

## COMMUNITY PERCEPTION OF NATURAL SEAWEED EXISTENCE ON BAWEAN ISLAND, GRESIK DISTRICT

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### Abstract

The aim of the public perception research on Bawean Island concerning the existence of natural seaweed is to evaluate the extent to which the general public is informed about the function, management, and role of natural seaweed. Integrated coastal management represents a paradigm shift in the pursuit of the Sustainable Development Goals. The utilisation of natural resources by the community is the most crucial aspect of sustainable management. This study employs questionnaires and confined interviews. Diversity of natural seaweed, utilisation of natural seaweed, and potential carbon dioxide absorption capacity of natural seaweed are all research indicators. The level of community knowledge was assessed using the Likert scale. The outcomes of a study conducted on Bawean Island show that there is a high degree of agreement among the respondents opinions on the three research indicators, which are presented in the form of Likert interval values ranging from 80% to 100%. With a 90.25% index value, most participants agreed that Bawean Island has natural seaweed. A majority of participants supported natural seaweed management on Bawean Island, scoring 85.88% on the index. A large majority of participants agreed that Bawean Island's natural seaweed can trap atmospheric carbon (83.17%).

**Keywords:** Sustainable Development Goals, Diversity of Natural Seaweed, Utilisation of Natural Seaweed, Potential Carbon Dioxide Absorption Capacity of Natural Seaweed, Likert Scale.

### INTRODUCTION

Even though it does not have true stems or leaves, seaweed is nevertheless considered to be a type of lower plant because it does possess a thallus. Since 2700 BC, people have been getting their nutrition by eating seaweed<sup>1</sup>. A number of countries have found seaweed to be useful for their economies, with a particular emphasis placed on eastern countries such as Japan and China. According to its production of 11.6 million tons in 2016, as of the year<sup>2</sup>. The production of moist seaweed in Indonesia accounts for a substantial portion of the global total. Seaweed offers a number of benefits to humans, both directly and indirectly, due to its ability to remove carbon from the atmosphere and store it<sup>3</sup>. These benefits come on top of the direct advantages that seaweed offers. The achievement of the Sustainable Development Goals (SDGs) is considerably aided by the contributions made by seaweed.

Seaweed has the potential to satisfy eleven of the United Nations Development Programme's seventeen principles for sustainable development<sup>4</sup>. These concepts were detailed in the UNDP's Sustainable Development Principles and Goals report. It is possible for seaweed to minimize

the amount of methane that is released by animals by converting feed made from seaweed into a natural fertilizer. This process helps to restore soil nutrients, trap carbon, and avoid the acidification of ocean water. In addition to these benefits, it is an essential component in the production of biodegradable packaging and stimulates the participation of women in this sector of the economy.

Policies that encourage integrated seaweed management are essential in order to maximize the contribution of seaweed to the Sustainable Development Goals (SDGs). In spite of the fact that it is located in a region that is naturally rich in seaweed, Bawean Island is still one of the areas in which seaweed is not utilized to its full potential. One factor that has the potential to influence the actions of individuals is the view of the general public. The purpose of this research is to investigate the extent to which the general population is aware of the presence of naturally occurring algae on Bawean Island. It is hoped that the results of this inquiry will lay the groundwork for the responsible and environmentally friendly management of seaweed on Bawean Island.

## MATERIAL AND METHODS

The study was conducted on Bawean Island, located in Gresik Regency (Figure 1). The study was conducted in April 2023, during a period when there was a significant abundance of natural seaweed in the waters of Bawean. The study employs a quantitative descriptive methodology to ascertain popular perceptions. A questionnaire instrument was utilised to gather public impression data, serving as one of the methods for collecting extensive amounts of data<sup>5</sup>. The questionnaire has 13 structured enquiries that are categorised into three indicators, encompassing public attitudes regarding the presence and utilisation of natural seaweed as well as the role of natural seaweed as a carbon sink. Data from the questionnaire was collected through a Google Form link that was distributed over social media<sup>6</sup>. The research sample comprised 40 indigenous Bawean individuals, which falls within the required sample size range of more than 30 and fewer than 500 respondents for descriptive research<sup>7</sup>. The questionnaire findings were subsequently analysed quantitatively using the Likert method of interval analysis.

