusted based on the level of importance to the determination of land suitability for seaweed cultivation.

Before the overlapping operation stage is carried out, a table of land suitability classes for seaweed cultivation is first made which contains information on criteria, then scoring, weighting and to determine the suitability class are carried out.

The final result of GIS analysis through index approach overlay The model is to obtain a ranking or sequence of land suitability classes for seaweed cultivation. Land suitability classes are distinguished at the class level and are defined as follows:

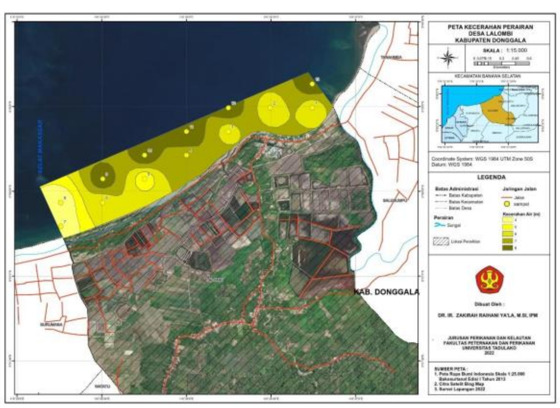
Class S1: Not suitable, namely land or areas that are not suitable for seaweed cultivation because they have severe limiting factors that are permanent.

Class S2: Not suitable, namely if the land or area has rather serious limiting factors or influences the productivity of seaweed cultivation. In its management, additional technological input is needed from the treatment level.

Class S3: Suitable, namely if the land or area is very suitable for seaweed cultivation without significant limiting factors or has minor limiting factors and will not significantly reduce productivity.

RESULTS AND DISCUSSION

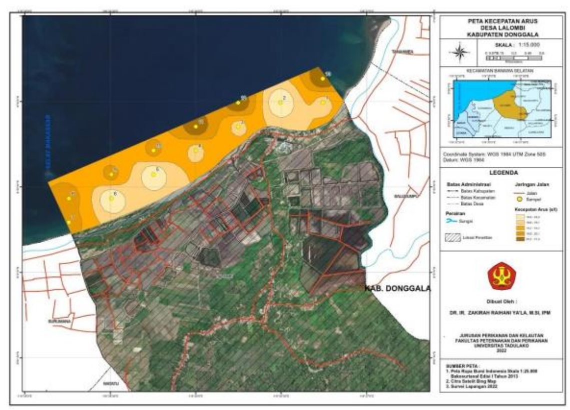
Figure 1. Brightness Map



Sunlight is necessary for the photosynthesis process of seaweed. The amount of sunlight that enters the water is closely related to the brightness of the sea water. There are certain limits for the clarity of seawater. The brightness of the water is up to a limit of 5 meters or the limit of sunlight can penetrate sea water. Habitats Chlorophyceae generally closer to the beach, more central again Phaeophyceaea, and even deeper Rhodophyceae. According to Aslan (2020), optimal brightness is increased if it allows plants to receive sunlight.

Brightness in the waters of the research location ranges from 4 – 8 meters. These results show that the brightness at each entry point shows appropriate results - not appropriate. Points 1, 2, 6, 8, 9, 10, 11, 12, and 13 are included in the appropriate criteria while those included in the less suitable criteria are at points 3, 4, 5 and 7. Mubarak, et al (1990) said that for ideal seaweed cultivation activities, the brightness level of the waters is >5 meters.

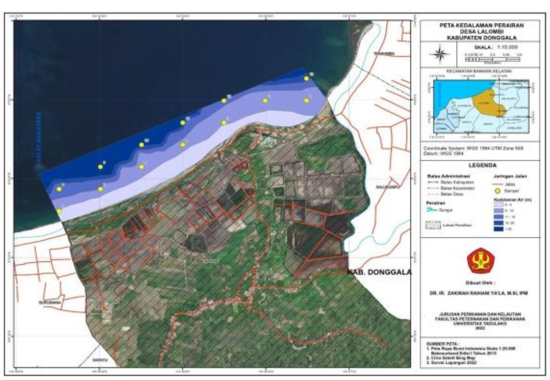
Figure 2. Current Velocity Map



Apart from being protected and the condition of the substrate, the fertility of a cultivation site is determined by the presence of currents (Kotiyaet al., 2011). Current velocity is an important ecological factor in seaweed cultivation where through the movement of this water it can supply nutrients, dissolve oxygen, disperse plankton and remove silt which is much needed supplied and distributed for seaweed growth.

