Towards Climate Change Resilience: Curtailing the Offense Against Seagrass Meadows

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Abstract Having the ability to sink carbon, seagrass meadows have a prominent role in the pathways of climate change resilience. However, the status of seagrass meadows in Indonesian waters is currently in a less healthy state since the percentage of meadows is 42.23%. Hence, this research aims to analyze the regulatory frameworks for curtailing the offences against seagrasses to enhance their sustainability thus achieving Sustainable Development Goal 14 (life below water). This doctrinal research uses both a conceptual and a statutory approach to comprehensively analyze the issued legal problems. The results show that the prominent act that threatens seagrass meadows' sustainability in Indonesia is the detriment of seagrass due to the management of the coastal area and isles, particularly the practices of destructive means and methods resulting in damaging the seagrasses and their ecosystem. To curtail it, the mentioned practices are deemed as offences against seagrasses as stipulated in Article 73 Paragraph (1) point c of Law No. 1 of 2014 amending Law No. 27 of 2007 concerning the Management of Coastal Areas and Isles. Yet, to strengthen its enforcement, this research encourages revising the Act by regulating corporate criminal liability and reforming its sentencing system, which is not only by recognizing both offence-related corrective action and payment of compensation as penal measures but also by updating the existing fines based on the fines' classification as stipulated in the new *Penal* Code, in consideration of the high cost of seagrass meadows restoration.

Keywords: Climate Change Resilience, Offences against Seagrass Meadows, Regulatory Frameworks, Sustainable Development Goals

1. Introduction

Seagrass meadows are one of the submerged coastal aquatic ecosystems located in shoreline waters.[1] Seagrasses, which have more than 295,000 species, are part of the *Magnoliophyta* (flowering plants), and the vast majority are terrestrial.[2]–[4] Being one of the most common coastal habitats on Earth, seagrass meadows are potentially covering more than 300,000 km^2 in at least 159 countries.[5] They are among the most productive marine ecosystems for they purify water, provide food to hundreds of millions of people, and support rich biodiversity[5] since they have the ability to photosynthesize.[6], [7] More recently, estimates have suggested seagrass beds support the productivity of 20% of the world's largest fisheries by providing a nursery habitat.[8] Furthermore, they are mostly regarded as major carbon sinks

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following their sediments constitute one of the planet's most efficient stores of carbon.[5]

Having the ability to sink carbon, seagrass meadows have a prominent role in the pathways of climate change resilience,[9] hence the need for comprehensive policy frameworks to enhance their protection and sustainability. Climate change requires new approaches to sustainable development goals that take account of elaborate relations between climate and the ecological system.[10] This is so as an important marine ecosystem, the restoration of seagrasses has been recommended as a blue carbon strategy for climate change mitigation[4] to achieve sustainable development goals.

In Southeast Asia, seagrass ecosystems have a significant role in climate change resilience since they have prominent potential to contribute up to 7.03% of the countries' reduction goal of CO_2 emissions by 2030.[11] Accordingly, ensuring healthy seagrass meadows, which are located in highly shallow waters down to 60 m depth, is an important action to achieve some level of climate stability.[8] On the other hand, being one of enormous biodiversity countries, Indonesia has roughly 292 thousand hectares of seagrass meadows hence the largest in Southeast Asia.[12] That being said, Indonesia has 5%-10% of the world's seagrass meadows whereas one square kilometer of seagrass can store almost twice as much carbon as forests.[13] Consequently, Indonesia has an important role in mitigating climate change by protecting seagrasses as the ocean's great carbon absorb through policy frameworks to curtail the offences against seagrasses hence enhancing their sustainability.

