Protecting fisheries resources and marine ecosystem from climate change: Solutions and legal constraints

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Abstract. Warming, acidification and deoxygenation of the ocean are already affecting the productivity and stability of marine ecosystems. It is projected also that climate change will force the fish stocks that cross through two or more exclusive economic zones to shift significantly from their historical habitats and migration that may lead to international conflict on the transboundary fish stocks. Meanwhile, overfishing and habitat destruction has had long-term effect on marine environment. Recently, the 2023 UNGA Resolution on sustainable fisheries reported the decline in global fish stocks. The resolution called upon the States to identify the impacts on fisheries due to climate change, thus it is crucial for States to consider effective adaptation and strategies to tackle the challenges. The present study is designed to analyse the impacts of climate change on fish and their interdependent ecosystems, but also impacts upon the laws and policies relevant to their exploitation and conservation. By using a comparative approach between three vulnerable countries to climate change, the paper highlights how Indonesia, India, and Vietnam are working to cope with the issues arising from climate change on the fisheries sector. The finding shows how the three countries must modernize their legal frameworks for fisheries management to reflect the current challenges such as climate change and ecosystem-based management.

1 Introduction

The phenomenon of climate change has, globally, lifted the appearance of tropical cyclones resulted excessive high wave, stimulating the El Nino [1] and changing the monsoonal pattern between Asia and Australia. This situation has brought the impact of marine and fisheries ecosystem in peril condition.[2]

The massive impacts of climate change have made number of areas become fragile, and fisheries field is one of easily affected. [1] Carbon dioxide emissions directly cause a decrease in ocean pH, rising of sea temperature, and creating acidic nature of ocean. These reactions can transform the ocean ecosystem that cover the natural environment, fish stocks, and

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pattern of fish behaviour. Some improvement has been taken to tackle the climate change effect towards ocean, however this effort seems unidentified.[2]

Recognising the geographical configuration, Indonesia is an archipelagic country in which the water area is more dominant than land area, as such, the country is more exposed by the detrimental impact of climate change, especially to the coastal, marine habitat, and fisheries activities. In fact, Most of the Indonesia population relies to some degree on these ecosystems as source of foods and protein.[3]

In South East Asia region, Vietnam is ranked among the top five nations most vulnerable to climate change. A one-meter rise in sea levels is projected to result in a loss of 5% of land, affect 11% of the population, impact 7% of agricultural activities, and reduce the Gross Domestic Product (GDP) by 10%.[4] Furthermore, Vietnam is positioned 27th out of 33 countries globally regarding the fragility of its economy due to phenomenon of climate change towards fisheries and aquaculture.[5] Rising sea levels threaten to submerge coastal areas, damaging aquaculture infrastructure and eroding habitats critical for fish spawning and growth, such as mangroves and coral reefs. Changes in ocean temperatures and salinity are altering fish migration patterns and reducing the availability of fish stocks. Ocean acidification, driven by increased carbon dioxide absorption, is further harming coral reefs and other marine ecosystems that serve as essential habitats for many fish species.

India was identified as the world's seventh most vulnerable country to the impacts of climate change during 2019.[6] India's fisheries is considered as crucial for economic field and food security. According to the Department of Fisheries' annual report for 2022-2023.[7] the total fish production in India reached 14.16 million metric tons, contributing 1.24% to the national GDP. Among this the marine fisheries accounts for 4.19 million metric tons and the remaining contribution is from the inland rivers, lakes and reservoirs and aquaculture farming practices in the coastal states of India.

The marine sector and the industries established on the coastlines of 7,500 kilometres, having coverage of 2.02 million square kilometres as an exclusive economic zone is supporting around 28 million citizens of India, both directly and indirectly. Therefore, the fisheries sector is vital for ensuring the nation's food security and providing the growth of economic sector through exports. In addition, as per the 2022 report of the Food and Agriculture Organization (FAO), India has ranked second globally in fish production with a total production of 14.16 million metric tons, contributing to the national GDP. Also, the FAO's report on "The State of World Fisheries and Aquaculture" highlights that the global fisheries sector is under increasing pressure due to the issues of overfishing and climate change across the globe, with 35.4% of global fish stocks being overfished.[7] The surge in the unregulated global fishing including in the deep sea has critically impacted the fish stocks and their routes across the globe.