The Likert scale is subsequently converted into interval data using formulas (1) and (2) according to reference<sup>8</sup>:

$$Total\ score = T \times Pn \quad (1)$$

Information:

T : total number of respondents

Pn : choice of Likert score numbers

$$Index\ \% = \frac{Total\ score}{Y} \times 100(2)$$

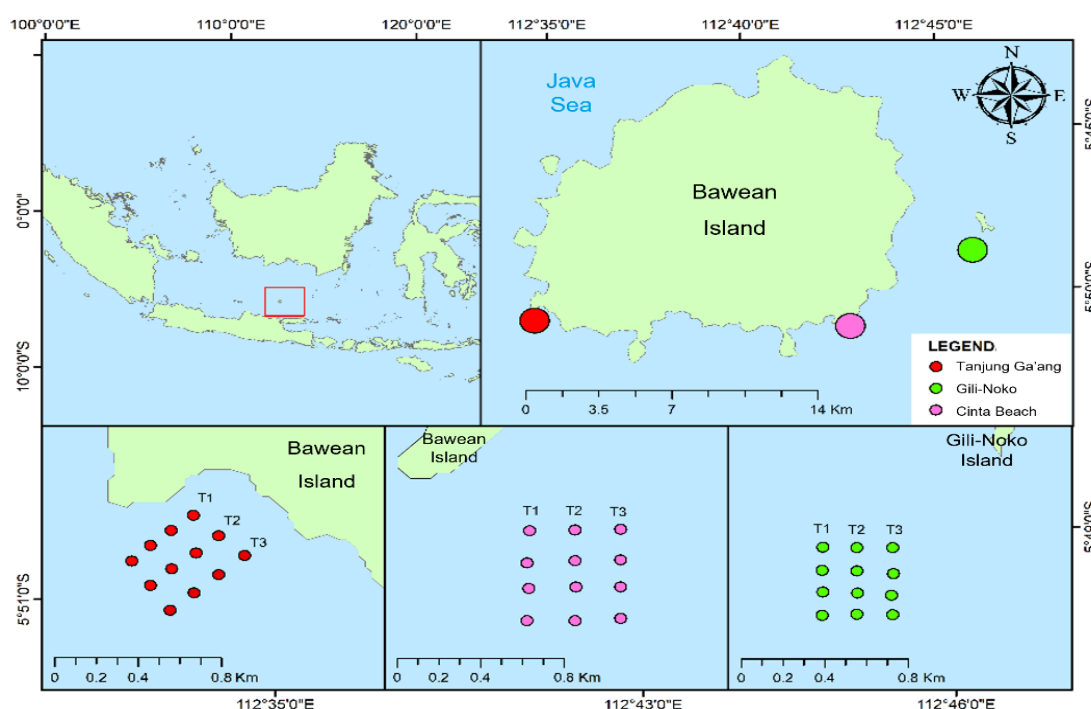
Information:

Y : highest Likert score x number of respondents

The % index results are then adjusted to the percent score interval (Table 1) to determine the results of the public perception assessment<sup>9</sup>.

**Table 1: Likert scale percentage index interval**

Percent Score (%)	Intervals
0 – 19.99	Strongly Disagree
20 – 39.99	Disagree
40 – 59.99	Doubtful
60 – 79.99	Agree
80 – 100	Strongly Agree



**Figure 1: Research Location**

## RESULTS AND DISCUSSION





### Condition of The Research Area

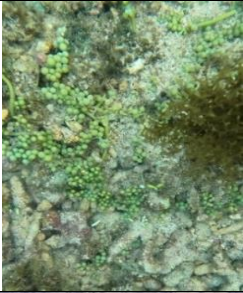

The Java Sea's geographic location in the Gresik Regency serves to identify the island of Bawean. Exactly 120 kilometers separate the district center and Bawean Island in the Gresik Regency to the north. Comprising two subdistricts, Sangkapura District and Tambak District, Bawean Island covers an area of 197 km<sup>2</sup><sup>10</sup>. Included in the sand and muddy categories are beach characteristics at the research station. Seaweed in its natural habitat grows in water containing coral fragments, grainy white sand, and mud<sup>11</sup>. Natural seaweed grows on Bawean Island due to the sloping seashore topography.