Despite the mentioned facts, they are an underappreciated ecosystem due to being overshadowed by coral reefs and mangroves.[5] Additionally, the lack of information regarding the importance of seagrass meadows resulted in the said potential ecosystem being neglected.[14] Moreover, although they have environmental and socio-economic value, they are rapidly decreasing due to various threats such as rising sea surface temperatures, extreme temperature events, and industrial effluent disposal resulting in detriment ecological and socio-economic consequences.[15], [16] Seagrass meadows are decreasing on a global basis, compromising their capacity as blue carbon sinks, yet, seagrass restoration could reinstate their carbon sequestration capacity.[17]

To support the above statement, based on the report of the Indonesian Institute of Sciences, the status of seagrass meadows in Indonesian Waters is currently in a less healthy state since the percentage of the meadows is 42.23%.[18] The importance for seagrass safeguarding, evaluation, management, and restoration has become more apparent as a result of informed losses.[19] Nevertheless, future restoration initiatives ought to involve monitoring funds to make sure proper surveillance intervals are kept track of.[16]

One of the significant factors that threatens seagrass meadows' sustainability in Indonesia is the offences against them such as the detriment of seagrass due to the management of the coastal area and isles. The still-occurring offences against seagrasses threaten the sustainability of the marine ecosystem, including seagrass meadows, yet its enforcement remains challenging. Therefore, the regulation of

offences against seagrasses must be enforced effectively to enhance climate change resilience. To ensure it, this research will thoroughly analyze the regulatory frameworks regarding the offences against seagrasses considering they are the basis of the enforcement. For that reason, the said regulatory framework, which is the Management of Coastal Area and Isles Act, will be reviewed not only the related articles and their elements but also the regulated sentences.

Currently, research regarding seagrass meadows in Indonesia has been conducted by many, such as, *firstly,* the study conducted by Wahyudi, et.al, (2020) concerning the assessment of carbon stock and sequestration of the tropical seagrass meadows in Indonesia, *secondly,* the research was done by Unsworth, et.al., (2018) examined Indonesia's globally significant seagrass meadows which are under widespread threat. Furthermore, a preliminary study was written by Ambo-Rappe (2020) regarding seagrass meadows for fisheries in Indonesia. Yet, none of the research specifically analyzes the related laws to curtail the offences against seagrasses in order to conserve their sustainability that is so supporting climate change resilience hence the urgency of this research.

2. Research Problem

How is the regulatory framework regarding the curtailing of the offence against seagrass meadows in Indonesia and how is the sentencing system designed to enhance climate change resilience?

3. Method

This legal research is doctrinal research using the statutory approach and conceptual method to comprehensively analyze the legal norms related to the issued legal problem by elaborating on the provision on the curtailment of the offences against seagrass meadows, which is the Management of Coastal Area and Isles Act, after which results and conclusions were presented. Furthermore, the primary legal materials used in this research are Law Number 1 of 2014 amending Law Number 27 of 2007 concerning the Management of Coastal Areas and Isles and Law Number 1 of 2023 on the Criminal Code. The said data were obtained through both document and literature studies and analyzed using the descriptive-qualitative method.

4. Discussion

Seagrass meadows are deemed not only as an ecosystem engineer but also global biological sentinels of multiple anthropogenic pressures in coastal ecosystems since they provide innumerable ecosystem services.[19]–[22] Being one of the coastal ecosystems, seagrass beds store large amounts of carbon, so their protection is regarded as a vital instrument in mitigating climate change.[23] Recognizing seagrass meadows' significant carbon sink potential has recently led to the idea that seagrass meadows can potentially be utilized in climate change mitigation strategies centred on both seagrass meadow protection and reforestation.[24] Thus, seagrass has a

prominent role in achieving climate stability considering its ability to absorb carbon. Yet, seagrass resource depletion in coastal areas is accelerating.[25] To protect them, legislation and policy are used to counter the major threats to seagrass,[22] including the seagrasses' destruction.

