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BLUE ECONOMY POLICY NOTE SERIES:

VOLUME 1
Monitoring, Control & Surveillance and the Blue Economy



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Monitoring, Control & Surveillance and the Blue Economy

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Acronyms and abbreviations

ABMT	Area-based management tool
ABNJ	Areas beyond national jurisdiction
AI	Artificial intelligence
AIS	Automatic identification system
APFIC	Asia-Pacific Fishery Commission
ASO	At-sea observer
BBNJ	Biodiversity Beyond National Jurisdiction
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CDEM	Construction, Design, Equipment and Manning (standards)
CHM	Clearing-House Mechanism (under the BBNJ Agreement)
CTI-CFF	Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EM	Electronic Monitoring
ERS	Electronic Recording and Reporting System
FAO	Food and Agriculture Organization of the United Nations
FFA	Pacific Islands Forum Fisheries Agency
GBF	Kunming-Montreal Global Biodiversity Framework
GEF	Global Environment Facility
ICT	Information and Communication Technology
IMO	International Maritime Organization
IPOA-IUU	International Plan of Action to Prevent, Deter and Eliminate IUU Fishing
ISA	International Seabed Authority
IUU	Illegal, Unreported and Unregulated (fishing)
LDC	Least Developed Country
LRIT	Long Range Identification and Tracking
MARPOL	International Convention for the Prevention of Pollution from Ships
MCS	Monitoring, Control and Surveillance
MPA	Marine Protected Area
MSC	Marine Stewardship Council
NEAFC	North East Atlantic Fisheries Commission

NTSA	Niue Treaty Subsidiary Agreement
PNA	Parties to the Nauru Agreement
PSC	Port State control
PSMA	FAO Agreement on Port State Measures
RFMO	Regional Fisheries Management Organisation
S-AIS	Satellite-based Automatic Identification System
SAR	Synthetic Aperture Radar
SEAFDEC	Southeast Asian Fisheries Development Centre
SIDS	Small Island Developing State
SPC	Pacific Community
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
VIIRS	Visible Infrared Imaging Radiometer Suite
VMS	Vessel Monitoring System
VTR	Vessel Trip Report
WCPFC	Western and Central Pacific Fisheries Commission



Photo: FFA

1. Introduction

1.1 Introducing the Blue Economy

Countries in the Asia-Pacific region have jurisdiction over globally significant ocean areas that support a diverse range of species, habitats, and marine resources. Many, particularly Small Island Developing States (SIDS) and coastal least developed countries (LDCs), depend on ocean resources to support socio-economic development and coastal livelihoods. The emergent concept of the Blue Economy, gained international prominence at the Rio+20 Sustainable Development Conference in 2012 and again at the first UN Oceans Conference in 2017, conceptualises the ocean as a 'development space' and constitutes an important sustainable development framework. The concept promotes economic growth, social inclusion and improved livelihoods at the same time as ensuring the environmental sustainability of the ocean (UNDP, 2018).

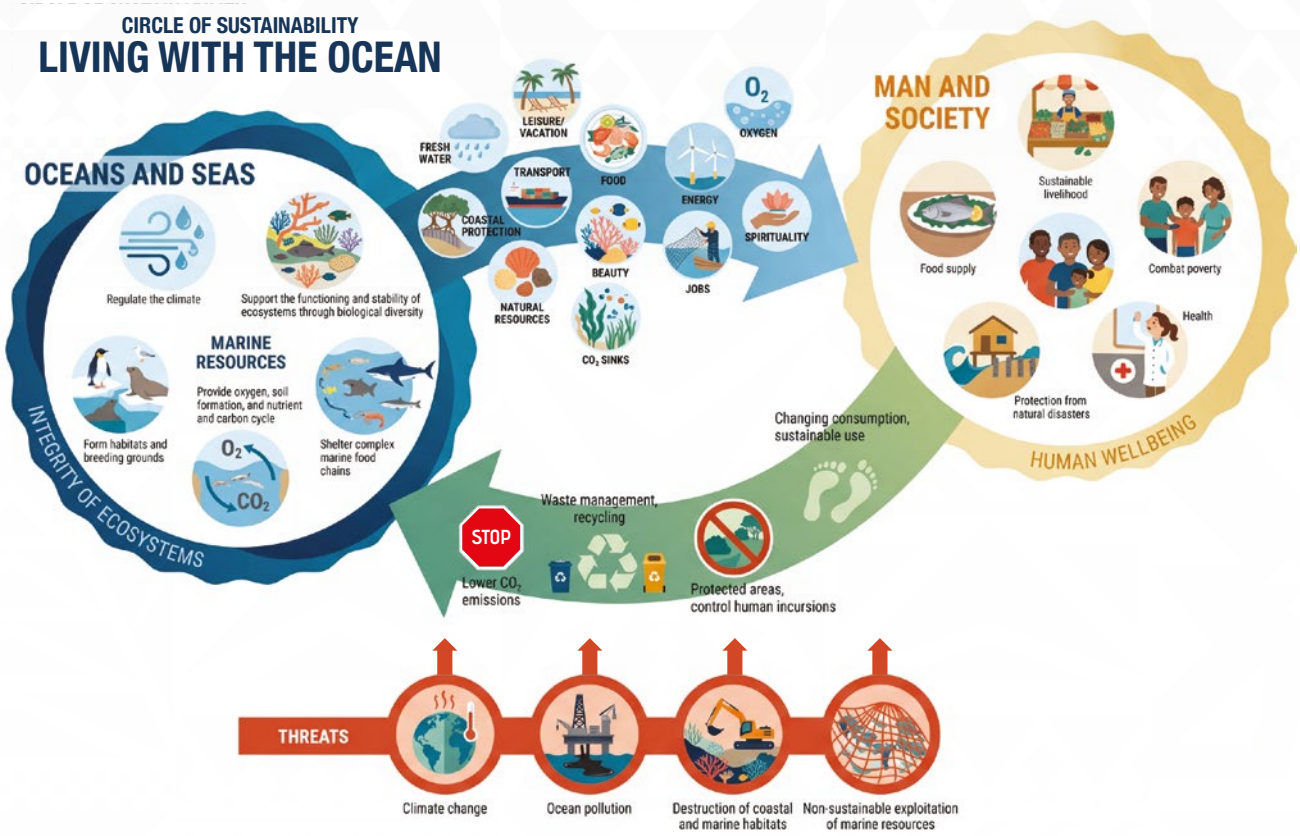


Figure 1: Circle of Sustainability: Living with the Ocean. Adapted from: Oceans Atlas, 2017[1].

UNDP defines the Blue Economy as:

> *the sustainable use of ocean resources for economic growth, jobs and social and financial inclusion, with a focus on preservation and restoration of ocean ecosystems and the services they provide.*

1 Source: Heinrich Böll Foundation Schleswig-Holstein, Heinrich Böll Foundation and University of Kiel's Future Ocean Cluster of Excellence (2017), Ocean Atlas 2017, pp. 42–43. Graphic: Petra Böckmann. Licensed under CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0/). Cropped from the original.

According to UNDP's definition, the Blue Economy takes into account the health of the ocean, as it strives to balance the three dimensions of sustainable development, namely: environmental, economic and social (United Nations, 2015). This interpretation promotes development from economic activities that minimise environmental degradation, biodiversity loss and unsustainable use of resources, while maximising economic and social benefits.

The Blue Economy is not a uniform theme, but rather a concept that embraces multiple sectors. The list of sectors relevant from a maritime perspective is broad and will vary from country to country. While it may be tempting to view the Blue Economy in isolation, it should not, however, be seen as a development strategy in and of itself, but rather, conceived in the context of a broader national sustainable development framework, particularly in terms of how it can contribute to national development goals.

Viewed through this lens, a Blue Economy centred approach offers countries in the Asia-Pacific region with a development framework through which to boost economic growth and tackle unemployment, food insecurity and poverty, while at the same time mitigating some of the inherent structural challenges of small states, including: small undiversified economies; limited fiscal space; and, high unit costs of providing public services. Many countries in the region are also highly vulnerable to the impacts of climate change, with many only a few meters above sea level and facing natural hazards that threaten the viability of communities and critical infrastructure.

Within the Asia-Pacific region, interest in the Blue Economy has grown rapidly. However, despite its potential, many developing states are not yet fully embracing the economic potential of the ocean. In order to support the transition to a sustainable Blue Economy, the UNDP Regional Bureau for Asia and the Pacific, is providing strategic technical support to transform the blue economies of countries in the region.

UNDP's ambition is to support a global Blue Economy that sustainably uses ocean resources for inclusive and sustainable development. Over the last 25 years, UNDP has mobilized more than US$1 billion for ocean protection and restoration in more than 100 countries. The adoption, by States, of an integrated 'sustainable Blue Economy' approach aligns with UNDP's integrated development priorities. This is also detailed in UNDP's *Nature Pledge*[2]*, Ocean Promise*[3] and its integrated offer[4] for SIDS, *Rising Up for SIDS*, which prioritises investment in people, particularly women, youth, and vulnerable communities, while leveraging digital transformation, data, and innovative financing to secure sustainable development gains.

1.2 Context for this policy note

The Blue Economy approach recognises and emphasises the critical need for countries to effectively address the sustainable management of ocean resources by the further development and refinement of integrated ocean governance mechanisms. In 2023, UNDP released the *Blue Economy Action Brief* which provides a blueprint for a multisectoral, integrated approach to the Blue Economy. The Action Brief provides countries with information concerning the tools required to underpin the Blue Economy, particularly with regard to the most important components for a governance approach that integrates and coordinates the sustainable Blue Economy (see Figure 2 below).

The Blue Economy Action Brief demonstrates how decision makers in the Asia-Pacific region and beyond can accelerate the transition to a sustainable Blue Economy. However, while the development of the governance framework is an important step in understanding how to operationalise a Blue Economy approach, there is a need for this framework to be 'unpacked' and the various components explained.

2 Nature Pledge | United Nations Development Programme
3 Ocean Promise | United Nations Development Programme
4 Rising up for SIDS: UNDP's Strategy to Support SIDS in the Next Decade | United Nations Development Programme

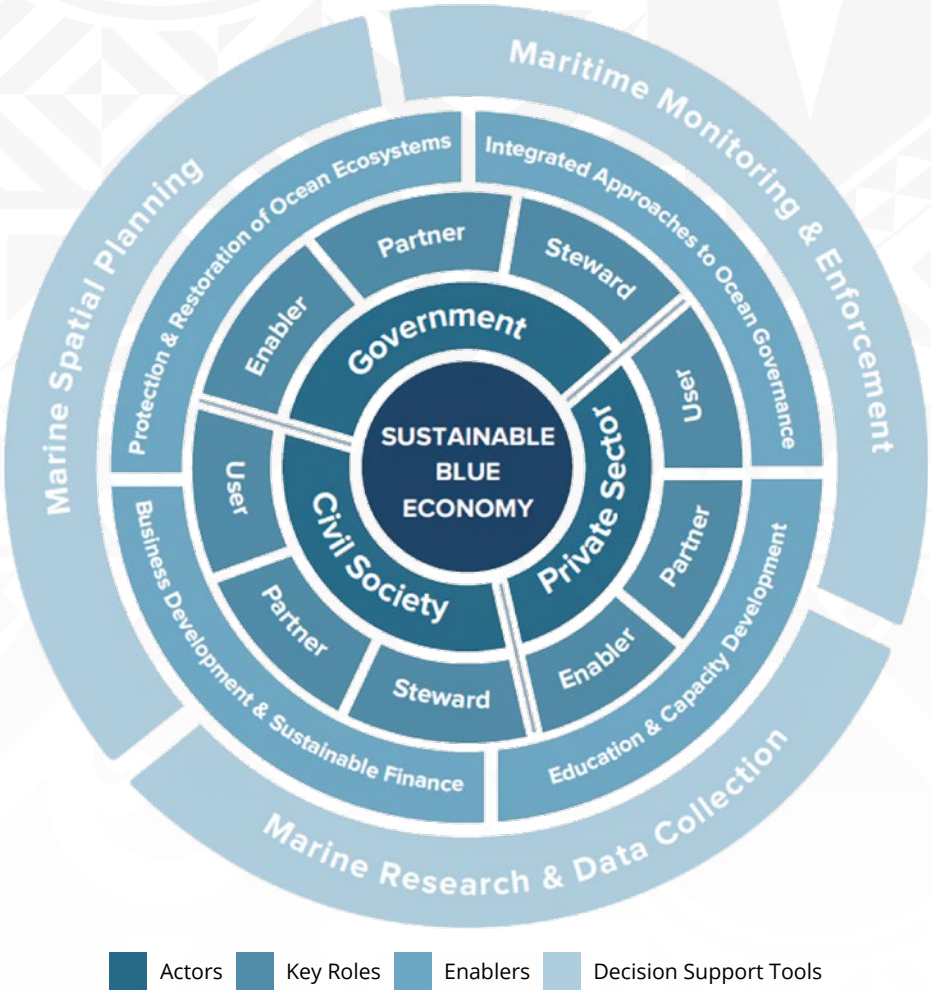


Figure 2: The Sustainable Blue Economy Governance Wheel. Source: UNDP (2023)

To this end, UNDP, in collaboration with its partners, has prepared a series of thematic 'Policy Notes' to accompany the Blue Economy Action Brief. Each of these policy notes elaborates information on a specific component of the governance framework outlined in Figure 2 above.