Therefore, it can be noticed really well that climate change is causing significant changes and issues within the fisheries and marine sector to Indonesia, Vietnam, and India. Ocean warming, acidification, and deoxygenation are contributing into the change in the marine and associated ecosystems. Eventually, resulting massive changes and unequal number of fish stock distribution and followed by decreased productivity in the region and even biodiversity loss.

2 Impacts of Climate Change on Fisheries

In tropical region, the rise of temperature will stimulate fish resources moving to higher space and thus, it will lower the production of phytoplankton. Further, acidification will destruct marine habitat and coral reefs.[2] Indonesia will soon experience a downward trend in marine capture fisheries because of overexploitation and lack of sustainable management. While Indonesia still has land available to expand marine, brackish, and inland aquaculture, long-term aquaculture production needs to be addressed for future changes in climate change and vulnerability to food security.[2]

Due to increasing greenhouse gas emissions, ocean temperatures are rising, which is significantly altering the distribution and abundance of fish stocks. Notably, the Indian Ocean is recognized as the fastest-warming ocean in the world, with sea surface temperatures increasing by an average of 1°C from 1950 to 2020, as highlighted by a study from the Indian National Centre for Ocean Information Services (INCOIS)[8]. This warming has prompted the migration of numerous fish species. For instance, Indian mackerel, once abundant in coastal regions, has migrated to deeper, cooler waters. The Central Marine Fisheries Research Institute (CMFRI) recorded a 30% reduction in mackerel catches in 2021 compared to previous years, largely due to this migratory behaviour.[9] Sardine stocks along Kerala's coast have also dropped significantly, with a 75% decline between 2012 and 2020, primarily attributed to rising water temperatures.[9] These changes in fish distributions have profound socio-economic impacts on coastal society in India, particularly fishermen who are not in industrial sector who rely on traditional methods, also cannot access fish that have moved to deeper waters.

Additionally, ocean acidification which is caused due to the excessive absorption of CO2 and other greenhouse gases by seawater, poses as a severe threat to the India's marine ecosystem. The low level of pH in the seawater affects the functioning ability of the shellfish and coral reefs to calcify. The coral reefs in India, especially those present in the region of Gulf of Mannar, Lakshadweep, and the Andaman and Nicobar Islands, are under significant stress from ocean acidification. As per the report, provided by the Ministry of Environment, Forest and Climate Change (MoEFCC), coral reefs in India have significantly diminished by 20-30% over the past two decades, highlighting that the acidification was the key factor to it.[10] The continuous decline in coral reefs which is a home ground to other fish species for breeding, will eventually impact and reduce the fish population, leading to impact the biodiversity and the overall yield.

Furthermore, the issue of deoxygenation, whereunder there is reduction of oxygen levels in the ocean leading it to be another climate change-induced issue threatening marine life. The 'dead zones' with low oxygen levels are expanding in the Indian waters, particularly in the Arabian Sea. A 2021 study conducted by the National Institute of Oceanography (NIO) found that the size of these dead zones in the Arabian Sea has grown by 10% over the past 50 years, severely affecting fish populations.[11] Fish species sensitive to oxygen levels, such as the Indian oil sardine, are experiencing reduced spawning success in these regions, leading to decreased population sizes. Furthermore, the FAO's 2023 report, "The State of World Fisheries and Aquaculture," emphasizes that over 30% of fish stocks in global rate are currently identified as over-exploited, and deoxygenation due to climate change exacerbates the issue by shrinking habitable zones for these species.[3]

However, the detrimental effects of climate change—including rising sea levels, ocean acidification, and an increased frequency of extreme weather events—present significant challenges to Vietnam's marine ecosystems and its fisheries. Extreme weather events, such as typhoons and floods, are becoming more frequent and intense, directly threatening fishing communities and disrupting fishing activities. The degradation of marine ecosystems not only impacts biodiversity but also reduces the productivity of fisheries, leading to declining

fish catches. Typhoon Yagi, upon its passage through Vietnam, inflicted severe repercussions on the nation's seafood industry. In only four northern provinces and cities, the total estimated damage reached thousands of billions of Vietnamese Dong, resulting in the destruction of numerous boats and fish farms.