In Indonesia, the protection of seagrass ecosystem is regulated in Law Number 1 of 2014 amending Law Number 27 of 2007 concerning the Management of Coastal Areas and Isles. Regarding the purpose of the enactment of the Act, its consideration mentioned coastal ecosystems, including seagrass meadows, are essential for the development of social, economic, cultural, and environmental, therefore, they need to be managed sustainably and with a global perspective by paying attention to aspirations, participation in society, and the nation's values based on its national legal norms. Moreover, assuming that the top meter of soils as well as all of the natural carbon in seagrass biomass are remineralized, the current rates of seagrass loss might lead to the release of up to 299 Tg carbon annually.[23] For that reason, the management of coastal areas and isles should be based on the principle of sustainability to ensure the protection of coastal ecosystems in developing coastal areas.

One of the drivers of seagrass meadows' destruction, hence hindering the climate change resilience, is human activity in the form of offence against seagrasses which is the detriment of seagrass due to the management of the coastal areas and isles. The said offence is regulated in Article 73 Paragraph (1) point c jo Article 35 paragraph h of the Management of Coastal Areas and Isles Act.

The elements	The sentences
Every person	a. Imprisonment: 2 (two) years at the minimum and 10 (ten) years at the maximum, and b. Fine: Rp 2,000.000.000,00 (two billion rupiahs) at the minimum and Rp 10,000.000.000,00 (ten billion rupiahs) at the maximum
Intentionally	
Using the way and method that destructing seagrass meadows	

The first element is *every person,* meaning that the subject of the article, or in other words, the committing parties of the mentioned offence are an individual and/or corporation (either a legal entity or not), as regulated in Article 1 paragraph 38 of the Management of Coastal Areas and Isles Act. The new *penal* code (Law Number 1 of 2023 on the Criminal Code) defines a corporation as a legal entity in the form of a limited corporation, foundation, cooperative, state-owned company, regionally owned enterprise, or those equated with it, as well as a well-bodied legal or unincorporated group, business entity that takes the form of a firm, *Commanditaire Vennootschap,* or that, in conformity with the rules and regulations, is equated with it. Accordingly, the subjects of this article shall be held liable in case they commit the stipulated offence.

Criminal liability is the continuation of objective blame for a criminal act based on applicable legal provisions and subjectively directed at the author (who committed the disgraceful act) who fulfils the requirements in law (criminal) to be

subject to negative sanctions in the form of a criminal offence because of the act committed by the author.[26] Regarding corporate criminal liability, the Management of Coastal Areas and Isles Act does not regulate it, hence, despite avowed as a subject of the Management of Coastal Areas and Isles Act, the corporation is unable to be held criminally liable for the offence. However, the new criminal code recognizes corporate criminal liability, as stipulated in Article 49, which mentions that not only the executives or functional bodies or beneficiary owners can be held criminally liable for their crimes but also the corporation.

The urgency of corporate criminal liability is that the environmental crimes, including the offence against seagrass beds, already have widespread and complicated consequences, such as causing direct damage to both ecosystems and communities, and even compromising the nation's stability in both finances and economy.[27] In addition, there are a number of challenges related to the scope of regulation of corporate criminal liability that must be regulated in Indonesian laws, including provisions regarding management accountability, corporate criminal responsibility formulation models, as well as corporate compensation for those deemed to be impacted by business conduct.[28]

The next element is *intentional*, which is defined as a state where the legal person both knows the committed actions are prohibited acts as well as intends to do them, or knowingly does them to cause consequences that are prohibited by law.[29] Therefore, as a criminal offense, any act committed against seagrasses should be intentional and conducted with the intent to cause harm or with disregard for the potential destruction.[30] Regarding a corporation as a legal person, according to Article 48 of the Criminal Code 2023, corporations can be held criminally liable if the criminal act is included in the scope of business or activity as stated in the articles of organization or other provisions that apply to corporations, profit the corporation illegally, classified as corporate's policy, The company failed to take the required precautions to carry out preventive, lessen the impact, and guarantee adherence to the relevant legal requirements in order to prevent crimes, and/ or corporate tolerates the offence.

