Management, Retrieval and Recycling of End-of-Life and Abandoned, Lost and Discarded Fishing Gear

THE EVIDENCE BASE FROM CAPTURE FISHERIES

COORDINATING MINISTRY FOR MARITIME AFFAIRS AND INVESTMENTS REPUBLIC OF INDONESIA

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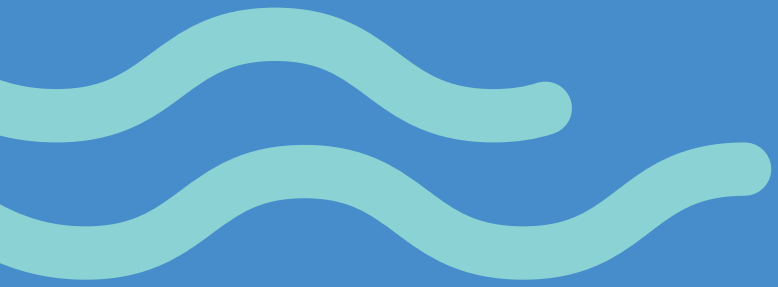

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Acronyms and Abbreviations

ALDFG	Abandoned, Lost and Discarded Fishing Gear
AP2HI	*Asosiasi Perikanan Pole & Line dan Handline Indonesia* - Indonesian Pole-and-Line and Handline Association
API	*Asosiasi Purse Seine Indonesia* – Indonesian Purse Seine Association
APRI	*Asosiasi Pengelolaan Rajungan Indonesia* - Indonesian Blue Swimming Crab Association
ASTUIN	*Asosiasi Tuna Indonesia* - Indonesia Tuna Association
ATLI	*Asosiasi Tuna Longline Indonesia* - Indonesia Tuna Longline Associations
BPPI	*Balai Besar Pengembangan Penangkapan Ikan* - Fishing Technology Development Center
BPS	*Badan Pusat Statistik* - Central Bureau of Statistics
BRSDM	*Badan Riset dan Sumber Daya Manusia* - Agency for Research and Human Resources
DJPT	*Direktorat Jenderal Perikanan Tangkap* - Directorate General of Capture Fisheries
EC	European Commission
EEZ	Exclusive Economic Zone
EOLFG	End of Life Fishing Gear
EPR	Extended producer responsibility
EU	European Union
FAD	Fish Aggregation Device
FAO	Food and Agriculture Organization of the United Nations
GGGI	Global Ghost Gear Initiative
GOI	Government of Indonesia
GRB	Garbage Record Book
GT	Gross Tonnage
HNPN	*Himpunan Nelayan Purse Seine Nasional* - Indonesia Purse Seine Association
HNSI	*Himpunan Nelayan Indonesia* – Indonesian Fishers Association
ISO	International Organization for Standardization
IUU	Illegal, Unreported, and Unregulated (fishing)
IUU	*Keamanan, Ketertiban, Kebersihan, Keindahan, dan Keselamatan Kerja* - Security, Order, Cleanliness, Beauty, and Work Safety Report
MARPOL	International Convention for the Prevention of Pollution from Ships
MMAF	Ministry of Marine Affairs and Fisheries
MoEF	Ministry of Environment and Forestry

MPA	Marine Protected Area
MSC	Marine Stewardship Council
MSP	Marine spatial plan
NGO	Non-Governmental Organization
NPOA	National Plan of Action
NPOA-MPD	National Plan of Action on Marine Plastic Debris
P3	Public Private Partnership
PA	Polyamide Nylon 6/Nylon 66
PE	Polyethylene
PES	Polyester
PEPRES	*Peraturan Presiden Republik Indonesia* – Regulation of the President of Indonesia
PERUM	*Perusahaan Umum* – Public Corporation
PP	Polypropylene
PPI	*Pangkalan Pendaratan Ikan* - Fish Landing Quay
PPN	*Pelabuhan Perikanan Nusantara* - Archipelagic Fishing Port
PPP	*Pelabuhan Perikanan Pantai* - Coastal Fishing Port
PPS	*Pelabuhan Perikanan Samudera* – Oceanic Fishing Port
RR	Relative Risk
RZWP3K	*Rencana Zonasi Wilayah Pesisir dan Pulau-Pulau Kecil* - Zoning Plans for Coastal Zone and Small Islands
SIUP	*Surat Ijin Usaha Perikanan* - Fishery Business License
SME	Small - and Medium-size Enterprise
SNI	*Standar Nasional Indonesia* - Indonesian National Standards
TPA	*Tempat Pembuangan Akhir* - Landfill
TPI	*Tempat Pelelangan Ikan* – Fish Auction
TPS	*Tempat Penampungan Sementara* – Temporary Disposal Site
UN	United Nations
UPT	*Unit Pelaksana Teknis* - Technical Implementation Unit
WPP	*Wilayah Pengelolaan Perikanan* – Fisheries Management Area

Executive Summary

The Government of Indonesia's National Plan of Action on Marine Plastic Debris (NPOA-MPD 2017-2025) outlines the ambitious objective to reduce marine plastic debris by 70 percent by 2025. One of the five pillars of this plan is dedicated to "reducing sea-based leakage" that is reported to contribute at least 20 percent of all marine plastic debris in Indonesia. Global studies indicate that Abandoned, Lost and Discarded Fishing Gear (ALDFG) is a major component of sea-based sources of marine debris, and causes significant impacts on the environment, economy, livelihoods and food security. The scale of ALDFG impacts on fisheries, marine ecosystems and human users has prompted international action, including under Sustainable Development Goal 14.

ALDFG management and mitigation strategies have the potential to contribute to Indonesia's goals for marine plastic waste management and debris reduction, while also providing economic opportunities. End-of-life fishing gear (EOLFG)—fishing gears and fishing gear components that through wear and tear need to be replaced—can be a major source of material stock for recycling provided such materials are landed ashore and not disposed of or discarded at sea. Many of the materials used in modern fishing gears such as nylon (PA), polyethylene (PE) and polypropylene (PP) are recyclable materials that can be processed into raw materials for secondary products.

This report aims to enhance the evidence available to support efforts to improve management, retrieval and recycling of EOLFG and ALDFG in Indonesia. It includes details on the development and testing of a methodology to assess gear-specific risk of ALDFG impacts, to establish baselines for the elements relevant to managing EOLFG and ALDFG and, in the longer term, to monitor and evaluate the impacts of prevention, mitigation and/or curative actions.

To support the development of measures to manage and address ALDFG in Indonesia, a common understanding of key terms and their definitions is essential. This report presents a glossary of key ALDFG terms and their definitions in the context of Indonesia's fisheries, including:

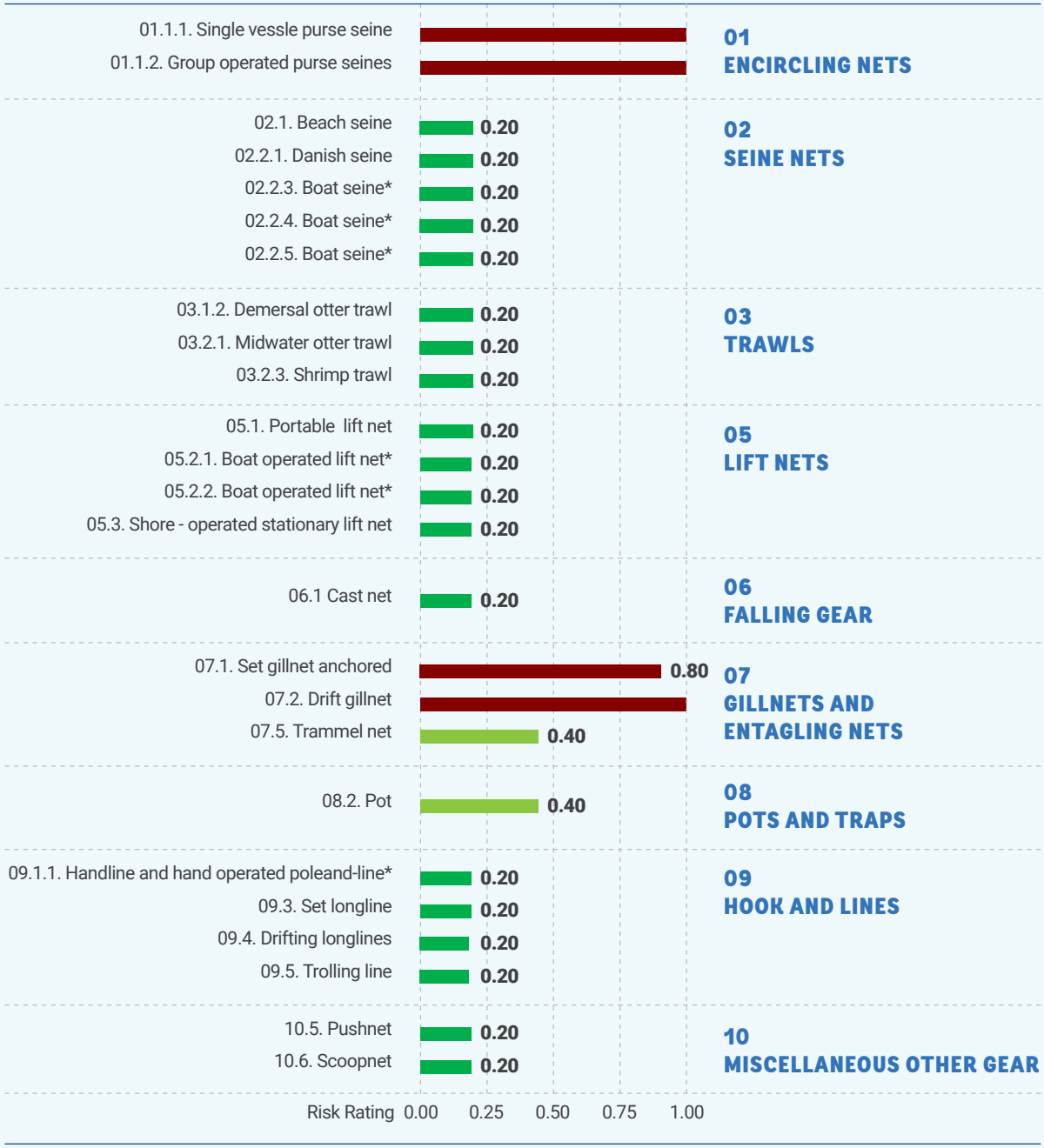
- **End-of-life fishing gear** includes fishing gears and fishing gear components that, through wear and tear, need to be replaced.
- **Abandoned fishing gear** could be retrieved by operator but is deliberately left at sea due to force majeure or other unforeseen reasons.
- **Lost fishing gear** cannot be located and/or retrieved by the operator, and hence is fishing gear over which the operator has accidentally lost control.
- **Discarded fishing gear** is released at sea without any attempt for further control or recovery by the owner/operator.

Field surveys were conducted in 10 Oceanic Fishing Ports (PPS, *Pelabuhan Perikanan Samudera*) and Archipelagic Fishing Port (PPN, *Pelabuhan Perikanan Nusantara*) to determine the lifecycle of fishing gears in Indonesia. Fishing gear storage and repair infrastructure and facilities are not available in most ports, and fishers undertaking gear repair activities at home or in open areas near to the location where catches are landed. Practices for managing fishing-related waste vary from one port to another, with irreparably damaged fishing gear generally disposed in intermediate storage facilities, together with other general waste, before being transported to landfill facilities. Some incidental reuse of EOLFG occurs, including the use of nets to construct aquaculture cages or fences for agriculture purposes. However, there are currently low rates of recycling of fishing-related waste, which may in part be due to the condition of this waste which is usually mixed and contaminated —sorting and cleaning of the waste are the largest compo-

nent of recycling costs. Greater economies of scale, increased supply (and hence lower cost) of raw materials, and/or cheaper processing costs are required to enhance the profitability and hence scale of fishing gear recycling enterprises.

A methodology for monitoring and evaluating ALDFG risk was developed, field tested and validated. This methodology was based on global best practices, and adapted for the unique context and dynamics of Indonesia's fisheries. The risk assessment considers three risk factors: (i) quantity of end-of-life plastic material generated; (ii) vulnerability to loss and damage (i.e., likelihood of a specific gear being abandoned, lost or discarded); and (iii) magnitude of ecological impacts.

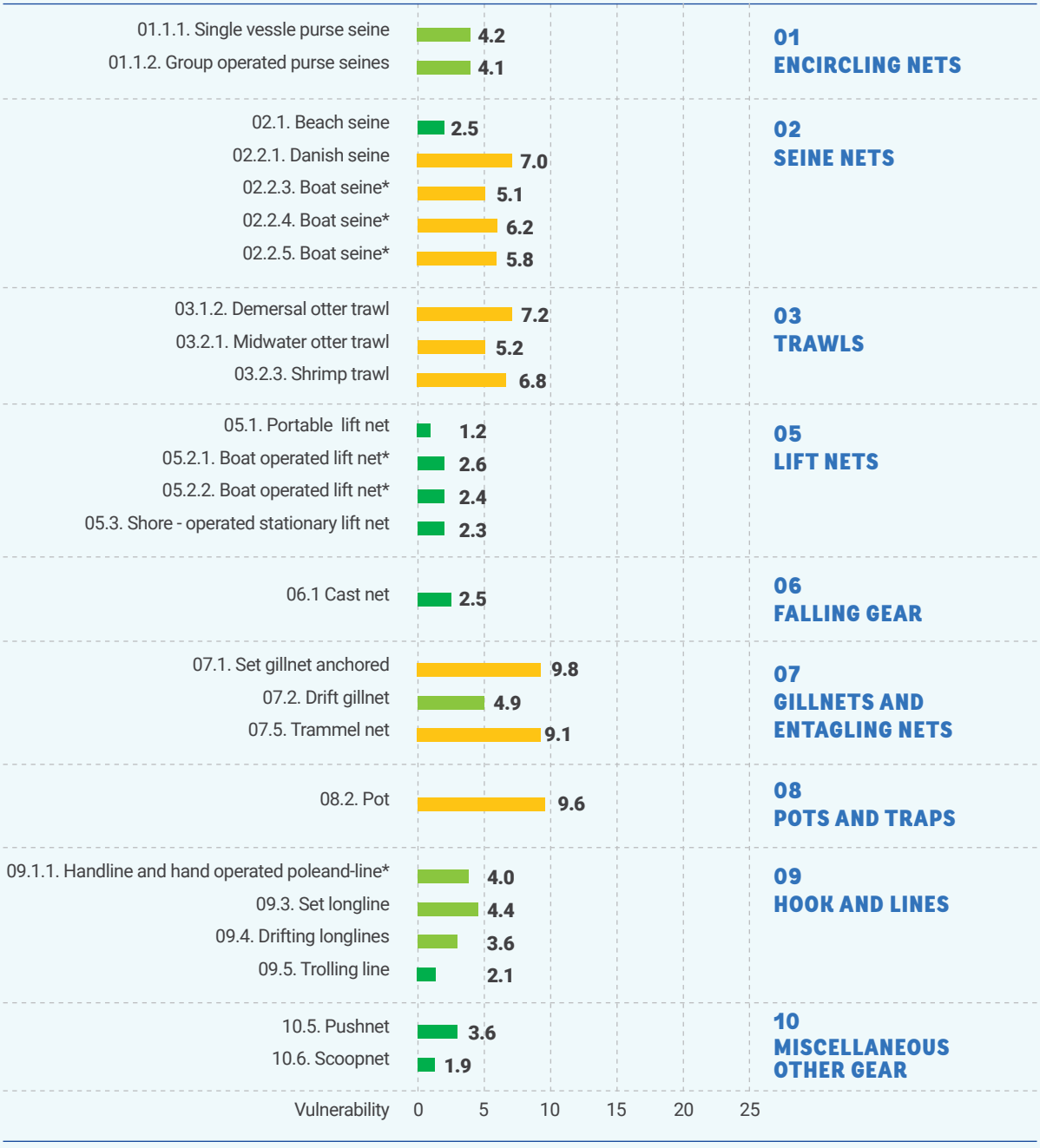
QUANTITY OF END-OF-LIFE MATERIAL GENERATED



Purse seine fisheries deploy 56 percent (47,212 t) of all plastic material deployed in Indonesia's fisheries, while purse seine vessels represent only 4.9 percent (8,265 vessels) of the total fleet of motorized inboard fishing vessels. An estimated 13,824 t of plastic material is replaced annually.

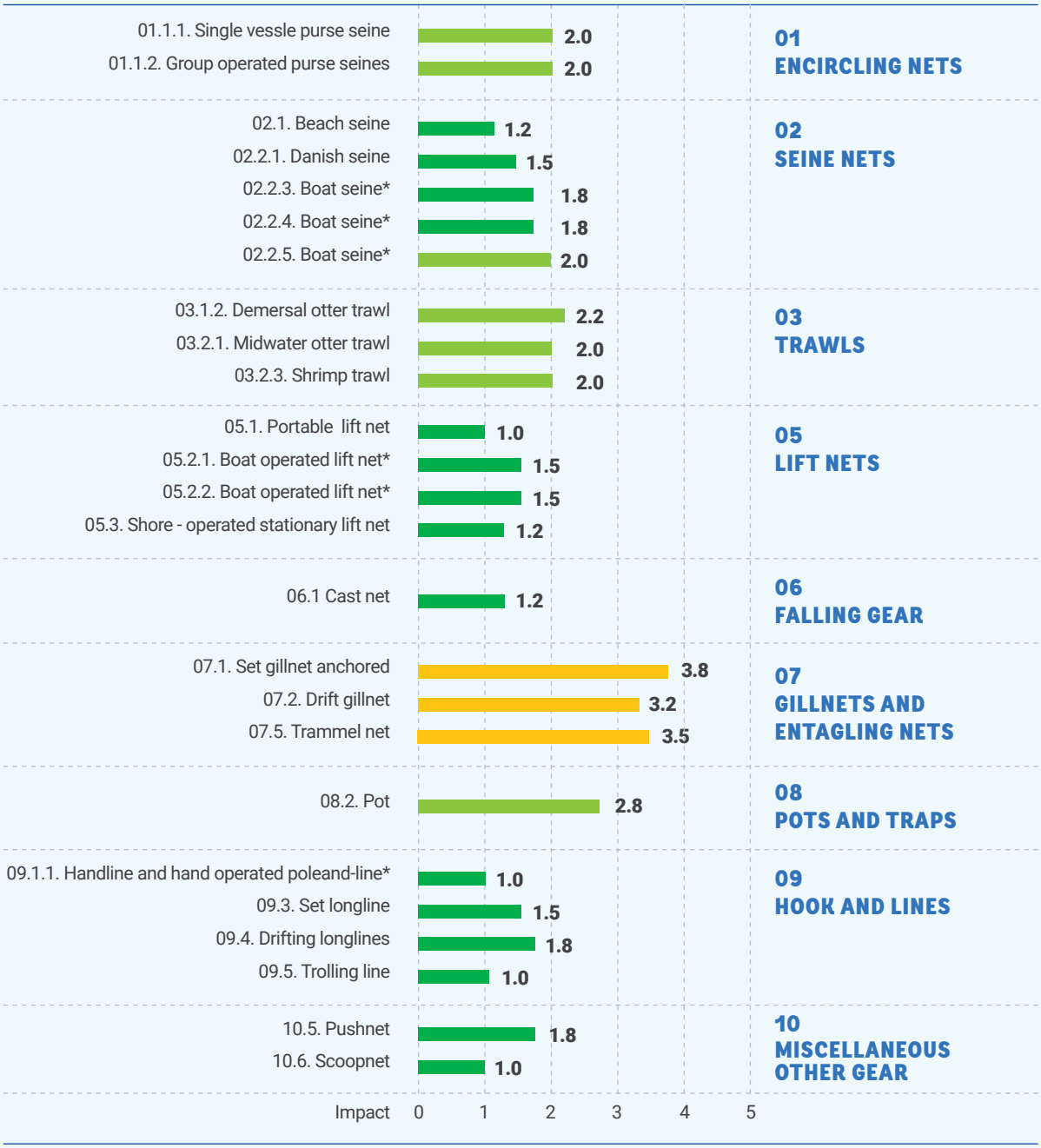
Gillnet and entangling net fisheries deploy 34.3 percent (28,764 t) of the plastic material in Indonesia's fisheries, with an estimated 18,206 t replaced annually. Gillnet vessels represent 40 percent (67,032 vessels) of Indonesia's total motorized inboard fishing fleet.

VULNERABILITY TO DAMAGE AND LOSS



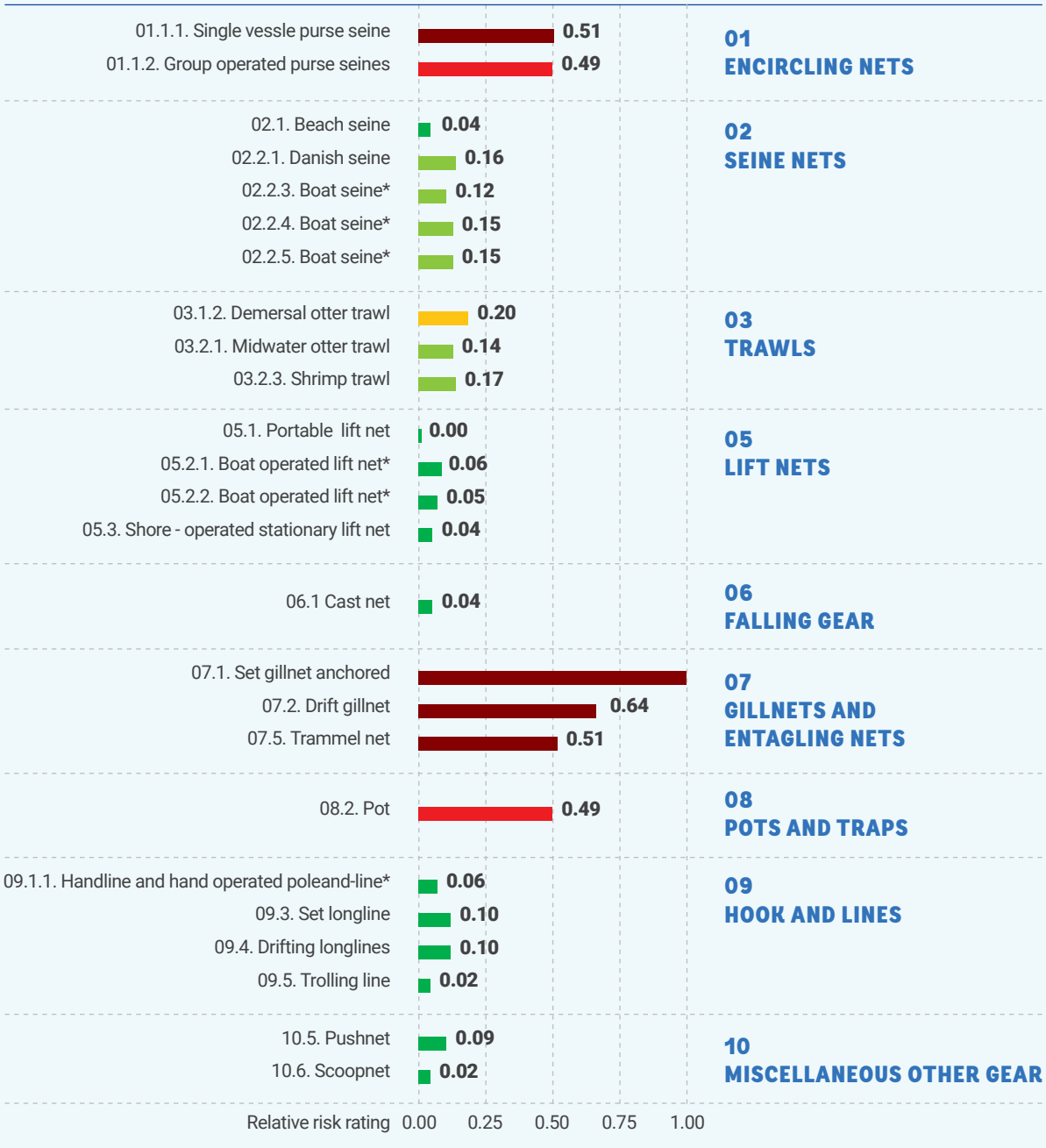
The fishing gears most vulnerable to damage and loss are: (i) plastic pots and traps; (ii) set anchored gillnets; and (iii) set anchored trammel nets. High vulnerability to damage and loss is associated with passive fishing gears that (i) operate without the attendance of the vessel; (ii) have relatively long soak times; (iii) operate through stealth; and (iv) are set on the seabed.

LIKELIHOOD OF ECOLOGICAL IMPACTS



Gillnets and entangling nets have the highest likelihood of ecological impact due to their ability to remain in the water column for long periods during which ghost fishing, entanglement and rafting of invasive species can occur. Pots and traps may also have a high likelihood of ecological impact due to their robust materials, longevity, and ability to self-bait and continue ghost fishing for prolonged periods.

OVERALL RISK



Gilnets and entangling nets pose the greatest ALDFG risk in Indonesia due to the large quantities of plastic material deployed and replaced annually, relatively high vulnerability of to loss and damage, and high likelihood of ecological impacts arising from ghost fishing, entanglement, rafting of invasive species or smothering of habitats.

Purse seines and encircling nets were assessed as having high relative risk. The small number of vessels operating these gears in Indonesia make these fisheries a good candidate for piloting ALDFG prevention and mitigation approaches. **Traps and pots** pose the third most significant ALDFG risk.

Existing waste management initiatives in Indonesia could be built upon to address issues associated with ALDFG.

POLICY AND REGULATORY FRAMEWORKS

Government Regulation 81/2012 on Domestic Waste Management implements the International Convention for the Prevention of Pollution from Ships (MARPOL). The requirements under MARPOL Annex V Regulation 10.3 to implement a garbage management plan apply to 858 fishing vessels in Indonesia that are larger than 100 GT, while the requirement to carry and fill out a garbage record book does not apply to any of Indonesia's 171,744 inboard or 181,178 outboard motor vessels. Given that MARPOL Annex V in its present form is not sufficiently tailored to Indonesia's fishing operations and practices, the Government of Indonesia could develop national policy, laws and regulations that build upon and go beyond the requirements of MARPOL Annex V in order to improve the reporting requirements of the national fleet.