### Natural Seaweed in Bawean Island

The species of seaweed discovered in the waters surrounding Bawean Island are species that are common and widely distributed throughout the waters of Indonesia<sup>12</sup>. The Phaeophyta division, comprising three species, is where the most commonly discovered organisms are found. This is followed by the Chlorophyta division, which comprises two species, and the Rhodophyta division, which comprises one species. This result is consistent with previous research that identified red seaweed *Gracillaria* sp., green seaweed *Halimeda* sp., *Caulerpa* sp., and brown seaweed *Sargassum* sp. along the southwest coast of Bawean Island<sup>13</sup>. A table of seaweed species discovered on Bawean Island is provided below in Table 1.

**Table 2: Seaweed Species**

Species	Figure	Information
<i>Sargassum</i> sp.		<ul style="list-style-type: none"> <li>- Brownish-yellow in hue, possessing a lanceolate blade that is typically elliptical in shape and has a blunt apex.</li> <li>- Each branch contains a circular gas reservoir that provides support for the thallus, allowing it to remain afloat during photosynthesis<sup>14</sup>.</li> </ul>
<i>Padina australis</i>		<ul style="list-style-type: none"> <li>- Its thallus is a flat, convex sheet<sup>15</sup>.</li> <li>- It is frequently observed in intertidal regions and is dark brown in color.</li> </ul>
<i>Neomeris annulata</i>		<ul style="list-style-type: none"> <li>- Although typically solitary, they are occasionally observed in clusters.</li> <li>- The blade is shaped like an egg and has a rounded point, resembling a tuft of hair.</li> </ul>
<i>Halimeda tuna</i>		<ul style="list-style-type: none"> <li>- An inverted cone-shaped structure featuring a sizable thallus and tip at its core.</li> <li>- Containing an oval-shaped apex and fused in the manner of a basal segment<sup>16</sup>.</li> <li>- Exceptional adaptability and possesses a fibrous holdfast that facilitates adhesion to uneven substrates<sup>17</sup>.</li> </ul>

Species	Figure	Information
<i>Caulerpa</i> sp.		<ul style="list-style-type: none"> <li>- Its thallus resembles a green grape.</li> <li>- Its holdfast is composed of rhizomes, which aid in adhering to rigid substrates like boulders or decomposing coral.</li> </ul>
<i>Gracillaria</i> sp.		<ul style="list-style-type: none"> <li>- In general, the thallus generates slender branches characterized by a smooth or hairy appearance<sup>18</sup>.</li> <li>- A spherical disc-shaped holdfast for attachment to the substrate is present along with the color, which ranges from greenish to purpleish red<sup>19</sup>.</li> </ul>

### Public Perception of the Natural Seaweed

Forty respondents from Bawean Island participated in a survey regarding community perceptions.

### Public Perception of the Existence of Natural Seaweed

Table 3 presents the results of the public perception calculation pertaining to the existence of natural seaweed on Bawean Island.

**Table 3: Likert scale calculation of the existence of natural seaweed**

Answer Choices	Score	Questions						Total Score	Index (%)
		1	2	3	4	5	6		
SS	5	24	23	23	21	24	23	690	90.25
S	4	13	16	16	18	15	15	372	
RR	3	2	0	0	0	0	1	9	
TS	2	1	1	1	1	1	1	12	
STS	1	0	0	0	0	0	0	0	
<b>TOTAL</b>		40	40	40	40	40	40	180,5	<b>SS</b>