1.3 Purpose and organisation of this policy note

This policy note, the first in the series, was prepared in collaboration with the Pacific Islands Forum Fisheries Agency (FFA) with financial support from the Global Environment Facility (GEF) through the Oceanic Fisheries Management Project. It presents an overview of the role played by maritime Monitoring, Control & Surveillance (MCS) in the transition to a sustainable Blue Economy. The policy note is aimed at officials and policy makers who plan to initiate development of a Blue Economy development framework, and serves to provide guidance on the option for and benefits of integrating MCS into the national framework for supporting the Blue Economy transition. The purpose of this policy note is not to provide detailed information about how to establish and operate a MCS system, but rather to provide the reader with a better understanding of how best to integrate MCS and associated tools to support the sustainable Blue Economy transition.

The countries of the Asia-Pacific region are very diverse with respect to their geographical, ecological, and governance aspects. This policy note takes diversity into account, along with differences in the capacity of practitioners as well as marine management approaches, and does not espouse a "one size fits all" approach. It instead offers ideas and inspiration for Blue Economy practitioners across the region about what has worked elsewhere.

Because the Blue Economy is inherently multi-sectoral, this policy note treats MCS as shared infrastructure serving the full range of ocean-based activities rather than as a function belonging to the fisheries sector alone. Readers will nonetheless encounter a greater number of fisheries examples in the sections that follow, and this is deliberate. MCS evolved primarily as a fisheries management tool and is, the most mature MCS application. The fisheries experience offers the clearest practical template for the other sectors of the Blue Economy, and the tools, institutional arrangements and legal reforms described below are in the great majority of cases directly transferable. Where this note draws on a fisheries example, the reader is invited to consider how the same capability could be applied to pollution control, habitat protection, infrastructure security or maritime safety within their own jurisdiction.

2. Introduction to Monitoring, Control & Surveillance (MCS)

The transition to a sustainable Blue Economy depends, among other things, on effective and efficient monitoring, control and surveillance of human activities in the ocean. Transnational threats include Illegal, Unreported, and Unregulated (IUU) fishing, waste dumping, pollution, illegal bunkering, piracy, and the trafficking of drugs, arms and people, all of which contribute to major environmental and maritime security challenges across Asia and the Pacific. Enforcing legislation, especially offshore, requires awareness of illegal activity. Without a clear picture of what is happening at sea, this becomes difficult. To transition effectively to a sustainable Blue Economy, countries must better understand and address illegal unreported and unregulated activities in their maritime space.

MCS systems improve situational awareness across maritime safety and security, border control, the marine environment, fisheries control, trade and economic interests, as well as law enforcement and defence (European Commission, 2012). They also enable authorities to identify suspicious activities in the maritime domain that potentially pose transnational threats of the kind described above. Well-implemented MCS also helps both to deter and to address violations of fisheries regulations and other maritime laws, since it supplies the evidence on which enforcement action depends.

Strengthening MCS is a key mechanism with which to assure the effective management of the offshore waters of the Asia-Pacific region, where the distances from land make it harder to ensure compliance with rules set by national authorities, regional bodies such as Regional Fisheries Management Organisations (RFMOs) and international organisations such as the Food and Agriculture Organization of the United Nations (FAO) and the International Maritime Organization (IMO) (Cremers, Bouvet, Wright and Rochette 2021).

2.1 What constitutes Monitoring, Control & Surveillance?

The term 'Monitoring, Control & Surveillance' may be subject to different definitions and interpretations. The concept was first formalized by the FAO in 1981, as a key principle in sustainable fisheries management, and came to prominence in the 1990s due to a combination of:

1. rapidly depleting fish stocks;
2. global initiatives to respond to this crisis; and
3. technological developments which facilitate the remote monitoring of vessels.

However, while most rules and procedures pertaining to MCS have been developed around fisheries and IUU fishing, MCS as a concept should be viewed more broadly since it has a range of applications. A contemporary understanding of MCS should, therefore, focus less on fisheries management and the traditional understanding of IUU fishing, but rather one constructed around maritime domain awareness and the prevention and detection of unlawful activities across the ocean space as a whole. Contemporary definitions of MCS must therefore encompass the broad range of human activities undertaken in the ocean. This more comprehensive understanding includes the following:

Monitoring

Under the broader interpretation adopted in this policy note, **Monitoring** is defined as the continuous requirement for the collection, measurement and analysis of information concerning those maritime activities occurring within a State's ocean space and, more broadly, in areas Beyond National Jurisdiction (ABNJ). This information includes primary data that marine resource managers and regulators can use to

arrive at management decisions. If this information is unavailable, inaccurate or incomplete, managers will be handicapped in developing and implementing management measures.

While this is broader than the classic 'fisheries monitoring' interpretation, in essence the function is little changed; what differs is the range and volume of additional information that must be collected and analysed. Extra information may include:

- maritime traffic data (from the Automatic Identification System (AIS), Long Range Identification and Tracking (LRIT) and comparable systems);
- maritime security data (piracy activity, illegal substances or goods smuggling, human trafficking and other security threats);
- search and rescue data;
- environmental safety data (including pollution monitoring);
- and meteorological and oceanographic data (including science and research activities).

Control

Under a broader definition, **Control** is the specification of the regulatory conditions (including enforcement) under which maritime activities occurring within a State's ocean space may be conducted. These specifications are normally contained in national legislation and other arrangements that might be nationally, sub-regionally, regionally or internationally agreed. The legislation provides the basis for which marine management arrangements, via MCS, are implemented.

Surveillance

Under a broader definition, **Surveillance** is defined as the regulation and supervision required to maintain compliance with the regulatory controls imposed on activities within a State's ocean space, including enforcement activity. Surveillance is critical to ensure that harm to the marine environment and the resources it supports is minimized and management arrangements are implemented.

Surveillance is always the largest and most expensive element of MCS funding. The surveillance component can be executed by both remote or direct surveillance equipment and tools. Each method has advantages and disadvantages and in practice they are normally used in combination.

2.1.1 The enforcement triangle

In its entirety, MCS is a key element in the 'enforcement triangle', which comprises a range of actions, legal steps, processes, tools and systems to counter non-compliant activities. The implicit consequences of such a system are that any regulatory action arising from MCS requires that:

i. non-compliance with a regulatory provision(s) is recognised;
ii. 'interception' of the perpetrators of non-compliant activities then occurs;
iii. 'interdiction' follows and this may result in actual seizure of the person(s), vessel(s), catch or goods involved;
iv. restraint is applied to prohibit further non-compliant activity; and
v. 'deterrence' ensures that the potential benefits of non-compliant activity are minimised (Miller, Slicer and Hanich, 2013).

A well-designed MCS system thus allows States to effectively implement their national marine resource management policies and, increasingly, their wider maritime, environmental and maritime security policies. Notwithstanding its importance, however, many states lack the required expertise, resource and capability in MCS matters, making it difficult to reach key marine resource management policy objectives.

A broader definition of MCS also implies a broader institutional footprint. Where MCS is understood as covering the full range of human activity at sea, responsibility no longer rests with fisheries, port and maritime administrations alone, but is shared with environmental agencies, customs and revenue authorities, immigration and border services, police and prosecuting authorities, defence and coastguard forces, and the bodies responsible for shipping safety, marine pollution response and offshore infrastructure. Each of these holds only part of the picture. Realising the value of MCS therefore depends on whether they are legally permitted to share information with one another, whether their systems are technically capable of doing so, and whether formal arrangements exist to govern that exchange. These questions are considered further in section 3.3.

2.2 MCS as a critical enabler of the Blue Economy transition

MCS encompasses a broad range of measures (including legal frameworks, data collection and analysis, licensing and access conditions, observer programmes, and surveillance and patrol systems) that together help ensure compliance across the full range of marine sectors. The threats MCS must address are correspondingly wide-ranging, as outlined below.

Ocean ecosystems in Asia and the Pacific offer major socio-economic and cultural benefits, but they are under severe pressure. Globally, overexploitation, habitat destruction, pollution and poor ocean management have reduced opportunities, worsened food insecurity, and diminished economic prospects for some of the world's poorest people. The main human threats include the following (World Bank and UNDESA, 2017):

- Unsustainable extraction of marine living resources, such as unsustainable fishing coupled with poorly managed access to fish stocks and rising demand. According to the FAO's most recent State of World Fisheries and Aquaculture report, approximately 38 percent of the world's assessed fish stocks by number are at biologically unsustainable levels (FAO, 2026). Fish stocks are further exploited by IUU fishing, the scale and cost of which are set out in Text Box 1 below;
- Physical alteration and destruction of marine and coastal habitats and landscapes, due largely to harmful fishing practices, coastal development, deforestation, and sand/aggregate mining;
- Marine pollution, for example in the form of discharges of oily waste and other harmful substances, untreated sewage or ballast water, and marine debris such as plastics, together with pollutants reaching the ocean from land-based sources;
- Impacts of climate change, for example in the form of both slow-onset events like sea-level rise, ocean warming and acidification, and more intense and frequent weather events.

The Blue Economy cannot be fully realised unless ocean health is restored and ecosystems are protected. Supporting this transition therefore requires stronger monitoring and enforcement, underpinned by an effective and efficient MCS system. This need is reinforced by the Kunming-Montreal Global Biodiversity Framework (GBF), adopted in December 2022, to effectively conserve and manage 30 percent of the world's oceans by 2030. Achieving it will also require significant high seas Marine Protected Areas (MPAs) under the *Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction* (BBNJ Agreement), discussed at section 3.2.4 below, and effective MCS will be essential to ensure these areas deliver real conservation outcomes.

MCS has a range of applications that may support the transition to and implementation of a sustainable Blue Economy, including (Cremers, Wright and Rochette 2020):

- Monitoring of human activities (e.g. in the form of data collection and reporting);
- Control of human activities and their impacts on marine biodiversity (e.g. through regulation, licensing, and controls on how, where and when activities in the ocean take place);
- Surveillance of vessels (e.g. through observer programmes and electronic surveillance systems);

- Encouraging compliance with regulations through transparency, sanctions and other measures;
- Enforcement action (e.g. to tackle IUU fishing and other illegal activities in the maritime domain.)

None of these five functions is sector-specific. The MCS functions that support fisheries management also underpin every other sector of the Blue Economy, and in most States they are delivered by the same assets, drawing on the same data and operated by the same people.

This shared maritime domain awareness is what makes MCS a Blue Economy-wide investment. A single satellite-derived vessel track can establish that a ship was fishing without a licence, that it entered a marine protected area, that it discharged oily waste along a given stretch of water, that it anchored over a coral reef or a submarine cable, or that it departed from an agreed traffic separation scheme. A patrol vessel dispatched to investigate unlicensed fishing can equally respond to a pollution incident, a search and rescue call, a smuggling alert or a breach of an offshore safety zone. A national maritime coordination centre that brings together radar, satellite and reporting data serves fisheries officers, environmental regulators, port authorities, customs officials and disaster managers from the same screen.