While Vietnam has made substantial progress in developing laws and policies to mitigate the impacts of climate change on fisheries, several challenges persist. One of the primary obstacles is the enforcement of existing regulations, particularly in regard to illegal, unreported, and unregulated (IUU) fishing and the action to sustain marine resources. Strengthening enforcement mechanisms, as well as ensuring regulatory compliance are crucial for the long-term sustainability of Vietnam's fisheries sector.

Another pressing challenge lies in the need for increased investment in research and innovation to develop climate-smart technologies and practices for both capture fisheries and aquaculture. This includes advancing the use of renewable energy in fishing operations and aquaculture, improving waste management systems, and fostering the development of more resilient fish species and sustainable farming techniques.

Regarding exploitation activities, by 2030, Vietnam aims to limit its fishing fleet to a maximum of 83,600 vessels employing around 600,000 workers. The restructuring of the fisheries sector will involve the following distribution: trawling (10.0%), purse seining (6.1%), gillnetting (40.3%), general fishing (18.9%), seine fishing (3.0%), cage trapping (2.9%), and other fishing activities (16.6%), with fishing logistics accounting for 2.2% of the total fleet. Additionally, Vietnam plans to develop a comprehensive, inter-regional system of fishing ports and storm shelters to meet the growing demand for anchorage and fishing logistics services. [12]

3 Legal and Policy Frameworks

3.1 The Legal Constraints

Barrier on how the roadmaps and framework are being implemented seemed deficient at provincial level. This lacking adaptation has attributed to invalid statistics in fisheries and aquaculture. Fish species are not fully classified and very often its out of stock assessment and management. It is noticed that misclassified species and inadequate classification affected by climate change in ASEAN region is 66.4% of the entire fish production. Most of this percentage is for miscellaneous fish classification. For that reason, improvement on the level, accuracy of fishery data collection and compilation with consist of various species is urgently needed.[2]

Gaps and data deficiencies have been issues in Indonesia's fishery. The country is experiencing discrepancies in the accuracy of fish catch, target species, and vessel. This situation is getting more complex with degradation of the coastal ecosystem, tackling illegal unreported and unregulated (IUU) fishing, and shrinking ocean pollution. Another challenge to manage fisheries and marine resources also comes from conflict of interest between economic and environmental sector.[3]

Fisheries sector in Vietnam faces significant threats from climate change, yet the country has demonstrated a strong commitment to addressing these challenges through its legal framework and policy initiatives. The Law on Fisheries, the Law on Environmental Protection, and the National Strategy on Climate Change provide a robust foundation for sustainable fisheries management and climate adaptation. However, sustained effort, investment, and international cooperation will be essential to ensure that Vietnam's fisheries continue to develop despite the threat resulted from climate change. Moreover, the growth of shrimp farming in some mangrove areas have been harmful and it has impacted to the balance

of ecological environment. Vietnam is taking its effort to do mangrove rehabilitation and fisheries resources protection. Recently, Vietnam consider management plan to relocate Shrimp Farming in Mangroves in Southern part that adjusted to socio-economic and environmental aspect in coastal areas. [25]

The ongoing dispute between India and Sri Lanka over Illegal, Unreported, and Unregulated (IUU) fishing in the Palk Bay region is a prominent example of how climate change can exacerbate existing legal and diplomatic tensions. Due to the depletion of fish stocks in Indian waters, driven partly by climate change, Indian fishers from Tamil Nadu have increasingly ventured into Sri Lankan waters, leading to conflicts and arrests. According to the Ministry of External Affairs, over 350 Indian fishers were arrested by Sri Lankan authorities between 2019 and 2022 for crossing into Sri Lankan waters (Ministry of External Affairs, 2022). Both countries have engaged in diplomatic negotiations to resolve the dispute, with India focusing on promoting alternative livelihoods for its fishers and enhancing monitoring and enforcement measures to prevent illegal, unreported, and unregulated (IUU) fishing. [13,14]

