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NAVIGATING THE DARK SIDE OF THE BLUE ECONOMY: INTEGRATING BLUE CRIME GOVERNANCE INTO SUSTAINABLE OCEAN DEVELOPMENT

Ali Umar Ahmad[1]*, Marhaini Mohd Noor[2] and Jagan Jeevan[3]

[2,3]Faculty of Maritime Study, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia. [1]School of Social and Management Sciences, Maryam Abacha American University of Nigeria, Hotoro GRA, Kano 700213, Nigeria.

**Corresponding author: umarahali204019@gmail.com*

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ABSTRACT

The Blue Economy promises sustainable ocean-based growth, but is increasingly threatened by rising illicit maritime activities, known as Blue Crimes, including piracy, illegal fishing, smuggling and environmental offences. These crimes erode economic stability, damage ecosystems, and weaken governance, yet their relationship to Blue Economy development remains insufficiently theorised. This paper develops an integrated framework that positions Blue Crime governance as essential to sustainable ocean development. Using a conceptual and integrative review of interdisciplinary scholarship and reports from global institutions, the study shows that Blue Crimes undermine the Blue Economy through interconnected economic, ecological and institutional pathways, especially in regions with fragile governance. The paper introduces the "Whole-of-Ocean Governance" model, emphasising coordinated approaches that link security, environmental management and social inclusion. By embedding crime prevention and justice within the sustainability discourse, the study offers a novel contribution that strengthens efforts toward achieving SDGs 14 and 16.

Introduction

The Blue Economy has become a central framework for promoting sustainable growth based on the responsible utilisation of ocean and coastal resources. It reflects an integrated development approach that aims to balance economic expansion, environmental protection, and social well-being within marine systems (OECD, 2020; UNDP, 2022). Globally, oceans generate approximately USD 3 trillion annually through sectors such as fisheries, shipping, renewable energy and tourism (World Bank, 2022). For many coastal and island states, the Blue Economy is both a strategic opportunity and an essential pathway for advancing the Sustainable Development Goals, especially SDG 14: Life Below Water (UN, 2015). However, expanding ocean-based economic activities has also intensified illicit maritime practices, known as Blue Crimes, which threaten environmental sustainability and maritime security (Bueger, 2015; Hübschle & Lindley, 2024). Blue Crimes include piracy, illegal, unreported and unregulated (IUU) fishing, trafficking, smuggling, oil theft and pollution (UNODC, 2020). These activities exploit weak governance, limited enforcement capacity, and fragmented legal frameworks, particularly in developing regions (Okafor-Yarwood, 2020; Warikandwa, 2023). Their impacts are profound, undermining economic stability, degrading marine ecosystems, and worsening social inequalities. In West Africa, IUU fishing alone results in losses exceeding USD 2.3 billion annually, harming livelihoods

and food security (Belhabib *et al*., 2015). Piracy in the Gulf of Guinea also inflates insurance costs, disrupts trade and deters investment (Bueger & Edmunds, 2020; Mohammed, 2023). Such crimes violate international maritime law and weaken institutional foundations needed for sustainable ocean governance.

Despite these challenges, the relationship between Blue Crimes and the Blue Economy remains insufficiently theorised. Sustainability literature often prioritises ecological protection, economic diversification and innovation, while overlooking the governance risks stemming from criminal exploitation of marine resources (Bennett *et al*., 2019; Becker-Weinberg, 2023). Conversely, maritime security scholarship treats Blue Crimes primarily as law-enforcement issues detached from broader development concerns.

This disciplinary separation has produced a critical research gap: The absence of an integrated framework that anchors Blue Crime governance within sustainable Blue Economy development. Addressing this gap is essential to realising a holistic Blue Economy that aligns economic prosperity with environmental resilience and social justice. Accordingly, this study seeks to conceptually integrate Blue Crime governance into the sustainable Blue Economy paradigm by examining: (1) How Blue Crimes undermine the economic, ecological and social pillars of the Blue Economy; (2) the institutional weaknesses that facilitate the interaction between Blue Crimes and the Blue Economy; and (3) how an integrated governance framework can strengthen sustainable ocean development.

The analysis draws on the security-development-environment nexus, which highlights the interconnected nature of ecological, economic and governance challenges (Voyer *et al*., 2021; Bueger & Mallin, 2023). It also incorporates emerging ideas, such as Blue Justice, which advocates for equitable marine governance and Whole-of-Ocean Governance, which promotes cross-sector collaboration between environmental management, maritime security, and socio-economic development (Bennett *et al*., 2019; Hübschle & Lindley, 2024). The study reframes the Blue Economy not merely as an economic model but as a governance construct in which maritime security, sustainability and equity are mutually reinforcing. By bridging sustainability and security scholarship, it underscores that addressing Blue Crimes is fundamental to achieving the SDGs and ensuring long-term ocean resilience (Bueger & Edmunds, 2020; Becker-Weinberg, 2023).