The analysis found an index value of 90.25 %, indicating that a significant majority of respondents strongly agreed that there was natural seaweed on Bawean Island. As per the second question, twenty-three out of forty participants indicated that Bawean Island is home to a diverse array of natural seaweed. At the location of the research, *Sargassum* sp. and *Gracilaria* sp. are the dominant seaweeds with the highest density. The *Sargassum* species is frequently called "karamkam" by the Bawean people. "Sasangon" is an alternative local term for *Gracilaria* species. *Sargassum* sp. is consistently observable at the research station on Bawean Island throughout the year, whereas *Gracilaria* sp. is exclusively detected at the Gili Noko station. From June to October, *Gracilaria* sp. is exclusively observed at Cinta Beach and Sido Beach, among other locations. Based on research findings<sup>20</sup>, it has been determined that

*Gracilaria* sp. is the predominant species in Tuban Waters, East Java, during the month of October.

### Public Perception of the Natural Seaweed Utilization

Table 4 presents the results of the public perception calculations pertaining to the utilisation of natural seaweed on Bawean Island.

**Table 4: Likert scale calculation of natural seaweed utilization**

Answer Choices	Score	Questions				Total Score	Index (%)
		1	2	3	4		
SS	5	16	26	17	17	380	85,88
S	4	19	11	18	18	264	
RR	3	2	1	2	3	24	
TS	2	2	2	3	2	18	
STS	1	1	0	0	0	1	
<b>TOTAL</b>		40	40	40	40	171,75	<b>SS</b>

The results of the analysis showed an index value of 85.88%, indicating that a significant majority of respondents supported the view that Bawean Island implemented natural seaweed management. The results of the study agree with the situation of the Bawean people, who frequently consume natural seaweed, particularly for food consumption. *Gracilaria* sp. is commonly dried and processed with palm sugar to produce jelly, which is subsequently consumed during local community activities or on sweltering days. Among other seaweeds, *Gracilaria* sp. produces jelly<sup>21</sup>. *Sargassum* species are primarily used as a side dish, either in the form of *pencek-pencek* (a seasoning for broiled fish) or for consumption directly. Fishermen typically consume *sargassum* sp. directly after cleaning it with beach sand and serving it as raw vegetables. *Sargassum* sp. is rich in crude fibre, which is beneficial to the diet and digestive health<sup>22</sup>.

### Public Perception of the Potential for Carbon Absorption in Natural Seaweed

Table 4 presents the results of the computation of community perceptions regarding the potential of natural seaweed on Bawean Island to trap carbon.

**Table 5: Likert scale calculation of the potential for carbon absorption in natural seaweed**

Answer Choices	Score	Questions			Total Score	Index (%)
		1	2	3		
SS	5	12	16	16	220	83,17
S	4	21	17	18	224	
RR	3	5	5	5	45	
TS	2	2	2	1	10	
STS	1	0	0	0	0	
<b>TOTAL</b>		40	40	40	166,33	<b>SS</b>

The results of the analysis produced an index value of 83.17%, indicating that a significant majority of respondents agreed that the natural seaweed present on Bawean Island possesses

the capacity to trap atmospheric carbon. Respondents are aware of the correlation between seaweed and global warming. The participants expressed great enthusiasm regarding the capacity of seaweed to trap carbon. Since the people of Bawean have thus far utilised natural seaweeds for personal use, the island is abundant with such species. Due to an ongoing lack of proficiency among farmers on Bawean Island, the island's seaweed processing and marketing infrastructure remains insufficient<sup>23</sup>. The evaluation is predicated on the prevalence of seaweed cultivation, which is usually limited. Researchers only found one pond cultivating *Gracilaria* sp. seaweed with dimensions of 17 x 34 m in Daun Village, Sangkapura District.

Knowledge of the administration and operation of coastal ecosystems serves as the foundation for integrated coastal management. Coastal ecosystem health can be enhanced via a scientific methodology<sup>24</sup>. Seaweed's public perception as a carbon sink and the maintenance of healthy littoral ecosystems are essential for the attainment of the Sustainable Development Goals. As explained in *The World 2050*, the attainment of the SDGs requires six transformations. One of the transformations discusses the energy decarbonisation system in accordance with *the Paris Agreement*<sup>25</sup>. Fuel use must be accompanied by carbon absorption and storage. One of the carbon sinks in the research area is seaweed, so public knowledge about the role of seaweed is very important.