3.2 Indonesia

Number of improvements are taken by the government to protect marine and fisheries resources. A reformative step has been implemented through regulation review that evaluate the use of *cantrang*, provision on sinking the IUU ships, and baby lobster as export product. The government has also put the effort to strengthen economic sector Indonesia's parliament passed the Omnibus Law on Job Creation to stimulate competitiveness, broaden the job opportunity, and escalate foreign investments in domestic market. However, it then risked certain group of society in particular indigenous and small-scale fishers. Currently, the Government of Indonesia has issued a sectoral policy to provide framework on the mitigation and adaptation to climate change impact on fisheries. This policy is accommodated in the Ministerial Decision of Maritime and Fisheries Affairs regarding The Roadmap of Climate Change Mitigation on Marine and Fisheries Sector between 2025 and 2029. According to this policy, there should be three phases namely Planning, Executing, and Monitoring.

Starting from planning, the mitigation works in this phase requires an updating the sources and relevant data of categories of activities resulting impact of gas emission to the blue carbon ecosystem. The latest data must also inform the fuel and refrigerant usage in fishing vessels, as well as the electricity used by the fishing port. Further step is to focus on rehabilitating the mangrove ecosystem and seagrass. This is to note also that there should be an initiative to document arrangement regarding blue carbon in the conservation areas and to consider the renewable energy to support electricity power in the fishing ports. The last phase is monitoring action to ensure all mitigation phases are accomplished and to review the report mechanism from each phase. Improvement on fisheries data is also needed to assess the stock. The data must be designed to describe the catch accuracy, statistic to support stock assessment, target species, and fishing vessel. Thus, Indonesia can set catch levels to ensure the stock sustainability. [2]

3.3 India

India has developed several laws and policies to manage its fisheries sector, demonstrating a strong commitment to addressing the challenges posed by climate change. The Indian Fisheries Act, 1897, though still in force, provides a foundational framework for regulating fishing practices. Fisheries being a state subject, all of the coastal states in India have conducted Marine Fisheries Regulation Acts (MFRAs) in each region to govern, monitor and control the fishing activities within their territorial waters (Indian Fisheries Act 1897.[15]

These acts clearly mentions as to whom the license will be issued, the conditions, responsibilities and limitations put forth while fishing in the Indian waters, defining and marking the protected areas and regulate and monitor the types of fishing gear allowed to catch fishes, providing clarity to the government officials for overall fisheries management.[16]

The National Fisheries Policy 2020, is the nation's innovative approach towards the promotion of sustainable development methods within India's fisheries sector. This policy promotes the methods which leads to climate resilience by adopting eco-friendly fishing technologies. Further calling out for a collaborative approach for monitoring the impact of climate change on marine habitat with an aim to repair the adaptive actions and reducing vulnerability.[17] Also, the Blue Revolution scheme released in 2022, the government has attempted to modernize the sector by promoting sustainable practices among the fishers, improving the basic infrastructure, promoting traditional knowledge and supporting climate-resilient aquaculture practices by the coastal communities. The scheme further highlights; the protection of biodiversity by creating marine protected areas, ensuring the protection and conservation of variety of fish stocks, enabling promotion of responsible fishing practices.[18] In 2022, the Ministry of Fisheries, Animal Husbandry, and Dairying has reported that in order to guard and conserve various species of fishes, 1,500 marine protected areas have been established under the scheme covering a total of 10,000 square kilometres of the Indian waters. Taking position as a signatory country to several international treaties that provide legal frameworks for the conservation and sustainable management of marine resources, as well as a party to the United Nations Convention on the Law of the Sea,[19] India is obligated to manage its marine resources sustainably. Under Article 61 and 62 of the same, it is clearly stated that the state(s) have to duly conserve and protect the marine living resources present in their exclusive economic zones and to collaborate in the use of transboundary fish stocks. India's participation in the United Nations Fish Stocks Agreement.[20] Further highlights its commitment to the sustainable management of highly migratory and transboundary fish stocks, which are becoming increasingly affected by climate change. India follows the FAO Code of Conduct for Responsible Fisheries, which sets out principles for sustainable fisheries management. The code encourages the adoption practices in tackling climate change, as well as international cooperation in managing shared marine resources.[21]