Understood in this way, MCS supports the Blue Economy across at least six broad areas:

- **living marine resources:** licensing, catch and effort verification, protection of stocks and compliance with fisheries and aquaculture regulation;
- **maritime transport and ports:** navigational safety, traffic management, port State control, and the detection of illegal bunkering, smuggling and cargo-related offences;
- **marine and coastal tourism:** regulation of dive, cruise and charter operations, anchoring restrictions and visitor limits at sensitive sites;
- **offshore energy and seabed resources:** enforcement of safety and exclusion zones, monitoring of discharge and environmental permit conditions, and oversight of exploration activity;
- **marine infrastructure:** protection of submarine telecommunications cables and pipelines from anchoring and bottom-contact damage;
- **the marine environment:** detection of pollution incidents, monitoring of protected and managed areas, and verification of compliance with spatial management measures.

Viewed in this way, it can be understood that the underlying capability is a shared one; the cost of MCS should not be carried by, or justified against, a single sector. A vessel monitoring centre, a satellite data subscription, a cadre of trained maritime analysts or a surveillance aircraft procured for fisheries purposes delivers value to shipping regulators, environmental agencies and security services simultaneously. Framing MCS as cross-sectoral national infrastructure allows its costs to be shared across ministries and its benefits to be counted across the whole ocean economy – an argument of particular importance for small island developing States, where no single sector could readily justify the investment on its own.

MCS is therefore a valuable tool for the implementation of the Blue Economy and should be seen as a priority by countries in the Asia-Pacific region. This is reflected in the Blue Economy Governance Wheel (Figure 2), which identifies MCS as one of three important tools that support Blue Economy decision-making.

3. Applying MCS to Support the Blue Economy

3.1 Application of MCS in the context of the Blue Economy

A key principle of the Blue Economy is that ocean health is inseparable from sustainable livelihoods for coastal communities and the wider economy. Unsustainable use of marine resources, habitat destruction, pollution and poor ocean management are eroding economic and social benefits and weakening the ocean's role in addressing broader challenges. Effective marine management, including control of harmful activities, is therefore fundamental to sustainable development.

Many countries, however, struggle to enforce existing rules, especially against IUU fishing. This is particularly challenging for SIDS, where Exclusive Economic Zones (EEZs) can be hundreds of times larger than land areas, making monitoring and surveillance difficult.

The subsections that follow examine four broad categories of pressure on the Blue Economy in which MCS has a demonstrable role: the unsustainable use of marine living resources; marine pollution; damage to marine habitats; and risks to maritime traffic, infrastructure and other ocean-based industries. The first is the most developed in both law and practice and is treated here at greatest length, but the tools and institutional arrangements it has generated apply directly to the other three.

3.1.1 Unsustainable use of marine resources

In the context of the Blue Economy, food security and sustainable livelihoods are closely related to sustainable use of biodiversity, and to the exploitation of wild fisheries (PEMSEA, 2021). As such, the fisheries sector plays an important role in the national economies of most, if not all countries in the Asia-Pacific region.

IUU fishing refers to activities that violate laws, regulations, and fishery management measures. It is a global problem that is hard to monitor and enforce, making it a major barrier to sustainable fisheries. In Asia and the Pacific, IUU fishing includes offences such as fishing without a licence or quota; fishing in closed or protected areas or seasons; exceeding catch limits; failing to report catches or submitting false reports to coastal States and RFMOs; using banned gear; under-reporting vessel size; using forged licences or registrations; and catching threatened, endangered, or protected species. Related trade offences include landing catches in non-designated ports, carrying out unauthorised transhipments to cargo vessels, operating without a required observer, and failing to use a vessel monitoring system (VMS).

IUU fishing leads to depletion of fish stocks, jeopardises food security, destroys marine habitats, distorts competition, puts honest fishers at a market disadvantage and weakens coastal communities' economies, particularly in developing countries, as the collapse of fisheries jeopardises the livelihoods of those who depend on them. As a result, IUU fishing has adverse impacts on the realisation of Blue Economy ambitions across Asia and the Pacific (Mohamad, 2009).

TEXT BOX 1: The impact of IUU fishing

Between 11 and 26 million tonnes of fish are caught illegally each year, which equates to approximately 11–19% of reported global fisheries production and leads to losses of roughly $10–23.5 billion in value. IUU fishing greatly impacts the livelihoods of small-scale coastal fishing communities that depend on fisheries for food. It is also associated with other crimes, including human trafficking and forced labour, drugs and arms smuggling, tax and customs fraud, money laundering and illegal wildlife trafficking.

As a result, resources, revenue, nutrition and livelihoods decline, posing serious challenges both at sea and on land. Developing countries are particularly vulnerable to IUU fishing, and weak governance has been shown to have a clear correlation with high levels of IUU fishing activities (WWF, 2019).

In the Pacific, the Secretariat of the Pacific Community (SPC) has estimated that, in the period 2017–2019, between 183,809 to 200,884 tonnes of tuna were either harvested or transhipped illegally in the Pacific tuna fisheries. This represents an economic loss of between USD 312 million and USD 358 million to Pacific Islands. (MRAG Asia Pacific, 2022).

3.1.2 Marine pollution

Marine pollution is a major threat to the marine environment that carries high costs and hinders socioeconomic development by harming fisheries. Threatening food security and coastal livelihoods, and affecting sectors such as tourism and shipping. It also weakens the ocean's resilience and its ability to mitigate climate change.

In the Asia-Pacific region, point source discharges of pollution from shipping and offshore oil and gas operations are of particular concern, as is the dumping of hazardous substances and garbage at sea and the discharge of ballast water, which can introduce invasive aquatic species and pathogens. Regional coastal and offshore waters support many of the most significant global shipping routes as well as extensive offshore petroleum production activities. Despite stringent international and regional controls, the discharge of oily waste from ships' bilges remains a significant problem. Oil slicks in traffic-heavy locations like the Strait of Malacca are known to occur, but bilge dumps also happen elsewhere in Southeast Asia.

However, with the use of new technologies and satellite imagery, anyone, anywhere can see what is happening on the water and help to raise an alarm. By matching the time of the imagery to broadcasts from a vessel tracking service called Automatic Identification System (AIS), the identity of vessels that appear to be causing the slicks can be identified (PEMSEA, 2021).

TEXT BOX 2: Detecting illegal bilge discharges from space – Indonesia and the Malacca Strait

Deliberate discharge of oily bilge water is prohibited under MARPOL 73/78, but it is difficult to detect and harder still to prosecute, because it typically occurs at night, far from shore and beyond the range of any patrol asset. Synthetic aperture radar (SAR) satellites have changed that calculation. Oil on the sea surface damps down small waves and therefore appears on radar imagery as a distinctive dark linear streak, visible irrespective of cloud cover or darkness.

In January and February 2019 the environmental monitoring organisation SkyTruth used freely available Sentinel-1 radar imagery from the European Space Agency's Copernicus programme to identify two substantial slicks in Indonesian waters: one extending at least 117 km near Bangka-Belitung, and a second of roughly 18 km off Sumatra. By matching the acquisition time of each image against archived AIS broadcasts, analysts were able to identify the vessel at the head of each slick – in one case a crude oil tanker, in the other an Indonesian cement carrier.

The case illustrates both the promise and the limits of the approach. The detection technology is mature, low-cost and already applied in the region. The constraint lies in what happens next: no prosecution is known to have followed either detection. Converting a satellite observation into an enforcement outcome requires legislation that admits remotely sensed evidence, standard operating procedures for preserving the chain of custody, an agency with an unambiguous mandate to act, and a judiciary equipped to weigh the evidence – precisely the non-technological components discussed in sections 3.2 and 3.3 below.

(Sources: SkyTruth, 2019; PEMSEA, 2021.)

3.1.3 Damage to marine habitats

Damage to marine and coastal habitats is another key challenge to realising a sustainable Blue Economy. For countries in the Asia-Pacific region, the health of coral reefs and associated biodiversity, in particular, is of critical importance, both from an environmental perspective and as an economic one, due to the strong reliance of SIDS' economies on the tourism and fisheries sectors. Despite their importance, coral reefs are facing significant challenges from human activities, especially from pollution, over-harvesting, destructive fishing, and physical destruction (PEMSEA, 2021). These human impacts are exacerbated by the impacts of global climate change.

The Coral Triangle[5] is one of the most biodiverse and ecologically important coral reef regions in the world, covering 1.6 percent of the planet's oceanic area, but containing 76 percent of all known coral species and 37 percent of all reef fish species (WWF, 2017a). Unsustainable fisheries practices and marine pollution can both adversely impact coastal and offshore habitats. Conversely, damage to coastal habitats can adversely impact on fisheries productivity. Hence, the control of activities that damage coastal habitats is also seen as a critical need in the transition to a sustainable Blue Economy. In terms of impact on the sustainability of fisheries resources, several illegal practices, such as the use of cyanide and explosives, have serious consequences, not only for the coral reef ecosystem and human health in general, but also for other fish species. These destructive fishing practices affect the biodiversity of the marine environment and result in the depletion and eventually the collapse of fish stocks.

5 The Coral Triangle spans six countries (Indonesia, the Philippines, Malaysia, Papua New Guinea, Solomon Islands, and Timor-Leste, with the largest area falling within Indonesian territorial waters.

TEXT BOX 3: Monitoring and surveillance in the Coral Triangle

The Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), a multilateral partnership between Indonesia, Malaysia, Papua New Guinea, the Philippines, Solomon Islands and Timor-Leste launched in 2009, coordinates one of the world's largest networks of tropical marine protected areas. Its transboundary seascapes include the Sulu-Sulawesi Marine Ecoregion, which alone exceeds one million square kilometres.

Protecting habitat at this scale requires control of activities that no fisheries licensing regime reaches: anchor damage to reefs from cargo vessels and cruise ships, dive and tourism pressure concentrated at particular sites, sediment plumes from coastal development and sand extraction, and vessel movement through no-take zones. Increasingly these are monitored using the same tools developed for fisheries compliance. Satellite AIS and VMS tracks show which vessels entered a closed area and how long they remained stationary over sensitive habitat; optical and multispectral satellite imagery is used to map reef condition, seagrass extent and mangrove loss over time; and community-based reporting through smartphone applications supplements official surveillance across areas too remote or too numerous for routine patrols.

The Coral Triangle experience carries a governance lesson as much as a technical one. A protected area boundary is only as meaningful as the capacity to observe activity within it, and that observation is most efficiently achieved where a single national maritime picture serves fisheries managers, environment agencies, tourism regulators and port authorities together, rather than each maintaining a separate and partial view.

(Sources: CTI-CFF; WWF, 2017a; PEMSEA, 2021.)

3.1.4 Risks to maritime traffic, infrastructure and other ocean industries

Beyond living resources, pollution and habitats, the Blue Economy depends on a set of ocean-based industries and assets whose safe operation and security likewise rest on effective MCS. These can include maritime transport and the ports that serve it, offshore energy installations, submarine telecommunications cables and pipelines, and marine and coastal tourism operations. Each generates its own compliance requirements: navigational safety and traffic separation, exclusion and safety zones around installations, anchoring restrictions over cables and pipelines, licensing of tourism operators, and the environmental monitoring conditions attached to offshore permits.

What these requirements have in common is that they are enforced through observation of vessel behaviour, the same observation on which fisheries MCS depends. A State able to establish which vessel was where, when, and doing what, can regulate all of these activities. A State unable to do so can regulate none of them effectively, whatever its legislation may provide. This is the clearest practical expression of the argument made in section 2.2: the marginal cost of extending an existing MCS capability to a further sector is generally small, while the cost of building a separate capability for each sector is prohibitive for most administrations in the region.