## CONCLUSION

The findings of the study reveal a substantial degree of consensus among members of the community concerning the existence of indigenous algae on Bawean Island. An index value of 90.25% indicates that a significant majority of respondents strongly agreed that Bawean Island contains natural seaweed. The community exhibits substantial endorsement for the utilization of natural seaweed as a valuable resource on account of its manifold benefits. However, the community has yet to attain the highest level of efficiency in its utilization of seaweed. A significant plurality of respondents (85.688 percent) indicated support for the implementation of natural seaweed management on Bawean Island, as indicated by their index score. Further action is necessary to mitigate the issue of seaweed utilization, particularly with regard to the *Sargassum* sp. and *Gracilaria* sp. species, which are the predominant species found on Bawean Island. The index score of 83.17% indicates that a significant majority of respondents agreed that the natural seaweed discovered on Bawean Island possesses the capacity to sequester atmospheric carbon; therefore, the sustainability of seaweed must be maintained.

## Acknowledgements

The author would like to express his thanks to the indigenous people of Bawean Island who have helped in collecting data so that the research results can be properly structured regarding the public's perception of the presence of seaweed on Bawean Island.

## Declaration of Interest Statement

The authors declare that there is no conflict of interest.

**Footnote**

- 1) Dewi, "Potential seaweed resources."
- 2) Wibowo, "Seaweed is an Important Commodity That Has Not Been Optimized."
- 3) Krause-Jensen and Duarte, "Substantial Role of Macroalgae in Marine Carbon Sequestration."
- 4) Smit, "Standing Up for SDG 14, and Speaking Up for Seaweed."
- 5) Pranatawijaya et al., "Application of Likert scales and dichotomous scales in online questionnaires."
- 6) Wahyuni, Yunisca, and Handican, "Blended Learning."
- 7) Bangun, Rohayati, and Kusmayanti, "Designing Getzke website service attributes using WebQual 4.0 integration and the Kano model."
- 8) Sumartini, Harahap, and Sthevany, "Study of quality control of precooked frozen tuna loin products using the Likert scale method at tuna freezing company x."
- 9) Sumartini, Harahap, and Sthevany.
- 10) Tribun News, "Bawean Island."
- 11) Herlinawati, Arthana, and Dewi, "Diversity and density of natural seaweed in the waters of Serangan Island, Denpasar, Bali."
- 12) Pakidi, "Potential and utilization of active ingredients of brown algae *Sargassum* sp."
- 13) Violando et al., "Microplastics Content of Seaweeds in the Mariculture Potential Zone at The Southwest of Coastal Bawean Island."
- 14) Rigg and Henry, "On the Origin of the Gases in the Float of Bladder Kelp."
- 15) Safitri et al., "Macroalgae community structure in Temajuk Waters, Paloh District, West Kalimantan."
- 16) Nemcova, Orlando-Bonaca, and Neustupa, "Halimeda Tuna (Bryopsidales, Ulvophyceae) Calcification on the Depth Transect in the Northern Adriatic Sea; Carbonate Production on the Microscale of Individual Segments."
- 17) Rombe et al., "Composition and density of algae species in the Banda Sea marine tourist park in Central Maluku Regency."
- 18) Bhushan et al., "Biology, Farming and Applications of Economically Important Red Seaweed *Gracilaria Edulis* (S. G. Gmelin) P. C. Silva."
- 19) Wang et al., "Diversity of *Gracilariaceae* (Rhodophyta) in China."
- 20) Putriarti and Rachmadiarti, "The diversity of seaweed and its use by the community on the coast of Palang District, Tuban Regency."
- 21) Hangga and Meiyasa, "Study of the chemical and organoleptic properties of nori with a comparison of *Ulva Reticulata* and *Glacilaria* Sp."
- 22) Herliany et al., "Potential of *Sargassum crassifolium* and *Boergessenia forbessi* from Sepang Bay Beach as functional food."
- 23) Rahim et al., "Alternative business for cultivating green seaweed *Caulerpa* sp. With an off-base method in coastal communities."
- 24) Rudianto and Guntur, Integrated Model of Coastal Ecosystem Restoration Management.
- 25) Sachs et al., "Six Transformations to Achieve the Sustainable Development Goals."