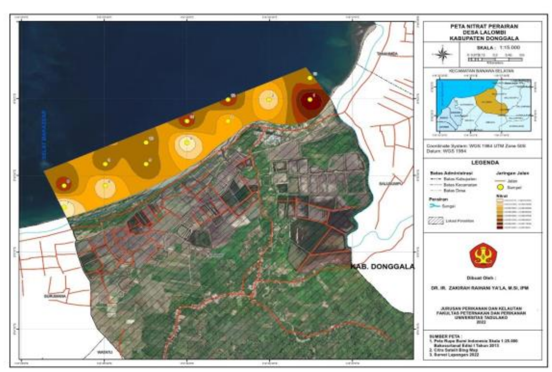
The Directorate General of Cultivation (2013) says that a good current speed for seaweed cultivation is 20-40 cm/sec. Brown (2016) says that good currents will bring nutrients to plants and the plants will be clean because dirt and adhering deposits will be washed away by the currents so the plants will grow well. Waves and currents facilitate the transport of nutrients and cause the water mass to become homogeneous. This homogeneous water mass avoids large fluctuations in temperature, salinity, pH and dissolved oxygen. Current speed desired for cultivationE. Cottonii between 20 -40 cm/sec. Current speed is one of the important factors affecting the growth of seaweed, indirectly preventing an increase in pH and a significant increase in temperature and play a role in gas exchange in the water column (Mudeng et al., 2015).

Figure 3. Water Depth



Water depth has a close relationship with light penetration, vertical temperature stratification, density and oxygen and nutrient content. As the depth increases, the penetration of light will decrease. Seaweed is abundant in the intertidal zone and is usually found at depths of 30–40 meters. In clear tropical areas it can reach a depth of 200 m (Sumich, 1980). Furthermore Bell (1992), put forward the most members Rhodophytalive in deep and warm waters, commonly seen when stranded on the surface. For cultivation Gracilariasp minimum required depth of 50 cm (Yala, 2022). Depth is one of the determining factors in the process of seaweed cultivation. The depth of the cultivation location will affect water productivity, temperature, light penetration and nutrients for seaweed growth. Depth also plays a role in determining the method of seaweed cultivation. Depth is a determining factor for the location of seaweed cultivation because depth is related to the penetration of sunlight which has an important effect on growth (Fahrizal & Ratna, 2018). Depth at the study site ranged from 4 – 27 meters. The highest depth value is at points 11 and 10 while the lowest depth is at point 3.

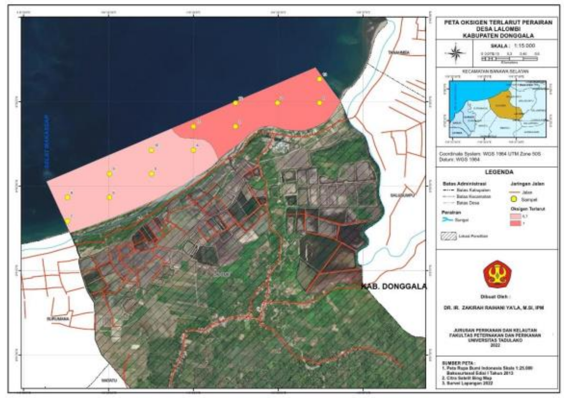
Picture 4. Water nitrate content



The existence of nutrients with their composition in seawater, although very small, is very important for ecological processes. Movement of water greatly influences many ecological and distributional processes, especially the circulation of nutrients and oxygen. Photosynthesis of marine plants in addition to producing oxygen, is also for the formation of proteins, enzymes, energy reserves, transport energy, and other molecules. The concentration of N and P in the waters is very small even though they are needed. The average nitrate content in seawater is 0.5 ppm and the phosphate content is lower than that. Both of these compounds can exceed the limit in the surface area of the water (Wiyarsih et al., 2019).