A key gap in current scholarship is the lack of an integrated framework linking Blue Crimes directly to sustainability outcomes. Maritime security research often isolates crime typologies such as piracy or IUU fishing, while Blue Justice studies rarely address how criminal activities undermine equity. This paper introduces a unified Whole-of-Ocean Governance framework that integrates environmental governance, the security–development nexus, and Blue Justice into a single analytical model. It demonstrates how economic disruptions, ecological degradation and institutional erosion interact as pathways through which Blue Crimes weaken the Blue Economy.

Finally, the paper is organised into sections covering the foundations of the Blue Economy, the nature of Blue Crimes, their interlinkages, the theoretical framework, methodological approach, empirical insights, governance implications and directions for future research, offering a comprehensive foundation for embedding Blue Crime governance into global Blue Economy agendas.

Literature Review

The Blue Economy: Foundations and Opportunities

The Blue Economy has undergone a significant conceptual evolution, shifting from traditional resource-extraction activities to a multidimensional framework rooted in sustainability, circularity, and social inclusion. Early interpretations focused heavily on extractive industries, such as fisheries, hydrocarbons and mineral exploitation,

prioritising economic gain over ecological sustainability (Pauli, 2010). Growing awareness of overfishing, marine degradation and climate change subsequently prompted calls for a more responsible and integrated approach to ocean governance (OECD, 2020; UNDP, 2022). Modern definitions of the Blue Economy emphasise the balance between economic utilisation, environmental integrity and intergenerational equity, advancing ocean-based development aligned with Sustainable Development principles (World Bank, 2017).

This transformation has been bolstered by global initiatives, such as the United Nations Decade of Ocean Science for Sustainable Development (2021-2030), which promotes scientific collaboration to safeguard ocean health (UNESCO, 2021). Key international organisations including the World Bank (2022) and UNCTAD (2021) now position the Blue Economy as a vehicle for low-carbon, inclusive development, expanding its scope to encompass emerging sectors like offshore renewable energy, biotechnology and eco-tourism (Chen, 2022; Sarjana *et al*., 2024).

Moreover, the concept has demonstrated notable adaptability across contexts: Small Island Developing States (SIDS) prioritise fisheries and tourism, whereas industrialised economies focus on marine logistics, renewable energy and technological innovation (OECD, 2020; UNCTAD, 2021;). The result is a comprehensive paradigm that integrates economic opportunity, environmental stewardship and social justice into a unified governance framework (Bueger & Mallin, 2023).

The Blue Economy consists of a diverse set of interlinked sectors that serve as its strategic pillars. Fisheries and aquaculture remain foundational, supporting global food security and more than 59 million livelihoods (FAO, 2020; World Bank, 2022). While overfishing and ecosystem degradation threaten wild stocks, aquaculture now provides over half of global fish consumption and continues to grow, supported by sustainable practices such as integrated multi-trophic aquaculture (IMTA) (Salin *et al*., 2018; OECD, 2021). Maritime transport is another core sector, facilitating over 80% of global trade and generating USD 380 billion annually, though decarbonisation remains a pressing challenge (UNCTAD, 2021; IMO, 2022). Marine renewable energy including offshore wind, wave and tidal power offers transformative potential, with offshore wind projected to exceed 200 GW in capacity by 2030 (IRENA, 2021; IEA, 2022).

Coastal and marine tourism also plays a critical role, generating USD 390 billion annually and supporting millions of jobs, particularly in SIDS (OECD, 2020; UNWTO, 2021). Marine biotechnology contributes to global health and high-value product development, with its market projected to reach USD 6.4 billion by 2025 (Global Market Insights, 2021; Molinski *et al*., 2021). Seabed mineral resources offer strategic opportunities, but pose major environmental risks that require robust governance (Niner *et al*., 2018; Hein *et al*., 2020). Marine construction, engineering and infrastructure development, including offshore energy installations, remain essential for economic expansion but must integrate climate-resilient design (OECD, 2020; IEA, 2022).

Marine conservation and ecosystem services underpin Blue Economy sustainability, with blue carbon ecosystems, such as mangroves and seagrasses, providing critical climate mitigation benefits and biodiversity protection (Barbier *et al*., 2011; UNEP, 2021). Maritime security and surveillance protect ocean resources from threats like piracy, smuggling and IUU fishing, requiring enhanced cooperation and technological monitoring (Bueger & Edmunds, 2017; UNODC, 2020). Ocean observation and research, supported by innovations such as autonomous underwater vehicles, improve understanding of marine systems and inform policy (NOAA, 2021; IOC-UNESCO, 2022).