TEXT BOX 4: Protecting submarine cables through vessel tracking – New Zealand and the Pacific

Submarine telecommunications cables carry effectively all international internet and data traffic and are a critical dependency for the region's economies, especially Pacific islands, several of which are served by a single cable. The dominant cause of cable damage worldwide is not sabotage but routine maritime activity – anchors dragged across cable corridors, and bottom-contact fishing gear. Repairs are expensive and slow to arrange in remote ocean areas, and for a single-cable State, a break can sever national connectivity for weeks.

In June 2026 New Zealand launched what it described as the first national round-the-clock submarine cable monitoring system, delivered by the telecommunications infrastructure company Kordia using the Starboard Maritime Intelligence platform developed in New Zealand. The system continuously screens vessel tracking data against the boundaries of statutory cable protection zones and automatically alerts cable operators where a vessel's behaviour – slow speed, loitering, or a track consistent with anchoring – indicates a developing risk, allowing operators to make contact before damage occurs. It builds on an investment of NZ$4.5 million a year in a national maritime data fusion capability, with the recurrent surveillance cost met by cable owners.

The relevance for the wider region is that the platform, the data feeds and the analytical skills involved are the same as those used for fisheries surveillance. For Pacific and Southeast Asian States already operating a vessel monitoring capability, extending it to cable protection is largely a matter of adding a geographic layer, an alerting rule and a data-sharing arrangement with infrastructure owners – a marginal cost set against a substantial gain in national resilience.

(Source: New Zealand Government, 2026.)

3.2 MCS policy and legal frameworks

The legal basis for implementation of MCS can be found in various international and regional instruments such as the United Nations Convention on the Law of the Sea, UN Fish Stocks Agreement, FAO Compliance Agreement, the FAO Port State Measures Agreement and the FAO Code of Conduct for Responsible Fisheries. In addition, the International Maritime Organization (IMO) has created a comprehensive legal framework addressing the safety of navigation and the control and prevention of pollution from shipping.

These instruments form part of the global ocean governance framework that supports the sustainable Blue Economy and provide the basis for States to apply specific MCS-related measures for the most significant and harmful activities that occur in the ocean.

3.2.1 United Nations Convention on the Law of the Sea (UNCLOS)

The overarching framework governing the management of the oceans is provided by the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which establishes a comprehensive scheme of rules and principles governing the use of ocean space and resources. This includes rules on the determination and delimitation of certain maritime zones (Figure 3), together with rules concerning the exercise of various rights, obligations and jurisdiction over each zone. These rights and obligations, in many cases, establish the need for both economic development and effective control of a country's marine resources, including fisheries. (Girard and Du Payrat, 2017).

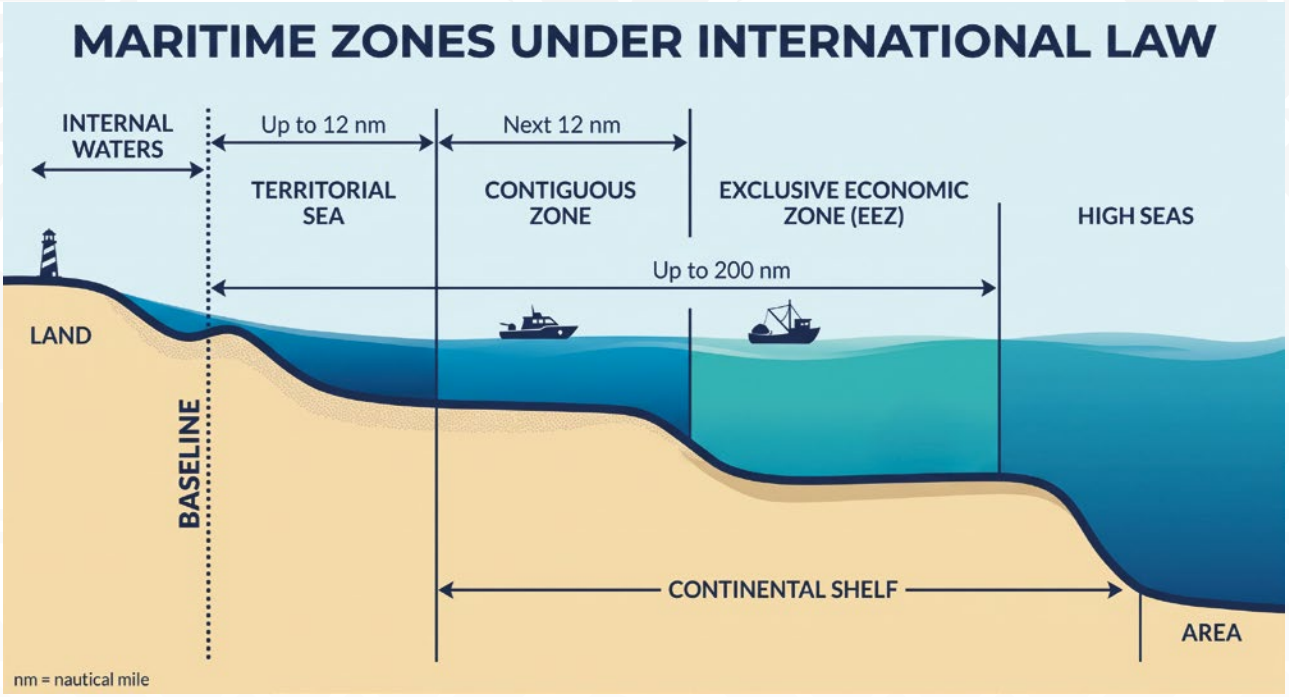


Figure 3: Maritime zones under international law.

The legal status of the different maritime zones determines how a coastal State can exert its authority over different maritime activities. States have sovereignty over their internal waters, territorial seas and archipelagic waters, while in the EEZ, States have sovereign rights for exploration, exploitation, conservation and management of natural resources and over other economic activities and jurisdiction over the protection and preservation of the marine environment. On the continental shelf, States have sovereign rights for exploration and exploitation of non-living resources and sedentary living resources on the seabed. Coastal States have the exclusive right to undertake monitoring and surveillance within their own territory, including territorial sea. States also have the exclusive right to undertake monitoring and surveillance in connection with the economic exploitation and exploration of their EEZ.

On the high seas, all States have the implied right to undertake monitoring and surveillance, but not to the extent of interfering with the exercise of the freedom of the high seas by ships flying a foreign flag.

Securing access to and the rights to utilise marine resources, requires countries to establish the legal limits of their maritime jurisdiction through the delimitation of maritime boundaries in accordance with the provisions of UNCLOS. In some cases, the absence of clearly defined maritime boundaries can prevent the management of the ocean space and marine resources. The settlement of unresolved maritime boundaries is therefore a priority for the effective implementation of MCS throughout the region.

TEXT BOX 5: The legal status of ports and their relevance to MCS

Jurisdiction over Internal Waters and Ports

Under UNCLOS, Internal Waters and Ports are especially important for MCS. Coastal States exercise similar authority there as on land. Foreign vessels have no automatic right to enter a port, and by doing so they submit to the coastal State's jurisdiction. This allows port States to set entry conditions, enforce non-discriminatory laws and regulations, and check compliance with international standards and national law.

Port State Control

Port State Control (PSC) is the inspection of foreign ships in national ports to verify compliance with international requirements on ship condition, equipment, manning, and operation. Its purpose is to promote maritime safety and security and prevent pollution. PSC is carried out by port authorities through routine inspections or inspections triggered by specific concerns or complaints.

Many IMO conventions authorise Governments to inspect foreign ships visiting their ports to ensure compliance with standards in instruments to which the port State is a party. PSC is also a core element of the FAO Port State Measures Agreement (PSMA). It is therefore a key mechanism for enforcing maritime standards, protecting lives and the environment, and supporting safe and efficient port operations.

3.2.2 Fisheries management instruments

Since the adoption of UNCLOS, many additional international instruments have reinforced the need for effective MCS to tackle IUU fishing. Principal among these are: (i) UN Fish Stocks Agreement; (ii) the Agreement on Port State Measures (PSMA) developed to prevent, deter, and eliminate IUU fishing by preventing vessels engaged in IUU fishing from using ports and landing their catches; and (iii) the International Plan of Action to Prevent, Deter, and Eliminate IUU Fishing (IPOA-IUU) - a voluntary instrument that encourages all States to use available measures (including coastal and port States, and market-related measures) in an integrated manner, to tackle IUU fishing. These instruments collectively emphasise the need for flag States to ensure the accountability of their vessels operating within and outside their EEZs.

3.2.2.1 UN Fish Stocks Agreement

The *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* (UN Fish Stocks Agreement) aims to ensure the long-term conservation and sustainable use of straddling and highly migratory fish stocks within the UNCLOS framework.

In MCS terms, the Agreement sets out flag State duties on vessel registration and records, authorisations, compliance, enforcement and broader MCS measures. It also addresses cooperation in international, regional and subregional enforcement, including boarding and inspection procedures and port State measures.

The Agreement gives port States both the right and duty to support subregional, regional and global conservation and management measures. Port States may inspect documents, fishing gear and catch on vessels in port or at offshore terminals, and may prohibit landing or transhipment where catches undermine high seas conservation and management measures. It therefore gives port States an important role in conserving straddling and highly migratory stocks.

3.2.2.2 *Agreement on Port State Measures*

The FAO *Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing* (PSMA) is the first binding international agreement to specifically target IUU fishing. Its purpose is to prevent, deter and eliminate IUU fishing by denying vessels engaged in it access to ports and landing rights (Cremers, K., Bouvet, M., Wright, G., Rochette, J, 2021).

The PSMA requires parties to strengthen port controls over foreign-flagged vessels, helping keep IUU catches out of global markets and reducing incentives for illegal operators. States implementing the PSMA may refuse port entry or services, including landing and transhipment, to foreign-flagged vessels known to have engaged in IUU fishing. Some countries also restrict trade with States that lack port State measures.

The PSMA further requires flag States to take action, at the request of a port State or when their vessels are found to have engaged in IUU fishing, including in areas beyond national jurisdiction.

The PSMA also underscores the need for cooperation between flag and port States, including information-sharing with relevant States, RFMOs, the FAO and other international bodies.

3.2.2.3 *International Plan of Action to Prevent, Deter, and Eliminate IUU Fishing (IPOA-IUU)*

The IPOA-IUU was developed as a voluntary instrument, within the framework of the *Voluntary Code of Conduct for Responsible Fishing* (CCRF)[6]. The objective of the IPOA is to prevent, deter and eliminate IUU fishing by providing all States with comprehensive, effective and transparent measures by which to act, including through appropriate RFMOs established in accordance with international law. Many States have implemented it regionally, through Regional Plans of Action. These are usually associated with, and supplemented at the national level by National Plans of Action to Prevent, Deter and Eliminate IUU Fishing, which closely follow the structure and measures of the IPOA-IUU.

The IPOA-IUU reiterates enforcement measures States may apply through their MCS systems. It calls for comprehensive, effective MCS from the start of fishing to landing and final destination, including measures reflected in UNCLOS, the FAO Compliance Agreement and the UN Fish Stocks Agreement, such as fishing authorisations, vessel records, observer programmes, vessel monitoring systems, and boarding and inspection (Palm-Robles, 2021).

3.2.3 Shipping/pollution control instruments

Shipping is one of the most heavily regulated marine activities. Over time, the IMO has adopted and revised instruments addressing the risks posed by international shipping. Environmental treaties focus mainly on three types of measures: discharge standards, construction, design, equipment and manning (CDEM) standards, and navigation standards. They regulate pollution from both accidents and normal ship operations. Key treaties include MARPOL 73/78, the International Convention on the Control of Harmful Anti-Fouling Systems on Ships, and the International Convention for the Control and Management of Ships' Ballast Water and Sediment.

Many IMO conventions allow ships to be inspected in foreign ports to ensure they meet IMO requirements. Although originally intended to back up flag State implementation, these PSC inspections have proved highly effective. IMO resolution A.682(17) promotes regional cooperation so inspections can be coordinated, focus on substandard ships, and avoid unnecessary duplication. This approach helps maximise inspections while minimising unnecessary delays. Although flag States remain primarily responsible for ship standards, PSC provides an important safety net for identifying substandard ships.