Nitrate content is one of the criteria for the suitability of waters for seaweed cultivation, because nitrate is one of the nutrients needed by seaweed. Nitrate content in the waters where seaweed cultivation was obtained ranged from 0.0051-0.0058 This shows that at each point the criteria are not appropriate. In line with Rohman (2018) stated that Nitrate content which is good for seaweed growth ranges from 0.1 – 0.2 mg/l. Nitrate levels below 0.1 mg/l or above 45 mg/l are limiting factors that can result in eutrophication which can stimulate the rapid growth of phytoplankton (Atmanisa et al., 2020).

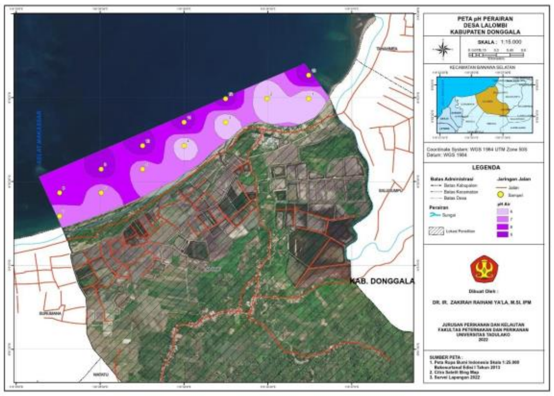
Figure 5. Water Dissolved Oxygen Content



Oxygen is the single most important factor in any aquatic system. Almost all plants and animals require oxygen for respiration. The main source of oxygen comes from the atmosphere and the photosynthesis process of green plants. The regular entry of fresh water and sea water into the waters together with their shallowness, stirring and mixing by the wind, means that there is sufficient oxygen in the water column (Sadighrad et al., 2021). Life in the water column survives if dissolved oxygen is at least 4 ppm, the rest depends on the resistance of organisms, the presence of contaminants and water temperature (Sastrawijaya, 2021).

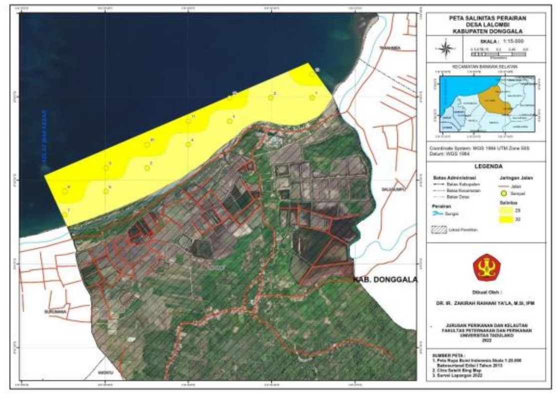
Dissolved oxygen is the amount of oxygen dissolved in water. Dissolved oxygen is an important factor in supporting the growth of organisms as well as other factors. The results of measuring the dissolved oxygen content at each point indicate that dissolved oxygen is included in the appropriate criteria for seaweed cultivation where at each point it ranges from 6.7 and 7.0. This is supported by the Zuldin (2016) who said that the dissolved oxygen content to support seaweed cultivation is 3.0 – 8.0 mg/l. Furthermore Nurdin (2012)said that seaweed can grow and develop optimally in the range of dissolved oxygen > 6.5 mg/l.