Waste management, pollution control and circular economy initiatives are vital for reducing marine pollution, including plastics and hazardous materials (Jambeck *et al*., 2015; UNEP, 2021). Coastal and Marine Spatial Planning

(CMSP) helps allocate ocean space equitably and reduce user conflicts (OECD, 2020). Maritime education and training develop skilled workforces for sustainable ocean industries (UNESCO, 2021; IMO, 2022). Climate change adaptation strategies, particularly blue carbon restoration, enhance resilience to sea-level rise and ocean acidification (Duarte *et al*., 2020; IPCC, 2021). Cultural and heritage tourism supports indigenous knowledge and community development (UNWTO, 2021; UNESCO, 2021). Finally, ocean governance and policy including UNCLOS and national regulatory frameworks are essential for safeguarding marine resources and guiding Sustainable Development (Bennett *et al*., 2019; UNODC, 2020;).

Economic, Environmental and Social Contributions

The Blue Economy contributes to Sustainable Development by advancing economic growth, environmental protection and social well-being. Economically, it holds an estimated value of USD 3 trillion annually by 2030, driven by sectors such as fisheries, renewable energy and tourism (OECD, 2016; UNDP, 2022). Fisheries and aquaculture support over 200 million livelihoods and play a major role in global GDP, particularly in developing coastal states (FAO, 2020). Maritime transport and offshore energy further boost trade connectivity and economic diversification (World Bank, 2022).

Environmentally, ocean-based renewable energy reduces carbon emissions, while marine protected areas conserve biodiversity and sustain fish stocks (IRENA, 2021). Waste management and circular economy innovations minimise marine pollution and safeguard blue carbon ecosystems, such as mangroves and seagrasses (Duarte *et al*., 2020; UNEP, 2021). Socially, the Blue Economy enhances food security and poverty reduction, with fisheries providing over 20% of animal protein to more than three billion people (FAO, 2020). Capacity-building and inclusive governance strengthen community resilience (UNESCO, 2021; IMO, 2022). However, its rapid expansion also exposes vulnerabilities, as Blue Crimes increasingly threaten its ecological and economic integrity.

The Blue Crime Phenomenon: Threats to Maritime Sustainability

The expansion of the Blue Economy has not only created new economic opportunities but also intensified illicit maritime activities collectively known as Blue Crimes. These crimes undermine global efforts toward sustainable Ocean governance, posing significant threats to environmental security, economic development and maritime stability. Blue Crimes encompass a wide range of illicit acts, including piracy, human trafficking, drug smuggling, illegal fishing, environmental pollution and financial crimes that exploit the vast, poorly regulated maritime domain (Bueger, 2015; UNODC, 2020). The transnational and networked nature of these activities complicates enforcement, as criminal groups leverage technological sophistication, jurisdictional gaps and governance weaknesses to evade detection and prosecution (Voyer *et al*., 2021; Hübschle & Lindley, 2024). Consequently, Blue Crimes represent both a security challenge and a developmental obstacle, directly constraining the economic and ecological ambitions of the Blue Economy.

a) Definition and Typology of Blue Crimes

1. At Sea: Piracy and Armed Robbery

Piracy and armed robbery at sea are among the most visible and dangerous forms of Blue Crime, particularly in regions such as the Gulf of Guinea and the Western Indian Ocean. These activities involve the hijacking of ships, kidnapping of crew members, and theft of cargo, posing significant risks to maritime security and global trade (IMO, 2021; ICC, 2022). The Gulf of Guinea, for example, accounted for over 90% of global kidnappings at sea in 2020 (UNODC, 2020). The economic impact of piracy is profound, with increased insurance costs, rerouting of ships and heightened security measures costing the global economy an estimated USD 7 billion annually (World Bank, 2022). Combating piracy requires coordinated international efforts, including naval patrols, intelligence sharing and prosecution

of offenders (Edmunds, 2021). In the Gulf of Guinea, Mohammed (2023) highlights the challenges and opportunities in maritime security governance, emphasising the need for stronger state responses to combat piracy and other maritime crimes effectively.

2. Across the Sea: Human Trafficking and Drug Smuggling

Human trafficking and drug smuggling are transnational crimes that exploit maritime routes to transport victims and illicit goods across borders. Human trafficking, often linked to forced labour and sexual exploitation, is a growing concern in the fishing and shipping industries, with an estimated 16 million victims globally (ILO, 2021; UNODC, 2020). Drug smuggling, particularly of cocaine and heroin, relies heavily on maritime transport, with criminal networks using fishing vessels, cargo ships and even submarines to evade detection (INTERPOL, 2021). The global drug trade is valued at over USD 320 billion annually, with maritime routes accounting for a significant portion of this illicit activity (UNODC, 2020). Addressing these crimes requires enhanced surveillance, international cooperation and targeted interventions to disrupt criminal networks (Bueger & Edmunds, 2017).