ALDFG PREVENTION

It is more cost-effective to first prevent ALDFG before looking at measures to mitigate impacts or recover ALDFG. **Effective marine spatial plan** (MSP) implementation, notification and zoning enforcement can contribute to ALDFG prevention by minimizing the damage and losses that arise from gear conflicts or resource user interactions. **Stakeholder education and awareness-raising** are important tools to build knowledge about the issues surrounding ALDFG, and contribute to changing public perceptions and behaviors.

Certification bodies and eco-labels establish market incentives to prevent ALDFG, hold tremendous potential to leverage industry action, while also strengthening compliance with national, regional and international obligations. **Vessel design** is amongst the main direct drivers of ALDFG generation, including due to insufficient and inadequate gear stowage. While Government Regulation 27/2021 on Governance of the Marine and Fishery Sector includes specific clauses addressing vessel design, including fish hold and wastewater system design, there are currently no clauses addressing gear storage and securing systems. Opportunities may exist under the APEC Roadmap on Marine Debris to strengthen capacity for vessel innovation in Indonesia to combat marine debris, and Ministerial Decree 29/KEPMEN-KP/2021 on Technical Guidelines for Assistance to Fishing Vessels provides one avenue via which assistance related to vessel design and technical specifications could be delivered to stakeholders.

ALDFG MITIGATION

Improvements in **gear design and materials** can mitigate the impacts of ALDFG by, for example, minimizing rates of damage and loss, improving rates of detection and recovery, and reducing the incidence and duration of ghost fishing. While Indonesian National Standards (SNI, *Standar Nasional Indonesia*) exist for some categories of fishing gears, these could be extended to define key material and operational specifications for all gear types, while still maintaining flexibility to accommodate the wide variety of gear designs in Indonesia. The absence of gear specifications can result in suboptimal gear design or materials that contribute to ALDFG, including the re-use of waste plastic water bottles as fishing gear components or inferior materials used in the construction of fish aggregation devices. **Gear marking** can assist with identifying ownership, detecting illegal, unregulated and unreported (IUU) fishing, enhancing the visibility of passive gears, and aiding monitoring and enforcement of ALDFG regulations. Government Regulation 27/2021 provides a framework for gear marking, to some extent, via clause 136 point (f) which refers to the catch eligibility of fishing vessels and explicitly addresses the prevention of owner-less nets, while Ministerial Regulation 58/PERMEN-KP/2020 on Capture Fisheries Business addresses several issues that could support the implementation of gear marking schemes, including unique vessel identifiers (*tanda pengenal kapal perikanan*) and defintion of the fishing gears that are permitted in each fishery management area and fishing zone. Integrating ALDFG management measures into the **fisheries licensing** process can help to establish the incentive structures for fishers and fishing operators to minimize their contribution to ALDFG generation. The license to fish could include requirements such as (i) gear marking; (ii) use of appropriate biodegradable materials, escape mechanisms, or passive deterrents to reduce the time that lost fishing gear remains active; (iii) reporting of end-of-life and lost gears; and (iv) installation of adequate onboard gear storage and securing systems.

ALDFG RETRIEVAL

The detection, location and careful retrieval of ALDFG is the only way to eliminate its negative impacts on navigational safety, resource users and the environment. **ALDFG reporting** is important for two reasons: (i) lost gears can often be retrieved if their location is known; and (ii) an understanding of the scale, sources, locations and causes of gear loss is essential to develop effective prevention and management strategies. Under the framework of the NPOA-MPD 2017-2025, the Ministry of Environment and Forestry has developed guidelines for monitoring marine debris, however monitoring and reporting obligations that specifically address ALDFG are currently limited in Indonesia. While a number of one-off and ad hoc clean up initiatives have occurred in Indonesia, these tend to be focused on the wider issue of marine debris rather than explicitly addressing ALDFG retrieval and clean up. Regular coordinated ALDFG retrieval efforts could be implemented in Indonesia, and may include the establishment of requirements or incentive for fishers to remove ALDFG when encountered.

ALDFG IN THE CIRCULAR ECONOMY

Adequate **maintenance and repair facilities** can keep gears in service longer, minimize damage and reduce rates of waste and ALDFG generation. The Food and Agriculture Organization of the United Nations recommends that small- and medium-sized fishing ports should have dedicated gear repair facilities, with 500 m2 allocated in artisanal ports and 1,000 m2 of part-covered areas for coastal and offshore fishing ports. While informal open areas in or adjacent to ports are currently used for gear repairs, opportunities exist to improve the adequacy of these areas, including under Ministerial Regulation 8/PERMEN-KP/2012 on Fishing Ports which specifies the facilities to be provided by a fishing port, including “places for the maintenance of vessels and fishing gear, such as places for repairing nets” (article 4, clause 3.d). The installation, maintenance and management of fit-for-purpose fishing gear **waste collection and storage infrastructure and facilities** at fishing ports can facilitate the aggregation of dispersed sources of waste, aid the sorting of different gear and material types, and facilitate cleaning to minimize contamination. In turn, these facilities provide opportunities to extract additional value from materials by enhancing raw material supply and reducing costs associated with the **reuse and recycling of EOLFG**. Policy and regulatory frameworks that promote price stability, market stability and market accessibility can establish the enabling conditions for the **development of markets for EOLFG**, while greater economies of scale, increased supply (and hence lower cost) of raw materials, and/or cheaper processing costs can enhance the profitability of net recycling enterprises.

Introduction

The Government of Indonesia's (GoI) National Plan of Action on Marine Plastic Debris (NPOA-MPD 2017-2025) outlines the ambitious objective to reduce marine plastic debris by 70 percent by 2025. Sea-based leakage is reported to contribute at least 20 percent of all plastic waste that leaks into Indonesia's marine environment (World Bank, 2018). Sea-based leakage includes pollution from maritime activities such as aquaculture, shipping, fisheries and tourism, as well as debris transported by ocean flows. Recognizing the significance of this source, one of the five pillars of the NPOA-MPD 2017-2025 is dedicated to "reducing sea-based leakage". Achieving this goal will require an integrated suite of actions including "greening" of ports (e.g., via investments in the development of efficient waste management systems that include fit-for-purpose waste collection facilities), incentivizing and enforcing good practices to ensure waste enters collection systems, strengthening and implementing regulatory frameworks such as Presidential Regulation 83/2018 on Handling of Marine Waste, and identifying and mitigating the main components of sea-based marine debris.

Abandoned, Lost and Discarded Fishing Gear (ALDFG) is considered to be a major component of sea-based sources of marine debris. Some studies have estimated that ALDFG comprises more than 50 percent of all marine debris (e.g., Consoli et al., 2021). Current estimates of global ALDFG leakage are as high as 1.14 Mt per year (Eunomia, 2016; Gilman et al., 2021), though scientists are currently working to improve quantitatively rigorous estimates (Richardson et al., 2021). A recent meta-analysis of global fishing gear losses during the period 1975 to 2017 estimated that 5.7 percent of all fishing nets, 8.6 percent of all traps and 29 percent of all lines are lost each year (Richardson et al., 2019).

ALDFG has increased in recent decades due to the expansion of fishing effort and greater use of synthetic fishing gear materials. Plastic is considered an excellent fishing gear material because it is highly resistant to abrasion and rust, is recognized for its longevity and durability, is lightweight and buoyant thus reducing handling and associated costs, and is relatively cheap (Huntington, 2019; Derraik, 2002; Halpern et al., 2008). Because of these characteristics, combined with the expanding footprint of fishing effort across all oceans (Kroodsma et al., 2018), plastic-based fisheries equipment has greatly accelerated since the 1960s (Macfadyen et al., 2009).

Drivers of ALDFG generation include gear characteristics, fishery management frameworks and socioeconomic factors. Causes of ALDFG generation include loss during inclement weather, snagging on submerged features and debris, conflicts between gears or other marine vessels, practices by inexperienced new entrants, and availability of affordable and convenient port reception facilities for gear maintenance or end-of-life disposal (Gilman et al. 2022; Macfadyen et al., 2009; MacMullen et al., 2003; Richardson et al., 2018, 2021). A growing body of research (e.g., MacMullen et al., 2003; Gilman et al., 2018; Proctor et al., 2019; Sinopoli et al., 2020; Richardson et al., 2018, 2021; Stevens, 2021) indicates that the drivers of ALDFG generation vary considerably across gear types, fisheries, operational characteristics (e.g., whether gears are attended or unattended), regions, and other categories, including the robustness of the fisheries management framework and influence of market-based incentives (Gilman et al., 2022). Socioeconomic factors are amongst the most important drivers of ALDFG generation, influencing the types and qualities of gears employed, as well as gear stewardship behaviors such as maintenance, replacement and end-of-life disposal (Richardson et al., 2018). A recent study of trawl, gill and purse seine nets fishers in Indonesia and Australia identified potential drivers of ALDFG generation relevant to the Indonesia context (Box 1), and analyzed their causes, effects and interactions (Figure 1).

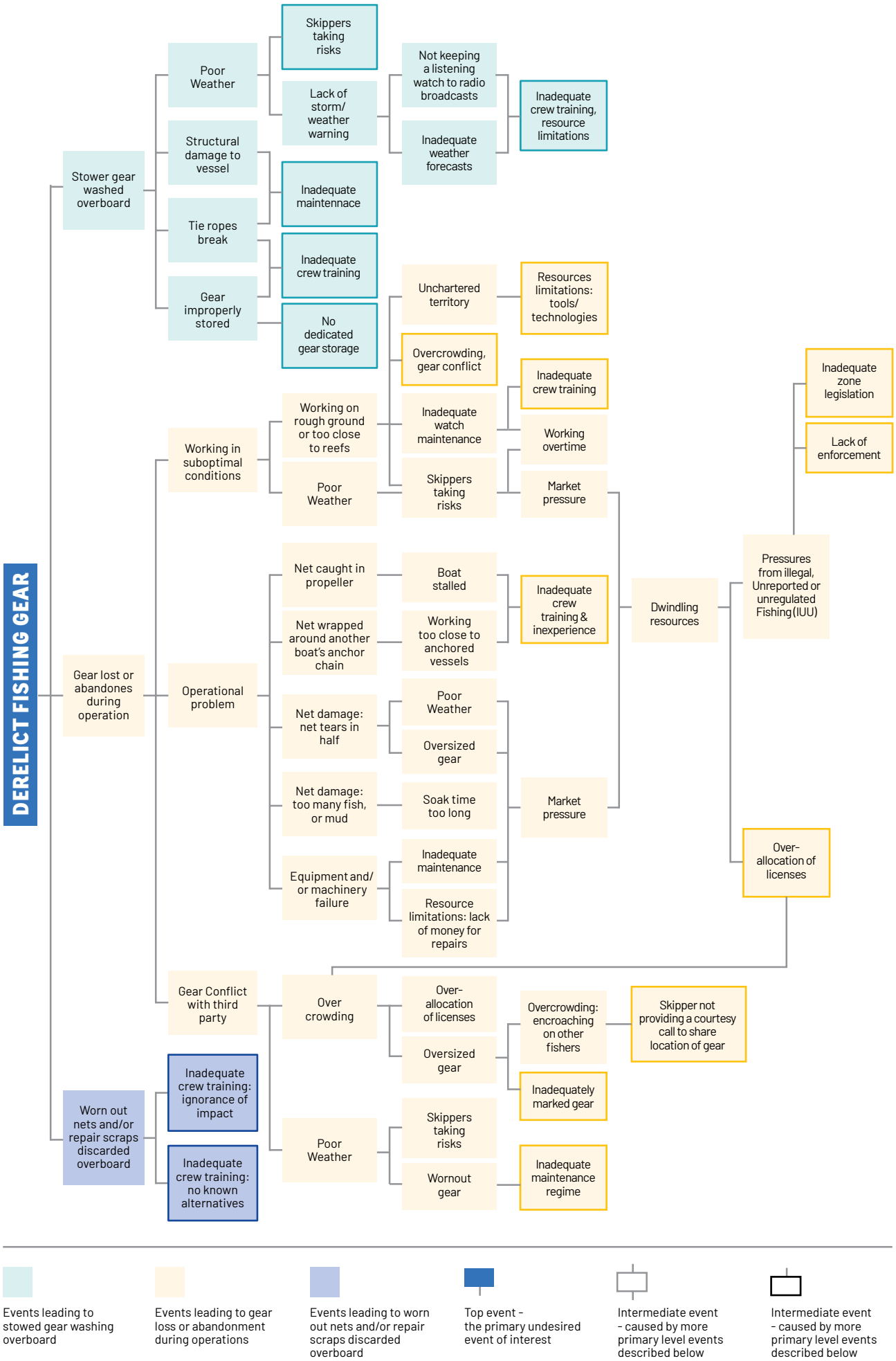


Figure 1: Problem tree analysis identifying the causes of derelict fishing gear from trawl gillnet and purse seine fisheries. Source: Richardson et. al., 2019

Box 1: Perceptions of fishers in Indonesia and Australia on the main drivers of ALDFG generation.

Interviews conducted with trawl, gill and purse seine nets fishers at ports in Indonesia and Australia (Richardson et al., 2018) revealed that:

- Australian fishers reported replacing nets when worn (preventative measure) compared to Indonesian fishers replacing nets when damaged (reactive measure);
- One-third of Indonesian trawl fishers and 12 percent of Indonesian gillnet fishers reported that, if net damage was too severe, unusable nets were discarded;
- Gear loss reported in Indonesian gillnet fishers was commonly caused by: (i) snagging on an obstruction; (ii) gear conflict with trawlers; and (iii) bad weather.
- Indonesian fishers reported: (i) over-allocation of licenses; (ii) inadequate zone legislation; and (iii) lack of enforcement as the 'basic initiating events' of gear loss in the region.

Importantly, Indonesian fishers attributed ineffective management regimes as a contributing factor to declining resources that leads to increased fishing effort (to maintain catches) and ultimately to fatigue and increased risk taking. Over allocation of fishing licenses was reported by fishers to result in overcrowding of fishing grounds, increased competition and gear conflicts that leads to gear loss / damage. Risk taking included fishing in suboptimal conditions such as poor weather, fishing on rough ground or too close to reefs.

The impacts of ALDFG on the environment, economy, livelihoods and food security are significant. ALDFG compromises fisheries sustainability through losses of gear and catch, as well as adverse impacts to marine habitats, target and non-target species, gear efficiency and associated fisheries profits (DelBane et al., 2019; Macfadyen et al., 2009; NOAA, 2016; Scheld et al. 2016). Under certain conditions, ALDFG can travel long distances (Brown et al., 2005) and continue to ensnare and capture marine organisms for years or decades, a phenomenon known as 'ghost fishing' (FAO, 2016; Good et al., 2010; Kaiser et al., 1996; NOAA, 2015). Ingestion of hooks, lines, nets or weights by marine wildlife causes harmful effects including perforation of the gastrointestinal tract, obstruction, sepsis, toxicity, or starvation (McCauley & Bjorndal, 1999; Moore et al. 2013; Zabka et al., 2006) that can result in population level impacts on marine mammals, seabirds, chelonians and other wildlife (e.g. Boren et al., 2006; Franson et al., 2003; Good et al., 2009; Hanni & Pyle, 2000; Orós et al. 2016; van der Hoop et al. 2013), and significant commercial losses from fisheries (Goodman et al., 2021). This potential to entangle, ensnare or be ingested over long distances and timescales results in disproportionately higher impacts to marine wildlife compared to other types of debris (Gilardi et al., 2010; Laist, 1995; Wilcox et al., 2016). ALDFG can also cause significant damage to marine ecosystems and benthic habitats (Gilman, 2015; Macfadyen et al., 2009; NOAA , 2015), present hazards to navigation and safety at sea (Hong et al., 2017), damage marine infrastructure and submarine cables (IPCC, 2021), transport invasive alien species (Enrichetti et al., 2021), reduce the socioeconomic value of coastal areas (English et al., 2019) and transfer toxins and microplastics into marine food webs with associated risks to human health from seafood contamination (Barnes et al., 2009; Foley et al., 2018; GESAMP, 2015; Rochman, 2015).

The scale of ALDFG impacts on fisheries, marine ecosystems and human users has prompted international action. The United Nations (UN) has called upon members to take action to reduce ALDFG (FAO, 2016a; UNEA, 2014; 2016; 2018), and to support UN 2030 Agenda for Sustainable Development Goal 14 which asks members to regulate destructive fishing practices and significantly reduce marine pollution (UNSDG, 2018). In addition, the Food and Agriculture Organization of the UN (FAO) has emphasized the need for fishing gear marking and ALDFG reporting and recovery via its Committee on Fisheries, Code of Conduct on Responsible Fisheries and Voluntary Guidelines on the Marking of Fishing Gear (FAO 2016a; 2018; 2019b), and the International Maritime Organization has outlined actions to reduce ALDFG from fishing via vessels (IMO, 2018).

ALDFG management and mitigation strategies have the potential to contribute to Indonesia's marine plastic debris while also providing economic opportunities. Increasingly a variety of ALDFG management and mitigation strategies are being implemented around the world, including modifying gear materials and design (e.g., OSPAR, 2020), marking gears (e.g., He & Suuronen, 2018), improving monitoring of ALDFG volume and distribution (e.g., Gilman, 2015), incentivizing the collection of ALDFG and marine debris (e.g., Cho, 2009) and enhancing the collection, disposal and recycling of fishing gears (e.g., Weißbach et al., 2022). Many of the materials used in modern fishing gears such as nylon (PA), polyethylene (PE) and polypropylene (PP) are recyclable materials that can be processed into raw materials for secondary products (Chen et al., 2020). These circular economy methodologies have been tested and proven by several enterprises globally (e.g., Juan et al., 2021; Charter et al., 2022), and have potential to contribute to Indo-

nesia's goals for marine plastic waste management and debris reduction, while also providing alternative incomes for coastal communities. End-of-life fishing gear (EOLFG)—fishing gears and fishing gear components that through wear and tear need to be replaced—can be a major source of material stock for recycling provided such materials are landed ashore and not disposed of or discarded at sea. Successfully addressing ALDFG in Indonesia will require an improved understanding of the life cycle and end-of-life management of Indonesia's fishing gears, and a framework to evaluate the effectiveness of interventions to prevent, minimize and mitigate the generation and effects of ALDFG (Kuczenski et al., 2021; Richardson et al., 2021; Gilman et al. 2021).

This study aims to enhance the evidence available to support efforts to improve the management, retrieval and recycling of EOLFG and ALDFG in Indonesia. This evidence base report presents:

- A glossary of key ALDFG terms and their definitions in the context of Indonesia's fisheries (Chapter 2);
- An overview of Indonesia's fisheries, including a description of fishery management areas, fishing ports, main fishing fleets and the fishing gear in use to provide context for the EOLFG and ALDFG issues presented in subsequent sections of the report (Chapter 3);
- A description of the lifecycle of fishing gear in Indonesia, including existing EOLFG collection, processing and recycling systems, based on information obtained during field surveys (Chapter 4);
- A description of the development and testing of a methodology to assess the gear-specific risk of ALDFG impacts, to establish baselines for the elements relevant to managing EOLFG and ALDFG and, in the longer term, to monitor and evaluate the impacts of prevention, mitigation and/or curative actions (Chapter 5);
- An overview of current EOLFG and ALDFG management in Indonesia—including current facilities and practices for handling EOLFG and retrieved ALDFG and their entry into the re-use, recycling and waste disposal chains—and how this compares with international best practices (Chapter 6); and
- Recommendations to inform the development of a Fisheries and Aquaculture Plastic Action Plan (Chapter 7).

ALDFG terms and their definitions

To support the development of measures to manage and address ALDFG in Indonesia, a common understanding of key terms and their definitions is essential. The Voluntary Guidelines on the Marking of Fishing Gear (FAO, 2019b)—developed via Expert and Technical Consultations in which Indonesia participated, and adopted by the Food and Agriculture Organization of the United Nations at the 33rd session of the Committee on Fisheries in July 2018—are a tool that contributes to developing sustainable fisheries, improving the state of the marine environment, and enhancing safety at sea by combatting, minimizing and eliminating ALDFG and facilitating the identification and recovery of such gear.

The Voluntary Guidelines on the Marking of Fishing Gear are a useful starting point for discussions on the development of ALDFG management measures in Indonesia, and provide definitions for many of the key terms associated with ALDFG. These terms were reviewed to identify any gaps related to the specific context and needs of Indonesia's fisheries and to ensure compatibility with Indonesia's existing policy and regulatory frameworks. To develop working terms to serve the needs of this study and to inform follow up activities—including the promulgation of such terms and definitions into law where appropriate—a review of the global literature on ALDFG was conducted, key terms were identified, and definitions were translated into Bahasa Indonesia (Table 1). Terms and definitions were consulted with stakeholders during the course of this study, and were revised to enhance clarity and comprehension where necessary. The compatibility of terms and definitions with existing laws and regulations was reviewed.

Table 1: Glossary of ALDFG-related terms and their definition in English and Bahasa Indonesia.

TERM	ENGLISH DEFINITION	INDONESIAN DEFINITION
Fishing Gear	refers to any physical device or part thereof or combination of items that may be placed on or in the water or on the seabed with the intended purpose of capturing or controlling for subsequent capture or harvesting marine organisms, in accordance with MARPOL Annex V.[1]	Setiap perangkat fisik yang ditempatkan di atau di dalam air atau di dasar laut dengan tujuan untuk menangkap organisme laut. Alat tangkap biasanya terdiri dari sejumlah komponen berbeda (lihat di bawah) yang secara bersama-sama membentuk satu set atau unit alat tangkap. Catatan: Alat Tangkap termasuk Alat Pengumpul Ikan
	NOTES - FAD is not part of the definition but has been included as supporting device since FAD mooring lines can be a significant element of ALDFG. Ministerial Regulation 18/PERMEN-KP/2021 defines fishing gears as "tools, equipment or other items used to catch fish" and auxiliary fishing equipment as "tools used to aggregate fish for fishing activities"	
Components (of fishing gear)	Individual elements of fishing gear, including net panels, ropes, floats (buoys), weights, fastenings.	Bagian atau elemen alat tangkap, termasuk panel jaring, tali, pelampung (pelampung), pemberat, pengikat.

[1] Definition / term adopted at the FAO Technical Consultation on the Marking of Fishing Gear and endorsed by the FAO Committee on Fisheries (COFI) in 2018 http://www.fao.org/3/ca5184en/CA5184EN.pdf

Abandoned fishing gear	Fishing gear over which the operator/owner has control and that could be retrieved by owner/ operator, but that is deliberately left at sea due to force majeure or other unforeseen reasons.	Alat tangkap yang dikendalikan oleh operator / pemilik dan alat tangkap dapat diambil kembali oleh pemilik / operator, tetapi alat tangkap tersebut sengaja ditinggalkan di laut karena keadaan kahar atau alasan tak terduga lainnya.
Lost fishing gear	Fishing gear over which the owner/operator has accidentally lost control and that cannot be located and/or retrieved by the owner/operator.	Alat penangkapan ikan yang tanpa sengaja kehilangan kendali oleh pemilik / operator dan tidak dapat ditemukan dan / atau diambil oleh pemilik / operator
Discarded fishing gear	Fishing gear that is released at sea without any attempt for further control or recovery by the owner/operator.	Alat tangkap yang dilepas ke laut tanpa adanya upaya pengendalian atau pemulihan lebih lanjut oleh pemilik / operator
Ghost fishing	The capture and/or entanglement of fish and other animals by fishing gear that has been abandoned, lost or otherwise discarded.	Penangkapan dan / atau terbelitnya ikan dan hewan laut lainnya dengan alat tangkap yang telah ditinggalkan, hilang atau dibuang
Replenishment (of fishing gear)	The total quantity / volume of fishing gear or component of fishing gear that are added to a fishing vessel to replace or top up any fishing gear or components of fishing gear that are abandoned, lost, discarded or removed from the vessel for any reason whatsoever.	Jumlah total / volume alat tangkap atau komponen alat tangkap yang ditambahkan ke kapal penangkap ikan untuk mengganti atau menambah alat tangkap atau komponen alat tangkap yang ditinggalkan, hilang, dibuang atau dipindahkan dari kapal dengan alasan apa pun.
Annual Replenishment Rate	Annual Replenishment Rate of Fishing Gear refers to the amount of fishing gear and fishing gear components replenished by a fishing vessel in one year.	Laju penggantian tahunan dari alat tangkap adalah jumlah alat tangkap dan komponen alat tangkap yang diganti oleh kapal penangkap ikan dalam satu tahun.
Retrieval	The recovery of fishing gear after it has been abandoned, lost or discarded. The retrieval can be conducted by either the fisher responsible for the gear or an authorized third party.	Pemulihan peralatan hantu setelah ditinggalkan, hilang atau dibuang. Pengambilan kembali dapat dilakukan oleh nelayan yang bertanggung jawab atas peralatan tersebut atau pihak ketiga.
Collection	The process by which fishing gear or ALDFG is gathered into one or more designated locations / spaces for subsequent repair, recycling or disposal.	Proses dimanah alat tangkap atau ALDFG dikumpulkan ke dalam satu atau lebih lokasi / tempat yang ditentukan untuk perbaikan, daur ulang atau pembuangan selanjutnya.