3.4 Vietnam

Resolution No. 24-NQ/TW, dated June 3, 2013, issued by the 11th Central Conference, titled "On Proactive Response to Climate Change, Strengthening Resource Management and Environmental Protection," outlined several key principles of the Vietnam's climate change response. This resolution recognized that proactive climate change response, enhanced resource management, and environmental protection are of paramount importance, requiring a comprehensive, unified, inter-sectoral, and inter-regional management approach. The resolution also emphasized that climate change is a global issue and a severe challenge for all of humanity. Moreover, it underscored that resources are national assets and natural capital essential for national development, while environmental protection serves both as a key objective and a fundamental element of sustainable development.

Vietnam has developed a comprehensive legal framework aimed at addressing the impacts of climate change on its fisheries and ensuring sustainable management of marine resources. In alignment with the Party's guidelines and policies on proactively addressing climate change in tandem with sustainable socio-economic development, the National Assembly and the Government of Vietnam have issued numerous instruments to concretize these directives. Notably, the 2013 Constitution for the first-time incorporated provisions on

climate change response, etc. Successive terms of the National Assembly have also passed key legislation related to this matter, including the Law on Fisheries 2017, the Law on Environmental Protection 2020. Furthermore, the Government has issued a number of directives aimed at addressing climate change, such as Decision 2053/QD-TTg, which promulgated the plan for implementing the Paris Agreement on Climate Change, and Resolution No. 120/NQ-CP, dated November 17, 2017, on the sustainable development of the Mekong Delta in response to climate change.

The Law on Fisheries [22] This is a milestone of Vietnam's approach to sustainable fisheries management. It underscores the protection of marine ecosystems and advocates for the use of scientific research and evidence-based management strategies. The law mandates the responsible exploitation of fish stocks and supports the conservation of key marine habitats, such as mangroves, coral reefs, and seagrass beds, which are vital in enhancing fisheries' resilience to climate change by serving as natural storm barriers and breeding grounds for marine species. Chapter two focuses on the protection and development of aquatic resources, including establishing marine and natural protected areas, and funds for the protection of fisheries. Additionally, the law integrates environmental protection and climate change adaptation into fisheries management. It also tackles illegal, unregulated, and unreported (IUU) fishing, which poses a significant threat to sustainability and increases the vulnerability of fish stocks to climate change impacts.

The Law on Environmental Protection [23] adopts a comprehensive approach, addressing the environmental challenges posed by climate change across all sectors, including fisheries. This law prescribes specific measures for the protection of marine and coastal ecosystems, such as reducing greenhouse gas emissions and preserving biodiversity. It requires that climate change adaptation strategies be integrated into the planning and management of natural resources, including fisheries, at both national and local levels. Additionally, the law promotes the development of climate-resilient infrastructure and technologies to mitigate the vulnerability of fisheries to extreme weather events and other climate-related risks. It further encourages the adoption of sustainable aquaculture practices that are capable of adapting to evolving environmental conditions.

The Government of Vietnam has issued "the Plan for the protection and exploitation of aquatic resources for the period 2021 – 2030", with a vision to 2050, consistent with the strategic orientation for socio-economic development, fisheries, and marine economy; consistent with the national master plan, national marine space, national land use, and related plans to ensure consistency and synchronization; ensure national interests, national defence, and security. Protect and sustainably develop aquatic resources, protect the habitat of aquatic species, caution to rising sea levels; conserve biodiversity, increase the area of protected and conserved water bodies in seas and inland areas based on a cautious approach and an ecosystem-based approach. Along with the interests and responsibilities of the community and consistent with the natural, socio-economic conditions of each region and economic sectors; contributing to ensuring social security, gender equality, benefit sharing, and responsibility of organizations and individuals in benefiting from the exploitation and use of aquatic resources or activities in industries and occupations that directly affect aquatic resources. At the same time, exploiting aquatic resources in accordance with its potential, in an effective, sustainable, responsible manner, harmonizing socio-economic development and environmental protection, contributing to ensuring food security, nutrition, increasing value and income for people on the basis of applying science and technology, digital transformation, improving state management capacity, and reorganizing aquatic production.