3. In the Sea: Environmental Crime

Environmental crimes in the maritime domain, such as illegal fishing and pollution, have devastating impacts on marine ecosystems and the sustainability of the Blue Economy. Illegal, unreported and unregulated (IUU) fishing accounts for up to 26 million tons of fish annually, representing over 15% of global catch and causing economic losses of USD 23 billion per year (FAO, 2020; World Bank, 2022). IUU fishing not only depletes fish stocks but also undermines the livelihoods of coastal communities and threatens food security. Lindley (2022) emphasises the harm caused by illegal fishing and fish fraud, particularly in the context of food security and sustainable oceans, highlighting the need for robust enforcement mechanisms to protect marine resources. Marine pollution, including plastic waste, oil spills and chemical discharges, further exacerbates environmental degradation, with an estimated 8 million tons of plastic entering the oceans annually (UNEP, 2021). These crimes require robust enforcement of international regulations, such as the Port State Measures Agreement (PSMA), and the adoption of sustainable practices to protect marine ecosystems (FAO, 2020).

4. Beyond the Sea: Financial Crimes Linked to Maritime Activities

Financial crimes significantly exacerbate Blue Crime by facilitating illegal maritime activities, such as IUU fishing, piracy and drug trafficking. Criminal networks exploit complex financial systems to launder an estimated USD 1.6 trillion annually, while corruption within port authorities and regulatory agencies undermines enforcement efforts (UNODC, 2020; INTERPOL, 2021; Edmunds, 2021). Effective mitigation requires robust anti-money laundering (AML) regulations, enhanced transparency in maritime trade and strengthened international cooperation to trace illicit financial flows (UNODC, 2020). These financial dimensions underscore that Blue Crimes are not isolated security threats but systemic disruptors affecting economic, ecological, and institutional pillars of the Blue Economy. Piracy increases shipping risks, IUU fishing depletes marine resources, trafficking exploits governance gaps and environmental offences degrade ecosystems critical for sustainable development. Their persistence reflects weak, fragmented, or poorly coordinated institutional responses. Understanding these interlinked vulnerabilities is essential for evaluating how Blue Economy sectors remain exposed and highlights the need to examine legal and institutional frameworks governing maritime conduct at international, regional and national levels.

Legal and Institutional Frameworks

The international legal response to Blue Crimes is anchored in multilateral treaties, regional agreements and national legislations aimed at

regulating maritime conduct and strengthening enforcement. UNCLOS (1982) provides the foundational framework for Ocean Governance, defining states' rights over territorial seas, EEZs and the high seas. Complementary instruments include the FAO's PSMA (2009), targeting IUU fishing through port inspections (FAO, 2016). Regional frameworks, such as the Djibouti Code of Conduct (2009) and Yaoundé Code of Conduct (2013), enhance cooperation against piracy and maritime crimes (IMO, 2021). National measures, like the EU IUU Regulation (2010) and the US MDLEA, extend legal enforcement and traceability mechanisms (Ma, 2020; USCG, 2020). Implementation challenges persist due to limited resources, technical capacity, corruption and jurisdictional inconsistencies (Feng *et al*., 2020; Warikandwa, 2023). UNTOC facilitates international cooperation and law harmonisation (UNODC, 2020). Effective legal accountability requires robust legislation, capacity building, information sharing and regional integration to address transnational organised maritime crime (Becker-Weinberg, 2023; Hübschle & Lindley, 2024).

Transnational Organised Crime and Maritime Security Governance

Transnational Organised Crime (TOC) in the maritime domain comprises adaptive networks that exploit governance gaps, economic disparities and technological loopholes, often blending legal and illegal maritime activities (Menzel & Otto, 2020; Phayal *et al*., 2024). Maritime TOC includes drug smuggling, human trafficking and IUU fishing, collectively threatening security, development and environmental sustainability (UNODC, 2020). Economically, IUU fishing causes global losses exceeding USD 23 billion annually, affecting coastal livelihoods and government revenues (FAO, 2020; World Bank, 2022). Security-wise, piracy and smuggling destabilise strategic sea lanes, raise shipping costs and deter investment, particularly in West Africa and Southeast Asia (Bueger & Edmunds, 2017; Mohammed & Dalaklis, 2024). Environmentally, these crimes drive overexploitation, pollution and biodiversity loss (UNEP, 2021). Governance responses involve multi-level cooperation and technology, such as INTERPOL's Project SCALE, UNODC GMCP, satellite monitoring, drones and AIS (Potgieter, 2018; INTERPOL, 2021; UNODC, 2020). Scholars advocate a "whole-of-ocean" approach, integrating security, environmental sustainability and economic development to counter Blue Crimes and promote inclusive ocean governance (Bueger & Mallin, 2023; Hübschle & Lindley, 2024).