Context of Indonesia's Fisheries

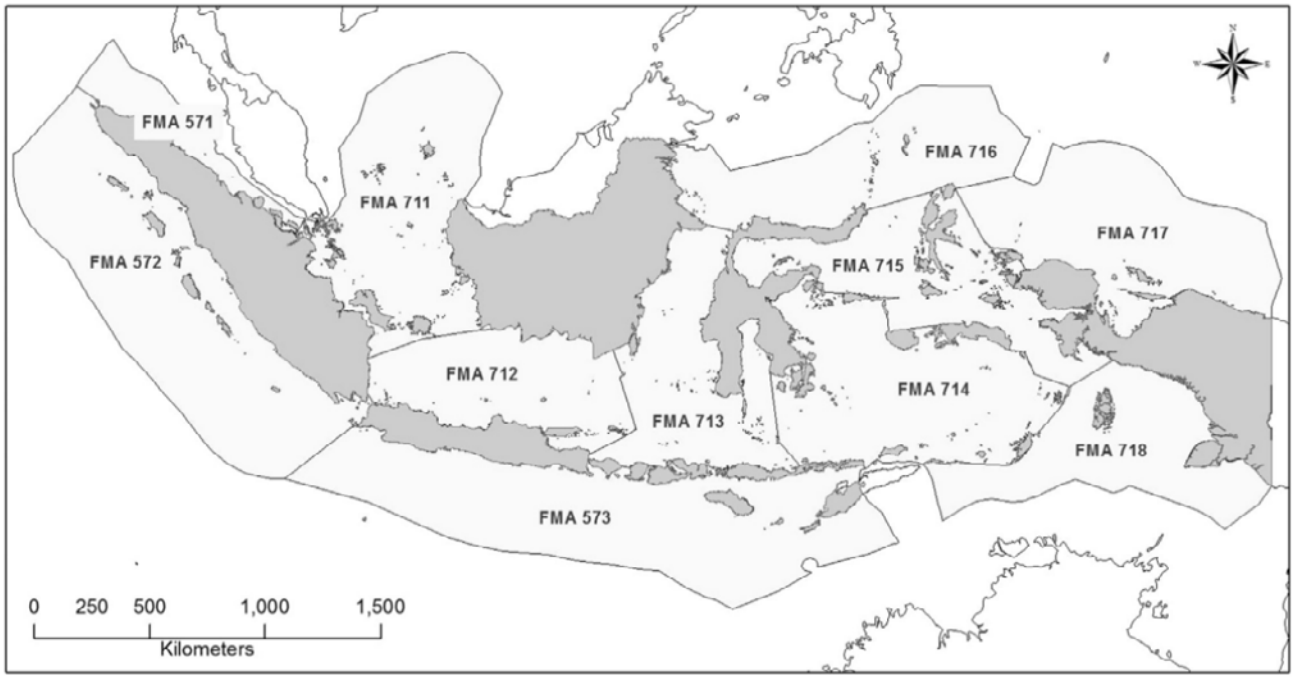


Figure 2: Fishery management areas of Indonesia.

FISHERY MANAGEMENT AREAS

The marine waters of Indonesia are divided into 11 Fishery Management Areas (WPP, *Wilayah Pengelolaan Perikanan*) (Figure 2) based on the characteristics of the fish resources and its environment.[2] These are:

- WPP 571 Malacca Strait and Andaman Sea;
- WPP 572 Indian Ocean of Western Sumatera and Sunda Strait;
- WPP 573 Indian Ocean of Southern Java, Southern Nusa Tenggara, Sawu Sea, and Western of Timor Sea;
- WPP 711 Karimata Strait, Natuna Sea and South China Sea;
- WPP 712 Java Sea;
- WPP 713 Makassar Sea, Bone Bay, Flores Sea and Bali Sea;
- WPP 714 Tolo Bay and Banda Sea;
- WPP 715 Tomini Bay, Maluku Sea, Halmahera Sea, Seram Sea and Berau Bay;
- WPP 716 Sulawesi Sea and Northern sea of Halmahera Island;
- WPP 717 Cendrawasih Bay and Pacific Ocean:; and
- WPP 718 Aru Bay, Arafuru Sea, and Eastern Timor Sea.

[2] Regulation of the Minister of Marine Affairs and Fisheries 18/PERMEN-KP/2014 on Fishery Management Areas. https://jdih.kkp.go.id/peraturan/18-permen-kp-2014-ttg-wilayah-pengelolaan-perikanan-negara-republik-indonesia.pdf

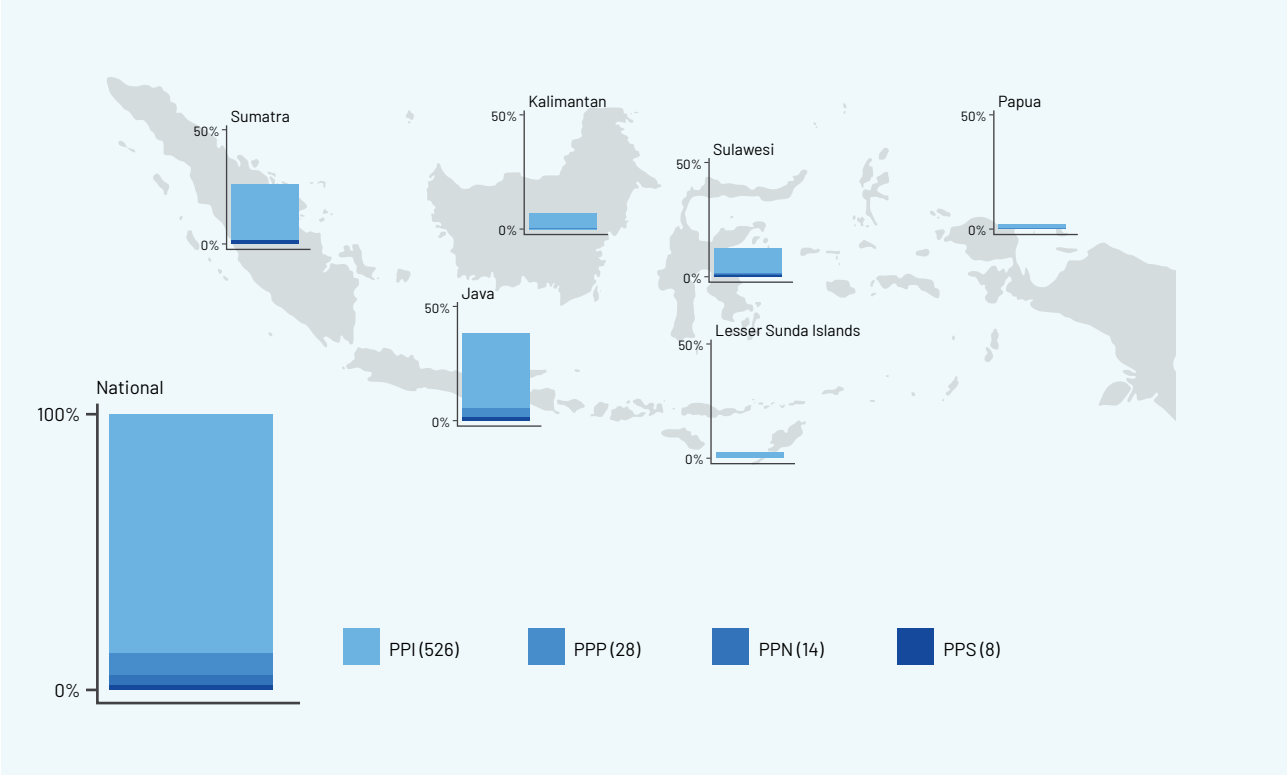


Figure 3: Distribution of PPS, PPN, PPP and PPI class fishing ports across different regions of Indonesia (left) and the national distribution (right). Source: BPS, 2019.

FISHING PORTS

There are 576 fishing ports throughout Indonesia (BPS, 2019), with the greatest concentration in western Indonesia (Figure 3). The province of Aceh has the most fishing ports (114), while the provinces of Jambi, South Sulawesi and West Papua have the least (1) (Table 2).

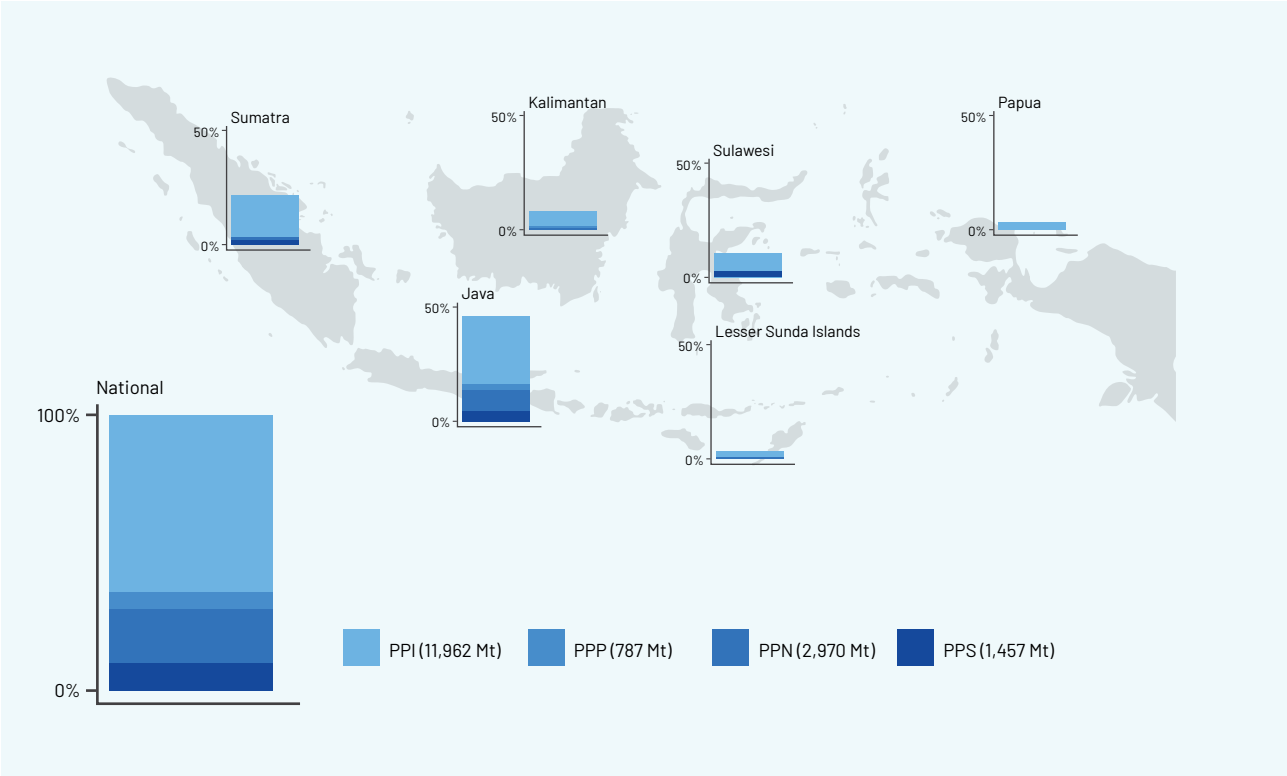


Figure 4: Distribution of fishery production across different regions of Indonesia (left) and the four classes of fishing port (right). Source BPS, 2009

Indonesia's fishing ports are classified into four classes[3] (Table 3):

- **Fisheries Port Class A or Oceanic Fishing Port** (PPS, *Pelabuhan Perikanan Samudera*) serve fishing vessels that operate in Indonesia's territorial seas, Indonesia's Exclusive Economic Zone (EEZ), and the high seas. Indonesia has eight PPS, located in the provinces of Aceh, North Sumatra, West Sumatra, DKI Jakarta, Central Java, East Java, North Sulawesi and Southeast Sulawesi (Table 2).
- **Fisheries Port Class B or Archipelagic Fishing Port** (PPN, *Pelabuhan Perikanan Nusantara*) serve fishing vessels that operate in Indonesia's territorial seas and Indonesia's EEZ. Indonesia has 14 PPN distributed across 12 provinces, with the provinces of Bangka Belitung and Maluku both having two PPN.
- **Fisheries Port Class C or Coastal Fishing Port** (PPP, *Pelabuhan Perikanan Pantai*) serve fishing vessels that operate in Indonesia's territorial seas. Indonesia has 28 PPP, with the greatest concentration in Central Java (9 PPP).
- **Fisheries Port Class D or Fish Landing Quay** (PPI, *Pangkalan Pendaratan Ikan*) serve fishing vessels that operate in Indonesia's territorial seas. Indonesia has 526 PPI distributed throughout all provinces and with the greatest concentration in Aceh Province (113).

The greatest number of fishing ports are located in WPP 712, WPP 572 and WPP 573 (Table 4, see Annex 7 for a breakdown of the number[4] of ports in each class and their competent authorities).

Table 4: Number of Fishing Ports in each WPP.

FISHERY MANAGEMENT AREA	NO. FISHING PORTS
WPP 712	174
WPP 572	159
WPP 573	135
WPP 713	82
WPP 711	77
WPP 571	60
WPP 715	53
WPP 714	34
WPP 716	27
WPP 717	7
WPP 718	6
TOTAL	814

Fishery production volumes vary across ports and provinces (BPS, 2019) (Figure 4). The top five most productive provinces are West Java, Aceh, East Java, Central Java and Banten which together account for 54.7 percent of Indonesia's annual capture fishery production (Table 5).

Table 2: Distribution of fishing ports across Indonesian provinces.

PROVINCE	PPS	PPN	PPP	PPI	TOTAL
Aceh	1			113	114
North Sumatra	1	1		19	21
West Sumatra	1			8	9
Riau				3	3
Jambi			1		1
South Sumatera				1	1
Bengkulu				28	28
Lampung				9	9
Bangka Belitung Islands		2		7	9
Riau Islands				2	2
DKI Jakarta	1			1	2
West Java		1	3	44	48
Central Java	1	1	9	67	78
DI Yogyakarta			1	16	17
East Java	1	1	5	50	57
Banten		1	1	25	27
Bali		1		9	10
West Nusa Tenggara				6	6
East Nusa Tenggara			1	7	8
West Kalimantan		1	2	14	17
Central Kalimantan				6	6
South Kalimantan				4	4
East Kalimantan				8	8
North Kalimantan			1	1	2
North Sulawesi	1		1	6	8
Central Sulawesi				12	12
South Sulawesi		1		27	28
Southeast Sulawesi	1			9	10
Gorontalo		1		11	12
West Sulawesi				2	2
Maluku		2		3	5
North Maluku		1	2	5	8
West Papua			1		1
Papua				3	3
TOTAL	8	14	28	526	576

[3] Regulation of the Minister of Marine Affairs and Fisheries 8/PERMEN-KP/2012 on Fishing Ports. http://jdih.kkp.go.id/peraturan/per-08-men-2012.pdf
[4] The actual number of fishing ports and their distribution by class vary in different Indonesian publications.

Table 3: Typology of fishing ports in Indonesia
(HS = high seas, EEZ = exclusive economic zone, TS = territorial seas).

CRITERIA	PPS	PPN	PPP	PPI
Operational area served	HS, EEZ, TS	EEZ, TS	TS	TS
Mooring facilities	≥60 GT	≥30 GT	≥10 to <30 GT	≥5 GT
Port length	≥300 m	≥150 m	≥100 m	≥50 m
Port water depth	≥3 m	≥3 m	≥2 m	≥1 m
Ship holding capacity	≥6,000 GT	≥2,250 GT	≥300 GT	≥75 GT
Average fish landed volume	50 t/day	30 t/day	5 t/day	10 t/day
Export targeted market	Yes	Yes	No	No
Total port area	≥20 ha	≥10 ha	≥5 ha	≥1 ha

Source: Ministerial Regulation 8/KEPMEN-KP/2012

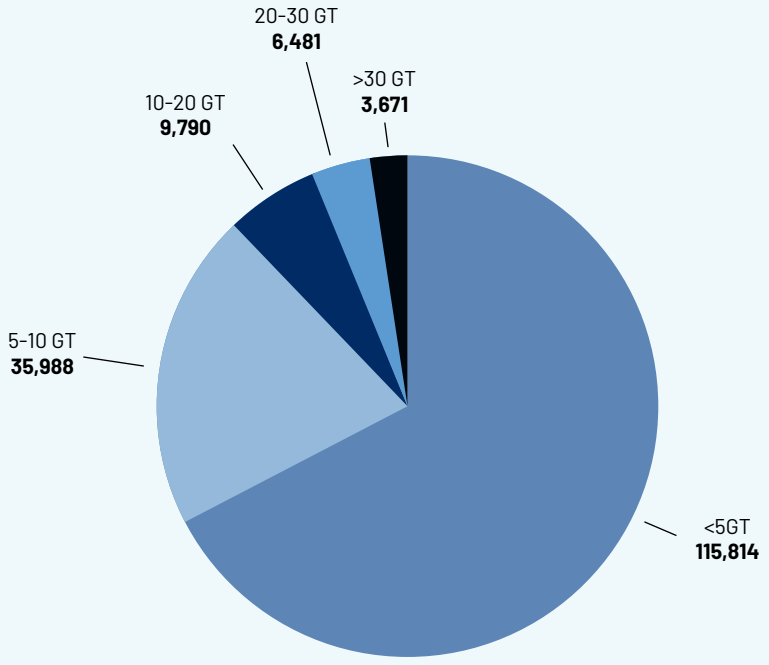


Figure 5: Composition of the Indonesian fishing fleet by vessel size. Source: MMAF, 2018.

Table 5: Annual catch volume (metric tonne) landed at all province and port classes in 2019. Source: BPS, 2019.

PROVINCE	PPS	PPN	PPP	PPI	TOTAL	RANK
Central Java	3,650	5,794	81,943	305,642	397,029	1
Aceh	1,825			240,480	242,305	2
East Java	374	56,301	15,485	107,620	179,781	3
West Java		3,230	4,106	165,126	172,463	4
South Sulawesi				159,651	159,651	5
DKI Jakarta	67,799			66,905	134,703	6
West Kalimantan		8,943	12,958	73,794	95,694	7
North Sulawes	49,001		10,877	34,912	94,791	8
North Sumatera	19,637	23,926		45,671	89,233	9
Banten		2,281	1,460	64,277	68,018	10
Southeast Sulawesi	27,229			26,609	53,838	11
North Maluku		3,833	5,110	30,660	39,603	12
West Sumatera	639			37,048	37,686	13
West Nusa Tenggara				35,816	35,816	14
East Kalimantan				33,142	33,142	15
Bangka Belitung Islands		8,669		24,455	33,124	16
South Kalimantan			8,121	23,816	31,938	17
Bali		12,136		16,425	28,561	18
West Sulawesi				23,451	23,451	19
Papua				22,218	22,218	20
Central Kalimantan				21,143	21,143	21
DI Yogyakarta			2,281	16,945	19,226	22
East Nusa Tenggara			4,745	10,685	15,430	23
Bengkulu				11,078	11,078	24
Maluku		8,486		456	8,943	25
Gorontalo		3,833		4,995	8,787	26
Central Sulawesi				8,012	8,012	27
Lampung				7,537	7,537	28
North Kalimantan			5,293	1,049	6,342	29
Riau				4,198	4,198	30
Riau Islands				2,674	2,674	31
West Papua			1,369	173	1,542	32
South Sumatera				548	548	33
Jambi						34
INDONESIA	**170,154**	**137,432**	**153,747**	**1,627079**	**2,088,411**	

FISHING FLEET

There are 171,744 vessels with inboard engines in the Indonesian fishing fleet. Of these, 67 percent are smaller than 5 GT, 88 percent are smaller than 10 GT, and 98 percent (168,073 vessels) are smaller than 30 GT (Table 6, Figure 5). In addition, there are 181,178 vessels equipped with outboard motors, and 190,923 non-motorized vessels.

Table 6: Composition of the Indonesian fishing fleet from 2012 to 2016.

CATEGORY	YEAR				
	2012	2013	2014	2015	2016
Non-motorized vessels	**172,333**	**175,510**	**165,066**	**143,135**	**190,923**
Outboard motor	**245,819**	**237,625**	**238,010**	**246,882**	**181,178**
Inboard motor:	**198,538**	**226,573**	**222,557**	**178,312**	**171,744**
<5 GT	137,587	151,939	153,493	117,848	115,814
5-10 GT	37,694	46,358	41,374	39,429	35,988
10-20 GT	11,583	15,208	14,301	10,515	9,790
20-30 GT	7,611	8,782	9,578	7,680	6,481
30-50 GT	917	1,074	1,029	825	805
50-100 GT	1,641	1,727	1,766	1,435	2,008
100-200 GT	1,167	1,127	840	571	847
> 200 GT	338	358	176	9	11
GRAND TOTAL	**616,690**	**639,708**	**625,633**	**568,329**	**543,845**

Source: MMAF, 2018.

Based on the data from BPS and MMAF, the national fleet of 171,733[5] fishing vessels equipped with inboard engines are distributed across the ten major categories of fishing gears listed in Fishery Regulation Number 59/PERMEN-KP/2020.[6] The distribution of the fleet across these ten gear categories are shown in Table 7.

Because of major differences in weights of fishing gears within subcategories, the numbers of vessels within each subcategory and weights of fishing gears within subcategories were also determined (Table 8).

Table 7: Breakdown of the number of fishing vessels by GT class and fishing gear type.

CATEGORY	CODE	GT					TOTAL	%
		<5	5-10	10-20	20-30	> 30		
Surrounding Gear	01	1,706	1,782	2,030	1,766	980	8,265	4.8
Seines	02	6,697	2,211	910	346	53	10,217	5.9
Trawls	03	2,497	609	37	2	0	3,145	1.8
Dredges	04	1,223	195	11	0	0	1,428	0.8
Lift Nets	05	4,883	1,887	431	829	601	8,630	5.0
Falling Gear	06	924	54	0	3	99	1,079	0.6
Gill/ Entangling Nets	07	47,757	15,625	2,508	1,188	711	67,789	39.5
Traps	08	15,076	3,077	413	74	364	19,003	11.1
Hooks & Lines	09	34,565	10,430	3,445	2,273	852	51,565	30.0
Misc. gears	10	487	118	5	0	0	610	0.4
TOTAL		**115,814**	**35,988**	**9,790**	**6,481**	**3,660**	**171,733**	
%		**67.4**	**21.0**	**5.7**	**3.8**	**2.1**	**100**	

Table 8: Breakdown of the number and proportion of fishing vessels by fishing gear sub-category.

FISHING GEAR	FISHING VESSELS	
	NO	%
SURROUNDING NETS		
Purse seine <30GT	8,265	88.1
Purse seine >30GT		11.9
SEINE NETS		
Beach Seine	10,217	14.0
Danish Seine		22.6
Pair seine		2.4
Payang		38.3
Cantrang		12.7
Lampara dasar		9.9
TRAWLS		
Bottom otter trawl	3,145	33.6
Shrimp trawl		7.0
Single boat midwater trawl		16.7
LIFT NETS		
Bagan	8,630	59.4
Bouke ami		11.1
Bagan Tankap		29.0
FALLING GEARS		
Cast net	1,079	97
GILLNETS & ENTANGLING NETS		
Set anchored gillnet	67,789	22.5
Driftnet		49.2
Trammel net- Combined		22.1
TRAPS		
Set net	19,003	0.2
Pot		81.2
Fyke net – Stow nets		8.1
HOOKS AND LINES		
Handline and hand operated pole & line	31,398	60.9
Set longlines	51,565	16.1
Drift longlines		4.9
Trolling lines		17.4
MISCELLANEOUS		
Pushnet	344	
TOTAL	**167,289**	

FISHING GEARS

Indonesia's fishing gear typology is well described in fishery regulations.[7] This section provides a brief illustrated description[8] of the major gears used in Indonesia. Annex 7 provides a detailed breakdown of the types of fishing gear that are permitted for use in each WPP.

Surrounding Gear (Jaring Lingkar)

A surrounding net is a long net that is generally constructed from rectangular sections of netting framed by ropes. A headrope with numerous floats runs across the top of a surrounding net, while a weighted footrope runs along the lower edge (Figure 6). This causes the net to hang vertically in the water, where it catches by surrounding a school of fish. The netting is generally comprised of small mesh sizes to minimize fish becoming enmeshed and is comprised of polyamide (PA) or polyester (PES) twine. There are two types of surrounding nets: purse seines with a purse line, and other surrounding nets without a purse line. The gear is attached to the vessel at all times, reducing the risk of loss or damage resulting from other vessels running over the gear. The weight of plastic material in a single purse seine ranges from 4,800 - 13,200 kg.

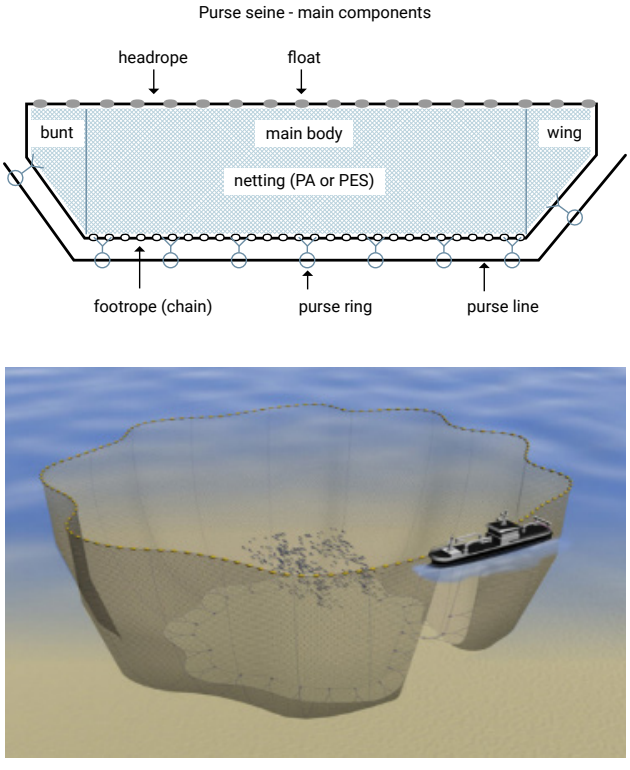


Figure 6: Single boat purse seine.