Figure 6. Water pH content



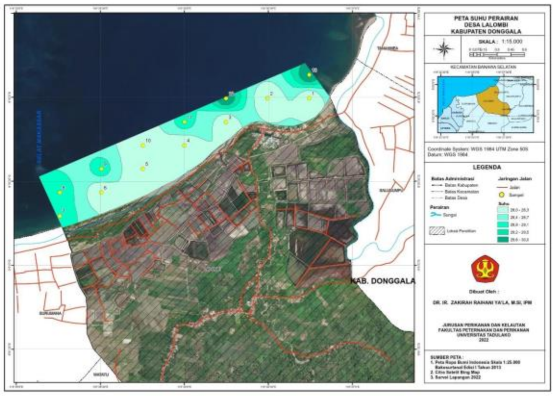
According to Aslan (1998), the degree of acidity of water (pH) is suitable for growth Eucheuma generally ranges from 6–9, while the optimal is 6.5. Meanwhile, according to Poncomulyo et al., (2006), pH is good for growth Eucheuma ranged from 7.3-8.2. According to Tuli (2020), the optimal pH for growth Gracilaria sp ranges from 6-9. Based on the results of measuring the pH parameters of the waters at each point, the range is between 6 – 7. This shows that the pH value supports the growth of seaweed. Appropriate criteria are at points 5, 6, 7, 9, 10, 11, 13 and those that fall into unsuitable criteria are at points 1, 2, 3, 4, 8, and 12. This is supported by Hilson (2017) who said that a good pH for seaweed cultivation ranges from 6.5 – 8.5.

Figure 7. Water Salinity



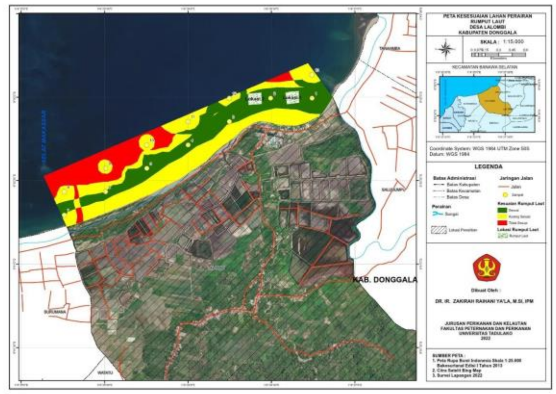
Salinity of waters suitable for cultivation Eucheuma cottonii generally ranges from 28 -35‰. Salinity below 28‰ makes seaweed susceptible to disease. Eucheuma sp is an algae that is only able to tolerate changes in a narrow range of salinity, so that salinity below 30‰ can result in poor growth. Gracilaria Sp originating from the Atlantic and East Pacific maximum growth during cultivation ranged from 15-28‰, with optimal levels of 25‰ (Aslan, 1998). Based on the results of salinity measurements at each point it ranges from 29 - 30 ppt where these results indicate that the salinity content at each point is within the appropriate criteria for seaweed cultivation. This is supported by Adipu et al (2013) that the salinity for a very suitable location for seaweed cultivation is between 28 – 34 ppt.

Figure 8. Water Temperature



Even though the water temperature does not have a lethal effect, it can inhibit the growth of seaweed. Too large a difference in water temperature between day and night can affect growth. This often occurs in waters that are too shallow. Seaweed can usually grow well in areas with temperatures between 26 - 30ºC (Afrianto & Liviawaty, 2019). Meanwhile, according to Gusrina (2013), water temperature is good for growth Eucheuma cottonii ranges from 26–33ºC. In seaweed cultivation (Eucheuma spinosum), the condition of reef exposure with a sand bottom that is not mixed with silt, water clarity, high salinity, temperature and strong currents are the necessary requirements (Neudeck et al., 2002). According to Aslan (1998), the optimal temperature for cultivation Gracilaria sp range 20 -25 0C. Based on the results of temperature measurements at each water point in Lalombi Village, the range is between 28 – 30oC (can be seen in table 4.5). These results indicate that the temperature at each point is at the appropriate criteria for seaweed cultivation. This is supported by Andriano (2016) that the good water temperature range for seaweed is 27 – 30oC, Asni (2015) also said that seaweed grows and develops well in waters that have a temperature range of 26 – 33oC.