Interlinkages Between Blue Economy and Blue Crime

Blue Crimes pose systemic vulnerabilities to the Blue Economy by infiltrating maritime sectors, undermining resource sustainability, distorting markets, weakening institutions and eroding community resilience. Weak governance and enforcement deficits create enabling conditions that exacerbate economic, ecological and governance pressures, highlighting the intertwined nature of Blue Crimes and the Blue Economy; one promoting sustainability, the other fostering insecurity and environmental degradation (UNEP, 2021; UNDP, 2022; Hübschle & Lindley, 2024).

a) Mechanisms of Interaction

Blue Crimes destabilise economic, ecological and governance systems through multiple channels. Economically, piracy, IUU fishing and smuggling disrupt trade, escalate operational costs and deter investment. Piracy in the Gulf of Guinea alone causes annual losses of USD 818 million (Voyer *et al*., 2021; World Bank, 2022; Mohammed, 2023). Ecologically, illegal exploitation, pollution and habitat destruction compromise biodiversity and ecosystem services critical for tourism and aquaculture (UNEP, 2021; Becker-Weinberg, 2023). Socially, forced labour, human trafficking and organised violence exacerbate insecurity and inequality (ILO, 2021; Lindley, 2021). Weak maritime governance, limited surveillance and fragmented legal frameworks amplify

these impacts, eroding institutional legitimacy (Hübschle & Lindley, 2024).

b) Sectoral Vulnerabilities and Economic Impacts

Fisheries and aquaculture are heavily affected, with IUU fishing causing over 26 million tons of fish loss annually, valued at USD 23 billion (FAO, 2020; Witbooi *et al*., 2020). Maritime transport, logistics and tourism face piracy, smuggling and environmental risks that raise security costs and reduce revenues (Bueger, 2015; OECD, 2020; IMO, 2021; UNWTO, 2021). Offshore energy and marine resource extraction incur losses from illegal siphoning and vandalism exceeding USD 2 billion annually (Mohammed, 2023; Warikandwa, 2023). Collectively, these impacts undermine Sustainable Development, investor confidence and equitable growth, necessitating integrated crime prevention, law enforcement and environmental management within Blue Economy strategies (Potgieter, 2018; World Bank, 2022).

Implications for Sustainable Development and Ocean Governance

The convergence of Blue Crime and Blue Economy dynamics poses significant challenges to sustainable development and ocean governance. Blue Crimes undermine SDG 14 by depleting fish stocks, degrading habitats and increasing pollution, while also obstructing SDG 16 by weakening institutions, fostering corruption and eroding rule of law (UNDP, 2022; Bueger & Mallin, 2023). The interplay between environmental degradation and institutional decay creates a multidimensional governance challenge, where illicit activities and ecosystem harm reinforce one another (Hübschle & Lindley, 2024).

Effective Blue Economy governance requires integrating marine conservation with law enforcement, crime prevention and transparency mechanisms (Voyer *et al*., 2021; Becker-Weinberg, 2023). Regional cooperation through frameworks, like the Djibouti and Yaoundé Codes of Conduct, enhances maritime domain awareness, capacity building and information sharing (IMO, 2021; UNODC, 2020). The concept of "Blue Justice" highlights equity, accountability and inclusiveness, ensuring local communities benefit from ocean resources and resist illicit maritime pressures (Bennett *et al*., 2019). Institutional reforms embedding anti-crime measures within sustainable development strategies are essential for securing ocean prosperity and peace.

Theoretical and Conceptual Framework

This study integrates Environmental Governance Theory, the Security-Development Nexus, and the Sustainable Development Paradigm to examine the interplay between Blue Crimes and the Blue Economy. Environmental Governance Theory highlights how weak institutions, legal fragmentation and poor enforcement facilitate illegal fishing, pollution and resource theft (Lemos & Agrawal, 2006; Bennett *et al*., 2019; Okafor-Yarwood, 2020; Becker-Weinberg, 2023; Hübschle & Lindley, 2024).

The Security-Development Nexus situates maritime crime within socio-economic contexts, showing how poverty and limited livelihoods enable piracy, smuggling and other Blue Crimes, which undermine trade, investment and equity (Voyer *et al*., 2021; Mohammed, 2023; Warikandwa, 2023). The Sustainable Development Paradigm emphasises economic efficiency, environmental stewardship and social equity, demonstrating that Blue Crimes disrupt ecosystems, governance and community resilience (UN, 2015; OECD, 2020; UNDP, 2022; World Bank, 2022). The Whole-of-Ocean Governance model conceptualises Blue Crimes as systemic disruptors through economic disruption, ecological degradation and institutional erosion (FAO, 2020; UNEP, 2021; Bueger & Mallin, 2023; Hübschle & Lindley, 2024). Embedded within Blue Justice, the framework ensures inclusive, accountable and equitable governance, central to sustaining the Blue Economy (Bennett *et al*., 2019).