[5] The discrepancy between 171,444 and 171,733 is a result of rounding errors.
[6] http://www.perizinan.kkp.go.id/portal/assets/portal/embed/274/59-permen-kp-2020tentangJalur.pdf
[7] Regulation of the Minister of Marine Affairs and Fisheries 59/PERMEN-KP/2020 on Fishing Routes and Fishing Gears in the Fishery Management Areas of Indonesia and the High Seas. http://www.perizinan.kkp.go.id/portal/assets/portal/embed/274/59-permen-kp-2020tentangJalur.pdf
[8] Text and illustrations are based on He, P., Chopin, F., Suuronen, P., Ferro, R.S.T and Lansley, J. 2021. Classification and illustrated definition of fishing gears. FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

Seine Nets (Pukat Tarik)

Seine nets are cone-shaped nets with long wings and a codend. A seine net is usually framed by a headrope along the upper edge and a footrope along the lower edge of the net. The weighted footrope is used to maintain ground contract and reduce net abrasion. The wings are often elongated and used in conjunction with long ropes which act simultaneously for herding fish and for hauling the net. The bunt is typically in the center of the net and may consist of a netting bag similar to a trawl codend, but some seines may not have a bag. The mesh size in the bunt or the codend usually determines the size of animals caught. This gear may be set from the shore (beach seine) or from one or two boats (boat seine) (Figure 7). Seine nets can also be operated on the seabed or pelagically. With the exception of beach seines, the fishing gear is attached to the vessel at all times reducing the risks of loss of gear or damage from other vessels running over the gear. However, vessels operating these types of gears may collide with untended fishing gears such as set gillnets, longlines and pots. The weight of plastic material in a single seine ranges from 44 - 114 kg.

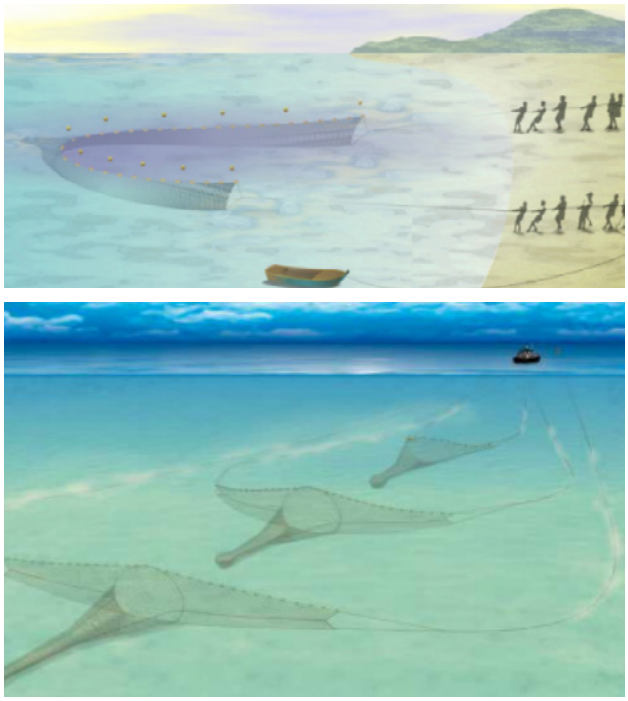


Figure 7: Illustration of a beach seine (top) and boat seine (bottom)

Trawls (Pukat Hela)

The trawl is a cone-shaped body of netting, usually with one codend, towed behind one or two boats to catch fish through herding and sieving. Trawls are designed to be towed across the seabed (bottom trawls) or in midwater (midwater trawls) (Figure 8). The trawl is attached to the vessel at all times reducing the risks of loss of gear or damage from other vessels running over the gear. However, vessels operating these types of gears may collide with untended fishing gears such as set gillnets, longlines and pots. A semi-pelagic trawl is a hybrid that can be set to fish on or off the seabed. A single boat can tow one trawl (most common), two trawls (twin trawl), or more than two trawls (multi-rig trawls). A single trawl can be towed by one boat (most common) or two boats (pair trawling). Trawls are very versatile and can be used to catch many different species. The towing speed is usually determined by the behavior and swimming capacity of the target species and the power of the boat. The weight of plastic material in a trawl ranges from 73 - 185 kg.

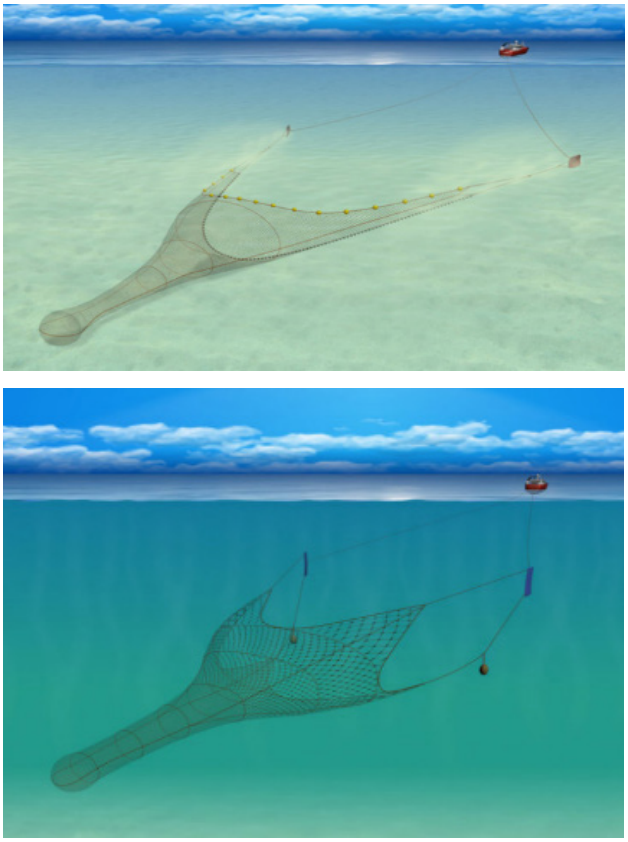


Figure 8: Illustration of a bottom trawl (top) and midwater trawl (bottom)

Dredges (Penggaruk)

A dredge is a cage-like structure often equipped with a scraper blade or teeth on its lower part, either pulled or towed to dig animals out of substrate and lift them into the cage or bag. As dredges are in heavy contact with the substrate, the bottom part of the dredge, sometimes the entire cage, is made of metal rods or chain mesh to withstand chafing with the seabed; however, mesh bags made of synthetic materials are also used. Dredges may be operated either by hand, wading in the water or from a small boat in shallow waters, or towed behind a boat in deeper waters. The dredge is attached to the vessel at all times reducing the risks of loss or damage from other vessels running over the gear. However, vessels operating these types of gears may collide with untended fishing gears such as set gillnets, longlines and pots. This gear type was omitted from the estimate.

Lift Nets (Jaring Ingkat)

A lift net is a piece of netting mounted onto a frame that is lowered into the water to allow fish to enter the area above

the net and is then lifted or hauled upward to collect the fish accumulated there. The net is either a series of simple horizontal sheets or a bag-shaped netting panel, like a funnel or cone with the opening facing upwards. The netting is often stretched over a frame of rods made of bamboo, wood, plastic or metal. The fish are often attracted over the net by lights or bait, or drift over the net with the current. These gears may be either small and portable and operated by hand or large in size and assisted by a winch or other mechanical device. They can be operated from shore, from a structure extended from the shore (e.g., a pier) or from a boat (Figure 9). With the exception of shore operated lift nets, the gear is attached to a vessel or floating structure at all times reducing the risks of loss of gear or damage from other vessels running over the gear. The weight of plastic material in a lift net ranges from 45 - 175 kg.

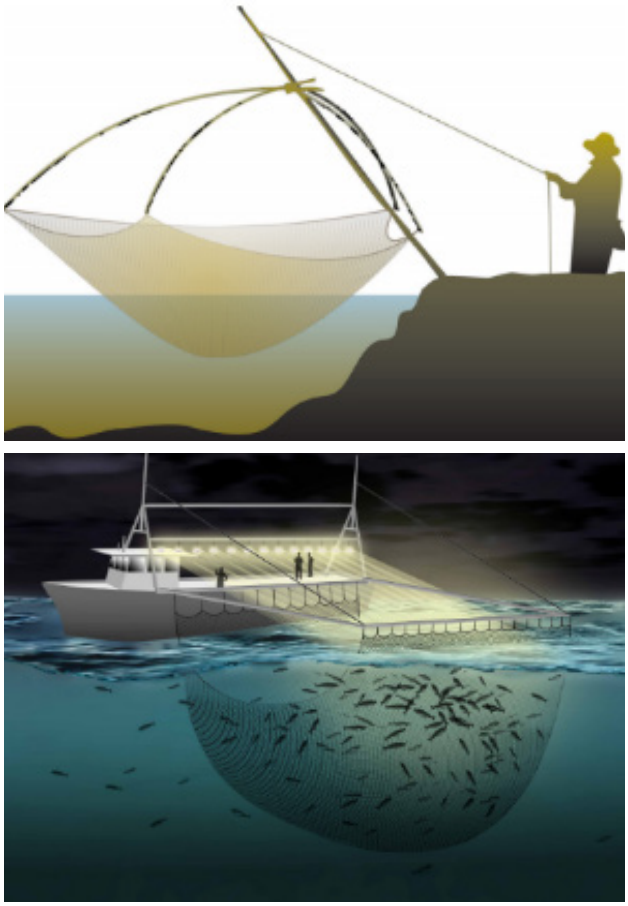


Figure 9: Illustration of a portable lift net (top) and boat operated lift net (bottom)

Falling Gears (Alat Yang Dijatuhkan Atau Ditebarkan)

Falling gear is a net or a basket-like structure which is cast, pushed down or allowed to fall from above to catch fish underneath it (Figure 10). The use of falling nets is usually restricted to shallow waters. However, some large-scale falling nets can operate in deep waters from a boat with the use of lights to attract and concentrate fish. The gear is attached to a vessel at all times reducing the risks of loss of gear or damage from other vessels running over the gear. The weight of plastic material in a falling gear (Jalah Jatuh) was estimated to be 161 kg.

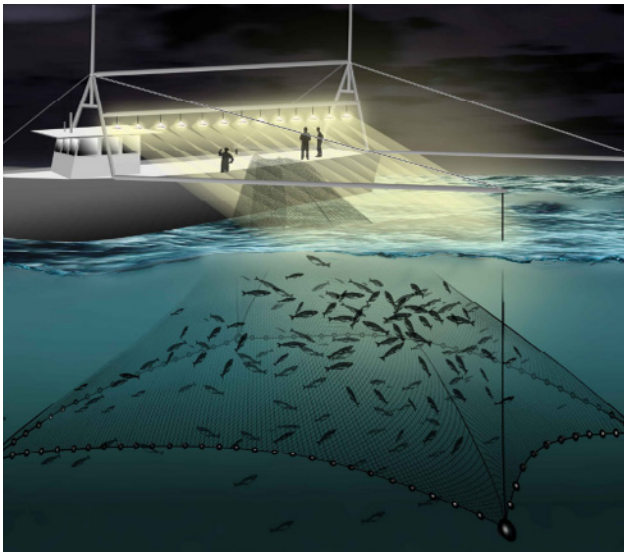


Figure 10: Illustration of a boat operated falling gear

Gillnets and Entangling Nets (Jaring Insang)

Gillnets and entangling nets are long rectangular walls of netting that catch fish by gilling, wedging, snagging, entangling or entrapping them in pockets. These nets are kept open vertically by floats attached to the head rope and by weights added to the footrope, but they can also be held open vertically by hanging the net onto stakes. These nets are usually fished in long fleets with a number of nets tied together to form a long string of nets (which may extend up to several kilometers) but they can also be used singly. Depending on their design, they may be used to fish at the surface, in midwater or near the seabed (Figure 11). They may be anchored to the seabed or allowed to drift freely with marker buoys or with the boat attached to it. Several types of net may be combined in one gear (for example, a trammel net combined with a gillnet). Fish are primarily caught by gilling and entangling. Drift gillnets are attached to the vessel at all times reducing the risks of loss or damage from other vessels running over the gear. Set anchored gillnets and trammel nets operate without being attached to the vessel increasing the risk of loss of gear and or other vessels colliding with and destroying / damaging the fishing gear. Set anchored gillnets and trammel nets are also set on the seabed and can be damaged through contact with rocks, corals and other submerged obstructions. The weight of plastic material in a gillnet/entangling net ranges from 53 – 1,006 kg (set anchored gillnets / trammels) and 63 – 1,330 kg (drift gillnets).

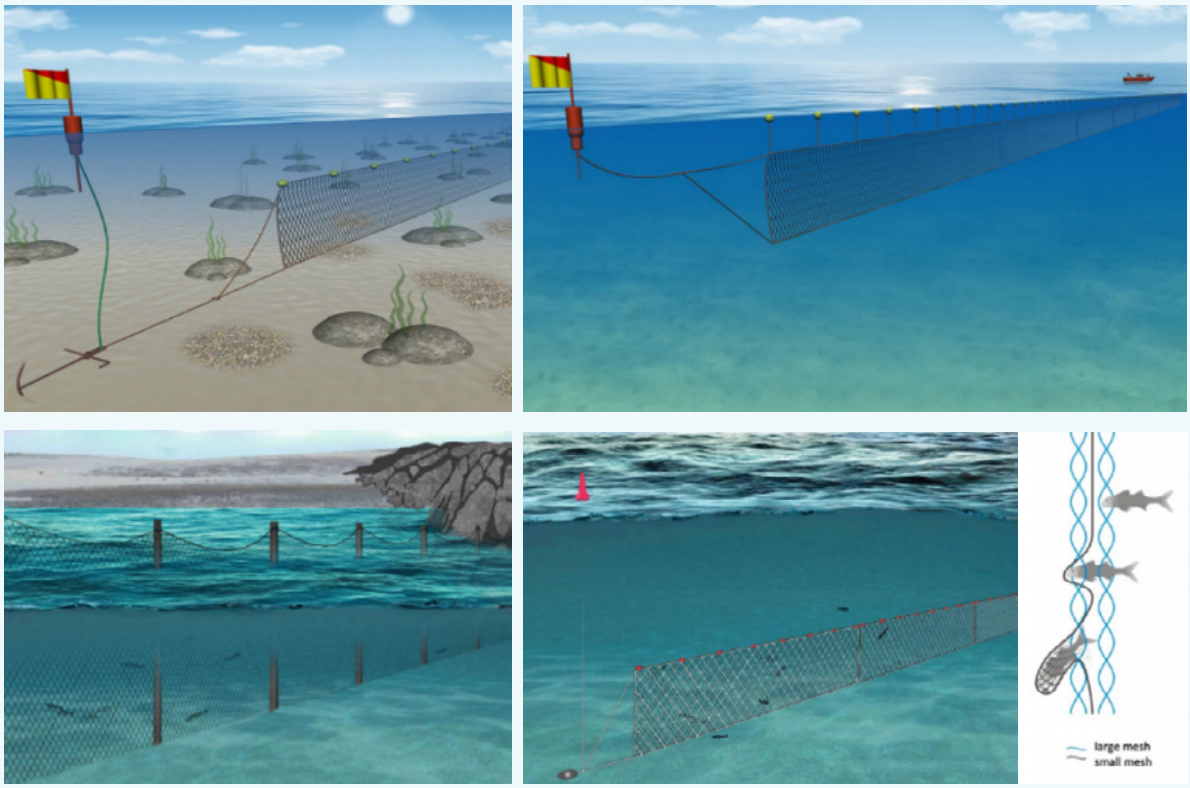


Figure 11: Illustration of a set anchored gillnet (top left), drift gillnet (top right), gillnet fixed on stakes (bottom left), trammel net (bottom center) and trammel net capture process (bottom right).

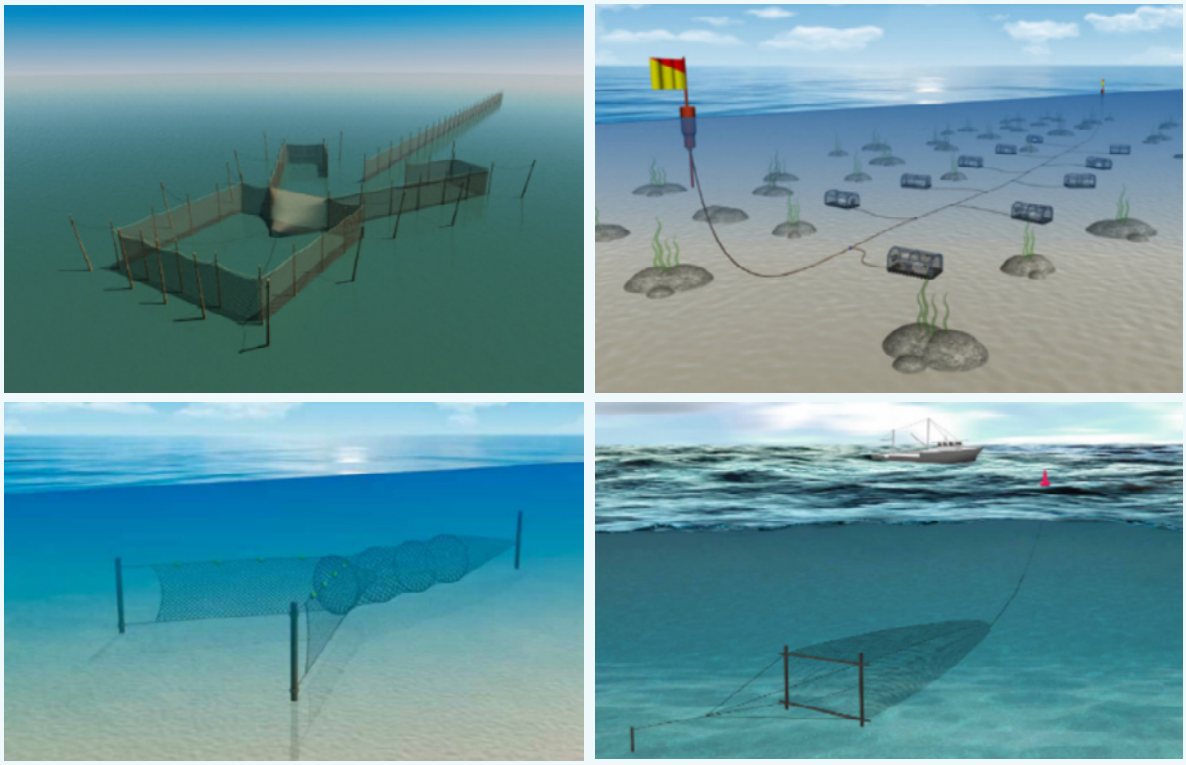


Figure 12: Illustration of a fixed pound trap (top left), crustacean pots (top right), fyke net (bottom left) and stow net (bottom right).

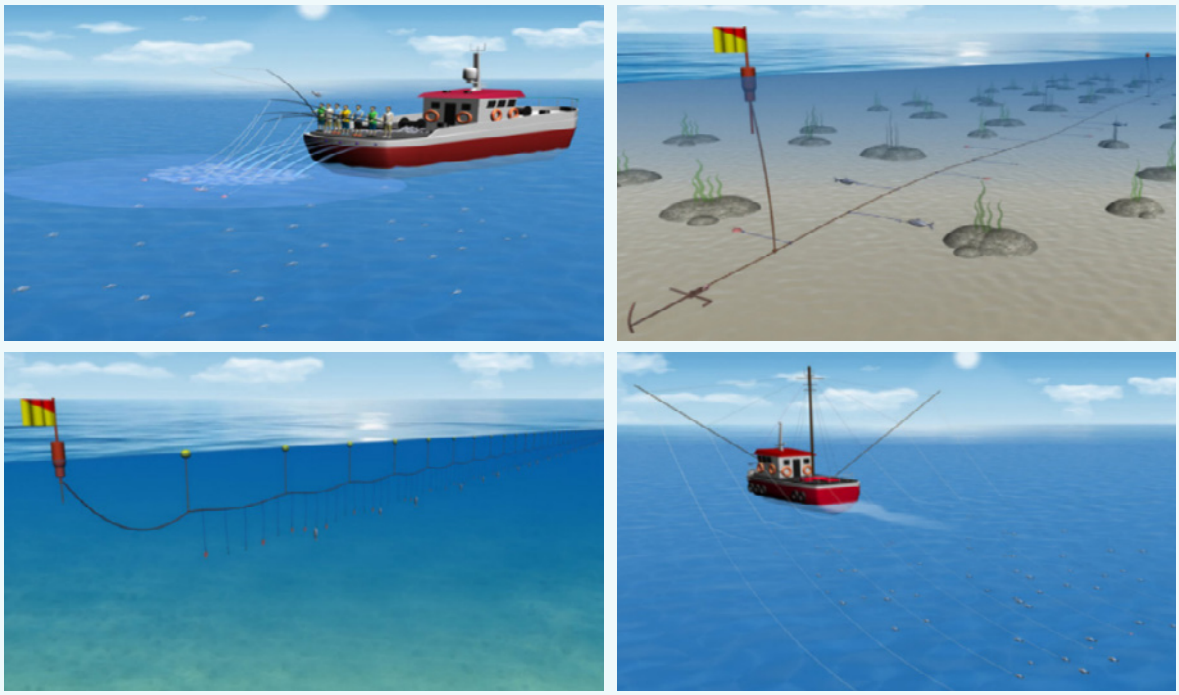


Figure 13: Illustration of hand operated pole and line (top left), set anchored longline (top right), drifting longline (bottom left) and trolling line (bottom right).

Traps (Perangkap)

Traps are stationary structures of many shapes and sizes (Figure 12) into which fish are guided, or pushed by the current, or drawn into the gear by bait or other attractants. Traps usually consist of a fish-holding chamber or a cod-end like bag into which the fish are held before hauling on to the boat. One or more funnels or non-return devices are often incorporated into the design to prevent fish from escaping once they have entered a chamber. Pots operate without being attached to the vessel increasing the risk of loss of gear and or other vessels colliding with and destroying / damaging the fishing gear. The weight of plastic material in traps ranges from 46 - 122 kg.

Hooks and Lines (Pancing)

Hook-and-line gears are those that use hooks (including jigs) and lines to catch fish (Figure 13). Hook-and-line gears catch fish by the mouth with baited hooks, or by penetrating their flesh (impaling, ripping or tearing) with unbaited hooks when they pass within the range of movement of the hook. Bait can include natural bait fish such as mackerel, herring and squid, or artificial lures such as rubber, plastic or feather. Hook-and-line gears may be used with one hook or with a large number of hooks. They may be tended by a fisher or with a machine or may be left untended. For untended gears, they may be set on or near the bottom with anchors or weights, near the surface or in midwater drifting with the currents. Drifting longlines are attached to the vessel at all times reducing the risks of loss or damage from other vessels running over the gear. Set anchored longlines also operate without being attached to the vessel increasing the risk of loss of gear and or other vessels colliding with and destroying / damaging the fishing gear. These gears are also set on the seabed and can be damaged through contact with rocks, corals and other submerged obstructions. The weight of plastic material in a hook and line gear ranges from <10 kg (handlines), 55 - 375 kg (set longlines) and 127 - 1,817 kg (drift longlines).

Miscellaneous Gear (Alat Penangkapan Ikan Lainnya)

Miscellaneous gears include all other gears not included in other categories. There are a variety of other gears in world fisheries, especially in small-scale and artisanal fisheries, in addition to those described in the nine main categories above. For Indonesia, this includes the push net, scoop net, Muro-ami and spear, amongst others.

FISH RESOURCES

Indonesia's capture fishery resources are categorized into large pelagic, small pelagic, demersal, and other species (e.g., miscellaneous non-finfish including crustaceans and mollusks that are often caught in association with the small pelagic group).[9] In general, Indonesia's demersal fisheries are multi-species fisheries that are exploited by a wide variety of gear types. Large and small pelagics are typically caught by purse seine, drifting gillnets, encircling gillnets, lift nets, pole and line, troll line and other surface gears.[10] Squid form one of the most important components of the 'other species' category, and are caught by squid jigging, lift net and cast net fishing gears.

Fishing activities in Indonesian waters can be grouped into four major areas: (i) Eastern Indian Ocean (small pelagics and large pelagics), (ii) the Sunda Shelf (demersal and small pelagics), (iii) Sulawesi waters (small pelagics and large pelagics) and (iv) Maluku-Papua waters (demersal and small pelagics, with large tuna and skipjack fisheries located in deeper Pacific waters).

Women make up the majority of workers in processing and administrative roles and are also involved in middle management in fishing industries.

SOCIAL STRUCTURE

A variety of classification systems have been applied to Indonesia's fisheries to support the diversity of planning purposes and needs. Classifications based on vessel size separate the sector into small-, medium- and large-scale sub-sectors, with the distinguishing feature of both medium- and large-scale sub-sectors being the use of vessels powered by inboard engines (Sumiono, 1997).[11] Alternative approaches have classified fishing operations based on the technology capacity (fishing gear and fleet), market orientation, and production relationship characteristics. For example, Satria (2015) described four levels of classification: (i) subsistence or traditional fisheries where catches primarily fulfill the needs of participants; (ii) post-subsistence fisheries characterized by the use of more advanced fishing technologies such as outboard motors; (iii) commercial fisheries that are oriented towards increasing profits; and (iv) industrial fisheries that are typically organized, capital intensive, export-oriented, and generate higher incomes.

Large-scale

Indonesia's commercial fisheries include private Indonesian companies, joint venture corporations and state-owned enterprises, and typically target high-value or export commodities. Significant examples include shrimp otter trawl, long-line tuna, and pole-and-line and purse seine skipjack fisheries. Within these fisheries, operational and maintenance costs—including for the purchase and maintenance of fishing gears—are generally paid by the company. However, as crew are typically paid via shared remuneration systems rather than fixed wages (Muawanah et al. 2021; Purwasih et al, 2016), spending on maintenance has the potential to reduce the profits available for distribution to crew and thus creates incentives to minimize such costs.

Small-scale

Indonesia's small-scale fisheries—by far the most important in terms of employment, numbers of fishing units and quantity of landings—are distinguished from other subsectors by type (or absence) of boat employed. The sub-sector includes all fishing units which use boats powered by sail or outboard engines, as well as fishers who operate gears without the use of a boat. Fishing operations are labor intensive, and occur primarily in coastal waters. The type of gear commonly used in small-scale fishing are seine nets, gillnets, handlines, traps and other traditional gears such as shellfish collections and cast nets.