## Reference

- 1) Bangun, Verona Marsha Alvinia, Yati Rohayati, and Ima Normalia Kusmayanti. "Designing Getzke website service attributes using WebQual 4.0 integration and the Kano model." *e-Proceeding of Engineering* 10, no. 3 (June 2023): 2387–93.
- 2) Bhushan, Satej, V. Veeragurunathan, Bhavik K. Bhagiya, S. Gopala Krishnan, Arup Ghosh, and Vaibhav A. Mantri. "Biology, Farming and Applications of Economically Important Red Seaweed *Gracilaria Edulis* (S. G. Gmelin) P. C. Silva: A Concise Review." *Journal of Applied Phycology* 35, no. 3 (June 2023): 983–96. <https://doi.org/10.1007/s10811-023-02955-8>.
- 3) Dewi, Rose. "Potensi sumberdaya rumput laut." *Jurnal Harpodon Borneo* 5, no. 2 (2012): 125–29.
- 4) Hangga, U. K. H., and Firat Meiyasa. "Study of the chemical and organoleptic properties of nori with a comparison of *Ulva Reticulata* and *Glacilaria Sp.*" *SEMNAS SATI* 1, no. 1 (January 2023): 151–60.
- 5) Herliany, Nurlaila Ervina, Maya Angraini Fajar Utami, Mukti Dono Wilopo, Doli Iskandar Muda, Shilfarina Dwi Mutiara, and Winda Luciana Dewi. "Potential of *Sargassum crassifolium* and *Boergessenia forbessi* from Sepang Bay Beach as functional food" 2022.
- 6) Herlinawati, Ni Desak Putu Dita, I Wayan Arthana, and Ayu Putu Wiweka Krisna Dewi. "Diversity and density of natural seaweed in the waters of Serangan Island, Denpasar, Bali." *Journal of Marine and Aquatic Sciences* 4, no. 1 (August 24, 2017): 22. <https://doi.org/10.24843/jmas.2018.v4.i01.22-30>.
- 7) Krause-Jensen, Dorte, and Carlos M. Duarte. "Substantial Role of Macroalgae in Marine Carbon Sequestration." *Nature Geoscience* 9, no. 10 (October 2016): 737–42. <https://doi.org/10.1038/ngeo2790>.
- 8) Nemcova, Yvonne, Martina Orlando-Bonaca, and Jiri Neustupa. "*Halimeda Tuna* (Bryopsidales, Ulvophyceae) Calcification on the Depth Transect in the Northern Adriatic Sea; Carbonate Production on the Microscale of Individual Segments." *PeerJ* 11 (March 16, 2023): e15061. <https://doi.org/10.7717/peerj.15061>.
- 9) Pakidi, Chalvyn S. "Potential and utilization of active ingredients of brown algae *Sargassum sp.*" 6 (2017).
- 10) Pranatawijaya, Viktor Handrianus, Widiatry Widiatry, Ressa Priskila, and Putu Bagus Adidyana Anugrah Putra. "Application of Likert scales and dichotomous scales in online questionnaires." *Jurnal Sains dan Informatika* 5, no. 2 (December 8, 2019): 128–37. <https://doi.org/10.34128/jsi.v5i2.185>.
- 11) Putriarti, Dewi, and Fida Rachmadiarti. "The diversity of seaweed and its use by the community on the coast of Palang District, Tuban Regency." *Lentera Bio* 12, no. 3 (June 6, 2023): 248–57. <https://doi.org/10.26740/lenterabio.v12n3.p248-257>.
- 12) Rahim, Andi Rahmad, Nur Maulida Safitri, Sutrisno Adi Prayitno, Ummul Firmani, Dwi Retnaningtyas Utami, and Wiharyanti Nur Lailiyah. "Alternative business for cultivating green seaweed *Caulerpa sp.* With an off-base method in coastal communities" 5 (2023).
- 13) Rigg, George B., and B. S. Henry. "On the Origin of the Gases in the Float of Bladder Kelp." *American Journal of Botany* 22, no. 3 (March 1935): 362–65. <https://doi.org/10.1002/j.1537-2197.1935.tb05025.x>.
- 14) Rombe, Katarina Hesty, Abdul Rahman, Mardiana Mardiana, and Dwi Rosalina. "Composition and density of algae species in the Banda Sea marine tourist park in Central Maluku Regency." *NEKTON: Jurnal Perikanan dan Ilmu Kelautan*, March 5, 2023, 1–12. <https://doi.org/10.47767/nekton.v3i1.383>.
- 15) Rudianto, and Guntur. *Integrated Model of Coastal Ecosystem Restoration Management*. Malang: UB Media, 2022.
- 16) Sachs, Jeffrey D., Guido Schmidt-Traub, Mariana Mazzucato, Dirk Messner, Nebojsa Nakicenovic, and Johan Rockström. "Six Transformations to Achieve the Sustainable Development Goals." *Nature Sustainability* 2, no. 9 (August 26, 2019): 805–14. <https://doi.org/10.1038/s41893-019-0352-9>.