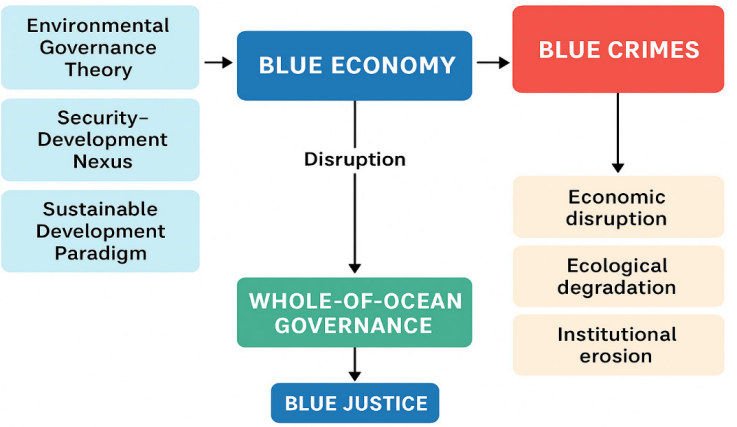

Figure 1: Whole-of-Ocean Governance Model: Integrating Environmental, Security, and Developmental Dimensions of the Blue Economy

Methodological Approach: A Conceptual and Integrative Review Framework

This study employs a conceptual research design grounded in an integrative review methodology to develop a theoretical framework linking Blue Crime and the Blue Economy within sustainable ocean governance. Conceptual research is suited to emerging, multidisciplinary issues, where empirical data are limited, allowing for theory building through synthesis of diverse secondary sources (Meredith, 1993; Jaakkola, 2020).

The integrative review combines literature from environmental governance, maritime security and sustainable development, generating new conceptual insights rather than merely summarising existing findings (Torraco, 2016; Snyder, 2019). Sources include peer-reviewed journals, policy papers and reports from FAO, UNDP, World Bank and OECD, selected based on conceptual relevance, analytical depth and geographical diversity. Thematic synthesis identified categories such as environmental governance, security-development nexus, institutional erosion and Blue Justice, which were integrated into the Whole-of-Ocean Governance model.

This model conceptualises Blue Crimes as systemic disruptors operating through economic, ecological and institutional pathways, undermining sustainable ocean-based economies. The conceptual-integrative approach addresses fragmented empirical data on transnational maritime crimes and provides a coherent framework for linking Blue Crime governance to sustainable development objectives, offering a foundation for future empirical and policy research (Jaakkola, 2020).

Empirical Insights and Regional Case Studies

Empirical studies across different regions reveal that the interplay between Blue Economy development and Blue Crime is highly contextual, reflecting variations in governance capacity, economic reliance on marine sectors and geopolitical dynamics. While the Blue Economy offers substantial prospects for sustainable growth, its realisation is constrained by widespread maritime insecurity, weak enforcement mechanisms and insufficient regional coordination. The following regional analyses highlight how Blue Crimes, such as piracy, illegal, unreported and unregulated (IUU) fishing, human trafficking and environmental degradation, undermine the sustainability and inclusivity of ocean-based economies.

Africa (Gulf of Guinea, West and East Africa)

The African maritime domain exemplifies how Blue Crimes undermine Blue Economy development through economic disruption, environmental degradation and institutional erosion. Economically, the Gulf of Guinea accounted for over 90% of global kidnappings at sea in 2020, with piracy, armed robbery and maritime violence inflating shipping costs, insurance premiums and deterring foreign investment (ICC, 2022; Mohammed, 2023; Uchenna *et al*., 2025). Nigeria's oil theft and maritime robbery further erode state revenue and destabilise energy markets (Amao *et al*., 2024). IUU fishing across West Africa causes annual losses exceeding USD 2.3 billion, threatening the livelihoods of over 12 million people (Belhabib *et al*., 2015; FAO, 2020). Environmentally, illegal trawling, pollution from oil theft and destructive fishing degrade marine ecosystems, particularly along Somali and Kenyan coasts, damaging biodiversity and intensifying food insecurity (UNODC, 2020; UNEP, 2021; McCabe, 2023). Institutionally, limited surveillance, corruption and weak enforcement foster criminal networks, exemplified by piracy in Somalia and smuggling via Kenya's Port of Mombasa (Edmunds, 2017; Okafor-Yarwood, 2020; INTERPOL, 2021). These interlinked dynamics affirm the need for integrated governance addressing security, environmental and developmental challenges.

Asia-Pacific (ASEAN and Western Indian Ocean)

The Asia-Pacific region illustrates how economic, environmental and institutional vulnerabilities collectively constrain Blue Economy development. Economically, Southeast Asian countries such as Indonesia, Malaysia and the Philippines face significant losses from IUU fishing, piracy and maritime trafficking. Indonesia alone loses approximately USD 3 billion annually to illegal fishing, nearly a quarter of its national catch (FAO, 2020; Dirhamsyah *et al*., 2022). Piracy and smuggling in the Strait of Malacca further increase security costs, with incidents rising 20% between 2020 and 2021 (ICC, 2022). Foreign incursions in the South China Sea disrupt markets and threaten resource-dependent communities (UNODC, 2020).

Environmentally, destructive fishing, coral reef degradation and pollution accelerate biodiversity loss, while illegal fishing in the Western Indian Ocean depletes up to 30% of regional stocks (FAO, 2020; McCabe, 2023). Institutionally, fragmented governance, overlapping jurisdictions and weak enforcement undermine collective responses to trafficking and maritime crimes (Bueger & Edmunds, 2017; IMO, 2021). These interlinked vulnerabilities confirm that integrated governance is essential to sustain economic, ecological and institutional resilience in the region.