Fishers typically use vessels with a single outboard motor sized between 1-5 GT. While some fishers may own their own vessels and gears, many more are dependent on patron-client relationships (Glaser et al., 2015; Muawanah et al., 2021). In these relationships, patrons provide capital in the form of

[9] Decree of the Minister of Marine Affairs and Fisheries 19/KEPMEN-KP/2022 on Estimation of Potential, Total Allowable Catch, and Utilisation of Fish Resources in the Fishery Management Areas of the Republic of Indonesia

[10] http://www.fao.org/3/bp404e/bp404e.pdf

money or production equipment (e.g., vessels, fishing gears or machinery), and may facilitate access to markets (Sinaga et al., 2015). Under such patron-client bonds, fishers may receive only a small proportion of revenues and have limited influence over significant operational and maintenance budgeting decisions (Aida et al., 2020; Sinaga et al., 2015).

Fisher associations

Fisher associations or *kelompok nelayan* are widespread throughout Indonesia. Most are informal, though some may have a proper organizational structure. Still others are well developed (Syarif, 2009) and may play a significant role in their local community, establish profitable fishing cooperatives (*koperasi nelayan*) or initiate programs and activities to protect their coastal areas such as undertaking beach cleanups or forming community surveillance groups (POKMASWAS).

While some *kelompok nelayan* are based around fish markets and auctions as a way to protect the financial interests of their members, others appear to exist simply to meet government criteria for recipients of development assistance (De Alessi, 2014). For example, around two-thirds of MMAF's 2017 fisheries assistance budget (DJPT Rencangan Kegiatan 2017: Bantuan Alat Tangkap) was allocated to the distribution of surface and midwater gillnets, with eligibility limited to *kelompok nelayan* containing 10 members.

Industry associations

Several fishing industry associations have been established in Indonesia to organize and represent the interests of medium- and large-scale enterprises. Significant examples include:

- Indonesian Fishers Association (HNSI, *Himpunan Nelayan Seluruh Indonesia*) which represents all gear types;
- Indonesian Blue Swimming Crab Association (APRI, *Asosiasi Pengelolaan Rajungan Indonesia*) which represents trap, gillnet and trawl blue swimming crab fisheries as well as processing and export companies;
- Indonesian Tuna Association (ASTUIN, *Asosiasi Tuna Indonesia*) which represents tuna harvest, processing and export companies;
- Indonesian Purse Seine Association (HNPN, *Himpunan Nelayan Purse Seine Nasional*) which represents tuna purse seine harvest, processing and export companies;
- Indonesian Tuna Longline Associations (ATLI, *Asosiasi Tuna Longline Indonesia*) which represents tuna long-line harvest, processing and export companies; and
- Indonesian Pole-and-Line and Handline Association (AP2HI, *Asosiasi Perikanan Pole & Line dan Handline Indonesia*) which represents tuna pole-and-line and hand-line harvest, processing and export companies.

These associations play an important role by organizing members, engaging with government, improving quality standards to meet export market standards, and enhancing standards of sustainability and traceability, including via the pursuit of international certification schemes such as Marine Stewardship Council and Fair Trade.

Gender roles

Men and women have important roles within Indonesia's fisheries and associated value chains (USAID, 2017). Men occupy most roles associated with fishing, lifting heavy loads, the most lucrative export-oriented trade commodities, and positions associated with authority, such as managerial and executive roles in fishing industries (Barclay et al., 2020). Furthermore, men are typically the main decision-makers when it comes to seeking credit from financial institutions (Gede et al., 2017) and controlling access to resources (e.g., vessels, fishing gears, and larger processing units) (USAID, 2017).

Women make up the majority of workers in processing and administrative roles and are also involved in middle management in fishing industries (Barclay et al., 2020). Women may occupy as much as 80 percent of the labor in some processing companies (Jumadi et al. 2017), though roles are unevenly distributed with women making up 60 percent of the workforce on the processing floor but only 30 percent of the workforce on the management side of the business (Barclay et al., 2020). Within coastal communities women are typically the main operators of small processing units and local marketing facilities (USAID, 2017), the main decision-makers with regard to how and where to sell fish, and play important roles in domestic, public, and social activities (Gude et al., 2017).

[11] This distinction is further clarified, including with regard to investment levels and areas in which sub-sectors are permitted to operate, via Government Regulation 27/2021 on Governance of the Marine and Fisheries Sector.

Lifecycle of fishing gear in Indonesia

Field surveys were conducted to provide a baseline assessment of ALDFG volumes and replenishment rates, to identify relevant stakeholders, and to describe current gear repair and disposal systems. Field surveys were conducted in 10 ports, with data collected via observational surveys and stakeholder interviews. Detailed methodologies, including port selection criteria, are described in Annex 1.

DESCRIPTION OF THE FISHERIES IN THE SAMPLED PORTS

Field surveys were conducted in ten ports: PPS Bitung, North Sulawesi; PPN Pekalongan, Central Java; PPN Ambon, Maluku; PPN Ternate, North Maluku; PPN Tual, Maluku; PPN Kupang, NTT; PPP Bacan, Maluku Utara; PPP Sorong, West Papua; PPI Daeo Majiko, North Maluku; and PP Merauke, Papua.

Field surveys were conducted in ten PPS and PPN class ports. These large ports support large and diverse fishing fleets, thus providing insights into a wide variety of gear lifecycles. The majority of large pelagics (mainly tuna) are landed into PPS Bitung, and are mainly caught in WPP 716 using purse seine, handline, and pole and line gear. The largest landings of demersal fish are in PPP Bajomulyo and are dominated by *Kuniran* goatfish (*Upeneus sulphureus*), with trawl, bottom longline and squid nets the main gears.

PPP Bajomulyo also has the highest landings of small pelagics, dominated by scads and mackerels (*Decapterus* spp.) caught with purse seines. Based on 2018 capture fishery production statistics (BPS, 2019), PPN Ambon had the lowest total production amongst the ports sampled in this study, while PPP Bajomulyo had the highest and is amongst the highest production across all ports in Indonesia (Table 9).

Table 9: Total volume (metric tonne) of fish landed in each fishing port in 2019, disaggregated by species group. Demersal includes reef fish. Other includes cephalopods, crustaceans, and other species.

FISHING PORT	LARGE PELAGIC	SMALL PELAGIC	DEMERSAL	OTHER*	TOTAL
PPN Pelabuhan Ratu	2,918.71	507.13	939.96	1,048.44	5,411.24
PPP Bajomulyo	11,537.44	43,944.93	17,967.23	32,730.05	106,179.64
PPS Cilacap	8,843.62	648	782.94	4,475.24	14,749.8
PPN Brondong	0	0	36,754	16,285	53,039
PPP Muncar	2,074	10,282	1,099	1,320	14,774.28
PPN Ambon	1,743.79	98.16	31.91	69.71	1,943.56
PPN Ternate	1,943	1,587.1	549.9	62.15	4,142.15
PPS Bitung	37,713.70	10,348.62	25.51	806.07	48,893.90
PPS Kendari	9,951.42	8,453	6.91	208.98	18,620.30
PPN Kejawanan	277.30	428.79	304.23	2,554.71	3,565.03

Source: BPS, 2019.

FISHING GEAR SUPPLIERS AND MIDDLEMEN

The main fishing gear manufacturers in Indonesia are shown in Table 10. Around three-quarters of gear manufactured in Indonesia is for domestic use, with the remaining quarter exported.

Table 10: Fishing gear manufactures in Indonesia.

PT Pacific Prima Nusajaya Jl Peternakan II 15-B JAKARTA 11720, P.O. Box: 11720, Jakarta, Indonesia, 021-6192131	annual production **500-600** TONS/YEAR	**70%** LOCAL NEEDS	**30%** EXPORTS
PT Indoneptune Net Manufakturing Jl. Raya Bandung Garut Km. 25, Bandung, Jawa Barat	annual production **240** TONS/YEAR	**50%** LOCAL NEEDS	**50%** EXPORTS
Inti Jaringmas Fishing Net Industri Jl. Raya Mauk Km. 5/47, Tangerang, Banten 021 - 558553	annual production **150** TONS/YEAR	**80%** LOCAL NEEDS	**20%** EXPORTS
United Rope[12] Jl. Muara Karang Raya No.161, RT.11/RW.3, Pluit, Kec. Penjaringan, Kota Jkt Utara, Daerah Khusus Ibukota Jakarta 14450, (021) 6606150	annual production **550** TONS/YEAR	**85%** LOCAL NEEDS	**15%** EXPORTS
PD. Matahari[13] Jl. Kapuk Kamal Muara No. 29 Penjaringan Jakarta utara 14470 Telephone: +62 (021) 555 2943, Fax: +62 (021) 619 1400	annual production **N/A**		
PT Namyoung Indonesia Jl. Raya Pecangaan-Batealit, RT.01/RW.01, Krajan, Geneng, Kec. Batealit, Kabupaten Jepara, Jawa Tengah 59462, (0291) 7512968	annual production **150** TONS/YEAR	**75%** LOCAL NEEDS	**25%** EXPORTS
King Dragon Fishing Net Dsn. Keceling Ds. Kemiri Sewu, Pasuruan, Jawa Timur 0343629937	annual production **100** TONS/YEAR	**100%** LOCAL NEEDS	
Water Dragon Fishing Net Industry[14] Sell online (marketplace) and based in Malaysia	annual production **N/A**		
Pt. Arteria Daya Mulia[15] Jl. Dukuh Duwur No. 46 Cirebon City West Java, Indonesia 45113, +62 231 206507	annual production **N/A**		
Pacific Prima Nusa Jaya	annual production **100** TONS/YEAR	**95%** LOCAL NEEDS	**5%** EXPORTS
Inja Fish Tangerang	annual production **N/A**		
King Da Fish Semarang	annual production **N/A**		

[12] http://unitedrope.net/pr_nets.php
[13] http://pd-matahari.com/contact.php

Figure 14: Current gear repair practices in the fishing port.

FISHING GEAR STORAGE AND REPAIR

Fishing gear storage and repair infrastructure and facilities are not available in most ports throughout Indonesia. In PPP Bajomulyo, PPS Cilacap, PPN Brondong and PPN Kendari, fishermen were observed to undertake gear repair activities at home or in open areas near to the location where catches are landed. These open areas are 50-100 m^2 and around one tonne of gear may be repaired annually.

Fishing gear storage and repair infrastructure and facilities were observed in PPS Pelabuhan Ratu and PPN Kejawanan. In PPN Pelabuhan Ratu, the repair area is an open space covered by 5 x 10 m roof (Figure 14). No repair services are provided, instead repairs are carried out by the fishermen. Consequently, no records of repair activities are maintained, making it difficult to estimate the number of fishing gears repaired or disposed annually. Any gears that are beyond repair are left in the repair center, and the port authority occasionally cleans up the center and moves disposed gears to an intermediate storage container before they are transported to landfill.

In 2019, PPN Sibolga established a netloft[16] as a service to support fishery business activities. The netflot building is used by fishermen and stakeholders to repair damaged fishing nets. In both PPN Kendari and PPN Bitung, stakeholders described plans to construct 800m^2 gear repair facilities as part of the Government of Indonesia's "Eco Fishing Port" program.

Figure 15: Abandoned fishing gear.

EOLFG COLLECTION, PROCESSING AND STORAGE

Practices for managing fishing-related waste vary from one port to another. In general, irreparably damaged fishing gear is disposed in intermediate storage facilities, together with other general waste, before being transported to landfill facilities. Transport of waste is typically managed by the port authority, and occurs 2-3 times per week.

Two types of intermediate storage facilities were observed in the ports surveyed. In PPS Pelabuhan Ratu, **half-opened containers** made from metal and measuring 310 x 190 x 135 cm were observed. Waste was stored for 2-3 days, with the port authority operating three trucks, each with 8,400 liter capacity, to transport waste to landfill. In PPN Kejawanan, **open wall storage facilities** measuring 1200 x 1200 x 200 cm were observed, with the port authority operating two trucks of 9,000 liter capacity to transport waste to landfill.

Fishermen also abandon damaged nets in undesignated areas within the port. In PPS Pelabuhan Ratu, about 0.2 m3 of damaged and abandoned net was observed in the repair center. In PPS Kendari, around 80 m^3 of abandoned gear had accumulated in the docking facility, and in PPS Cilacap, fishing gears were disposed of on the wharf (Figure 15).

EOLFG RECYCLING

Recycling of EOLFG depends on the availability of waste collectors. Collectors play an important role in aggregating and organizing gear waste and transporting it to market and plastic recycling plants. However, such collectors were rarely found during the surveys. One of the reasons noted in PPS Pelabuhan Ratu was a trend for fishers to use hook and line instead of gillnets, resulting in insufficient quantities of gillnet waste for economically feasible recycling. In addition, the low rate of recycling of fishing-related waste in ports may be due to the condition of the waste, which is usually mixed and contaminated. Sorting and cleaning of the waste are the largest component of recycling costs, and the current condition of fishing gear waste means it is not feasible to recycle. Another factor contributing to low recycling rates is the limited number of recycling plants that use nylon as a raw material.

Informal collection, repair and recycling businesses have become established where there are viable waste streams. For example, in Pekalongan up to ten net repair businesses were identified, with some importing purse seine nets from larger scale fishing operators in Bali and Java (Figure 16). Respondents reported that around 50 percent of nets can be repaired while the remaining 50 percent are sold to waste collectors for further recycling. Offcuts from the net repair process are also collected and sold at 2,500 - 5,000 IDR/kg to waste collectors for further recycling and repurposing into e.g., dish sponges.

Figure 16: A waste fishing gear collector from Pekalongan receives seine nets from Bajomulyo.

Efforts to recycle EOLFG were observed in ports where collectors are present. In PPN Pekalongan and PPP Bajomulyo, when the EOLFG has reuse or recycling value, fishermen transport it via motorcycle or rickshaw to sell to collectors (Figure 17). Collectors primarily source gillnet and millennium type nets made from nylon, which have first been cleaned by intermediate actors.

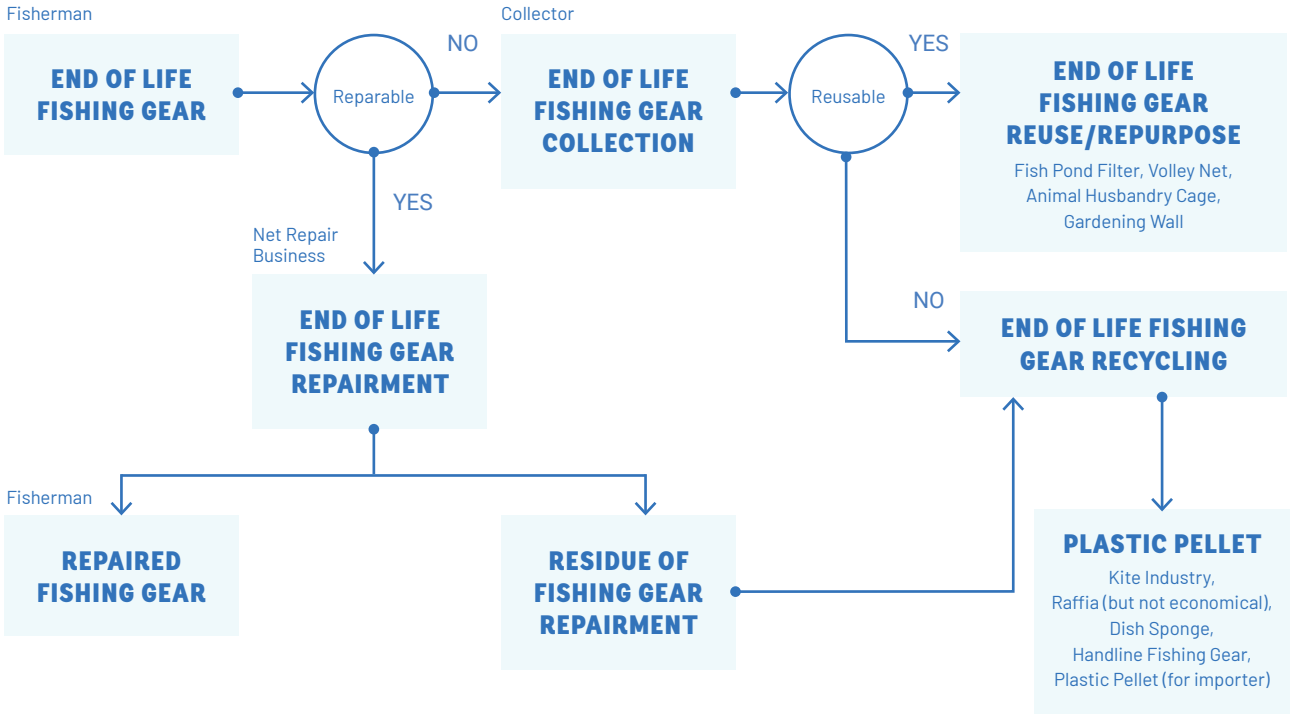


Figure 17: Schematic diagram of the fate of EOLFG observed in Pekalongan and Bajomulyo.

[16] https://kkp.go.id/djpt/ppnsibolga/artikel/9516-operasionalkan-layanan-perbaikan-jaring-di-netlof-ppn-sibolga

Some incidental reuse of EOLFG was observed. In PPN Kendari, waste gears were reused for agriculture or aquaculture purposes, whereas in PPS Pelabuhan Ratu damaged nets are often resold between fishermen. In almost all locations surveyed, damaged nets were reused as fencing for agriculture.
PPN Kendari and PPS Bitung are both equipped with plastic recycling facilities (Figure 18), but these are not actively used due to administrative issues. The port authorities have now started to engage with plastic recycling businesses outside the ports to help manage these facilities. A major challenge that has been identified in these locations is the distance to plastic recycling plants, resulting in high transportation costs and limiting the economic feasibility of recycling efforts.

It is estimated that there are less than ten plastic recycling businesses in Indonesia. The main fishing net recycling centers are located in Java (Cirebon, Tegal, Tangerang and Bekasi) and Kalimantan. While PP and PE are the main materials recycled in the general waste stream, nylon is the dominant recyclable material in fishing waste. Polyester cannot be recycled, but can be reused by braiding into rope.

A fishing net purchasing agent from a net recycling business in Bekasi, West Java was interviewed during this study and provided information about the materials recycled, the products produced, and the operational costs (Table 14). In this business, the cost of purchasing raw materials accounts for 60 percent of the selling price of the final product, the recycling process accounts for 27 percent, and transport costs account for 6 percent. While the 95 percent process efficiency represents a good yield, with a gross profit of only 7 percent of the selling price, fishing gear recycling in its current form appears to offer only marginal profitability, and is potentially loss-making once the capital costs of machinery are accounted for. Greater economies of scale, increased supply (and hence lower cost) of raw materials, and/or cheaper processing costs are required to enhance the profitability of net recycling enterprises.

Figure 18: Plastic recycling facilities in PPS Kendari (left) and PPS Bitung (right).

Table 14: Case study of a fishing net recycling business in Bekasi.

Year established
2017

Recycling capacity
40mt
RAW MATERIAL / MONTH
(results in 38 mt of pellets)

Selling price of plastic pellet
12,000
IDR (USD 0.82) / kg

Competitors
1 - 10
RECYCLING BUSINESS ENTITIES

Gear types recycled	All 'end of life' gillnets made of nylon in a clean and dry condition
Source End of Life nets	Pekalongan, Central Java Cirebon, West Java Sukabumi, West Java Indramayu, West Java
Price paid	Pekalongan IDR 7,000 (USD 0.47) / kg Sukabumi IDR 6,000 (USD 0.41) / kg Indramayu IDR 7,500 (USD 0.51) / kg
Equipment	Crusher and Injection molding machine (nylon pelletizing machine)
Recycling Process	Net crushing, washing, drying and pelletizing.
Residue	5% of the input. This residue is sent to the plastic waste extruder for further plastic extruding. Extruded plastic is then fed back into the recycling process. **The cost for plastic extruding is IDR 4,000 IDR (USD 0.27) / kg**
Recycling cost	Transport/pick up **IDR 500 - 1,000 (USD 0.03 – 0.06) / kg** Recycling **IDR 2,000 – 3,000 (USD 0.14 – 0.28) / kg**
Recycled product	Plastic (nylon) pellet
Market	Kite Industries Handline fishing gear industries Plastic pellet industries (exported to Southeast Asia countries, such as Thailand)

Source: PTHI fieldwork (Interview with an unnamed company in Jati Asih Bekasi).

Figure 19: A plastic waste collector in Pelalongan who currently focuses on plastic bottles and packaging.

Collectors need to perceive a clear economic benefit from collecting and processing waste fishing gear compared to other plastic waste, which is plentiful and has more economic value. One of the respondents interviewed during this study was a plastic waste (PE, PP) collector who has run his own business in Pelalongan for more than 15 years (Figure 19). This collector does not currently collect fishing gear nets, and instead focusses on recycling plastic bottles and packaging. The collector stated that he has limited knowledge about the market for EOLFG, and that price stability, market stability and market accessibility are important considerations that would influence his decision to collect fishing gear in the future.

PT Nelayan Samudra Jaya is a plastic molding company in Pekalongan, Central Java that uses plastic pellets to manufacture synthetic raffia that replace the traditional use of raffia palm leaves to make rough woven products such as hats, rugs, or broom bristles. PT Nelayan Samudra Jaya have successfully trialed the use of plastic pellets derived from recycled fishing nets but have yet to confirm that this is commercially viable. Similar to the plastic recycling business in Bekasi described above, PT Nelayan Samudra Jaya consider that EOLFG (and potentially recovered ALDFG) could represent a major source of good quality plastic waste material, but have concerns about the current lack of established collection or distribution chains. This, together with competition for good quality waste material from other recycling businesses, is the main constraint to increasing the weight of EOLFG recycled in Indonesia. Other challenges include:

- **Contaminated net waste.** The condition of fishing gear waste is generally contaminated by sludge, fish flesh, fish blood, plastic, and other materials. Cleaning must be performed before materials are transported to the recycling plant

- **Unsorted net waste.** During the field surveys it was observed that net waste is usually a mixed assemblage of nylon and PE nets. In many cases sorting is challenging, because of the difficulty of identifying net materials.

FATE OF FISHING GEARS

Based on the information obtained during field surveys, estimates were made of the proportion of fishing gears by type that are abandoned onshore or at sea, disposed of in landfill, or collected and recycled. Implications for the corresponding plastic material weight were also considered.

Interview respondents indicated that 70 percent of fishing gears are retained and reused every year (Figure 20), whilst 18 percent are damaged and/ or reach end-of-life and are landed for: (i) storage at the houses of fishermen or on company property; (ii) resale to waste collectors; or (iii) final disposal in landfill. The remaining fishing gears potentially become

Table 15: Relative proportions of each fishing gear that are disposed of on land or at sea, based on interview responses obtained during field surveys. Column n indicates the number of gears disposed annually as reported by respondents. Percentages are relative to n.

FISHING GEAR	n (units)	LAND					SEA		
		Stored	Reused	Sold	Port	Landfill	Abandoned	Lost	Discarded
Purse seine	259	25%	42%	1%	25%	0%	2%	5%	0%
Cantrang	286	0%	0%	8%	0%	87%	0%	1%	4%
Pancing	77	0%	0%	0%	0%	0%	0%	55%	45%
Gill net	10	10%	0%	70%	0%	10%	10%	0%	0%
Bubu trap	32	38%	0%	0%	0%	38%	3%	9%	13%

ALDFG, with 11 percent of gears reported to be lost and 1 percent discarded at sea every year.

The fate of the waste fishing gears can be divided into two end points: (i) disposed of on land; or (ii) disposed of at sea. Disposal on land includes storage at the houses of fishermen or on company property, internal reuse, reselling to collectors, and final disposal in landfills. Disposal at sea includes gears that have been abandoned, accidentally lost or deliberately discarded.

Hook-and-line (pancing) is the gear that is reported to most likely become ALDFG (Table 15). Interview respondents indicated that 90 percent of broken hook-and-line fishing gears are either discarded (45 percent) or lost (55 percent). However, it should be noted that the actual volumes of plastic material are low.

Traps (bubu) also have a relatively high probability of becoming ALDFG. Interview respondents indicated that one-quarter of all traps are either abandoned (3 percent), lost (9 percent) or discarded (13 percent) at sea. Traps and hook-and-line fishing gears are relatively cheap, and hence fishers have little incentive to invest time and effort into preserving or recovering gears.

Purse seines and gillnets were reported to have the highest rates of reuse and recycling. This may be a result of both gears being usually made from PA (Nylon) which is considered to be a medium value material. These high reuse and recycling rates are, however, location dependent. For example, high rates of reuse and recycling of Danish seines (cantrang) were not observed, despite these gears being made from the same material as purse seines and gillnets. Danish seines were predominantly found in Sulawesi, where the number of collectors and recyclers is relatively low.