6 *Code of Conduct for Responsible Fisheries*. (Rome, FAO. 1995). 41 p.

Nine regional PSC Memoranda of Understanding (MoUs), have been signed, covering: Europe and the North Atlantic; Asia and the Pacific; Latin America; the Caribbean; West and Central Africa; the Black Sea; the Mediterranean; the Indian Ocean; and the Gulf regions. The United States Coast Guard operates a tenth PSC regime.

These MoUs establish harmonised regional PSC procedures to reduce risks and help prevent marine accidents. They also support cooperation and information-sharing through tools such as shared databases, officer training, common inspection manuals, and aligned procedures across ports in each region (Cremers, Bouvet, Wright and Rochette, 2021).

3.2.4 BBNJ agreement

Enforcement of international rules on the high seas is primarily the responsibility of flag States. However, while flag States generally have the primary right of control over vessels flying their flags on the high seas, they sometimes have a poor track record of monitoring and enforcing standards against vessels registered under their flags and concerns persist about how flag States would effectively enforce standards that apply to the high seas.

In response to this concern, in June 2023, the UN General Assembly formally adopted the *BBNJ Agreement*. The Agreement entered into force on 17 January 2026.

The problems the BBNJ Agreement is intended to solve are multifaceted and based on a delicately crafted political agreement, with a focus on high seas biodiversity. The agreed package of topics for the instrument comprises: (i) marine genetic resources including questions on the sharing of benefits; (ii) area-based management tools (ABMTs) including MPAs; (iii) environmental impact assessment (EIA); and (iv) capacity building and transfer of technology.

Although the BBNJ Agreement does not directly interfere with the existing mandates of global and regional marine management bodies (such as the IMO, the International Seabed Authority (ISA) and RFMOs) it does have implications for MCS in areas beyond national jurisdiction. For example, the Agreement requires every proposal for a MPA in areas beyond national jurisdiction to include a draft management plan setting out monitoring, research and review activities, making MCS planning mandatory for future high seas MPAs. The Agreement also identifies the development of MCS capacity and technology as a priority for capacity-building.

The Agreement also establishes a Clearing-House Mechanism (CHM) as a central open-access platform for sharing information on ABMTs, EIAs, marine genetic resources, and capacity-building and technology transfer. This CHM can support MCS by improving data-sharing, matching States' needs with finance or technology providers, and increasing transparency of human activities in areas beyond national jurisdiction.

The relationship between the BBNJ Agreement and existing marine management bodies, is especially important for Asia and the Pacific. The Agreement should be interpreted and applied without undermining relevant legal instruments, frameworks and bodies. In practical terms this means that the Agreement neither displaces nor duplicates the mandates of bodies such as RFMOs: the management of fisheries in areas beyond national jurisdiction remains the responsibility of the competent RFMOs, and the Agreement is designed to operate alongside those bodies rather than in competition with them. FFA members were early Parties to the Agreement: Palau was the first country to ratify in January 2024, followed by the Federated States of Micronesia in June 2024. They will therefore play an important role in shaping how BBNJ ABMTs interact with Pacific RFMO measures and in ensuring the Agreement's MCS-related capacity-building benefits Pacific SIDS.

3.2.5 Regional cooperation

The instruments described so far operate at the global level. Their practical effect, however, depends on regional arrangements that translate broad obligations into shared operating procedures, and this holds across the Blue Economy: regional port State control memoranda coordinate ship safety and pollution inspection; regional seas and marine spill contingency arrangements coordinate environmental response; and regional maritime information-sharing centres coordinate surveillance against smuggling, trafficking and piracy. The most developed example of operational regional cooperation in the Asia-Pacific region, and the one with the longest track record, is in fisheries. It is therefore examined here in some detail, on the understanding that its underlying structure - a binding cooperative instrument, a shared surveillance centre, agreed data-sharing rules and joint operations – may be replicable across other sectors.

Because IUU fishing and other fisheries compliance challenges are often transboundary, national MCS measures are most effective when supported by regional cooperation. In practice, global fisheries instruments are frequently operationalised through regional plans of action, RFMO conservation and management measures, and other cooperative arrangements developed through regional bodies. These frameworks help translate international commitments into practical MCS measures, including vessel monitoring, observer coverage, information-sharing, joint surveillance, port controls and compliance procedures. In doing so, they provide the practical layer between global standards and national implementation, enabling neighbouring States to cooperate where unilateral action would be insufficient. This is especially important in large ocean spaces and shared fisheries, where vessels move across jurisdictions and enforcement gaps can easily be exploited.

The Pacific provides a strong example through the Niue Treaty Subsidiary Agreement (NTSA), administered by the FFA. In force since 2014, the NTSA provides a legally binding basis for cooperative MCS among Pacific Island countries, including shared surveillance operations, cooperative enforcement, information-sharing and capacity-building (FFA, 2025a). It demonstrates how regional cooperation can move beyond general commitments to create an operational framework for day-to-day MCS collaboration.

The practical value of this approach is illustrated by FFA-led regional surveillance operations such as Operation Kurukuru, which combine legal cooperation with intelligence-led planning and shared use of MCS tools and technologies to strengthen detection and enforcement across a vast maritime region (FFA, 2025b). At the national level, these regional arrangements are commonly complemented by domestic legislation, national plans of action and other MCS measures, including vessel registration, vessel monitoring, port inspection and catch documentation. The precise mix of measures varies by country and subregion, but the broader lesson is clear: effective MCS depends not only on national systems, but also on regional legal and institutional frameworks that enable cooperation across shared ocean spaces. This lesson has practical relevance beyond the Pacific. Analysts of Indian Ocean fisheries governance have pointed explicitly to the Pacific's experience as a model for how coastal States elsewhere could multiply the effectiveness of their own MCS through regional cooperation (Bergin, 2021), while comparable regional MCS partnerships in other developing regions, such as FISH-i Africa in East and West Africa, have drawn on similar principles of shared data, assets and capacity-building (Auld and Neat, 2025). For other developing regions considering how to strengthen MCS cooperation, the Pacific experience offers a practical example of how such arrangements can be implemented and sustained over time.

3.3 MCS system requirements

Effective compliance and enforcement can only be achieved by efficient use of available information, analyses and intelligence, achieved through engagement of assets of both governments and regional MCS partners. To this end, the requirements for a comprehensive MCS system should broadly include:

1. Policy and regulatory framework against which monitoring, control and enforcement activities can be undertaken;
2. Land-based monitoring and data collection capability;
3. Aerial and satellite surveillance capability; and
4. Maritime surveillance and interdiction capability.

The optimal configuration of these components varies by situation and will depend on such factors as cost, commitment, and organizational structure (national, subregional or regional).

3.3.1 Regulatory framework

The translation of international and regional frameworks for marine environmental protection and resource exploitation into a national legal framework is crucial for the management of natural resources. Legal rules provide rights, obligations, and responsibilities for all stakeholders and rights holders involved. The legal framework defines such matters as: which activities are permitted and which are prohibited; under what conditions can permitted activities take place (for example licencing requirements, temporal and spatial controls, legal limits for discharges etc); who has the mandate and authority to act; compliance requirements (such as record keeping and reporting); the legal consequences of different acts, omissions, and situations (for example legal penalties). In transboundary contexts, legal structures are also crucial for determining who may make binding decisions on the content and application of general norms in different jurisdictions (Shamsuzzaman and Mahmudul Islam, 2018).

The lack of an effective legal framework is recognised as an impediment to effective MCS in many jurisdictions. Barriers to establishing a robust legal framework may include: procedural requirements for updating laws and adopting comprehensive regulations; legal technical capacity in terms of understanding of the legal aspects of MCS tools; limited capacity to utilise MCS information in judicial proceedings; poor coordination among different institutions with marine resource management-related functions, and inadequate financial and human capacity.

Three issues deserve particular attention as MCS becomes more data-driven. The first is the admissibility of digital evidence: detections generated by AIS, VMS, satellite imagery, electronic monitoring systems and on-board digital logs are of limited enforcement value if national evidence law does not recognise them, or if no procedure exists to establish their authenticity and integrity. Beyond primary legislation this requires documented standard operating procedures, including inter-agency procedures, governing the chain of custody of digital evidence from acquisition through analysis to presentation in court, together with sustained engagement with prosecutors and the judiciary so that such evidence is understood and given appropriate weight.

The second is clarity of mandate: legislation should state unambiguously which agency is responsible for detecting, inspecting, investigating and prosecuting each category of offence, and where responsibilities are necessarily distributed, formal instruments such as memoranda of understanding can provide the legal basis for sharing information, personnel and physical assets, converting ad hoc cooperation into a dependable operating arrangement.

The third is the level and consistency of penalties: where sanctions are low relative to the profits of non-compliance, detection will not deter; and where neighbouring jurisdictions apply markedly different penalties, operators simply relocate towards the most permissive. Working towards broadly comparable penalty levels within a region is therefore as important as their absolute level.

3.3.2 Land-based monitoring and data collection

The land-based component of MCS coordinates activities such as port inspections, dockside monitoring, and oversight of transhipments and fish trade. Ports are the link between maritime and land borders. In fisheries, they are generally managed by port authorities; beyond fisheries, they also support oil and gas operations, shipping and trade. In short, ports serve both fishing and non-fishing activities.

PSC inspections cover a ship's structure, equipment, crew and documentation. Landing points also allow fisheries authorities to inspect catches, review logbook data, and weigh and measure catches by species.[5] If a vessel is non-compliant, inspectors may detain it, impose fines, or deny port entry until corrective action is taken. However, controls should avoid undue detention or delay. PSC inspections are relatively low-cost and efficient, generate substantial MCS data, and can support cost recovery. The regime continues to evolve, including greater use of technologies such as drones and remote sensing to inspect hard-to-reach areas of ships.

Ports and port States therefore play a key role in enforcing international rules when vessels call at port or seek services after illegal activity in any maritime zone, including the high seas.

3.3.3 Aerial and satellite surveillance capability

The aerial component of MCS is usually the first level of response to a coastal State or region of concern and covers the air and space equipment such as aircrafts and satellites used in MCS activities. The aerial component, whether based on aircraft or satellites, is often the cheapest way to collect information in the MCS's area of influence, regardless of whether the cost is directly related to the sophistication of the technology used. The flexibility, speed and deterrence of air surveillance make it a very useful and sometimes cost-effective tool for fisheries management.

For States responsible for very large ocean areas, the satellite component has become the more significant of the two, because satellite coverage does not degrade with distance from shore. In the Pacific, the FFA's Regional Fisheries Surveillance Centre in Honiara combines satellite vessel tracking with radar and optical satellite imagery to build a picture of activity across an area of some 21 million square kilometres during its annual coordinated operations, a scale that could not be approached by aircraft and patrol vessels alone. While aircraft and vessels remain essential, their role shifts from searching to verifying and intercepting targets that satellite analysis has already identified, a more efficient use of the most expensive assets in the system. The same principle applies to non-fisheries tasking: pollution detection, protected area monitoring and infrastructure protection all benefit from the same shift from patrol-led to intelligence-led surveillance (FFA, 2025b).

Patrol aircraft can gather accurate vessel location and identification data over large fishing zones, and over short periods of time. Evidence obtained by aircraft helps patrol boats coordinate swift controlled response making it possible to immediately direct patrol ships to the area where illegal behaviours are detected. Aerial patrols also provide a strategic picture of fishing activities that offer tactical data patrol vessels with information on the locations of fishing vessel activity and their movements (Pramod, 2023). However, patrol aircraft cannot verify gear or catch, and are relatively expensive to deploy. For this reason they are most effective when tasked on the basis of satellite detections and analysis, the two sources together providing a fuller picture than either can offer alone.