Europe (Mediterranean and Baltic Seas)

Europe's maritime context shows that even advanced governance frameworks remain vulnerable to Blue Crimes. Economically, the Mediterranean loses up to 20% of total fish catches, valued at approximately USD 1.5 billion annually, undermining small-scale fisheries and regional seafood markets (FAO, 2020). Human smuggling across the Mediterranean adds socio-economic pressures, with frontline states like Italy, Malta and Greece managing increased safety and resource demands (UNODC, 2020).

Environmentally, destructive fishing, illegal gear use and overfishing contribute to biodiversity loss and habitat degradation, while industrial pollution in the Baltic Sea further compromises ecosystems and critical services for tourism, fisheries and coastal development (UNEP, 2021; HELCOM, 2021). Institutionally, Europe's multi-level governance, despite instruments like the Marine Strategy Framework Directive and EU Integrated Maritime Policy, faces coordination challenges due to jurisdictional overlaps, inconsistent enforcement and uneven member

state commitment, creating exploitable gaps for criminal activity (Becker-Weinberg, 2023). These dynamics illustrate how economic, ecological and institutional vulnerabilities interact, reinforcing the need for integrated and adaptive maritime governance.

Latin America (Brazil and Ecuador)

Latin America's maritime regions demonstrate how Blue Crimes simultaneously undermine economic, ecological and institutional foundations of the Blue Economy. Economically, Brazil loses nearly 30% of its fish catch to IUU fishing, resulting in approximately USD 1 billion in annual revenue losses and disproportionately affecting coastal livelihoods (FAO, 2020; Belhabib *et al*., 2015). Ports such as Santos also facilitate transnational drug trafficking, highlighting the convergence of legitimate and illicit maritime activities (UNODC, 2020).

Environmentally, illegal fishing along Brazil's Atlantic coast and the Amazon estuary accelerates biodiversity decline and disrupts marine habitats, while Ecuador's Galápagos Islands face threats from industrial fleets operating in protected waters, jeopardising conservation and eco-tourism (Witbooi *et al*., 2020; INTERPOL, 2021; Leal *et al*., 2012). Institutionally, governance weaknesses, corruption and collusion between officials and illegal actors hinder regulatory effectiveness, leaving coastal states vulnerable to organised crime and maritime insecurity (Edmunds, 2021; Witbooi *et al*., 2020). These dynamics illustrate interconnected vulnerabilities, reinforcing the need for governance strategies that address structural drivers within ocean-based economies.

Discussion: Toward an Integrated Blue Crime Governance Framework

Regional case studies across Africa, Asia-Pacific, Europe and Latin America reveal that the rapid expansion of the Blue Economy has increased exposure to complex Blue Crimes, including IUU fishing, piracy, trafficking, marine pollution and offshore resource theft. Despite regional variations, these crimes share common drivers, such as weak governance, institutional fragmentation, environmental pressures and socio-economic disparities (Okafor-Yarwood, 2020; Hübschle & Lindley, 2024). In West Africa, piracy, oil theft and IUU fishing undermine state revenue and food security, while Southeast Asia faces destructive fishing, trafficking and coral degradation that threaten tourism, fisheries and biodiversity (Belhabib *et al*., 2015; Bueger & Mallin, 2023). Europe and Latin America, though comparatively better regulated, still contend with enforcement gaps in fisheries, offshore energy and maritime trafficking (Becker-Weinberg, 2023). These findings underscore that Blue Crimes are systemic governance failures impacting economic, ecological and geopolitical domains, threatening SDG 14 (Life Below Water) and SDG 16 (Peace, Justice, and Strong Institutions) (Warikandwa, 2023; Edmunds, 2021). Current governance frameworks, including UNCLOS and the Port State Measures Agreement, provide foundational regulation but are inadequate for addressing transnational, adaptive Blue Crimes (Becker-Weinberg, 2023). Regional codes of conduct, such as Yaoundé and Djibouti, promote cooperation but remain constrained by limited resources, inconsistent political will and weak coordination (Mohammed, 2023). Addressing these gaps requires a Whole-of-Ocean Governance framework integrating environmental, economic and security dimensions, emphasising inter-agency cooperation, cross-border information sharing and inclusive decision-making.