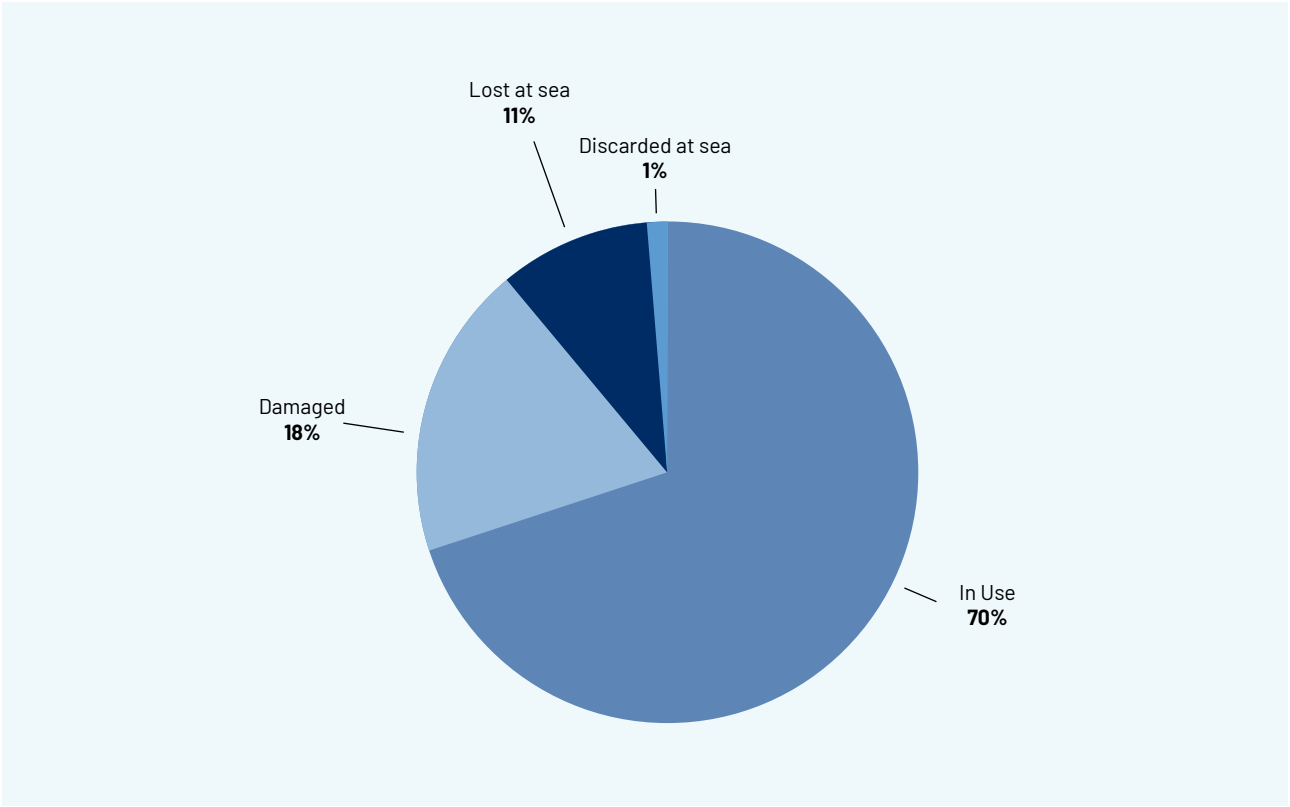


Figure 20: Proportion of in-use fishing gears that generate ALDFG, EOLFG, or are retained in use annually, based on interview responses obtained during field surveys.

Purse Seine

There are seven main brands of purse seine sold in Indonesia (Table 11). The price ranges from 800,000 to 7,000,000 IDR per kg. The high variability in price is likely to be due in part to the variable cost of transporting gears to different ports. The most frequently purchased brands are Ocean (from Taiwan) and Ikan Mas (from Indonesia).

Table 11: Main purse seine brands sold in Indonesia, with indicative price and encounter frequency during field surveys

BRAND	ORIGIN	PRICE IDR/Kg	FREQUENCY	%
Sutra	Indonesia	1,000,000	1	2
Arida	Indonesia	800,000 - 1,000,000	9	17
Ocean	Taiwan	3,500,000 - 5,000,000	16	31
Superstar	-	-	1	2
Ikan Mas	Indonesia	3,500,000 - 7,000,000	11	21
Eagle	Thailand	7,000,000	2	4
United	Indonesia	7,000,000	12	23

Hook and line (pancing)

Three main brands of hook and line gear were identified during the field surveys: Supreme, Maguro and Perfex (Table 12). All three originate from Japan, and have similar prices ranging from 200,000 to 500,000 IDR per unit.

Table 12: Main hook and line brands sold in Indonesia, with indicative price.

BRAND	ORIGIN	PRICE IDR/Unit
Supreme	Japan	200,000 - 500,000
Maguro	Japan	200,000 - 500,000
Perfex	Japan	200,000 - 500,000

Danish seine (cantrang)

Most respondents interviewed during the field surveys did not know what brand of cantrang they were using (Table 13). Prices ranged from 100,000 to 1,000,000 IDR per unit. No Chinese cantrang brands were detected during the field surveys, and no evidence for or against price dumping of nets was found.

Table 13: Main trawl brands sold in Indonesia, with indicative price and encounter frequency during field surveys

BRAND	ORIGIN	PRICE IDR/Kg	FREQUENCY	%
United	Indonesia	800,000 - 1,000,000	3	14
Unknown	Unknown	100,000 - 200,000	19	86

[14] http://Fishingnet-Wdfn.Com/Products.Html
[15] https://arida.co.id/

Risk assessment of fishing gear

This study undertook a preliminary assessment of the relative risks of ALDFG impacts arising from the various fishing gears deployed in Indonesia's fisheries. This assessment aimed to develop, field test and validate methodologies for monitoring and evaluating ALDFG risk, and to evaluate the applicability of these methodologies to the unique context and dynamics of Indonesia's fisheries.

While this risk assessment is based on best available data obtained from literature review and field surveys conducted during this study, the authors recognize that data limitations may arise from the limited scope and duration of this study, including constraints resulting from the COVID19 pandemic. Consequently, the results of this risk assessment should be viewed as indicative, and actions to improve primary data availability and to regularly reassess ALDFG risk are highly recommended.

The methodological approach adopted for this risk assessment is consistent with global norms (e.g., Gilman et al., 2021), and considers three risk factors: (i) quantity of end-of-life plastic material generated; (ii) vulnerability to loss and damage (i.e., likelihood of a specific gear being abandoned, lost or discarded); and (iii) ecological impact. The risk assessment calculates a relative risk index (RR) for each gear type ranging from 1 (low risk of ALDFG impacts) to 5 (high risk of ALDFG impacts). Detailed methodologies are described in Annex 1.

QUANTITY OF END-OF-LIFE MATERIAL GENERATED

The quantity of end-of-life material generated annually was calculated for each gear type. The total weight of plastic materials deployed in each gear category (Table 16) was calculated from the number of fishing units (obtained from national fishery statistics) and the average weight of netting, ropes and floats in a single gear (see Annex 4 for a detailed breakdown of these estimates). Gear replacement periods and rates of wear and tear were obtained from interviews with operators. A quantity risk index (Q) between 1 (low risk) and 5 (high risk) was assigned based on the annualized replacement weight (i.e., the weight of EOLFG generated annually) and the per-vessel weight of gears deployed (i.e., the potential for a small increase in fleet size to result in a large increase in weight of plastic deployed). Purse seine and drifting gillnet fisheries were assessed as generating the greatest quantities of end-of-life plastic materials, closely followed by set gillnets, and with traps and pots generating moderate quantities of end-of-life plastic material (Figure 21).

Table 16: Total weight of fishing gears deployed and replaced for each gear category, with proportion of Indonesia's total fishing fleet indicated.

	No Vessel	% Vessel	Weight delpoyed (tonnes)	% weight	Replacement period (years)	Annual replacement (%)	Annual replacement (tonnes)	Annualized replacement (tonnes)	Score
01 Encircling nets	8,265	4.9	47,212	56.30	7	15	7,081	13,824	5.0
02 Seine nets	10,217	6.1	805	0.96	5	20	159	318	1.0
03 Trawls	2,801	1.7	271	0.32	4	25	67	156	1.0
05 Lift nets	8,630	5.1	1,114	1.33	6	10	111	297	1.0
06 Falling gear	123	0.1	20	0.02	3	10	2	9	1.0
07 Gillnets and entangling nets	67,032	39.9	28,746	34.28	3	30	8,624	18,206	4.0
08 Pots and traps	18,397	11.0	2,015	2.40	7	15	302	1,310	2.0
09 Hook and lines	51,565	30.7	3,647	4.35	4	10	365	1,581	1.0
10 Miscellaneous other gear	954	0.6	28	0.03	1	10	3	16	1.0

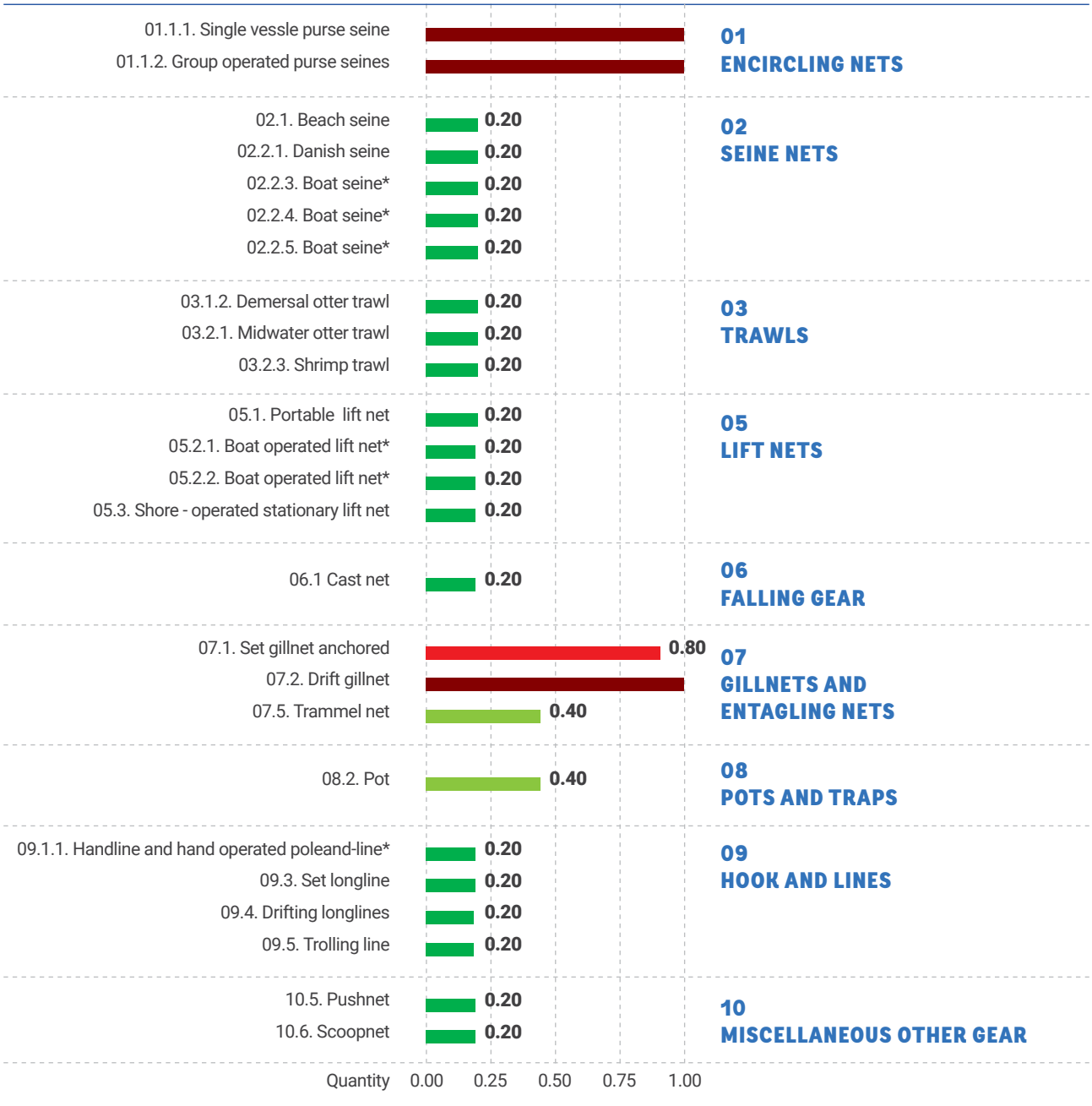


Figure 21: Gear-specific risk associated with the quantity of end-of-life material generated annually.

Purse seine fisheries deploy 47,212 t of plastic material, representing 56 percent of all plastic material deployed in Indonesia's fisheries. In contrast, purse seine vessels represent only 4.9 percent (8,265 vessels) of the total fleet of motorized inboard fishing vessels. Incidental wear and tear results in the replacement of 7,081 t of plastic material annually, with this quantity increasing to 13,824 t when scheduled full gear replacement was also considered.[17]

Gillnet and entangling net fisheries deploy 34.3 percent (28,764 t) of the plastic material in Indonesia's fisheries, and represent 40 percent (67,032 vessels) of the total motorized inboard fishing fleet. Incidental wear and tear results in the replacement of 8,264 t of plastic material annually, increasing to 18,206 t when scheduled full gear replacement is considered.

Hooks and line fisheries deploy just 4.3 percent (3,647 t) of the plastic material in Indonesia's fisheries, despite representing 30.7 percent (51,565 vessels) of the total motorized inboard fishing fleet. Incidental wear and tear results in the replacement of 365 t of plastic material annually, increasing to 1,581 t when scheduled full gear replacement is considered.

Trap fisheries deploy 2.4 percent (2,015 t) of the plastic material in Indonesia's fisheries. However the per-vessel weight of plastic material is relatively high, with these fisheries representing only 11 percent (18,397 vessels) of the total motorized inboard fishing fleet. Incidental wear and tear results in the replacement of 302 t of plastic material annually, increasing to 1,310 t when scheduled full gear replacement is considered.

VULNERABILITY TO DAMAGE AND LOSS

ALDFG generation is driven in part by the behavior of vessel operators through, for example, the deliberate discarding and disposal of fishing gears at sea even when such disposal are prohibited under international law. However, accidental loss and damage are equally important contributors to ALDFG generation, and are influenced by the design, construction and operating characteristics of the fishing gear and its vessel.

Vulnerability to damage

Of the ten major fishing gear categories used in Indonesia, some have inherent weaknesses that make them particularly vulnerable to damage. For example, fishing gears that operate by stealth (e.g., gillnets) are made from light, flexurally compliant materials that are difficult to detect by fish. These materials typically have low breaking strengths, and are readily damaged should nets unintentionally come into contact with seabed obstructions during setting or retrieval. Modifying gear design to increase the breaking strength and minimize risk of damage often has the undesired consequence of reducing flexural stiffness, increasing visibility and detectability of the gear by target species, and hence reducing fishing efficiency. Thus a fisher must consider the tradeoffs between materials that achieve the desired catch rate for the species targeted, and those that maximize the strength, resilience and longevity of the fishing gear.

On the other hand, capture techniques involving chasing, herding and surrounding fish such as trawls, seines and purse seines are typically made of more robust materials that can withstand the higher forces that are placed on netting during the capture process and that are generated during mechanical retrieval. For those fishing gears that operate on the seabed (e.g., bottom trawls and demersal seines), construction materials are selected that can withstand the forces of towing and a reasonable level of wear and tear from abrasion of netting as it is towed over the seabed. Heavier materials (e.g., thicker twines with increased breaking strain) are selected if the seabed characteristics change from sand and mud to shingle and rock. However, the use of heavier materials requires a greater towing force to move the net through the water which in turn leads to higher fuel consumption and higher operating costs. Although a vessel operator has the option to reduce towing speed, this can reduce fishing efficiency. Accordingly, a vessel operator must decide which combination of materials and operating characteristics provides the optimal balance between operating costs and catch rates.

Vulnerability to damage is also influenced by the degree of mechanization on the vessel. Some fishing gears are set and retrieved by hand (e.g., pole and line gear, handlines, hand set gillnets and pots), while others use mechanized winches of varying size. For gears that become snagged on the seabed, mechanized winches are capable of generating high loads that exceed the breaking strains of ropes and netting and may result in damage.

Vulnerability to loss

The most common type of fishing gear loss is typically associated with stealth fishing gears. Stealth fishing gears are set by the vessel and then left for several hours up to several weeks before the vessel returns to retrieve them. These gears include set anchored gillnets and trammel nets, set anchored longlines and pots. Losses may occur for a variety of reasons, including:

- An inability to re-locate set gillnets and pots due to limited navigational skills or limited equipment to re-locate the set gear;
- Setting gillnets and traps without adequately considering parameters such as water depth, currents and tides, all of which can lead to surface marker floats becoming submerged and non-detectable, or cause significant move-

[17] In addition to replacement of materials through wear and tear, vessel operators also have a schedule for full gear replacement. The schedule for such replacements varies according to gear type.

ment of the fishing gear from its set location (e.g., due to king tides); or

- Interactions with other vessels, for example where towed gears such as trawls and seines operate on the same fishing grounds as set gears such as gillnets, longlines or pots, there is an elevated risk of the towed gears running over the set gears, particularly if set gears are poorly marked.

Overall vulnerability assessment

Each fishing gear was evaluated against 14 variables that contribute to wear, tear and subsequent damage or loss (e.g., contact with seabed obstructions and poor maintenance), and two exogenous factors that impact all fishing fleets (severe weather and fleet separation). Each variable was scored on a 5-point scale for likelihood of occurrence (1 = unlikely, 5 = frequent), and for severity of impact to the gear (1 = negligible, 5 = catastrophic). An overall vulnerability index (V) was calculated as the average likelihood multiplied by the average severity. A full description of the vulnerability assessment methodology is described in Annex 1, including details of all 14 variables assessed. The rationale for the awarded risk assessment scores is presented in Annex 6, and complete likelihood and severity scorings for all variables are presented in Annex 5.

The fishing gear used in Indonesia that are most vulnerable to damage and loss (Figure 22) are: (i) plastic pots; (ii) set anchored gillnets; and (iii) set anchored trammel nets. High vulnerability to damage and loss was associated with passive fishing gears that (i) operate without the attendance of

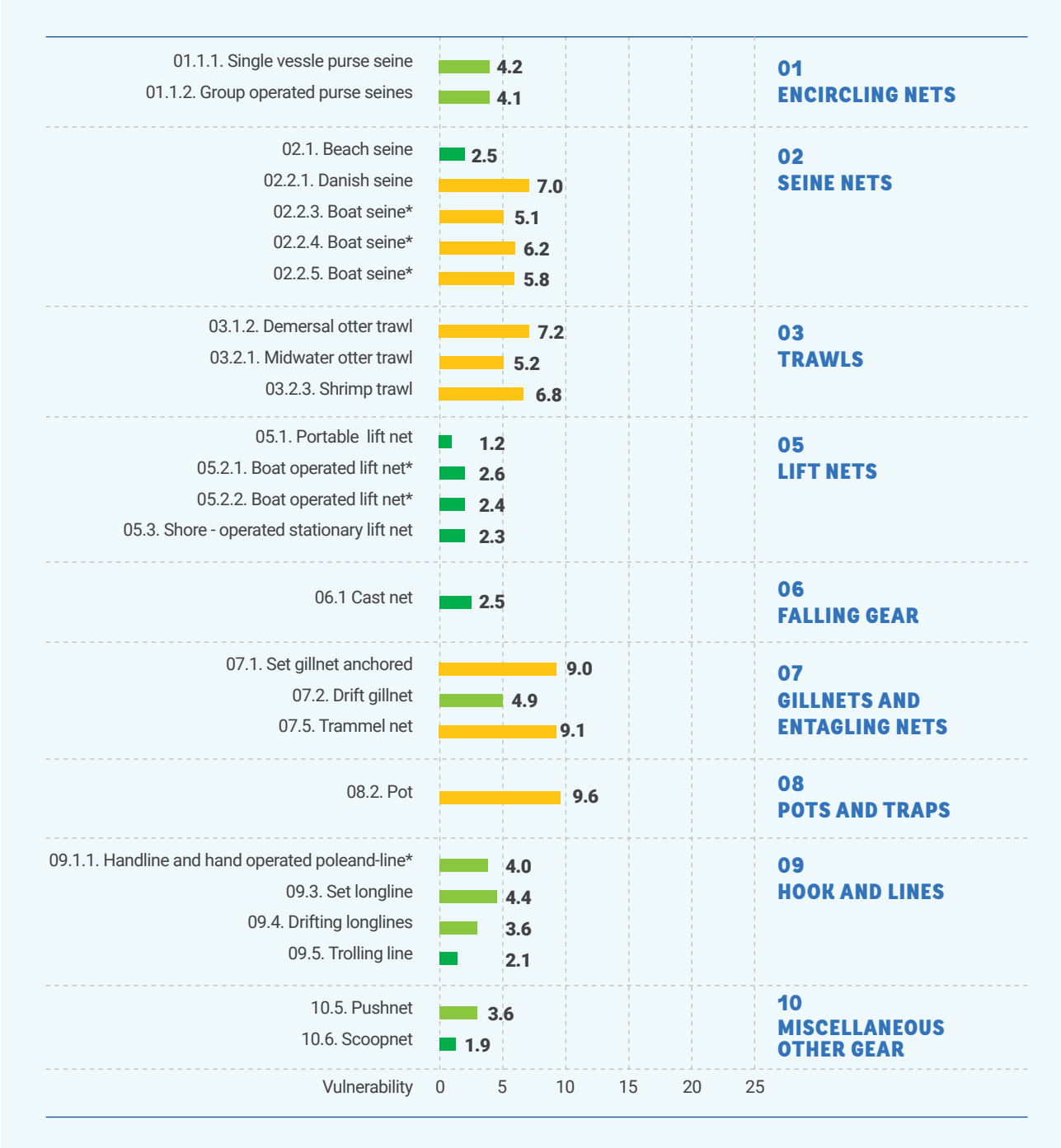


Figure 22: Gear-specific vulnerability to damage and loss.

the vessel; (ii) have relatively long soak times, often exceeding 24 hours; (iii) operate through stealth using lightly constructed materials to entrap fish (e.g., gillnets and entangling nets); and (iv) are set on the seabed. Factors influencing the vulnerability of each gear type are summarized in the paragraphs below.

- **Pots**. Plastic pots are the fishing gears that are most vulnerable to damage and loss in Indonesia, due to the quality of materials used in construction. Similar to bottom set gillnets, pots operate in the absence of a vessel, with relatively long soak times and in contact with the seabed. While the gears are passive, when large numbers of pots are set from a mainline there can be considerable abrasion to the mainline and pots as gears are retrieved and hauled onboard. The level of abrasion depends on substrate, water depth and the number of pots deployed. During this study, there was insufficient data to assess vulnerability for different pot designs and different fisheries. Instead, the vulnerability assessment assumed that pots were of the type used to target blue swimming crab and which are in widespread use in Indonesia. These pots are relatively light, collapsible traps with light polyethylene netting and a frame constructed from low grade steel with high iron content covered in plastic.

- **Gill and entangling nets**. Relatively high vulnerability to damage and loss was assessed for bottom set gillnets (V = 9.8) and trammel nets (V = 9.1). Drifting gillnet (V = 4.9) are slightly less vulnerable to damage and loss compared to bottom set gillnets (V = 9.8). Lower vulnerability scores were attributed to pelagic gears due to (i) a significantly reduced risk of encountering other gears; (ii) a high likelihood of the vessel being in attendance, and often attached to the gear; and (iii) relatively shorter soak times compared to set anchored gillnets. Moderate scores were achieved for damage resulting from poor seamanship and navigation (poor setting protocols associated with fleet operations) and loss associated with setting and retrieving gear in rough weather.

- **Boat seines**. Boat seines that make contact with the seabed such as dogol (V = 7.0), cantrang (V = 6.2) and lampara dasar (V = 5.8) have moderate vulnerability to damage and loss. Boat seines are designed for towing across relatively flat seabeds, and lighter materials are generally used in construction in comparison to e.g., trawls. The least vulnerable of all demersal boat seines was lampara dasar due to its use close to shore and low power due to limited mechanization. Pelagic seines such as payang (V = 5.1) have even lower vulnerability to damage and loss due to their operation off the seabed and away from potential contact with seabed obstructions or other set fishing gears.

- **Trawls**. Moderate vulnerability to damage and loss is associated with trawls that operate in contact with the seabed such as demersal otter trawls (V = 7.2) and shrimp trawls (V = 6.6). This study assumed that bottom trawls (including shrimp trawls) are designed and operated for use on smooth-medium ground, and vulnerability scores for damage and loss would need to be increased if trawls are towed at relatively high speed over rough and broken ground. Deep water bottom trawls targeting fish in very deep water (>1,000 m) on seamounts are particularly prone to damage and loss. Midwater trawls, by their nature, operate off the seabed, are less likely to encounter seabed obstructions or set anchored fishing gears, and hence are less vulnerable (V = 5.2) to damage and loss then bottom trawls. Notwithstanding, specialized midwater trawls for fishing on seamounts may be particularly susceptible to catastrophic loss when making contact with hard substrates, and the vulnerability of such gears should be reassessed if fisheries are present in Indonesia.

- **Purse seines and encircling nets**. Purse seines and encircling nets have low vulnerability to damage and loss (V = 4.2). Although fleets have high levels of mechanization for hauling and setting of the gear, and early onset wear and tear is likely, fishing gears are typically well maintained due to their high cost and the high value of catches. Damages associated with poor hauling and shooting (e.g., propeller wrap) do occur but are not common. Notwithstanding, moderate routine damage to netting, bunt and other components can result in high levels of waste on board. The likelihood of damage through interaction with other fishing gears or vessels is low because purse seines are set off the seabed, are always tethered to the vessel, and sophisticated navigation and echolocation equipment is carried onboard.

- **Beach seines**. Beach seines have very low vulnerability to damage and loss (V = 2.5). These fishing gear are set in known areas in relatively shallow water and close to the shore. In the event of problems occurring during setting and hauling, there is a high likelihood of gear being retrieved with minimal risk of damage.

- **Hook and line**. All subcategories of hook and line fishing were considered to have relatively low vulnerability to damage and loss.

Figure 23: Illustrative examples of ALDFG environmental impacts around the world. Sources: NPR, SWOT, FAO. ALDFG may entangle marine mammals, reptiles, elasmobranchs, seabirds and other marine wildlife, and represents a major conservation issue in addition to wasting commercially important fish stocks via the process of ghost fishing.

LIKELIHOOD OF ECOLOGICAL IMPACTS

ALDFG has the potential to cause significant environmental impacts. Each fishing gear type was scored from 1 (low likelihood) to 5 (high likelihood) with reference to the four commonly accepted ecological impacts of ALDFG: (i) ghost fishing; (ii) entanglement of marine life; (iii) rafting of invasive species; and (iv) smothering of habitats. In the absence of available data on the ecological impacts of ALDFG in Indonesia's fisheries, scorings were based on published literature for comparable fisheries worldwide.

Ghost fishing is the continued catching of target and non-target species by ALDFG. It is environmentally detrimental, and the fish caught by ghost fishing are wasted. Active fishing gears are dragged through the water, usually by the fishing vessel, and hence the catching process generally ceases once the gear is no longer attached. Consequently, ghost fishing is a much more prevalent issue for passive fishing gears such as longlines, gill nets, or traps and pots than for active fishing gears such as trawls and seines. Scraps of netting or other materials discarded by a vessel, whilst not classified as a fishing gear, may also contribute to ghost fishing.