3.3.4 Maritime surveillance and interdiction capability

Physical presence through at-sea patrols is a necessary requirement for arresting violators and securing evidence. The mere presence of patrol vessels can act as a deterrent to fisheries violations and help gather critical intelligence on vessel activities at sea. At-sea inspections provide information on the accuracy of data and provide checks on licences, use of legal gear, catch logs, radio reports, log books, discards and dumping. However, while boardings are also the primary means of conducting inspections of fishing fleets at sea (Pramod, 2023), vessels are costly to operate, and can only cover relatively small areas.
In fisheries, a key at-sea tool is the use of At-Sea Observers (ASOs) to collect essential data and support compliance with fisheries rules. ASOs can directly monitor fishing activity, but deployment is often constrained by limited space on vessels, low observer coverage, high training costs, and safety concerns. To address these challenges, many fisheries are trialling electronic monitoring (EM). Video-based EM has been tested worldwide for more than a decade as improving technology reduces costs and expands its use across MCS tasks.

EM can replace many observer functions and perform some tasks more accurately, such as tracking sporadic events over long periods. However, as a stand-alone tool it cannot carry out some essential ASO tasks, including biological sampling. It is particularly effective for monitoring discarding and measuring fishing effort. A likely next step is automated image analysis, which could allow software to review recorded video far faster than even highly-trained personnel (Plet-Hansen, Bergsson and Ulrich, 2019).

3.4 MCS tools and technologies

Traditional MCS tools such as ASOs, logbooks, surveillance aircraft and patrol vessels are increasingly being supplemented by new technologies. These advances can strengthen MCS and support the transition to a sustainable Blue Economy. Greater access to satellite technology now enables real-time, precise vessel tracking. Systems such as AIS and VMS are becoming increasingly important in many developing countries that lack real-time maritime visibility and aerial surveillance, and have transformed fisheries monitoring globally. Some Pacific countries now rely heavily on these systems to track vessels and coordinate surveillance across their EEZs. These tools significantly extend what enforcement agencies can see and respond to, but they remain inputs to an MCS system rather than a substitute for it: their value depends on a functioning legal framework, personnel trained to interpret and act on the data they generate, and institutions with the capacity to follow up detections with enforcement action.

3.4.1 Automatic Identification System (AIS)

AIS automatically broadcasts a vessel's identity, position, course and speed. It improves situational awareness, helps reduce collisions at sea, and supports monitoring of vessel traffic and fishing activity through transmissions received by nearby ships, shore stations and satellites. The IMO and other bodies require large ships, including many commercial fishing vessels, to carry AIS to improve collision avoidance. More than 400,000 AIS devices broadcast vessel data each year, which ground stations and satellites use to track vessels even in remote ocean areas.

Port authorities and other shore facilities may also use receive-only stations to monitor nearby traffic without transmitting their own location. This provides reliable local coverage, but only within VHF range, typically about 10–20 nautical miles.

According to Global Fishing Watch, AIS-equipped fishing vessels account for over half of fishing effort more than 100 nautical miles from shore and up to 80 percent of fishing on the high seas. As adoption continues to grow by 10–30 percent each year, AIS is becoming an increasingly valuable source of fisheries information.

3.4.4.1 *Satellite-based AIS*

Despite its importance, AIS offers limited utility in offshore waters, because of its restricted range.[7] More recently, the development of satellite-based AIS tracking technology (known as S-AIS) has greatly increased States' ability to monitor vessels across the ocean (Skauen, 2019). As a result, it is now possible to receive AIS signals by satellite in many parts of the world.

AIS is, however, subject to several limitations as a compliance tool. First, it is a cooperative system: transponders can be switched off, and operators intending to conceal their activity routinely do so, producing an AIS gap that is a useful indicator of where to look but not, in itself, evidence of what occurred. Second, the identity data transmitted is set by the vessel and can be falsified; deliberate spoofing of vessel identity and position is now well documented. Third, coverage is uneven. While AIS carriage is high among large vessels operating on the high seas, it falls sharply among vessels operating within Exclusive Economic Zones and is largely absent from the small-scale and semi-industrial fleets that account for much of the activity in Asian and Pacific coastal waters.

For these reasons AIS is best treated as one input among several rather than as a stand-alone source of proof. Its value increases substantially when corroborated against VMS, against non-cooperative detection such as radar and night-lights satellite imagery, against port and catch documentation, and against open source intelligence including vessel ownership registries, corporate records and media reporting. Analysis of historical tracks over months or years is frequently more revealing than any single detection, since it exposes recurrent patterns of behaviour, associations between vessels, and repeat offending by particular operators or fleets. The binding constraint here is rarely the availability of data; it is the availability of trained analysts able to interpret it, which is why investment in national and regional analytical capacity should accompany, and arguably precede, investment in new data feeds.

There is therefore a clear policy need to complement AIS and VMS with non-cooperative earth observation tools. SAR can detect vessels regardless of transponder status, while Visible Infrared Imaging Radiometer Suite (VIIRS) sensors can identify vessels using lights at night. Combined with artificial intelligence (AI) and machine learning, these technologies can strengthen MCS by detecting dark vessels, identifying high-risk behaviour such as unauthorised transhipment, and supporting near real-time targeting of enforcement effort (Papastavridis, 2025; Cremers et al., 2024).

The full value of these tools depends, however, on an enabling legal and institutional framework. In many jurisdictions, the evidential status of satellite imagery remains uncertain, underscoring the need for legal reform, clear procedures, and stronger enforcement pathways to ensure that detected infringements lead to effective sanctions (Papastavridis, 2025).

3.4.2 Vessel Monitoring Systems (VMS)

VMS are a core fisheries MCS tool used to track fishing vessels through automatic transmissions to shore-based monitoring centres. Like AIS, VMS provides positional data without requiring crew input, but it is designed primarily for fisheries compliance and management. VMS is now required in most commercial domestic and high seas fisheries and is widely used to detect and deter illegal fishing while supporting sustainable fisheries management.

Where vessels carry both AIS and VMS, the two systems can be combined to produce a more complete vessel track and improve the timely identification of suspected IUU activity. VMS data can also support marine spatial planning by showing where fishing effort occurs, helping authorities design spatial measures, including MPAs, in ways that balance conservation goals with impacts on fishers.

7 Shipboard AIS transponders have a horizontal range that is highly variable but typically only about 40 nautical miles.

When backed by clear rules and data-sharing arrangements, VMS can strengthen both enforcement and fisheries management. It helps authorities detect, deter and respond to IUU fishing, while also providing data to support management decisions on stock sustainability. Regional organisations, including RFMOs and the FFA, increasingly operate centralised, secure VMS platforms for multiple members. This improves timeliness, technical capacity and cost-efficiency, and strengthens cooperation across shared fisheries (Pew Charitable Trust, 2017).

TEXT BOX 6: Publishing vessel monitoring data as a policy choice – Indonesia

Vessel monitoring data has historically been treated as confidential, held by the flag or coastal State and shared, if at all, only with regional bodies under restrictive agreements. In June 2017, at the first UN Ocean Conference, Indonesia's Ministry of Marine Affairs and Fisheries became the first government in the world to publish its national VMS data openly, making the tracks of nearly 5,000 vessels available through the Global Fishing Watch platform. Most of these were mid-sized commercial vessels below the threshold at which AIS carriage is required, and had therefore been invisible to any public monitoring system.

The decision was a governance choice rather than a technological one – the data already existed – but its effects were considerable. Vessels that had operated beyond public scrutiny became subject to observation by neighbouring States, researchers, industry and civil society. Compliant operators gained a means of demonstrating their compliance to markets increasingly sensitive to provenance. Indonesia gained standing on the issue and a practical basis for cooperation with neighbouring administrations. Several other States subsequently published their own VMS data, among them Peru, Panama, Chile, Ecuador, Costa Rica and Brazil.

For Blue Economy policy makers the wider lesson concerns transparency as a low-cost multiplier of MCS effectiveness. Publishing data the State already holds costs comparatively little, requires no new hardware, and extends the observational reach of an administration well beyond what its own patrol capacity could achieve. The same logic applies outside fisheries – to port call records, pollution incident data and protected area transit information – subject in each case to a considered assessment of commercial confidentiality, personal data protection and crew safety.

(Source: Global Fishing Watch, 2017.)

3.4.3 Long Range Identification and Tracking (LRIT)

LRIT is an international tracking and identification system, mandated by the IMO, to ensure a thorough tracking system for ships across the world. LRIT is a long-range vessel monitoring system which also requires the periodic transmission of the name and course of vessels. However, the data is transmitted only at six hourly intervals and the transmissions take place by satellite meaning that LRIT is a closed system.

Until the advent of S-AIS, LRIT was seen as a more useful tool in this regard, since it has a broader operational range.[8] Whereas AIS data can be collected automatically (provided the AIS transponder is turned on) LRIT requires the active, willing participation of the vessel involved, which is, in and of itself, a very useful indication as to whether the activities being conducted aboard the vessel warrant closer examination. Thus, the information collected from the two systems is complementary.

8 Under the SOLAS regulations, coastal States are entitled to receive information about ships navigating within a distance of 1,000 nautical miles off their coasts.

3.4.4 Electronic Logbook or ERS

On-board logbooks are a mandatory requirement for high sea fishing vessels in many RFMOs. Electronic Recording and Reporting System (commonly referred to as E-Logbook) contribute to better management of fish stocks by keeping track of catches (origin and volume) and gear used. E-Logbooks collect information on species, volume and areas of catches, important data for fisheries. When properly deployed and used in conjunction with data from VMS and AIS, E-logbooks could transform the entire commercial fleet into a provider of good quality data and change the way fish resources are managed.

Table 1: Examples of MCS tools used in fisheries management. Reproduced from Cremers, K., Bouvet, M., Wright, G., Rochette, J (2021).

MCS Tool	Characteristics	Advantages	Limitations
Logbook, vessel trip reports (VTRs)	Paper-based record of fishing activity. Generally includes: vessel identity, date, time and location, gear used, fishing activity	• Cheap. • Can be used on any vessel and in any language.	• Complex/time-consuming. • Self-reported – risk of misreporting, incomplete/late logs, shifts in reporting dates, non-reporting. • Data often digitised without verification, double entry. • Data is often considered confidential.
Automatic Identification Systems (AIS)	Autonomous and continuous vessel identification and monitoring that allows vessels to exchange information with nearby ships and coastal authorities to facilitate traffic management and avoid collisions.	• AIS has a quasi-continuous monitoring function. • Improves safety and the management of maritime traffic. • Can be used to identify ships that pollute (oil spills), tranship, conduct IUU fishing and violate MPA rules. • Least expensive vessel monitoring system that can monitor in coastal areas as well as the high seas.	• Tampering (e.g. reporting fake vessel names or identification numbers, or turning it off). • Vessel identifier data that is transmitted is set by vessel captains or owners and is therefore frequently limited or incorrect. • More than one vessel can use the same identifier. • Confidentiality and safety concerns (e.g. may reveal commercial information or be used by terrorists). • Data generally only available to nearby receivers. Satellite transmission now possible (so-called S-AIS), and while coverage is near-global, detection performance varies by region, traffic density and satellite constellation.

MCS Tool	Characteristics	Advantages	Limitations
			• Use of data for MCS purposes requires relevant software and analytical capacity. • Flag States often do not sanction non-compliance with AIS obligations or impose low fines. • RFMOs do not require AIS (partly because they often already have a VMS requirement in place). • The evidential status of AIS data in national courts is frequently unclear, limiting its use in prosecutions unless supported by legislative reform.
Vessel Monitoring Systems (VMS)	Automatically transmits principally positional (GPS) information by satellite.	• Required by some flag States and most RFMOs. • Provides safety guarantees. • Tamper-evident system compared to AIS. • VMS data is admissible evidence in several courts. • Reporting can be tailored to any type of fishing activity.	• Lack of a uniform global regulation or standard. • Data is often reported every 1-4 hours (depends on gear, data storage and management capacity of the regulatory body). • Vessels without VMS equipment cannot be monitored. Provides limited information, so requires integration with other MCS tools to be effective. • Costly tool, especially for the small-scale fleet. Capacity for technical maintenance and IT support can be limited in some countries. • Access to data subject to legal and confidentiality constraints; information received by flag State not always shared with RFMOs or made public.