The protection and development of aquatic resources is also integral to fulfilling the objectives of Resolution No. 36-NQ/TW,[24] of the 12th Party Central Committee, which outlines "the Strategy for the sustainable development of Vietnam's marine economy by 2030 with a vision toward 2045". This strategy aims to foster sustainable and responsible fisheries

management in line with international integration, while prioritizing environmental protection, climate change adaptation, and proactive disaster prevention. It further contributes to enhancing the material and spiritual well-being of the population, ensuring social security, and safeguarding Vietnam's sovereignty, sovereign rights, jurisdiction, security, order, and national interests over its rivers and seas.

In pursuit of protecting and sustainably managing its aquatic resources, Vietnam plans to establish 27 marine protected areas by 2030, effectively managing a total of more than 463,580 hectares of protected marine waters. The plan includes safeguarding 149 marine areas, which consist of 59 aquatic resource protection zones, 63 temporarily prohibited fishing areas, and 27 artificial habitats for aquatic species. Additionally, 119 inland areas, including 66 aquatic protection zones and 53 temporarily restricted fishing areas, will be preserved to safeguard concentrated spawning grounds and habitats for young aquatic species.

4 Conclusion and Recommendations

This study highlights the essential effort to improve the protection on fish resources from climate change effect. Indonesia, Vietnam, and India are three countries where aquaculture and fisheries sector are crucial. It observed that fish overexploitation, scarcity in fisheries data, and the incompetence to maintain the stock endurably are the fundamental factors to decrease the fish stocks. It is urgently needed to improve the administration work in fisheries sector and it is related to capacity building. By doing so, human resources hold a central key as there should be number of specialists and experts in adaptation management, in laws and regulations for rule-making, in scientific assessment and enforcement in the areas of quality control, in international trade distribution and transportation, and in processing and storing. In regard with lack of valid fisheries data, the fisheries data collection needs to be incorporated with integrated policies and law enforcement. Further, in order to make the effort works effectively, it is of prime importance to have the attention of high-level policymakers to adopt policies to take immediate action to protect species decreasing as a result of climate change – not only at the national level but also at the ministerial level.

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References

[1] Lucentezza Napitupulu et al. Trends In Marine Resources and Fisheries Management in Indonesia. Report. Jakarta: World Resources Institute Indonesia. (2022). doi. org/10.46830/wrirpt.20.00064

[2] Thayalan Gopal and Venkatachalam Anbumozhi. Effects of Disasters and Climate Change on Fisheries Sectors and Implications for ASEAN Food Security. (2019). Jakarta, Indonesia: Economic Research Institute for ASEAN and East Asia.

[3] Agus Setiawan and Hendra Yusran Siry. Climate Change Impacts on Fisheries and Aquaculture in Indonesia: Current Initiatives and Challenges for Adaptation and Mitigation

[4] Le Minh NHAT. Climate Change Impacts and Adaptation Efforts in Vietnam. Access from https://unfccc.int/files/adaptation/application/pdf/viet_nam_summary_cca.pdf

[5] Quach Thi Khanh Ngoc. Impact of climate change on Vietnam's fisheries industry. Access from https://vasep.com.vn/san-pham-xuat-khau/tin-tong-hop/san-xuat/tac-dong-cua-bien-doi-khi-hau-den-nganh-thuy-san-viet-nam-6821.html

[6] United Nations Network on Migration. India: Enhancing the Resilience to Climate Change of Migrant and Vulnerable Households in the Coastal Areas of Odisha State and Drought-Prone Areas of Telangana State. Access from https://migrationnetwork.un.org/projects/india-enhancing-resilience-climate-change-migrant-and-vulnerable-households-coastal-areas

[7] Food and Agriculture Organization. (2022). The state of world fisheries and aquaculture 2022. FAO. Access from https://www.fao.org/state-of-fisheries-aquaculture