Lastly, the element of *using the way and method that destructing seagrass meadows.* In regards to this element, there are several human activities that are detrimental to seagrasses such as the use of harmful fishing gear, the dredging, stockpiling, or reclamation of coastal areas, coral extraction, oil spills, as well as agricultural and aquaculture waste.[31], [32] Moreover, there are six prominent global challenges to seagrass conservation which are (1) a lack of awareness of what seagrasses are and a limited societal recognition of the importance of seagrasses in coastal systems; (2) the status of many seagrass meadows are unknown, and up-to-date information on status and condition is essential; (3) understanding threatening activities at local scales is required to target management actions accordingly; (4) expanding our understanding of interactions between the socio-economic and ecological elements of seagrass systems is essential to balance the needs of people and the planet; (5) seagrass research should be expanded to generate scientific inquiries that support conservation actions; (6) increased understanding of the

linkages between seagrass and climate change is required to adapt conservation accordingly.[8]

On the other hand, as prominent and highly productive coastal ecosystems, seagrasses provide some essential coastal services including greater biodiversity, sediment stabilization, enhanced water quality, and carbon storage.[33] Seagrass meadows also have high primary production rates, and their canopies are effective at filtering particles out of the water column and preventing sediment resuspension.[24] For those reasons, the offence against seagrass meadows, which undermines the conservation of seagrass meadows, shall be effectively enforced to ensure their sustainability as blue carbon ecosystems, thus strengthening climate change resilience. Furthermore, the development of specific climate mitigation strategies regarding seagrass ecosystems is nascent.[22]

To promote the conservation of seagrasses, the aforementioned article not only regulates the offence against seagrass meadows but also the sentences that may be imposed on the perpetrator of the said offence. The sentences are imprisonment for a minimum of 2 (two) years and a maximum of 10 (ten) years, and fines for a minimum of Rp 2.000.000.000,00 (two billion rupiahs) and a maximum of Rp 10.000.000.000,00 (ten billion rupiahs). It is a cumulative sentencing system in which the perpetrator of the offence shall be sentenced to both imprisonment and criminal fines regardless of the duration or the amount of the sentences.

Following the enactment of the new criminal code, this research encourages the article to be revised to strengthen the effectiveness of its law enforcement by not only revising the existing sentencing system but also by accommodating the penal measures as the implementation of a double-track system in criminal sentencing. Regarding the former revision, the criminal fine should be adjusted to the new *Penal* Code. Accordingly, based on Article 121 paragraph (2) point b of the new *Penal* Code, since the regulated imprisonment is more than 7 (seven) years, the imposed fine must be Rp 5.000.000.000,00 (five billion) at maximum (7th category).

To ensure the fines are paid by the convict, the article should also stipulate the time limit and the following actions that may be taken as a consequence of the unpaid fines. The period of fines payment should be stated clearly in the verdict hence the following actions can be conducted after the period is over. The actions are the prosecutor can seize and auction the convict's wealth or income to pay for the crime's outstanding fines (Article 81 paragraph (3) of the Criminal Code 2023). If the confiscation and auction of wealth or income is unable to be carried out, for individual offender, the unpaid fine is substituted by criminal imprisonment for a minimum of one year and a maximum of the criminal acts involved (Article 83 paragraph (1) of the Criminal Code 2023) while for corporations, they are liable to criminal substitution charges in the form of partial or complete freezing of corporate business operations (Article 122 paragraph (4) of the Criminal Code 2023).

The payment of compensation should be added as an additional punishment for both individual perpetrators (Article 66 point d of the Criminal Code 2023) and corporate offenders (Article 120 paragraph (1) point a of the Criminal Code 2023) in preventing the same crime from occurring and supporting the expenses of seagrasses'

restoration since it is an economic sanction. Moreover, if the corporation fails to pay the compensation, prosecutors might seize and auction off its wealth or revenue to cover the unpaid compensation (Article 120 paragraph (3) of the Criminal Code 2023). Additionally, restoring the destroyed ecosystems (Article 120 paragraph (1) point b of the Criminal Code 2023) should be regulated as an additional sanction for corporations that commit the offence. For the later revision, which is adding penal measures in the article's sentencing system, this study proposes the *penal* measures on offence-related corrective actions such as restoring or repairing the harm resulting from the crime and corporate takeover. The former measure is imposed on individual doers (Article 103 paragraph (1) point e *jo* Article 108 of the Criminal Code 2023) whereas the latter one is imposed on corporate offenders (Article 123 point a of the Criminal Code 2023).