MCS Tool	Characteristics	Advantages	Limitations
Satellite-based remote sensing	The derivation of information by analysing radiation received by a sensor.	• Wide range of potential applications. • Can allow for detection of vessels that are not using or transmitting AIS/ VMS. • Can be used during all-weather types.	• Can only be used for the upper layer of the ocean (max 27 m depth). • Requires significant financial and human resources as well as capacity for data storage and analysis. • May take several days to access the data, there are generally fees associated with the data access and global coverage is not currently available on a daily basis.
At Sea Observers	Observers record information about the vessel they are on, and this information can be used for compliance purposes.	• Can monitor all activities of a vessel.	• Only 'viable' on larger vessels. • Effectiveness varies depending upon a range of factors. • Observers may be subject to harassment and bribery, especially on the high seas. • Observers have no mandate to enforce compliance.

3.5 Innovative Technologies

In addition to the tools outlined above, the rapid development of technology, such as low-cost, satellite-based remote sensing platforms, may also offer novel solutions that could enhance existing MCS capabilities enabling near real-time monitoring of activities across large areas of ocean space. Recent innovations are also improving the ability to translate this data into useful information and advanced processing techniques, coupled with new visualization portals, enable a wide array of decision support tools (Stuchtey, Vincent, Merkl et al., 2020). The urgent challenge is to ensure that these data are available and useful to ocean managers (Leape, Abbott and Sakaguchi, 2020). As with more established MCS tools, these emerging technologies are best understood as complements to, rather than substitutes for, the legal frameworks, trained personnel and effective compliance systems described elsewhere in this policy note: even the most sophisticated detection technology cannot itself secure a conviction or deter a repeat offender.

3.5.1 Satellite technology

Rapid advances in low-cost satellite remote sensing are making near real-time monitoring of large ocean areas more affordable. Satellites can track ecosystem change, coastal development, nutrient run-off, ship pollution and vessel movements, including those of small-scale fishers using GPS-enabled smartphones. International initiatives such as Global Fishing Watch[9] use satellite and AIS data to track and monitor fishing vessels worldwide. By analysing vessel identity, speed and direction with artificial intelligence, they can distinguish fishing from non-fishing activity.

9 https://globalfishingwatch.org

3.5.2 Drones & Autonomous Vehicles

Autonomous vehicles and drones are pilotless systems that use technologies such as computer vision, artificial intelligence and obstacle avoidance. They can operate above, on or below the water. In MCS, they can collect visual, acoustic and chemical data, and provide more detailed imagery than satellites. They also offer a relatively cost-effective way to monitor offshore areas in real time.

In the maritime sector, drones can support stock assessments, maritime safety, and surveillance of MPAs and EEZs, and can provide visual or audio evidence in legal proceedings. They are also being combined with GIS and other tools to monitor wildlife and map potential conservation areas (Girard and Du Payrat, 2017).

3.5.3 Artificial Intelligence (AI)

Within the field of AI, machine and deep learning are frequently used for a wide array of environmental management projects to predict patterns of anything from predicting the future effects of climate change to improved efficiencies at sea. When combined with the data collection capabilities of autonomous vehicles, AI can be used to process and interpret large quantities of remotely collected data for rapid use by decision makers.

TEXT BOX 7: Application of AI to enhance satellite and AIS data

A recent analysis published in the journal Nature combined available satellite imagery, vessel GPS data and deep-learning (AI) models to map industrial vessel activities and offshore energy infrastructure across the world's coastal waters from 2017 to 2021. The analysis found that a remarkable amount of activity occurs outside of public monitoring systems:

- 72–76% of the world's industrial fishing vessels are not publicly tracked, with much of that fishing taking place around South and Southeast Asia.
- 21–30% of transport and energy vessel activity is missing from public tracking systems.

These previously invisible vessels radically changed our knowledge about the scale, scope and location of fishing activity.

The analysis highlights the power of AI to map and interpret existing data. Moreover, much of the underlying data is made available through the Global Fishing Watch platform and can be accessed by marine resource managers across the globe, although some datasets and analytical functions are subject to access, licensing or data-sharing conditions and are distributed across several Global Fishing Watch tools rather than a single portal.

(Source: Paolo, Kroodsma, Raynor, et al., (2024).

3.5.4 Blockchain technologies

Blockchain - a secure, shared digital ledger that records transactions across a network, making tampering difficult and easier to detect – is increasingly discussed as a tool to improve traceability and influence behaviour along fisheries value chains (Jouanjean, 2019).

Consumers are increasingly calling for fully-traceable seafood that does not come from illegal fisheries or those that engage in human rights abuses. Wholesale and retail seafood buyers are asking for improvements in transparency and traceability to reduce the risk of their brands being associated with dubious and illegal activities. Blockchain also has potential to significantly decrease illegal activities by supporting secure data

transactions for traceability and sales; blockchain technology can potentially help track the journey of a single fish, recording information regarding where it was. As a result, many in the fisheries supply chain are increasingly looking to blockchain, and other distributed ledger technologies, to support supply chain traceability (Leape *et al,* 2020).

One example is Pacifical, which uses blockchain to support chain-of-custody documentation for Marine Stewardship Council (MSC) certified purse-seine tuna (Blaha and Katafono, 2020). This typically involves tagging fish at capture and linking them to supporting traceability data, sometimes through sensors, electronic tags, genetic tools or QR codes.

To date, most blockchain traceability projects in the seafood industry have been led by NGOs and/or the private sector (see Text Box 8). These initiatives show that it is possible to have a blockchain-based system operating at a micro level for specific seafood value chains. However, to date there has been no example of where an entire industry agrees to use the technology to improve value chain transparency in that industry.

TEXT BOX 8: Traceability to combat IUU fishing and forced labour in the tuna industry

IUU fishing remains a persistent problem in the Pacific region and blockchain technology can help improve traceability around this activity..

In 2018, WWF partnered with global blockchain venture studio ConsenSys, information and communication technology (ICT) implementer TraSeable, and tuna fishing and processing company Sea Quest Fiji Ltd on a pilot project focused on the Pacific Islands tuna industry. The goal of the pilot was to decrease incidences of IUU and slavery in the supply chain by increasing transparency and data security through secure traceability. To achieve this, fishers registered their catch on the blockchain through radio-frequency identification (rFID) e-tagging and scanning fish, which travelled with the fresh or frozen fish from harvest to sales. Consumers were then able to scan a barcode located on the can to trace their product's journey back to the point of origin. The pilot concluded after its initial phase and has not been scaled to the wider Pacific tuna fleet. It is described here as an early demonstration of what the technology can do, and of the difficulty of sustaining such systems beyond a pilot without industry-wide commitment, rather than as an operational system currently in use.

It was the first application of its kind in the Pacific region and demonstrated the technical feasibility of end-to-end digital traceability in a tuna supply chain.

3.5.4 Specific applications of ICT for fisheries data collection

Small-scale fisheries often operate in isolated areas, characterised by multiple actors, landing sites, fishing gear and species. This makes routine collection of reliable catch and effort data challenging. As a result, in many small-scale fisheries, there is a general lack of quantitative fisheries data (Fujita *et al*, 2018) with the data that is collected being of limited value for management purposes.

Smartphones and ICTs are increasingly recognised as a tool for participatory fisheries data collection with the potential to increase the accuracy of small-scale fisheries data, facilitating communities in achieving sustainable development, an improved quality of life and supporting the poor and excluded. Because smartphones and feature phones are quite widespread among fishermen, even in many small-scale fisheries, a number of mobile apps have been developed for catch monitoring.

These include apps that:

- collect catch and effort data from fishers and use it to fill out required forms (Electronic LogBook)
- log catch information such as quantity, type, weight and location
- use logbook data as inputs and transfer catch and other information to buyers and consumers
- link to GPS devices to allow vessel tracking
- use facial recognition software to identify fish species from photos, thereby allowing catch to be identified and sorted more accurately and efficiently, with a view to reducing by-catch.

The near real-time analytical potential of digital monitoring systems allows for the collection of reliable, high-resolution data (i.e. at the level of individual fish), which can serve both statistical and stock assessment purposes, but also cost-efficiently verifies data entered in remote locations. In the future, innovation through information and communication technologies will be a key enabler in developing the Blue Economy, particularly with regard to the collection of fisheries data, monitoring of human activities and transforming seafood value chains.

While electronic logbooks and smartphone apps for catch reporting have the potential to increase the amount and quality of catch data, they are subject to the challenges associated with all self-reported data: accuracy and reliability. Some fisheries will likely require catch and effort monitoring that does not depend entirely on self-reporting. Low-cost cameras coupled with image analysis may make independent catch monitoring possible in fisheries that lack the requisite resources and analytical capacity for electronic monitoring systems.

4. Costs and Benefits Associated with MCS

4.1 Costs of establishing and operating MCS

The cost of establishing and operating MCS systems is often a primary concern for small States. There is no one-size-fits-all model that can be prescribed for the design and implementation of MCS systems and costs are clearly related to the nature of the MCS system. Accurately defining the cost of such systems is, therefore, extremely difficult.

The structure and function of the MCS system is normally determined by four factors: (i) the regulatory framework and management objectives and controls in place; (ii) the assignment of responsibilities for different MCS functions among the various government agencies; (iii) the political/economic profile and relative importance of marine sectors (especially fisheries) within the country; and (iv) (in the case of fisheries) the physical and biological characteristics of the fisheries (Kelleher, 2002) (Table 2 below).

Table 2: Physical and biological characteristics of the fisheries (Adapted from Kelleher, 2002)

Characteristics	Examples
Size and extent of fishing grounds	Size of EEZ and continental shelf. E.g. Indonesia – more than 17, 000 islands, 81,000 km coastline, and more than 6 million km^2 of waters, including archipelagic waters, territorial sea, contiguous zone, EEZ and continental shelf. Nauru, approximately 68 km of coastline and an EEZ of approximately 308 506bkm^2 (UNCTAD, 2021).
Physical geography	Archipelago, indented coastline, isolation and availability logistic support for fishing fleet (Philippines, Solomon Islands)
Demography / nature of the fishing industry	Artisanal fishery (many Pacific SIDS, Cambodia), industrial fishery (China, Korea), mixed industrial/ artisanal (Thailand). Numbers of fishermen: Indonesia 4.5 million.
Involvement of military	Few ports (Fiji), Numerous ports/ landing sites (Philippines, Indonesia).
Economic importance of fisheries and value of fish products	Legal status of fishing zones (high seas enclaves; international lakes and rivers, waters under dispute); Regional cooperation in MCS: e.g. Forum Fisheries Agency (South Pacific)
Economic and political strength	Pacific Island nations dependence on tuna
Other ocean uses and enforcement priorities	Offshore oil (Brunei); Tourism (Pacific Islands); piracy; drugs and arms smuggling; immigration control.

The costs associated with MCS typically fall across different elements of the subsystem as outlined in Table 3 below.

Table 3: Cost elements associated with MCS systems (Adapted from Kelleher, 2002)

Cost Category	Cost Element
Capital costs	Buildings and basic infrastructure – for example MCS headquarters and field offices varies widely.
	Information and database systems – for example vessel licensing data, catch and landing data, resource assessment data etc information generated by surveillance and inspection activities (e.g., VMS data, records of violations, observer reports)
	Communication systems – radio, telephone etc
	Vessel monitoring systems
	Patrol vessels – offshore, coastal and inshore vessels and support facilities
	Aircraft – long-range and short-range and support facilities
	Training and capacity building of personnel – e.g. fishery inspectors, radio and FMS staff, senior policy makers etc
Recurrent operating costs	Personnel costs – salaries, staff development etc
	VMS operating costs
	Support and maintenance of patrol vessels – fuel, crew costs, maintenance etc
	Support and maintenance of aircraft – fuel, crew costs, maintenance etc
	Costs to fisherfolk - direct and indirect costs on fishers, or vessel operators including compliance costs

A civilian-led approach to fisheries enforcement (i.e., one led by civilian government agencies rather than by military/coastguard agencies) is often well aligned with fisheries priorities and can, in some instances, provide a cost-effective solution. It could also reduce the political sensitivity of incidents by avoiding the use of military assets. However, the military can still play an important supporting role in a strong MCS system. Many States have expanded their naval and air capabilities to monitor activities in their EEZs, making effective inter-agency arrangements essential so marine resource managers can draw on military support when needed.