Entanglement is 'an interaction between marine life and ALDFG whereby the loops and openings within the ALDFG material entangle animal appendages or entrap animals' (Laist, 1997). Entanglements can result in death or injury, however observations of scarred individuals indicate that some entangled animals may also die from infection and secondary complications (Hanni and Pyle, 2000). Entanglement of marine animals by ALDFG is largely associated with marine mammals, reptiles, elasmobranchs and seabirds (Figure 23), and is recognized as a major conservation issue (Stelfox et al., 2016). Unlike ghost fishing, where capture and entrapment is often associated with the main fishing element (e.g., gillnet or pot), entanglement can be associated with other components of the fishing gear including anchor lines, float lines and scraps of floating plastic material that can become hooked around the neck, body, limbs, or through the mouth of marine wildlife.

Rafting of invasive species occurs when ALDFG create an artificial habitat that adds new surfaces for colonization by organisms (Gündoğdu et al., 2017; Harrison et al., 2011), including both mobile and sessile species (CBD, 2012). Depending on its size and structure (Miralles et al., 2018), ALDFG may carry species beyond their native distribution, and hence can be considered potential vectors of invasive species (Rech et al. 2016) that may increase biological invasions and challenges biodiversity conservation (Simberloff et al., 2013).

Smothering of habitats by ALDFG causes direct physical impacts (Gregory, 2009) that include scouring, breaking and otherwise damaging sensitive habitats (Figure 24) such as coral reefs or seagrass beds (Dameron et al., 2007; Donohue et al., 2001). If gears become entangled, they may cause fur-

ther damage by pulling, breaking, covering sessile organisms or obstructing suspension feeders such as sponges and corals (Consoli et al., 2020). ALDFG may alter microhabitats by e.g., obstructing reef crevices, or entrap fine sediments that inhibit water flow, creating anoxic areas, which, if prolonged, can cause substantial mortalities (Gilman, 2015; Levin et al., 2009).

Gillnets and entangling nets were assessed as having the highest likelihood of ecological risk (Figure 25) due to their light materials and ability to persist in the water column for extended periods during which ghost fishing, entanglement and rafting of invasive species can occur. Pots and traps were also assessed as having a high likelihood of causing ecological impacts, due to their robust materials and ability to self-bait and continue ghost fishing for extended periods of time. Other gear types are typically constructed from heavier materials and settle out of the water column within a relatively short period of time. Consequently, while smothering of habitats may occur, the risk of impacts arising from ghost fishing, entanglement and rafting of invasive species is relatively lower.

Figure 24: ALDFG may be colonized and act as a vector for invasive species (left) or cause physical damage to benthic habitats (right). Source: Werner et al., 2016.

OVERALL ECOLOGICAL RISK

An overall relative ecological risk rating (RR) was calculated for each gear type following the approach described by Gilman et al. (2021) (see Annex 1). A weighting factor was applied to ecological risk to emphasize the potential for adverse outcomes and to reduce the likelihood of false negatives due to gear quantities being underestimated. Gilnets and entangling nets have the highest relative risk rating due to the high quantities deployed in Indonesia's fisheries, the relative high vulnerability of these gears to loss and damage, and the high likelihood of ecological impacts arising from ghost fishing, entanglement, rafting of invasive species or smothering of habitats.

Purse seines and encircling nets were assessed as having high relative risk rating due to the high quantities deployed across Indonesia's fisheries and the high per-vessel weights of plastic material, and hence potential for small increases in fleet size to result in large increases in the quantity of plastic material deployed. However, it should be noted that the small number of vessels operating these gears in Indonesia, combined with moderate vulnerability to damage and loss and moderate likelihood of ecological damage mean that these fisheries could represent low hanging fruit for preliminary ALDFG prevention and mitigation strategies.

Traps and pots were assessed as having high relative risk due to high per-vessel weights of plastic material, relatively high vulnerability to loss and relatively high likelihood of ecological impact due to the potential for self-baiting and ghost fishing over prolonged periods.

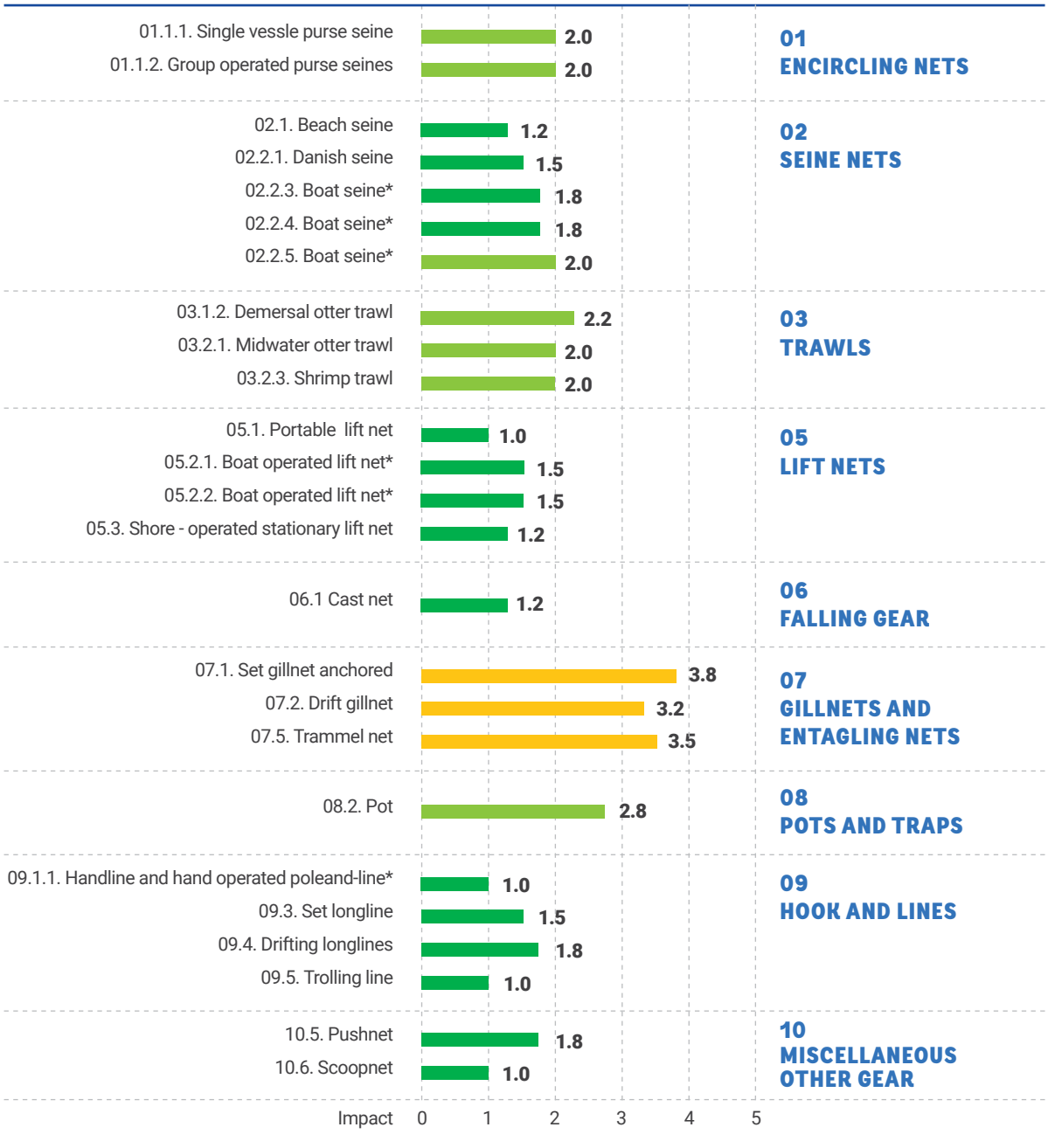


Figure 25: Gear-specific likelihood of ecological impacts of ALDFG.

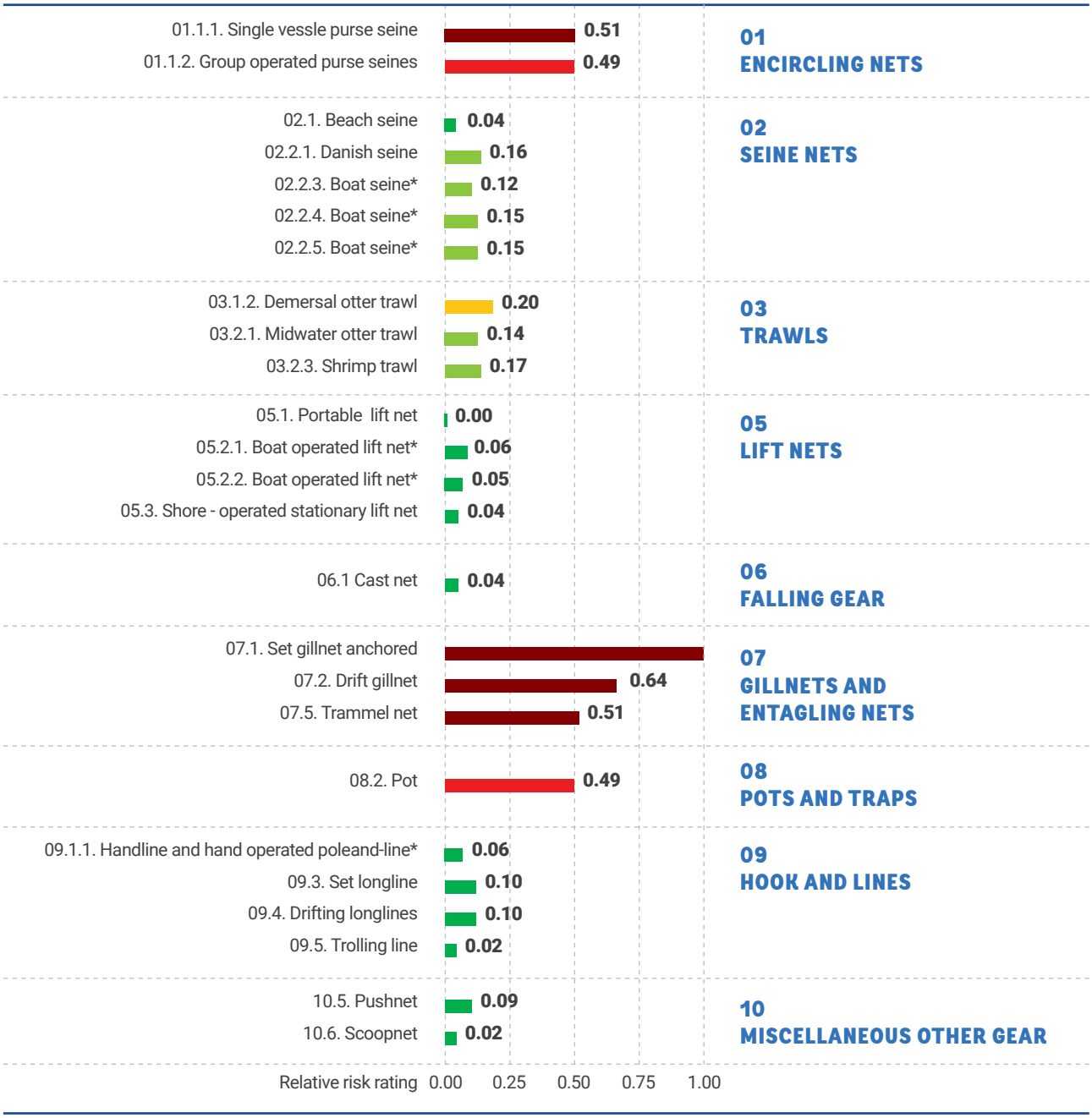


Figure 26: Gear-specific overall relative risk rating.

Fishing gear waste management initiatives in Indonesia

This chapter provides an overview of existing fishing gear management measures and initiatives in Indonesia, and briefly explores gaps and opportunities in the context of the global experiences and best practices presented in Annex 8.

POLICY AND REGULATORY FRAMEWORKS

MARPOL Annex V implementation in fishing ports

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention addressing pollution of the marine environment by maritime shipping. MARPOL currently consists of six technical Annexes that address various categories of pollutants via binding regulations. Annex V addresses the pollution by garbage from ships, and entered into force in 1988.

Government Regulation 81/2012 on Domestic Waste Management implements MARPOL Annex V in Indonesia, and requires all public ports to conduct waste separation, waste collection and temporary waste storage. It also outlines the subsequent treatment of waste, which includes compaction, composting, recycling and energy recovery.

Presidential Regulation 83/2018 on Marine Debris Management addresses the management of plastic waste from maritime activities and outlines targets to establish waste reception facilities at 112 public ports, establish waste handling facilities at 23 PPN and PPS, and to implement ISO 14001 Environmental Management standards in 67 public ports and 22 PPN/PPS. MMAF, the Ministry of Environment and Forestry (MoEF) and local governments are also obliged to develop Standard Operating Procedures for the operation of 'eco-friendly fisheries and aquaculture'.

Regulation of the Minister of Marine Affairs and Fisheries 26/PERMEP-KP/2021 requires all fishing vessels to: (i) not dispose of fishing gears or fishing tools at sea; (ii) to land and report damaged and unrepairable fishing gears and tools at ports so that they can be recycled; and (iii) report missing fishing gears and tools at the time of entering port.

A detailed review of MARPOL Annex V and its applicability to addressing plastic leakage from Indonesia's fishing fleets is presented in Annex 9. The main conclusions include:

- Indonesia has benefitted from the guidance provided on port reception facilities which have been established at the 23 PPN and PPS, and this may provide a foundation for follow up work on EOLFG and ALDFG reporting;
- The requirements under MARPOL Annex V Regulation 10.3 to implement a garbage management plan apply to only 858 fishing vessels that are larger than 100 GT, while the requirement to carry and fill out a garbage record book does not apply to any of Indonesia's 171,744 inboard or 181,178 outboard motor vessels;
- MARPOL Annex V in its present form is not sufficiently tailored to Indonesia's fishing operations and practices and will not significantly reduce plastic leakage from Indonesian fishing operations due to the lack of applicable reporting obligations; and
- As a more expeditious solution that is tailored to the local context, the Government of Indonesia may wish to improve the reporting requirements of its national fleet—especially those operating within Indonesia's EEZ—through the development of national policy, laws and regulations that build upon and go beyond the requirements of MARPOL Annex V.

National Plans of Action

Indonesia recently introduced two National Plans of Action (NPOA) of relevance to fishing and aquaculture gear waste:

The NPOA on Plastic Marine Debris 2017-2025 is overseen by the Coordinating Ministry of Maritime Affairs and Investment and adopts five main pillars:

- Improving behavioral change;
- Reducing land-based leakage;
- Reducing sea-based leakage;
- Reducing plastics production and use; and
- Enhancing funding mechanisms, policy reform and law enforcement.

Programs responding to these pillars have been developed at the international (to address transboundary pollution), national and local levels, with the ultimate goal of reducing marine plastic debris by 70 percent by 2025. The reduction of waste leakage from activities at sea is to be addressed via: (i) waste reception facilities at ports; (ii) bilateral & regional collaborations; (iii) collecting plastic waste from coastal and marine areas; and (iv) plastic waste management in tourism. There has also been awareness-raising to change behavior through school education, information campaigns, and beach and coastal clean-up actions.[18]

Specific activities that are already underway under the coordination of MMAF include:

- Organizing the "Indonesian Maritime School" or "*Sekolah Bahari Indonesia*" (24 activities)
- Waste management within estuaries (13 estuaries);
- Construction of waste management facilities and infrastructure within PPS and PPN (23 PPS/ PPN);
- Implementation of ISO 14000 Environmental Management standards for waste and waste management within PPS and PPN (22 PPS/PPN);
- Preparation of standard operating procedures for environmentally friendly capture fisheries (1 Ministerial Regulation);
- Preparation of standard operating procedures for environmentally friendly aquaculture activities (1 directorate general regulation);
- Construction of temporary disposal facilities (*Tempat Pembuangan Sampah* [TPS] or landfill) or recycling centers on the outermost small islands (TPS in 29 islands);
- Organizing the National Movement to clean beaches and seas or "*Gerakan Nasional Bersih Pantai dan Laut*" (24 locations); and
- Research on marine debris pollution and its impacts (11 WPPs)

The **NPOA on Plastic Pollution** was published in 2020. It supports Indonesia's National Action Plan on Marine Debris, Presidential Regulation No. 97/2017 on National Policy and Strategy for the Management of Domestic Waste and Domestic Waste Equivalents, and other efforts towards achieving a 70 percent reduction in the nation's marine plastic debris by 2025. It also looks beyond 2025, with longer-term objectives to achieve near-zero plastic pollution by 2040.

Various efforts to restrict the use of plastics have started to be implemented. Presidential Regulation No. 97/2017 sets the target of 30 percent waste reduction and 70 percent waste handling by 2025. Plastic waste management is also addressed under Presidential Regulation No. 83/2018 on Marine Debris Management, and a regulation on Extended Producer Responsibility is reported to be in development. Plastic waste trade is starting to be addressed via ministerial-level laws, while sub-national governments have started to issue instruments to limit single-use plastics (MoEF, 2020).

These recent developments and stated commitments show a strong level of political will from the Government of Indonesia to address issues related to plastic waste, and the potential for resources to be available to address ALDFG, particularly when viewed as part of efforts to address marine debris and to improve circularity for fishing gear.

To effectively tackle ALDFG and reduce its contribution to plastic marine debris, certain initiatives (e.g., enhancing awareness, improving waste management, and undertaking clean-up operations) should be integrated with activities and objectives under the NPOAs. Some sector-specific developments will also be required to address the key characteristics of fishing gear waste, such as the risk of ghost fishing, and the use of multi-use and durable materials that result in higher costs of separation, cleaning and recycling when compared to packaging and other consumer plastics.

[18] http://www.unesco.or.id/publication/SC_Retreat/4_MarineDebrisIndonesia.pdf

ALDFG PREVENTION

It is more cost-effective to focus first on measures to prevent ALDFG before looking at measures to mitigate impacts or recover ALDFG (GGGI 2021a). Current initiatives in Indonesia that have the potential to contribute to ALDFG prevention are summarized below.

Marine spatial planning

A well-established marine spatial plan (MSP) framework can contribute to ALDFG prevention by minimizing damage and losses arising from gear conflicts or interactions with other marine users. Effective MSP implementation, notification and zoning enforcement are essential if the contributions to ALDFG prevention are to be realized.

MSP in Indonesia continues to develop. Law 27/2007 on the Management of Coastal and Small Island Areas and Government Regulation 32/219 on National Marine Spatial Planning provide the overarching regulatory framework. Government Regulation 21/2021 on the Implementation of Marine Spatial Planning outlines the roles and responsibilities of designated ministries, which are implemented via ministerial-level regulations such as Regulation of the Minister of Marine Affairs and Fisheries 28/PERMEN-KP/2021. Provincial governments are tasked with developing and implementing Zoning Plans for Coastal Zone and Small Islands (RZWP3K, *Rencana Zonasi Wilayah Pesisir dan Pulau-pulau Kecil*), with coastal zones extending up to 12 nm from the shore.

Usage of maritime zones is governed by Regulation of the Minister of Marine Affairs and Fisheries 54/PERMEN-KP/2020 on Location Permit, Management Permit and Location Permit at Sea and Regulation of the Minister of Marine Affairs and Fisheries 53/PERMEN-KP/2020 on Administration of Permits for the Utilization of Small Islands and Surrounding Waters for Foreign Investment.

Indonesia has developed a national MSP, inter-regional plans, provincial plans, outermost islands plans, and has defined National Strategic Areas. According to MSPGlobal 2030,[19] the national plan is approved and implementation is underway, with the lower-level plans currently in progress. All the provincial RZWP3K zoning plans will be enacted through provincial government regulations, with 26 of Indonesia's 34 provinces having enacted these regulations. Offshore waters beyond 12 nm are addressed under a single plan under the responsibility of MMAF. Plans are reviewed and revised every five years.

Awareness raising

Stakeholder education and awareness-raising are important tools to build knowledge about the issues surrounding ALDFG, and contribute to changing public perceptions and behaviors. Programs should target all relevant stakeholders, including the government agencies tasked with implementing ALDFG management measures and the fishermen whose gear stewardship practices play a critical role in preventing ALDFG generation.

Figure 27: ALDFG socialisation and awareness raising at PPN Ternate in 2017. Source: http://pipp.djpt.kkp.go.id/detail_berita/8077

Awareness-raising to prevent ALDFG has been conducted via local-level pilot initiatives, such as in PPN Ternate.[20] As part of the NPOA-MPD 2017-2025 socialization and campaigns to reduce ghost fishing tool place from October 31 to November 6, 2017 PPN Ternate (Figure 27). The initiative included two days of face-to-face contact with fishermen and business actors accompanied by the dissemination of brochures, posters and other materials, followed by clean-up of surrounding beaches and the harbor in collaboration with local communities and diving clubs.

MMAF has established Fishery Extension (*Penyuluh Perikanan*) positions under the Agency for Research and Human Resources (BRSDM, *Badan Riset dan Sumber Daya Manusia*), who are responsible for communicating and socializing policies and regulations to stakeholders, and supporting provincial government to manage coastal areas. BRSDM and its Fishery Extension officers could play an important role if a national program for ALDFG education and awareness-raising were to be developed, possibly linked to ALDFG retrieval and clean-up operations.

[19] https://www.mspglobal2030.org/msp-roadmap/msp-around-the-world/asia/indonesia/
[20] http://pipp.djpt.kkp.go.id/detail_berita/8077

Certification and eco-labels

Certification bodies and eco-labels establish market incentives to prevent ALDFG (Gilman et al., 2022). As such, they hold tremendous potential to bridge the gap between consumer concern and industry action on ALDFG, while also strengthening compliance with national, regional and international obligations, and helping to differentiate fisheries that implement best practices (EIA, 2022).

The Marine Stewardship Council (MSC) began to establish a presence in Indonesia in 2018. By 2021 three fisheries had gained MSC certification, 20 suppliers had chain-of-custody certifications, and numerous fishery improvement projects are underway. Strong support from MMAF has boosted interest in MSC certification in Indonesia. MSC's Fish for Good[21] is a four-year program that supports fisheries in Indonesia to improve towards sustainable practices and potential certification. MSC has also supported FAD-tracking within Indonesia's tuna fisheries. In 2020 MSC began to review its standard in response to growing interest on the issue of ALDFG, and an explicit ghost gear scoring element will be incorporated into an upcoming revision to the standard which is due next year (MSC, 2021).

Vessel design

Effective vessel design can help to prevent ALDFG generation. Amongst the main direct drivers of ALDFG generation is insufficient storage space onboard for all gear that are used (e.g., when space used to store gear when starting a trip is subsequently used as a fish hold) or for worn and damaged components replaced during a trip (Gilman et al., 2022).

Regulation of the Minister of Marine Affairs and Fisheries 23/PERMEN-KP/2021 on Fishery Vessel Operating Standards and Monitoring Systems[22] establishes a legal operating standard for fishing vessels, while Ministerial Decree 29/KEPMEN-KP/2021 on Technical Guidelines for Assistance to Fishing Vessels[23] specifies the types and specifications of government assistance that can be provided to fishing vessels, including assistance related to vessel design and technical specifications. These regulations contribute to the implementation of Government Regulation 27/2021 on Governance of the Marine and Fishery Sector,[24] which outlines three main conditions of license that are reviewed during vessel inspections:

- the seaworthiness of the fishing vessel;
- the catchability of the fishing vessel, including suitability of the vessel, fishing equipment and type and size of fishing gears for the licensed fishery; and
- the suitability of the fishing vessel, including design and construction of fish holds; effectiveness of systems for the removal of ice and wastewater; and adequacy of systems and processes for monitoring fish hold temperature and ensuring cold chain integrity.

While Government Regulation 27/2021 includes specific clauses addressing vessel design, including fish hold and wastewater system design, currently there are no clauses addressing gear storage and securing systems. These regulations could be amended to include specifications for gear storage and securing systems in order to reduce the likelihood of gear being lost overboard. It may be costly and difficult to implement these changes retrospectively, but these requirements could be applied to the design of new fishing vessels entering the fleet, especially those larger than 30 GT. This process could be supported by the decision taken by the APEC Ocean and Fisheries Working Group in August 2021, under the auspices of the APEC Roadmap on Marine Debris, to strengthen capacity for vessel innovation in Indonesia to combat marine debris.

ALDFG MITIGATION

Current initiatives in Indonesia that have the potential to contribute to mitigating the impacts of ALDFG on marine habitats and wildlife, including by ghost fishing, are summarized below.

Gear design and materials

Improvements in gear design can mitigate the impacts of ALDFG on marine habitats and wildlife by, for example, minimizing rates of damage and loss in the first place, improving rates of ALDFG detection and recovery, and reducing the incidence and duration of ghost fishing.

Indonesian National Standards[25] (SNI, *Standar Nasional Indonesia*) exist for eight main categories of fishing gears that operate in Indonesia's waters:

- Bottom trawls (*pukat tarik dasar*);
- Midwater trawls (*pukat hela*);
- Seines (*pukat kantong payang, dogol and cantrang*);
- Monofilament gillnets (*jaring insang monofilamen*);
- Multifilament midwater and surface gillnets (*jaring insang pertengahan/ permukaan multifilament*); and
- Trammel net (*jaring tiga lapis*);

This list of SNIs does not yet cover all fishing gears defined under Regulation of the Minister of Marine Affairs and Fisheries 18/PERMEN-KP/2021 on the Deployment of Fishing Gears and Equipment.[26] This is reportedly due to the fact that not all gears used in Indonesia have a standard design, however it is worth noting that national standards could be developed to

[22] https://jdih.maritim.go.id/cfind/source/files/permen-kp/ed818-permen-kp-23-tahun-2021.pdf
[23] https://jdih.kkp.go.id/peraturan/a4c80-29-kepmen-kp-2021.pdf
[24] https://jdih.setkab.go.id/PUUdoc/176360/PP_Nomor_27_Tahun_2021.pdf

Figure 28: Waste water bottles are often reused as floats or, as in this case, weights for fishing gears.

define key operational specifications, while remaining flexible to accommodate different designs.