The above propositions are based on the fact that not only the required high cost of seagrasses' restoration, which is estimated to be roughly US$700,000 (Rp 10,4 billion) per hectare,[34] but also the long period of the restoration process of seagrass meadows along with a multidoor approach, such as the analysis of biodiversity and of the sedimentary processes and biogeochemical cycles, to evaluate the success of restoration actions of the seagrass ecosystem.[35] Consequently, to achieve a significant contribution to adaptation and mitigation in relation to environmental change, policymaking should bridge sectors and look beyond incremental improvements to consider transformative and positive change.[36] Hence, the above-mentioned article's revision, particularly corporate criminal liability and the sentencing system, shall be considered in reviewing and reforming the existing regulation.

5. Conclusion

To enhance climate change resilience, the offence against seagrasses (as a blue carbon ecosystem), which undermines the conservation of seagrass meadows, shall be effectively enforced. For that reason, the regulatory framework regarding the curtailing of the said offence must be revised by regulating corporate criminal liability, which may refer to the new *Penal* Code. Furthermore, to ensure the effectiveness of its law enforcement, following the enactment of the new criminal code, this research encourages the article to be revised to strengthen the effectiveness of its law enforcement by not only revising the existing sentencing system but also by accommodating the penal measures as the implementation of a double-track system in criminal sentencing. Regarding the former revision, the criminal fine should be adjusted to the new *Penal* Code, and the payment of compensation shall be regulated as an additional punishment for both individual perpetrators and corporate offenders. For the later revision, which is adding penal measures in the article's sentencing system, this study proposes the *penal* measures on offence-related corrective actions such as restoring or repairing the harm resulting from the crime and corporate takeover.

References

[1] F. T. et al. Duarte, Carlos M.; Borum, Jens; Short, "Seagrass ecosystems: Their global status and prospects.," *Aquat. Ecosyst. Trends Glob. Prospect. Cambridge Univ. Press*, pp. 281–294, 2008.

[2] M. J. M. Christenhusz and J. W. Byng, "Phytotaxa.," *Phytotaxa*, vol. 261, no. 3, pp. 201–217, 2016, doi: 10.11646/phytotaxa.261.3.1.

[3] K. J. M. & S. M. T. P. A. Chambers, P. Lacoul, "Global diversity of aquatic macrophytes in freshwater," *Hydrobiologia*, no. 595, pp. 9–26, 2008, doi: https://doi.org/10.1007/s10750-007-9154-6.

[4] G. P. and T. T. Charles-François Boudouresque, Aurélie Blanfuné, "Restoration of Seagrass Meadows in the Mediterranean Sea:A Critical Review of Effectiveness and Ethical Issues," *Water*, vol. 13, no. 8, 2021, doi: https://doi.org/10.3390/w13081034.

[5] UNEP, *Out of the Blue: the Value of Seagrasses to the Environment and to People*. 2020.

[6] et al. Russell, B.D., Connell, S.D., Uthicke, S., "Future seagrass beds: Can increased productivity lead to increased carbon storage?," *Mar. Pollut. Bull.*, vol. 73, pp. 463–469, 2013, doi: https://doi.org/https://doi.org/10.1016/j.marpolbul.2013.01.031.

[7] K. H. D. Tang and T. Hadibarata, "Seagrass Meadows under the Changing Climate: A Review of the Impacts of Climate Stressors," *Res. Ecol.*, vol. 4, no. 1, 2022, doi: 10.30564/re.v4i1.4363.

[8] C. J. et al. Unsworth, R.K.F., McKenzie, L.J., Collier, "Global challenges for seagrass conservation," *Ambio*, vol. 48, pp. 801–815, 2019, doi: https://doi.org/10.1007/s13280-018-1115-y.