[8] Indian National Centre for Ocean Information Services. Ocean Warming Report. INCOIS. (2020). https://incois.gov.in/documents/ANNUAL_REPORTS/2022-2023_English.pdf#:~:text=ESSO-INCOIS-Indian%20National%20Centre%20for

[9] Central Marine Fisheries Research Institute. Annual Report 2021. (2021). CMFRI. https://eprints.cmfri.org.in/16576/1/CMFRI%20Annual%20Report%202021.pdf

[10] Ministry of Environment, Forest and Climate Change. Coral Reef in India Status Threats and Conservation Measures Report. (2012). MoEFCC. https://www.nfdb.gov.in/PDF/Blue%20Revolution%20Final.pdf

[11] Sarma V. Bhaskar U., et.al. National Institute of Oceanography. Potential mechanisms responsible for occurrence of core oxygen minimum zone in the north-eastern Arabian Sea. (2021). https://drs.nio.res.in/drs/bitstream/handle/2264/8399/Deep_Sea_Res_165_103393a.pdf?sequence=1

[12] Minh Ha. Protection and sustainable development of Vietnam's aquatic resources. (2024). Access from https://consosukien.vn/bao-ve-va-phat-trien-ben-vung-nguon-loi-thuy-san-viet-nam.htm?fbclid=iwy2xjawfyifvlehrua2flbqixmaabheuwozwsrnxpmnynauz0-22m-z-9xejwkczkcedlrbn70kzzvxk0dworeg_aem_ehky6zehc280s4ktmszm-w

[13] India Today. (2024). Decoding India-Sri Lanka fishermen issue: A visual guide. https://www.indiatoday.in/india/story/india-sri-lanka-fishing-problem-and-maritime-dispute-2517886-2024-03-21

[14] Daily FT. (2024). Navigating troubled waters: Indo-Lanka fishing dispute and quest for sustainable solution. https://www.ft.lk/columns/Navigating-troubled-waters-Indo-Lanka-fishing-dispute-and-quest-for-sustainable-solution/4-762952

[15] Indian Fisheries Act, 1897. (1897). The Indian Fisheries Act. Government of India. https://legislative.gov.in/sites/default/files/A1897-04.pdf

[16] Marine Fisheries Regulation Acts. (n.d.). State Marine Fisheries Regulation Acts. Various State Governments

[17] National Fisheries Policy. National fisheries policy. Government of India. (2020). https://www.icsf.net/wp-content/uploads/2022/11/National-fisheries-Policy_-Inland-fisheries.pdf

[18] Blue Revolution Scheme. Blue revolution: Integrated development and management of fisheries. (2022). Ministry of Fisheries, Animal Husbandry, and Dairying. Blue Revolution Final.pdf (nfdb.gov.in)

[19] United Nations Convention on the Law of the Sea (UNCLOS). (1982). United Nations convention on the law of the sea. United Nations. https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

[20] United Nations Fish Stocks Agreement (UNFSA). (1995). United Nations fish stocks agreement. United Nations.

https://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm

[21] Food and Agriculture Organization. Code of conduct for responsible fisheries. 1995). FAO. https://www.fao.org/ccrf/en/

[22] Vietnamese Law on Fisheries. See more: https://thuvienphapluat.vn/van-ban/EN/Tai-nguyen-Moi-truong/Law-18-2017-QH14-on-fisheries/372768/tieng-anh.aspx

[23] Vietnamese Law on Environmental Protection. See more: https://thuvienphapluat.vn/van-ban/EN/Tai-nguyen-Moi-truong/Law-72-2020-QH14-on-Environmental-Protection/463512/tieng-anh.aspx

[24] Government's plan for implementing Resolution No. 36-NQ/TW. See more http://tapchiqptd.vn/en/research-and-discussion/governments-plan-for-implementing-resolution-no-36nqtw/17717.html

[25] H. Thi Nguyen, T. Thi Hoang, L. Vu Van, I. Prakash, T. Thi Tran. An integrated approach of GIS-AHP-MCE methods for the selection of suitable sites for the shrimp farming and mangrove development- A case study of the coastal area of Vietnam. SAINS TANAH-Journal of Soil Science and Agroclimatology. **19**, 99 (2022)