Figure 9. Waterland suitability



Based on the results overlay then the land area used for (appropriate, less suitable and not suitable) cultivation activities is obtained Eucheuma cottonii or almost balanced cultivation area. In developing a cultivation business, it is necessary to consider the area of utilization, such as the flow of shipping traffic, the distance between rope long line and for the protection of other ecosystems.

Based on the percentage of land suitability covering the appropriate area of 33.53%, it is not suitable 44.26% and 19.84% that do not fit. This shows that the condition of the seaweed cultivation area is less favorable in terms of water quality. Water quality parameters include physical, chemical and biological aspects. These three parameters are interrelated with one another. So that when one of the parameter elements is disturbed, it will automatically interfere with other elements. For example, when the temperature of the water rises, it will affect the decrease in dissolved oxygen levels in the water. This is due, when the temperature rises will causes the respiration process of aquatic organisms to increase resulting in a decrease in oxygen levels in the waters.

CONCLUSION

Based on the overlay results, the area of land used for (appropriate, less appropriate and inappropriate) Eucheuma cottoni cultivation activities or cultivation areas is almost balanced. In the development of aquaculture business, it is necessary to consider the utilization area such as shipping traffic flow, distance between long line ropes and for the protection of other ecosystems.

BIBLIOGRAFI

Adipu, Y., Lumenta, C., & Sinjal, H. J. (2013). Kesesuaian lahan budidaya laut di perairan Kabupaten Bolaang Mongondow Selatan, Sulawesi Utara. *Jurnal Perikanan Dan Kelautan Tropis*, *9*(1), 19–26.

Afrianto, E., & Liviawaty, E. (2019). Potensi Mikroba Probiotik dari Ikan Nila Mati Masal di Waduk Cirata. *Jurnal Perikanan Kelautan*, *10*(2).

Andriano, N., Bonaccorso, P., Iachelli, V., La Rosa, M., Cannata, E., & Lo Nigro, L. (2016). Genetic aberrations in the DNA repair pathway among children with Philadelphia chromosome positive leukemias. *Cancer Research*, *76*(14_Supplement), 2428.

Aslan, A., & Autin, W. J. (1998). Holocene flood-plain soil formation in the southern lower Mississippi Valley: implications for interpreting alluvial paleosols. *Geological Society of America Bulletin*, *110*(4), 433–449.

Asni, A. (2015). Analisis Poduksi Rumput Laut (Kappaphycus alvarezii) Berdasarkan Musim dan Jarak Lokasi Budidaya di Perairan Kabupaten Bantaeng. *Jurnal Akuatika Vol. VI No*, *140*(153), 253–262.

Atmanisa, A. (2020). *Analisis Kualitas Air pada Kawasan Budidaya Rumput Laut Eucheuma Cottoni di Kabupaten Jeneponto*. UNIVERSITAS NEGERI MAKASSAR.

Atmanisa, A., Mustarin, A., & Taufieq, N. A. (2020). Water Quality Analysis In The Eucheuma Cottoni Seaweed Cultivation Area In Jeneponto District. *Jurnal Pendidikan Teknologi Pertanian*, *6*, 11–22.

Bell, N. J. V, Burget, D., Howden, C., Wilkinson, J., & Hunt, R. H. (1992). Appropriate acid suppression for the management of gastro-oesophageal reflux disease. *Digestion*, *51*(Suppl. 1), 59–67.

Brown, S. L., Chaney, R. L., & Hettiarachchi, G. M. (2016). Lead in urban soils: a real or perceived concern for urban agriculture? *Journal of Environmental Quality*, *45*(1), 26–36.

Chen, J.-L., Hsu, K., & Chuang, C.-T. (2020). How do fishery resources enhance the development of coastal fishing communities: Lessons learned from a community-based sea farming project in Taiwan. *Ocean & Coastal Management*, *184*, 105015.

Eyayu, A., Getahun, A., & Keyombe, J. L. (2023). A review of the production status, constraints, and opportunities in East African freshwater capture and culture fisheries. *Aquaculture International*, 1–22.