In recent years, many coastal nations have also started to invest in sophisticated satellite based imagery, radar, and vessel monitoring systems to track their maritime spaces. Open source data sets are also becoming more widely available (see for example Text Box 7 above).

4.2 Benefits of MCS

IUU fishing is now generally acknowledged to be a major contributor to the crisis in global fisheries, with negative economic, environmental, ecological, and social consequences for many countries, especially developing countries. IUU fishing has not only been equated to "stealing food from some of the poorest of the world" but is also known to cause the displacement of legitimate fishers. IUU fishing can further threaten food security and lead to lower employment and reduction in household incomes, all of which exacerbate poverty, particularly among coastal and artisanal fishers. Such social impacts illustrate that IUU fishing not only affects industrial fishing, but is also a concern in small-scale fisheries.

Developing countries are often the most vulnerable to fish theft because, in the absence of a tangible enforcement presence at sea, illegal vessels can significantly increase their profits. As a result, distant water fleets often target such countries to maximise their profits and often contribute very little through their licensing revenues (Pramod, 2023).

In the Sulawesi Sea alone, the financial loss from IUU fishing has been previously estimated at about one third of the total annual value of the marine fisheries in the area (Palma and Tsamenyi, 2008). A separate analysis for the Forum Fisheries Agency estimated illegally harvested or transhipped tuna in the FFA region at about US$616.11 million a year (MRAG Asia Pacific, 2022).

Beyond direct economic losses, IUU fishing and other harmful activities also damage fisheries habitats and marine ecosystems, especially coral reefs. In the Sulawesi Sea, for example, loss estimates do not capture the social and environmental costs of ongoing habitat destruction and reduced future access to fisheries (Palma and Tsamenyi, 2008). In the Philippines, harmful fishing practices in the 1990s, including dynamite fishing and poison, reduced coral reef productivity to one-fifth of its original level, cutting annual fisheries production by an estimated 177,500 metric tons.

Although many benefits are hard to quantify, effective MCS can deliver major returns. FAO estimates that IUU fishing costs up to US$23 billion a year in the Asia-Pacific Fishery Commission (APFIC) area, with serious consequences for livelihoods, food security, national economies and the environment, especially in small-island and coastal developing States. Countries that fail to meet fisheries governance obligations may also face trade sanctions as export standards tighten (Wilcox *et al.*, 2021).

Even a 5 percent reduction in IUU fishing could significantly increase legal fisheries revenues and improve food security and biodiversity. FAO's analysis of Sri Lanka's MCS system found that the benefits exceeded operating costs, with a benefit-cost ratio of US$1.28 for every US$1 spent (FAO, 2019). Similarly, a World Bank study found that strengthening MCS in the Indian yellowfin tuna fishery could generate a 345 percent return on investment, with a five-year payback period. It projected annual profits of more than US$24.2 million and a capital value of US$303 million from a more sustainable and profitable fishery (BOBP-IGO, 2018).

The key point, therefore, is that although MCS requires substantial public expenditure, especially for surveillance and enforcement, it can yield strong management benefits by improving compliance, data quality, and the long-term sustainability of fisheries (Temple et al., 2021). Broader ecological benefits from MCS, such as biodiversity conservation, climate regulation and nursery functions, are much harder to quantify than direct economic returns from a fishery (Miller, Slicer and Hanich, 2013).

4.3 Options for strengthening MCS across the Asia-Pacific region

4.3.1 Options to strengthen national MCS arrangements

At the national level, countries in the Asia-Pacific region could consider establishing risk-based MCS frameworks that combine vessel tracking data (AIS and VMS) with fisheries-dependent data (such as catch logbooks and landing records) to identify vessels with a higher probability of non-compliance and direct enforcement resources accordingly (Sales Henriques et al., 2025).

Given that a small number of vessels are typically responsible for the majority of unreported catches, targeted risk-based approaches can substantially improve the cost-effectiveness of MCS without requiring proportionate increases in resources. Where possible, countries could also consider extending VMS requirements to smaller vessels and to vessels operating beyond the EEZ, and ensuring domestic legislation recognises satellite and earth observation data as admissible evidence in fisheries prosecutions (Papastavridis, 2025).

Strengthening the deterrent value of sanctions is equally important: research from West Africa found that illegal fishing caused losses of more than USD 2.3 billion per year between 2010 and 2016, of which only USD 13.8 million was recovered through MCS – highlighting the critical importance of ensuring that enforcement leads to a meaningful 'legal finish' (Cremers et al., 2024).

Countries may assess whether their MCS arrangements are structured to serve the Blue Economy as a whole. In many administrations, vessel tracking, pollution surveillance, port inspection and maritime security data are held separately by agencies with no routine means of exchanging them, with the result that the State pays several times over for a partial view of its own waters. Consolidating these feeds into a single national maritime picture, whether through a formal fusion centre or a lighter-weight data-sharing arrangement underpinned by memoranda of understanding, typically delivers more capability per dollar than any additional sensor, and is a realistic step even for administrations with modest resources. Where legislation restricts what agencies may share with one another, addressing those restrictions is usually the single highest-return reform available.

4.3.2 Options to strengthen regional MCS arrangements

At the regional level, the FFA's Regional MCS Strategy 2025–2029 (FFA, 2025c) and the NTSA provide an operational framework for coordinated surveillance across the Pacific. The FFA Regional Fisheries Surveillance Centre in Honiara serves as a hub for information-sharing, joint patrol coordination, and capacity-building. FFA's annual joint Operation Kurukuru exercises demonstrate the value of coordinated aerial and maritime surveillance in deterring IUU fishing across a vast ocean area.

RFMOs such as the North East Atlantic Fisheries Commission (NEAFC) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), operating in the North Atlantic and Southern Ocean respectively, provide further models: NEAFC's electronic catch reporting and vessel tracking scheme, and CCAMLR's satellite overwatch programme and 100 percent observer coverage on toothfish vessels, show how regional bodies can deploy layered MCS tools to manage fishing effort on the high seas (Cremers et al., 2024).

Countries in Asia and the Pacific could draw on these models and work through existing mechanisms, including the Southeast Asian Fisheries Development Centre (SEAFDEC), FFA and relevant RFMOs, to strengthen inter-regional cooperation and address the fragmented coordination that allows IUU vessels to exploit jurisdictional gaps (Fujii et al., 2021).

4.3.3 Benefits of cooperation between countries for MCS

Multilateral cooperation through the BBNJ Agreement further expands options for Pacific Island States. As noted in section 3.2.4, the CHM can match States that have MCS capacity needs with donors and technology providers, while the GEF Trust Fund offers a dedicated financing pathway for developing States Parties. As early Parties to the Agreement, Pacific island States are well-positioned to champion practical, MCS-ready proposals for high seas MPAs in the Pacific, building on the existing FFA and Western and Central Pacific Fisheries Commission (WCPFC) compliance infrastructure and leveraging the CHM to attract the technical support and financing needed to operationalise monitoring in remote areas beyond national jurisdiction (Cremers et al., 2026).

Effective MCS in ABNJ will ultimately require complementary action across all three levels: national reforms to strengthen flag State responsibility and legal admissibility of evidence; regional cooperation for joint patrols, intelligence-sharing and capacity-building; and global engagement through the BBNJ Agreement to close the governance gaps that have long enabled 'paper parks' and flag-of-convenience abuse on the high seas.

5. Summary and Key Findings

Effective management of the ocean is a precondition for realising the benefits that the Blue Economy offers to countries in the Asia-Pacific region. Activities that undermine the health of the ocean cannot be addressed without robust Monitoring, Control And Surveillance systems in place. As such, this policy note has set out why MCS should be a priority for transitioning towards a sustainable Blue Economy, and has outlined the key components, tools, technologies, costs and benefits that policy makers need to understand when designing and implementing MCS systems. The following key findings and recommendations emerge from this analysis:

1. MCS is a critical enabler of the sustainable Blue Economy

The Blue Economy Governance Wheel (Figure 2) identifies MCS as one of three core tools that underpin Blue Economy decision-making. Without an effective MCS system, States cannot fully enforce their rights over marine resources, deter illegal activities, or fulfil their obligations under international law. The economic losses from IUU fishing alone far exceed the cost of operating a well-designed MCS system, and cost-benefit analyses consistently demonstrate a positive return on MCS investment.

2. MCS is cross-sectoral infrastructure, not a fisheries function

Although fisheries remain the most developed application of MCS, and therefore supply most of the examples in this note, the capability itself is shared. The same vessel tracking data, satellite imagery, analytical skills, patrol assets and coordination centres that support fisheries compliance also underpin pollution control, marine protected area management, submarine cable and offshore infrastructure protection, navigational safety, marine tourism regulation and maritime security. Governments should plan, budget and govern MCS accordingly – as national infrastructure serving the whole ocean economy, with costs shared across ministries and benefits counted across sectors – rather than as an expense attributable to a single agency. For SIDS States in particular, this reframing is often what makes the investment affordable.

3. A comprehensive legal and policy framework is the foundation of any MCS system

The international instruments reviewed in this policy note together provide a robust framework of rights and obligations. However, this framework must be translated into effective national legislation and supported by adequate institutional capacity. Securing clearly delimited maritime boundaries, establishing an authoritative national legal framework, and ensuring that enforcement officers have the powers necessary to discharge their functions are all prerequisites for an effective MCS system.

4. Technology is transforming MCS, but cannot replace good governance

Satellite-based vessel monitoring (AIS, VMS, SAR), artificial intelligence, drones, electronic monitoring systems and blockchain traceability tools are expanding the MCS toolkit significantly and reducing the cost of ocean surveillance. However, technology is most effective when integrated into a well-functioning governance system that includes an adequate legal framework, capable institutions, and the analytical capacity to translate data into enforcement action. Countries should invest in technology in a manner that is proportionate to their needs and capacities, and should consider regional solutions and public-private partnerships where national capacity is limited.

5. Regional cooperation is essential, particularly for Pacific SIDS

IUU fishing and other maritime threats are inherently transboundary problems that cannot be addressed effectively through national action alone. The Pacific region has developed some of the world's most innovative models of cooperative MCS (including the Niue Treaty Subsidiary Agreement, the Parties to the Nauru Agreement (PNA) Vessel Day Scheme, and the FFA's Regional MCS Strategy 2025-2029), which smaller States could draw upon and strengthen. Regional data-sharing, joint surveillance operations, and cooperative port State control measures all help to close the loopholes that IUU operators exploit. This experience is a practical lesson for other developing regions grappling with similar transboundary MCS challenges, several of which (including in the Indian Ocean and West Africa) are already looking to the Pacific model as they design their own cooperative arrangements.

6. MCS investment must be scaled to national circumstances.

The appropriate configuration of land-based, aerial and maritime surveillance capability will depend on the size and characteristics of the maritime zone to be managed, the nature of the fisheries and other activities within it, the institutional capacity of the government, and the financial resources available. Countries should undertake a systematic assessment of their MCS needs and gaps before investing in new tools or technologies, and should seek to leverage development assistance, regional support, and public-private partnerships to close identified capacity gaps.

7. The BBNJ Agreement creates new MCS obligations and opportunities.

The entry into force of the BBNJ Agreement marks a watershed in the governance of areas beyond national jurisdiction. MCS planning is now required for any high seas MPA proposal under the Agreement, and the Agreement's capacity-building provisions explicitly encompass MCS tools and technologies. Countries in the Asia and Pacific region could engage actively in the Agreement's institutional architecture (including the Clearing-House Mechanism, the Scientific and Technical Body, and the Implementation and Compliance Committee) to ensure it effectively supports the MCS needs of developing States, and that the Agreement operates coherently alongside existing RFMO frameworks.

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