[9] J. C. Inés Mazarrasa, Jimena Samper-Villarreal, Oscar Serrano, Paul S.Lavery, Catherine E. Lovelock, Núria Marbà, Carlos M. Duarte, "Habitat characteristics provide insights of carbon storage in seagrass meadows," *Mar. Pollut. Bull.*, vol. 134, pp. 106–117, 2018, doi: https://doi.org/10.1016/j.marpolbul.2018.01.059.

[10] F. Denton *et al.*, "Climate-resilient pathways: Adaptation, mitigation, and sustainable development," *Clim. Chang. 2014 Impacts, Adapt. Vulnerability Part A Glob. Sect. Asp.*, pp. 1101–1131, 2015, doi: 10.1017/CBO9781107415379.025.

[11] A. K. ilica Stankovic, Rohani Ambo-Rappe, Filipo Carly, Floredel Dangan-Galon, Miguel D. Fortes, Mohammad Shawkat Hossain, Wawan Kiswara, Cao Van Luong, Phan Minh-Thu, "Quantification of blue carbon in seagrass ecosystems of Southeast Asia and their potential for climate change mitigation, Science of The Total Environment," *Sci. Total Environ.*, vol. 783, 2021, doi: https://doi.org/10.1016/j.scitotenv.2021.146858.

[12] Indonesia Window, "Indonesian seagrass beds in poor state: Scientists," 2020.

[13] D. Iqbal, "Seagrass Meadows, Endangered Carbon Storage," 2022.

[14] M. F. Miftahudin, B. H. Muzani, N. F. Ramadhita, and S. Widyarini, "Pengaruh lamun (seagrass) terhadap kehidupan ikan di perairan Pulau Pramuka, Kepulauan Seribu," *J. Geogr.*, vol. 18, no. 1, pp. 27–42, 2020.

[15] R. G. C. A.S. Freeman, F.T. Short, I. Isnain, F.A. Razak, "Seagrass on the edge: Land-use practices threaten coastal seagrass communities in Sabah, Malaysia," *Biol. Conserv.*, vol. 141, no. 12, pp. 2993–3005, 2008, doi:

https://doi.org/10.1007/s13280-018-1115-y.

[16] Y. M. Tan *et al.*, "Seagrass Restoration Is Possible: Insights and Lessons From Australia and New Zealand," *Front. Mar. Sci.*, vol. 7, no. August, 2020, doi: 10.3389/fmars.2020.00617.

[17] S. Liu *et al.*, "Changes in surface sediment carbon compositions in response to tropical seagrass meadow restoration," *Sci. Total Environ.*, 2023, doi: 10.1016/j.scitotenv.2023.166565.

[18] N. D. M. Sjafrie *et al.*, *Status Padang Lamun Indonesia 2018 Ver.02*. 2018.

[19] R. J. Orth *et al.*, "A global crisis for seagrass ecosystems," *Bioscience*, vol. 56, no. 12, pp. 987–996, 2006, doi: 10.1641/0006-3568(2006)56[987:AGCFSE]2.0.CO;2.

[20] C. S. Campagne, J. M. Salles, P. Boissery, and J. Deter, "The seagrass Posidonia oceanica: Ecosystem services identification and economic evaluation of goods and benefits," *Mar. Pollut. Bull.*, vol. 97, no. 1–2, pp. 391–400, 2014, doi: 10.1016/j.marpolbul.2015.05.061.

[21] C. R. Sievers M, Brown CJ, Tulloch VJD, Pearson RM, Haig JA, Turschwell MP, "The Role of Vegetated Coastal Wetlands for Marine Megafauna Conservation," *Trends Ecol Evol*, vol. 34, no. 9, pp. 807–817, 2019, doi: 10.1016/j.tree.2019.04.004.

[22] L. L. Griffiths, R. M. Connolly, and C. J. Brown, "Critical gaps in seagrass protection reveal the need to address multiple pressures and cumulative impacts," *Ocean Coast. Manag.*, vol. 183, no. September 2019, 2020, doi: 10.1016/j.ocecoaman.2019.104946.