- 17) Safitri, Ikha, Aswandi, Warsidah, M. S. J. Sofiana, Dwi Gusmalawati, and Wulandari Rousdy. "Macroalgae community structure in Temajuk Waters, Paloh District, West Kalimantan." *Journal of Fisheries and Marine Research* 7, no. 1 (March 28, 2023). <https://doi.org/10.21776/ub.jfmr.2023.007.01.7>.
- 18) Smit, Simone. "Standing Up for SDG 14, and Speaking Up for Seaweed." *UNDP*, January 9, 2021. <https://www.undp.org/south-africa/blog/standing-sdg-14-and-speaking-seaweed>.
- 19) Sumartini, Kurnia Sada Harahap, and Sthevany. "Study of Quality Control of Precooked Frozen Tuna Loin Products Using The Likert Scale Method at Tuna Freezing Company X." *Aurelia Journal* 2, no. 1 (2020): 29–38.
- 20) Tribun News. "Bawean Island." *Tribun*, Mei 2022. <https://www.tribunnewswiki.com/2021/05/14/pulau-bawean>.
- 21) Violando, Wiga Alif, Nur Maulida Safitri, Andi Rahmad Rahim, Mauludiyah, and Agus Purnomo Ahmad Putikadyanto. "Microplastics Content of Seaweeds in the Mariculture Potential Zone at The Southwest of Coastal Bawean Island." *Jurnal Biologi Tropis* 23, no. 2 (March 7, 2023): 75–83. <https://doi.org/10.29303/jbt.v23i2.4770>.
- 22) Wahyuni, Annisa Tri, Latifa Yunisca, and Rhomiy Handican. "Blended learning: what is student perception?" *Griya Journal of Mathematics Education and Application* 3, no. 1 (March 31, 2023): 125–34. <https://doi.org/10.29303/griya.v3i1.281>.
- 23) Wang, Xulei, Menglin Guo, Shusheng Yan, Yongqiang Wang, Zhongmin Sun, Bangmei Xia, and Guancee Wang. "Diversity of Gracilariaceae (Rhodophyta) in China: An Integrative Morphological and Molecular Assessment Including a Description of Gracilaria Tsengii Sp. Nov." *Algal Research* 71 (April 2023): 103074. <https://doi.org/10.1016/j.algal.2023.103074>.
- 24) Wibowo, A. "Seaweed is an Important Commodity That Has Not Been Optimized." *Kementerian Kelautan Dan Perikanan*, September 27, 2019. <https://kkp.go.id/artikel/14127-rumput-laut-komoditas-penting-yang-belum-dioptimalkan>.