Fahrizal, A., & Ratna, R. (2018). Analisa Proksimat Pellet Berbahan Limbah Ikan PPI Klaligi Kota Sorong. *Median: Jurnal Ilmu Ilmu Eksakta*, *10*(3), 31–38.

Gusrina, G., & Amri, Z. (2013). Englishspeak. Com As Media For Teaching Pronunciation Of Junior High School Students. *Journal of English Language Teaching*, *2*(1), 94–102.

Hilson, G., & Laing, T. (2017). Gold mining, indigenous land claims and conflict in Guyana's hinterland. *Journal of Rural Studies*, *50*, 172–187.

Mudeng, J. D., Ngangi, E. L. A., & Rompas, R. J. (2015). Identifikasi Parameter KualitasAir untuk Kepentingan Marikultur di Kabupaten Kepulauan Sangihe Provinsi Sulawesi Utara. *E-Journal Budidaya Perairan*, *3*(1).

Neudeck, P. G., Okojie, R. S., & Chen, L.-Y. (2002). High-temperature electronics-a role for wide bandgap semiconductors? *Proceedings of the IEEE*, *90*(6), 1065–1076.

Nurdin, I. N. (2012). *Evaluation of the Quality and Post Harvest Handling Seaweed Eucheuma cottonii Buto n in Southeast Sulawesi Province*. Thesis Graduate Program Faculty of Agricultural Technology Universitas ….

Poncomulyo, T., Maryani, H., & Kristiani, L. (2006). Budidaya dan pengolahan rumput laut. *PT. Agromedia Pustaka. Surabaya*, *89*.

Popp, J., Pető, K., & Nagy, J. (2013). Pesticide productivity and food security. A review. *Agronomy for Sustainable Development*, *33*, 243–255.

Rohman, M., & Hairudin, H. (2018). Konsep tujuan pendidikan islam perspektif nilai-nilai sosial-kultural. *Al-Tadzkiyyah: Jurnal Pendidikan Islam*, *9*(1), 21–35.

Sadighrad, E., Fach, B. A., Arkin, S. S., Salihoğlu, B., & Hüsrevoğlu, Y. S. (2021). Mesoscale eddies in the Black Sea: Characteristics and kinematic properties in a high-resolution ocean model. *Journal of Marine Systems*, *223*, 103613.

Sapitri, A. R., & Cokrowati, N. (2016). Pertumbuhan rumput laut Kappaphycus alvarezii hasil kultur jaringan pada jarak tanam yang berbeda. *Depik*, *5*(1).

Sastrawijaya, M. D. (2021). The Character and Moral Values in "to Kill a Mockingbird" by Harper Lee. *INFERENCE: Journal of English Language Teaching*, *3*(1), 81–87.

Sumich, J. L. (1980). Biology of marine life. *NC Brown Company Publ. Iowa*.

Tuli, M. (2020). Analysis of Shortfin Scad (Decapterus macrosoma) fisheries in Pohuwato, Gorontalo Province. *PROSIDING*, *10*(3453).

Wiyarsih, B., Endrawati, H., & Sedjati, S. (2019). Komposisi dan kelimpahan fitoplankton di laguna Segara Anakan, Cilacap. *Buletin Oseanografi Marina*, *8*(1), 1–8.

Ya'la, Z. R., Sulistiawati, D., & Tobigo, D. (2022). Multiple Biota Cultivation (Gracilaria sp and Chanos-chanos) Development Model as a Pillar of Milk Fish-Agar Agroindustry and its Applications. *IOP Conference Series: Earth and Environmental Science*, *1075*(1), 12008.

Yala, Z. R. (2022). Physical and chemical conditions of waters for seaweed cultivation in Morowali, Central Sulawesi, Indonesia. *Natural Science: Journal of Science and Technology*, *11*(01), 20–29.

Zuldin, W. H., Yassir, S., & Shapawi, R. (2016). Growth and biochemical composition of Kappaphycus (Rhodophyta) in customized tank culture system. *Journal of Applied Phycology*, *28*, 2453–2458.