[23] H. et al. Fourqurean, J., Duarte, C., Kennedy, "Seagrass ecosystems as a globally significant carbon stock.," *Nat. Geosci.*, vol. 5, pp. 505–509, 2012, doi: https://doi.org/10.1038/ngeo1477.

[24] C. M. Duarte, H. Kennedy, N. Marbà, and I. Hendriks, "Assessing the capacity of seagrass meadows for carbon burial: Current limitations and future strategies," *Ocean Coast. Manag.*, vol. 83, pp. 32–38, 2013, doi: 10.1016/j.ocecoaman.2011.09.001.

[25] A. S. Bourque and J. W. Fourqurean, "Effects of common seagrass restoration methods on ecosystem structure in subtropical seagrass meadows," *Mar. Environ. Res.*, 2014, doi: 10.1016/j.marenvres.2014.03.001.

[26] H. Hatrik, *Asas Pertanggungjawaban Korporasi Dalam Hukum Pidana*. Jakarta: Raja Grafindo Persada, 1996.

[27] A. Rifai and A. J. Meliala, "Patterns of Corporate Criminalization as Perpetrators of Environmental Crimes in Nickel Mining," *UNIFIKASI J. Ilmu Huk.*, vol. 9, no. 2, pp. 126–133, 2022, doi: 10.25134/unifikasi.v9i2.7171.

[28] D. Abdullah and A. Halim Barakatullah, "Reconstruction of Corporate Environmental Crime Liability Law Based On Justice Value," *Sch. Int. J. Law*, vol. 4, no. 10, pp. 2617–3484, 2021, doi: 10.36348/sijlcj.2021.v04i10.001.

[29] Hanafi Amrani dan Mahrus Ali, *Sistem Pertanggungjawaban Pidana: Perkembangan dan Penerapan*, 1st ed. Jakarta: RajaGrafindo Persada, 2015.

[30] D. A. Muller, "Using crime prevention to reduce deliberate bushfires in Australia," *Natl. Emerg. Response*, vol. 22, no. 4, p. 27, 2009.

[31] M. Jalaludin, I. N. Octaviyani, A. N. Praninda Putri, W. Octaviyani, and I. Aldiansyah, "Padang Lamun Sebagai Ekosistem Penunjang Kehidupan Biota Laut Di Pulau Pramuka, Kepulauan Seribu, Indonesia," *J. Geogr. Gea*, vol. 20, no. 1, pp. 44–53, 2020, doi: 10.17509/gea.v20i1.22749.

[32] E. Siswanto, M. Aras, and Windarti, "Jasa Ekosistem Padang Lamun Di Daerah Kawasan Konservasi Lamun Trikora (Studi Di Desa Teluk," *Berk. Perikan. Terubuk*, vol. 45, no. 1, pp. 59–69, 2017.

[33] J. T. Greiner, K. J. McGlathery, J. Gunnell, and B. A. McKee, "Seagrass Restoration Enhances 'Blue Carbon' Sequestration in Coastal Waters," *PLoS One*, vol. 8, no. 8, pp. 1–8, 2013, doi: 10.1371/journal.pone.0072469.

[34] The Conversation, "5 alasan mengapa pemerintah harus memprioritaskan restorasi lamun jadi solusi perubahan iklim.," 2023.

[35] R. D. Zaira Da Ros, Cinzia Corinaldesi, Antonio Dell'Anno, Cristina Gambi, Fabrizio Torsani, "Restoration of Cymodocea nodosa seagrass meadows: efficiency and ecological implications," *J. Soc. Restor. Ecol.*, vol. 29, 2021.

[36] M. D. Fortes, "Seagrass ecosystem conservation in Southeast Asia needs to link science to policy and practice," *Ocean Coast. Manag.*, vol. 159, no. May 2017, pp. 51–56, 2018, doi: 10.1016/j.ocecoaman.2018.01.028.