Emerging digital technologies, including satellite monitoring, AI-driven surveillance, anomaly detection and blockchain traceability, enhance transparency and accountability in fisheries and maritime operations (OECD, 2020; Voyer *et al*., 2021). However, equitable access and capacity-building are critical to prevent widening the digital divide, particularly in developing states disproportionately affected by Blue Crimes (UNDP, 2022). Regional cooperation platforms, such as IORA, the African Union's 2050 Maritime Strategy and ASEAN-led forums, demonstrate increasing emphasis on joint patrols, information sharing,

and harmonised regulations. Theoretical insights from Environmental Governance Theory, the Security-Development Nexus and the Sustainable Development Paradigm reinforce the empirical findings. Weak regulatory enforcement undermines human-ocean interaction management (Lemos & Agrawal, 2006), economic marginalisation and inequality exacerbate vulnerability to crime (Bueger & Mallin, 2023; Mohammed, 2023), and the interdependence of environmental, social and economic sustainability is confirmed (Bennett *et al*., 2019). Integrating these perspectives, the Whole-of-Ocean Governance model incorporates Blue Justice, emphasising participatory governance, distributive equity and social protection, ensuring coastal communities benefit from ocean-based development while mitigating the multidimensional threats of Blue Crimes (Bennett *et al*., 2019). This approach highlights the necessity of multi-level, justice-oriented and integrated governance for sustainable and secure ocean futures.

Policy, Practical and Governance Implications

The governance implications of this study emphasise that addressing Blue Crimes is essential for resilient and sustainable Blue Economy strategies. Blue Crimes undermine economic viability, ecological integrity and institutional resilience, necessitating integrated interventions that simultaneously target these pathways (Bennett *et al*., 2019). National and regional strategies should mainstream crime prevention, maritime law enforcement and transparency mechanisms into ocean development agendas, including inter-ministerial coordination linking environment, fisheries, defence, customs and justice sectors within a Whole-of-Ocean Governance framework. Strengthening monitoring, control and surveillance (MCS) through technologies, such as satellite vessel tracking, blockchain traceability, AI analytics and remote sensing, enhances detection and accountability, though effective deployment requires investment, capacity building and equitable access (OECD, 2020; UNDP, 2022).

Regional cooperative frameworks, including the Yaoundé and Djibouti Codes of Conduct, must be fully operationalised with dedicated resources, harmonised legislation and interoperable data-sharing systems to improve maritime domain awareness and enforcement (Mohammed, 2023; Okafor-Yarwood, 2020). Integrating Blue Justice principles ensures social inclusion and environmental equity, supporting coastal community empowerment, participatory resource management and gender-sensitive governance (Bennett *et al*., 2019; Hübschle & Lindley, 2024). Multi-agency task forces, public-private partnerships, and alignment of trade and financial regulations further reinforce transparency and sustainable investment (Voyer *et al*., 2021; World Bank, 2022). Collectively, these measures transform the Blue Economy into a resilient, secure, and socially just governance model capable of long-term sustainability.

Limitations and Future Research Directions

This study, while conceptually robust and theoretically insightful, has several limitations. As an integrative review, it does not include primary empirical data, leaving proposed causal mechanisms theoretical rather than empirically validated. Variations in governance capacity, institutional arrangements and data reliability across regions constrain the generalisability of the Whole-of-Ocean Governance framework. Additionally, the lack of standardised global datasets on Blue Crimes limits accurate quantification of their economic, ecological and social impacts.

Future research should adopt empirical, comparative and interdisciplinary approaches to refine the framework. Quantitative studies could assess the costs of Blue Crimes and their correlation with governance indicators, while mixed-methods research could explore socio-political factors influencing maritime crime and enforcement. Comparative evaluations of regional initiatives like the Yaoundé and Djibouti Codes of Conduct could identify best practices and interdisciplinary studies on AI, satellite monitoring and blockchain traceability

may enhance detection, transparency and accountability. These directions will strengthen evidence-based policies for sustainable and secure ocean governance.

Conclusions

This study examines the intersection of the Blue Economy and Blue Crime within sustainable ocean governance. It demonstrates that while the Blue Economy can advance economic growth, environmental protection and social well-being, illicit maritime activities including illegal fishing, piracy, pollution, trafficking and resource theft exploit governance weaknesses, destabilising ecosystems, markets and institutions. Grounded in Environmental Governance Theory, the Security-Development Nexus and the Sustainable Development Paradigm, the study emphasises the interdependence of environmental sustainability, maritime security, and socio-economic stability. It argues that addressing Blue Crimes is essential for achieving SDG 14 (Life Below Water) and SDG 16 (Peace, Justice, and Strong Institutions). The proposed Whole-of-Ocean Governance framework integrates environmental stewardship, coordinated security and inclusive socio-economic development under the principle of Blue Justice. By synthesising cross-regional evidence and theory, the study provides a conceptual pathway for resilient, equitable and transparent ocean governance capable of responding to the complex, evolving pressures on global oceans in the twenty-first century.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Author Contributions Statement

The authors confirm contribution to the paper as follows: Study conception and design: Marhaini Mohd Noor, Jagan Jeevan; literature review and development of the conceptual framing: Marhaini Mohd Noor; analysis and interpretation of findings: Marhaini Mohd Noor, Ali Umar Ahmad; drafting of the manuscript: Marhaini Mohd Noor, Ali Umar Ahmad; critical revision and intellectual guidance: Jagan Jeevan. All authors reviewed the results and approved the final version of the manuscript. Ali Umar Ahmad served as the corresponding author.

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