Regulation of the Minister of Marine Affairs and Fisheries 59/PERMEN-KP/2020 on Fishing Zones and Fishing Gears within Fishery Management Areas of Indonesia and the High Seas[27] specifies the gears that are permitted to operate within each WPP. However, this regulation does not provide details on the design specifications for these gears.

The absence of gear specifications can result in suboptimal gear design or materials that contribute to ALDFG. For example, the re-use of waste plastic such as water bottles as fishing gear components is a low-cost option that provides revenue to bottle collectors. However, some of these uses are not robust (Figure 28), resulting in ALDFG, marine litter and frequent replacement. The use of plastic bottles is also a major contributor to ALDFG in aquaculture (World Bank, 2022).

The majority of catches by tuna purse seiners are made using Fish Aggregating Devices (FADs). Regulation of the Minister of Marine Affairs and Fisheries 26/PERMEN-KP/2014 on Fish Aggregating Devices permits up to three FADs to be deployed per vessel, but in practice many more may be deployed, with estimates of as many as 10,000 anchored FADs deployed in Indonesia's tuna fisheries (Proctor et al. 2019). Addressing the materials used in FAD construction can contribute to a reduction in ALDFG. A wide variety of FAD designs and materials are used in Indonesia. FAD floats are often iron cylinders with conical endcaps, and may be filled with polyurethane or expanded polystyrene (Figure 29, top left). Other raft types can be found in some locations, such as net-covered foam cubes (Figure 29, top right). Non-entangling natural coconut or nipa (*silar*) fronds are typically used as attraction materials under the pontoon, though smaller scale operators may use logs or other natural floating materials.

Indonesia's FADs often have a small dwelling (*rakit*) to house a watchman who may be in radio contact with the company office or vessels, providing security and advising on fish aggregations. FADs for the tuna purse seiners are typically deployed some distance from shore (>12 nm) to minimize the catch of smaller neritic tunas and other small pelagics, and may be located at distances of 60 - 200 nm from port. Anchoring depths may be up to 6,000 m, but are more typically in the range 2,000 – 3,000 m. The cost of materials for deploying individual FADs may be up to IDR 70 million (~USD 5,400), depending on the anchoring depth. FADs can last up to 4 years, but usually much

[25] http://www.bkipm.kkp.go.id/bkipmnew/en/sni/SNI%20%20PERIKANAN%20TANGKAP
[26] https://jdih.kkp.go.id/peraturan/f06f4-permen-kp-18-tahun-2021.pdf
[27] https://jdih.kkp.go.id/peraturan/7e7b0-59-permen-kp-2020.pdf

Figure 29: FADs used by fishers operating from PPS Bitung (top) & PPN Pekalongan (bottom)

less, and are often sabotaged by competitors (PPS Bitung report) which further contributes to ALDFG generation.

A number of initiatives in Indonesia are exploring innovations in fishing gear design. Bogor Agriculture University are carrying out research on environmentally-friendly fishing gears constructed from plant fibers.[28] MMAF's Fishing Technology Development Center (BPPI, *Balai Pengembangan Penangkapan Ikan*) is piloting folding traps (*bubu lipat*) constructed from galvanized iron, wire and rope made from Polyethylene (PE) and Polyamide (PA).

The replacement of plastic in fishing gears with alternative materials is not expected to occur soon, as the efficacy of alternative materials compared to plastic tends to be low. Therefore, ensuring gears can be recycled, and developing effective collection and recycling systems is a greater priority. Amendments to gear regulations could outline specifications for recyclability and set targets for recycled material content to reduce the use of virgin plastic and increase demand for recycled material. However, this will require the recycling supply chain to be better established.

Gear marking

Properly marked gear can help to identify ownership, detect illegal, unregulated and unreported (IUU) fishing, enhance the visibility of passive gears, and aid monitoring and enforcement of ALDFG regulations. Gear marking can disincentivize deliberate abandonment and discarding, incentivize the retrieval of temporarily lost gear, and may create an incentive to report when gear is lost or abandoned (FAO, 2019b; He & Suuronen, 2018).

While Ministerial Regulation 18/PERMEN-KP/2021 regulates the types of fishing gears that are permitted in each WPP and fishing zone, it does not address issues related to gear marking. Similarly, while each Fishery Business License (SIUP, *Surat Ijin Usaha Perikanan*) includes details of the technical specifications of the fishing gears used by each vessel, they do not include any provisions related to marking of gears.

Government Regulation 27/2021 provides a framework for gear marking, to some extent, via clause 136 point (f) which refers to the catch eligibility of fishing vessels and explicitly addresses the prevention of ownerless nets.

Regulation of the Minister of Marine Affairs and Fisheries 58/PERMEN-KP/2020 on Capture Fisheries Business addresses several issues that could also support the implementation of gear marking schemes, including:

[28] https://innovation.ipb.ac.id/detail/1042-Jaring-Ikan-Ramah-Lingkungan

- Fishing vessel unique identifiers (tanda pengenal kapal perikanan);
- Permitted fishing gears (i.e., non-destructive fishing gears); and
- Permitted fishing gears per WPP and fishing zone.

The tracking of gear using radio buoys or acoustic tags can help to reduce ALDFG because gears can be more readily located and recovered by operators. Ministerial Regulation 18/PERMEN-KP/2021 requires radio buoys to be deployed every 2,500 m on drifting gillnets and longlines for fishing vessels larger than 30 GT. MMAF is reported to be in the process of drafting a new regulation on marine pollution which will contain provisions relating to ALDFG (APEC/GGGI, 2021).

A number of gear marking initiatives have been implemented in Indonesia. In Pekalongan, Java, the GoI in collaboration with the the Global Ghost Gear Initiative (GGGI) implemented a pilot project to evaluate gillnet marking approaches within small-scale fisheries as a tool for ALDFG prevention. The pilot identified several advantages of arising from gear marking, including identification of ownership, traceability to specific fishing gears, and greater accountability to retrieve nets. However, costs were identified as a disadvantage. Many local fishers do not have the means to purchase an entire net at once, and nets are often obtained from middlemen and paid back in installments or sometimes in-kind. In addition, tagged nets from international producers are more expensive than locally produced nets.

Fisheries licensing

Integrating ALDFG management measures into the fisheries licensing process can create incentives for fishermen and fishing operators to make every reasonable effort to minimize their contribution to ALDFG generation. The license to fish could include requirements such as (i) gear marking; (ii) use of appropriate biodegradable materials, escape mechanisms, or passive deterrents to reduce the time that lost fishing gear remains active; (iii) reporting of end-of-life and lost gears; and (iv) installation of adequate onboard gear storage and securing systems.

Government Regulation 27/2021 and Ministerial Regulation 58/PERMEN-KP/2020 provide the regulatory framework for fishery licensing, however, do not currently include any explicit mention of ALDFG or its management. Regulation of the Minister of Marine Affairs and Fisheries 21/PERMEN-KP/2021 on the Development of Fishery Management Plans and Fishery Management Institutions addresses the development of fishery management plans, and provides the opportunity to incorporate ALDFG management measures into harvest strategies and the associated licensing processes (noting however that higher level regulatory controls will be required in the longer-term).

Under MMAF's new policy of Measurable Fisheries (*Penangkapan Terukur*) several types of fishing zone have been delineated (industrial fishing zones, small-scale fishing zones, and spawning and nursery ground zones), and establishes a precedent for conservation and management measures to be integrated into the fishing license process.

ALDFG RETRIEVAL

ALDFG can continue to indiscriminately catch commercially important species and other marine life via the process of ghost fishing, cause physical damage to marine habitats, present a hazard to shipping and navigation, and diminish the intrinsic natural values of marine ecosystems. These issues can be mitigated by the detection, location and careful retrieval (to minimize additional environmental impacts) of ALDFG.

ALDFG reporting

In the context of ALDFG retrieval and management, reporting is important for two reasons. First, lost gears can often be retrieved if their location is known. Second, an understanding of the scale, sources, locations and causes of gear loss is essential to develop effective prevention and management strategies (Drinkwin, 2022).

Under the framework of the NPOA-MPD 2017-2025, MoEF has produced guidelines for the monitoring of marine debris.[29] However, monitoring and reporting that specifically addresses ALDFG is currently limited in Indonesia. As described in Section 6.1, Ministerial Regulation 26/PERMEP-KP/2021 requires all fishing vessels to land and report damaged and unrepairable fishing gears and tools at ports so that they can be recycled. In the absence of measures such as gear marking and garbage record books, mechanisms to monitor and enforce the requirement to report lost gears are, however, limited.

Opportunities exist to enhance monitoring and reporting of ALDFG in Indonesia, and Annex 10 outlines a proposed approach.

ALDFG retrieval programs

The retrieval of ALDFG is the only way to eliminate its negative impacts on navigational safety and the environment. For some fishing gears, such as gillnets, retrieval is most effective as soon as possible after the gear is lost. Nets may lose their structural integrity and fishing capacity over time, which means that waiting to retrieve the gear after weeks or even years may have little effect on reducing its negative impacts (Ayaz et al., 2006; Baeta et al., 2009; Good et al., 2010). For other gears, such as some traps and pots, their ability to catch can persist for a long time and retrievals conducted days, weeks or months after the loss can still eliminate negative environmental impacts (Antonelis et al., 2011; Butler et al., 2018).

This study did not identify any regular coordinated ALDFG retrieval efforts in Indonesia other than attempts at retrieval by the operators themselves when gear snagging occurs. As gear loss represents an economic loss it may be expected that fishers make reasonable attempts to retrieve their own gear whenever possible. However, there is no current requirement or incentive for fishers to remove ALDFG when encountered.

Occasional, one-off and ad hoc clean up initiatives have occurred in Indonesia, though these are often focused on the wider issue of marine debris rather than explicitly addressing ALDFG retrieval and clean up. A beach and port clean up event was implemented in PPN Ternate in November 2017, and is described in Section 6.2 above. The Love of the Ocean Movement (*Gerakan Cinta Laut or GITA LAUT*) is an initiative implemented by MMAF to support the objectives of Presidential Regulation 83/2018. GITA LAUT aims to increase public awareness about marine debris, and implements activities that engage stakeholders, including:

- Beach clean-up in South Sulawesi in 2020 initiated by Pandu Laut Nusantara, Yayasan Eco Nusa and Yayasan Konservasi Laut (YKL);[30]
- Beach clean-ups in Labuan Bajo and Probolinggo in 2020 initiated by MMAF;
- The Indonesia Jamboree for Clean and Waste Free Period 2016-2019;[31]
- The Clean Indonesia Movement (*Gerakan Indonesia Bersih*) initiated by the Coordinating Ministry of Marine Affairs and Investment; and
- Other activities and events initiated by the Indonesian navy and MMAF.[32]

The GoI implemented a ghost net collection and recycling initiative in Merauke, Papua, with positive uptake and interest by local communities, and with government interest in replicating the model. Over a ten-month period, ten tonnes of discarded nets were collected by a fishers cooperative who received direct cash payments for delivering the clean nets to established collection points. Baling and shipping of the nets were handled by the Coral Triangle Center's SeaNet project, which has established a market with the Slovenia-based firm, Aquafil. Aquafil processes the nets and transforms them into EcoNyl® regenerated nylon, which is sourced by brands globally for apparel and interiors such as carpets.

[29] http://pertalindo.or.id/download/file/Pedoman_Pemantauan_Sampah_Laut.pdf
[30] http://www.mongabay.co.id/2020/03/18/aksi-bersih-pantai-kumpulkan-1436-kg-sampah-didominasi-plastik/
[31] http://bebassampah.id/files/uploads/laporan-dampak-jambore-ibbs-periode-2016-2019-rev1.pdf
[32] https://kkp.go.id/djprl/p4k/page/4709-penanganan-sampah-laut-oleh-ditjen-prl

ALDFG IN THE CIRCULAR ECONOMY

In a circular economy the value of products and materials is maintained for as long as possible. The development of a circular economy for fishing gears can help to keep resources in use for as long as possible, extract the maximum value from materials whilst in use, and create systems and incentive structures to recover materials at the end of their serviceable life and repurpose or regenerate new products and uses. Current initiatives in Indonesia that have the potential to contribute to the circular economy for ALDFG and fishing gear waste are summarized below.

Repair facilities

Adequate maintenance and repair of fishing gears and their components can keep gears in service longer, minimize damage and reduce rates of waste and ALDFG generation.

Fishing gears in Indonesia are repaired wherever possible, often by small-scale fishers themselves or by informal net repair businesses. An important consideration is ensuring that fishers possess relevant and adequate skills to repair gear, thus contributing to the minimization of fishing gear waste generation and disposal. MMAF has organized technical trainings on techniques to repair fishing gears, such as the virtual training on PE net repair delivered to 465 participants from 34 province in July 2021.[33]

FAO recommends that small- and medium-sized fishing ports should have dedicated net repair facilities, with 500 m^2 allocated in artisanal ports and 1,000 m^2 of part-covered areas for coastal and offshore fishing ports (Sciortino, 2010). Regulation of the Minister of Marine Affairs and Fisheries 8/PERMEN-KP/2012 on Fishing Ports[34] specifies the facilities to be provided by a fishing port to support fishing operations, which include "places for the maintenance of vessels and fishing gear, such as places for repairing nets" (article 4, clause 3.d). However, few of the fishing ports sampled during this study had designated repair areas. Some did have informal open areas in or adjacent to the ports that are used by fishers and fishing companies to lay out and repair trawl and purse seine nets, which are the largest single items requiring flat, open spaces, clear of obstructions or debris for repair. There is often a compromise between available open space to facilitate the work and shelter for net repairers (Figure 30). Details of the gear storage and repair facilities and infrastructure observed during field surveys are presented in Section 4.3.

Figure 30: Gear repair activities found in PPN Ternate (top) and PPS Kendari (bottom).

[33] https://kkp.go.id/artikel/32504-kkp-gelar-pelatihan-camilan-olahan-ikan-dan-perbaikan-jaring-bagi-pelaku-utama-di-34-provinsi
[34] https://jdih.kkp.go.id/peraturan/per-08-men-2012.pdf

Fishing gear waste collection

When damaged or end-of-life fishing gears are returned to port, it needs to be managed responsibly. Waste collection and storage infrastructure and facilities represent the first step in a waste management pathway for waste fishing gears. The installation, maintenance and management of fit-for-purpose waste collection facilities at fishing ports makes the process of disposing of waste fishing gears easy, saving fishers time and money, and thus incentivizing best practice for disposal. Aggregation of waste at designated collection and storage facilities also enables more efficient waste sorting, supporting the reuse, repair or recycling of waste fishing gears into new products.

Ministerial Regulation 26/PERMEP-KP/2021 requires all fishing vessels to land and report damaged and unrepairable fishing gears and equipment at fishing ports. However, few ports have waste facilities that address the unique demands of waste fishing gear disposal, including the large volumes of waste generated by some fishing gears and the need to sort materials if waste pathways are to feed into a circular economy. Details of the fishing gear waste collection facilities and infrastructure observed at ports during field surveys are presented in Section 4. In most cases waste fishing gears are mixed with general waste, and details of general port waste management facilities are presented under Other Waste Issues below.

Some ports host fleets with specific gear types, which in turn create specific waste management challenges. For example, while Danish seine (cantrang) fisheries do not pose a high ALDFG risk (Section 5.4), in-port management of EOLFG is still required, particularly for warp ropes that are constructed from wrapped nylon Figure 31.

EOLFG recycling

Recycling of EOLFG provides opportunities to extract additional value from materials, while helping to reduce rates of ALDFG generation. However, the development of recycling initiatives must consider the characteristics of different gear and material types.

Data presented in Section 4.6 (particularly Table 15) indicates that almost 100 percent of hook-and-line gears and 25 percent of traps eventually become ALDFG. With these gears being relatively cheap, fishers have little incentive to invest time or effort into preserving or recovering gear. While a high proportion of these gears contribute to ALDFG and its associated impacts, the volumes of plastic involved in their construction are low. Consequently, recycling opportunities for these gears may be limited, and other preventative measures are likely to be more effective.

Figure 31. Waste warp ropes from Danish seine (cantrang) fishing gear in PPN Brondong.

In contrast, the high weights of plastics used by purse seine and drifting gillnet fleets make them ideal candidates for further investigation for recycling. Based on typical fishing patterns for these fleets, gear loss is likely to be relatively low and much of the 13,800 tonnes of end-of-life material that is replenished annually is re-purposed (e.g., as agricultural fencing) or disposed of in general waste. Purse seine and gillnets are also reported to have the highest rates of reuse and recycling (Section 4.5). This may correspond to the fact that both gears are usually made of PA (Nylon) which is considered to be a medium value material. These high rates, however, are location dependent. For example, similarly high rates of reuse and recycling are not found for Danish seines (cantrang) despite being made from the same materials. Danish seine fisheries are predominantly found in Sulawesi, and the low reuse and recycling rates may be due to the low number of collectors and recyclers in this locality.

In most sampled ports, however, the collection of EOLFG by re-users and recyclers does not occur. Contributing factors include: (i) mixing of various gear and material types; (ii) mixing of EOLFG with and other types of waste; (iii) contamination with sludge, fish waste, plastic and other materials; and (iv) lack of adequate waste fishing gear storage facilities to allow enough weight to accumulate to make collection economically viable. As a consequence, waste fishing gear enter the general solid waste stream and are disposed in landfill.

Some regional collection of waste fishing gears may occur when enough similar materials can be collected and where there are adequate storage facilities. For example, a pilot initiative was launched in Pekalongan in December 2019 which is still ongoing at the time of publication, and where net manufacturers in Indonesia purchase used nets from fisher co-

operatives to recycle into new nets. Fishers sell the nets to middlemen, who then sell the nets to various companies in Pekalongan and throughout Java, Sumatra and Kalimantan.
Limited availability of and accessibility to markets for waste plastic materials contributes to the low rate of waste fishing gear collection and recycling. It is estimated that there are less than ten plastic recycling businesses in Indonesia. The main fishing net recycling centers are in Cirebon, Tegal, Tangerang, Bekasi and Kalimantan. PP and PE are the main materials recycled in the general waste stream, but in terms of fishing waste, nylon is dominant. Polyester cannot be recycled but can be used by braiding into rope.

Developing markets for EOLFG

The development of markets for EOLFG can create the incentive structures that drive behavior change, leading to greater volumes of EOLFG entering waste pathways to be reused, recycled, or disposed of properly. Policy and regulatory frameworks have an important role to play in shaping the development of these markets.

Section 4 provides details about the EOLFG recycling initiatives encountered during this study. Many of these initiatives are at a nascent stage, and the continued development of EOLFG markets in Indonesia will require greater stakeholder knowledge and awareness about their potential, and the need for collectors to perceive clear economic benefits from collecting waste fishing gear compared to other plastic waste, which is plentiful and has more economic value. In their current form, fishing gear recycling initiatives in Indonesia appear to offer only marginal profitability, and are potentially loss-making once the capital costs of machinery are accounted for (Table 14). Policy and regulatory frameworks that promote price stability, market stability and market accessibility can establish the enabling conditions for market development, while greater economies of scale, increased supply (and hence lower cost) of raw materials, and/or cheaper processing costs can enhance the profitability of net recycling enterprises. The installation, maintenance and management of fit-for-purpose waste collection facilities at fishing ports can contribute to enhancing raw material supply and reducing costs by aggregating dispersed sources of waste, aiding the sorting of different gear and material types, and facilitating cleaning processes to minimize contamination.

PUBLIC-PRIVATE PARTNERSHIPS

Interviews conducted during this study revealed that practices introduced under earlier projects or initiatives have not been sustained, and that several port reception facilities are not operational. This highlights the need to ensure the upkeep and operation of facilities are integrated into the port waste management plans. Public-private partnerships (P3) have potential to deliver the investment, expertise, and services to develop, maintain and operate waste infrastructure over the long-term.

P3s are long-term contracts where the private sector designs, builds, finances and operates an infrastructure project. This process may or may not involve a Private Finance Initiative (PFI) process. P3s are being increasingly used by countries to invest in long-term, large-scale infrastructure development, especially in solid waste management. The rationale behind this approach is the ability of the private sector to often deliver projects and services in a more timely and cost-effective manner than the public sector, to spread a project's cost over a more extended period, and thus free up public funds for investment in sectors where private investment is impossible or inappropriate. The use of PFI and P3s include (Nishimura & Asahi, 2014):

- **Lower life cycle costs**, especially if long-term operation and maintenance (O&M) is included in the initial P3 partner selection process.
- **Better design**, as the public partners can set strict design specifications, and private sector partners can bring in specialist experience and knowledge to meet these specifications.
- **Improved quality of operations and maintenance services**, especially if longer-term O&M contacts are agreed. This helps quality targets to be set and met, as well as increased scope for operators to gain experience over the longer duration of the contract.
- **Efficient procurement**. Under traditional methods, goods and services are often purchased in small batches, so that small producers and providers are able to compete with large companies. While this has benefits for small businesses as a way of enhancing social welfare, it often does not provide an efficient or effective solution. P3s can allow a number of different elements of procurement e.g., design, construction, O&M all to be tendered in a single package.

P3s are gaining momentum in Indonesia[35] due to the GOI:

- Establishing and communicating a P3 legal framework that is now exceptionally strong and in line with global best practices, and with an emerging pipeline of P3s that have utilized the various tools and institutions that form the framework;

[35] https://blogs.worldbank.org/ppps/ppps-indonesia-are-gaining-momentum-these-5-steps-were-key

- Establishing a high-level de-bottlenecking committee in the form of the Committee for the Acceleration of Priority Infrastructure (KPPIP);
- Establish financing support for P3s, including the Indonesia Infrastructure Guarantee Facility (IIGF) and a finance facility;
- Creating a dedicated P3 unit within the Ministry of Finance; and
- Working with all development partners to participate and support the GOI vision.

There are, however, potential risks with P3s. It is important that these are carefully identified in advance, and that an appropriate risk allocation agreement is made between the public and private partners. Most importantly, projects should be carefully reviewed to ensure that P3s do indeed offer an effective and efficient solution.

The scale and dispersed nature of investments envisaged for ALDFG and EOLFG do not show an obvious fit for infrastructure-related P3. However, there is a need to engage with the private sector in developing the market for recycled plastic material from fishing and aquaculture gear. That engagement may highlight the need for significant investment that may be more suited to P3, e.g., in the expansion of recycling and manufacturing facilities.

OTHER WASTE ISSUES

The current study focuses on ALDFG and fishing gear waste, rather than general port waste issues. However, there is currently an overlap between waste fishing gear disposal and general waste disposal. The following information on port waste management is derived from information obtained during the field surveys, and is reported due to its relevance to fishing gear waste management.

Port waste management

Waste reception facilities and collection procedures in Indonesia's ports are often inadequate. Waste disposal facilities are not always provided throughout the port area, leading to the accumulation of general waste unless regular clean-up initiatives are implemented (Figure 32). While much of the waste is general and from land-based sources, waste fishing gear makes a significant contribution. Expanded polystyrene (EPS) from disused FADs, floats and fish boxes is particularly evident in some areas (Figure 32, bottom).

Figure 32: Fishing gear waste and general waste in PPN Pelabuhan Ratu (top) & PPS Bitung (bottom)

Some of the ports sampled during this study did have separate waste collection and storage facilities (Figure 33). However, these facilities are often inadequate. Storage facilities may be too small to accommodate the volumes of waste received and the frequency of waste collection. In addition, waste may spill from open skips due to the effects of wind or scavengers.

At PPN Pelabuhan Ratu 38 small solid waste bins are distributed throughout the port area. The volume of these waste bins varies from 0.3 to 0.6 m^3. Waste is collected from these bins 6-7 times per day by three carts attached to motorcycles. This waste is transferred to intermediate storage facilities consisting of open skips with a capacity of 8 m3. Trucks empty these skips 2-3 times per week and transport the waste to a landfill facility in Cibadak, 50 km away.

PPN Ternate has an 8-person team of janitors operating dump trucks (2 units), a crane truck (1 unit), forklifts (2 units), rubbish bins, and one intermediate storage skip of 12.9 m^3 capacity.

Solid waste in PPN Pekalongan is managed by the Port Authority. The Port Authority does not collect any data on the nature or volume of waste handled by the port, and environmental management is not currently certified to any international standard. However, there is an intention to obtain ISO 14,001 Environmental Management accreditation. Up to 50 tonnes of waste per week is collected from the temporary waste storage area in PPN Pekalongan. This is simply an open area without any liner, although a concrete facility is planned. Waste management facilities include 30 hard plastic waste bins, 2 drum composters for organic waste, 1 dump truck, 2 hand-carts and 2 moto-tricycles. The construction of additional waste management facilities in the port area is complicated because the land is owned by the state-owned enterprise Perum Perikanan Indonesia (PERINDO). PPN Pekalongan conducts sorting of plastic and non-plastic waste in all port areas:

- Organic waste is collected on a daily basis for composting, however this process is currently not operational because the officers have not been trained to operate the facility, and organic waste is currently sent to landfill together with the general waste;
- Plastic waste is collected and sold to private sector waste collectors; and
- Unsold waste is sent to landfill. A flat fee of IDR 50,000 (USD 3.40) per month is incurred.

In PPS Bitung and PPS Kendari storage facilities were built for plastic recycling (Figure 33), but these are not operational. It was also suggested that the replacement of plastic bottles used to be managed and recycled, but this is no longer the case. Plastic waste is therefore transported to landfill.

Figure 33: Intermediate waste storage facilities at PPN Pelabuhan Ratu (top) and PPN Ternate (bottom)

Figure 34: Plastic recycler unit in PPS Kendari (top) and the existing condition (bottom).

Figure 35: Unloading fish at the landing center of PPP Bajomulyo (top) and collection of waste plastic used by the cantrang fishers (bottom).

Some ports do have active arrangements to collect some of the plastic packaging waste used in fisheries, e.g., the plastic bags used to preserve demersal catch such as snapper in the Danish seine (cantrang) fishery (Figure 35). This occurs where there are sufficient quantities of similar waste types. These are then delivered to collection points in villages outside the port area for onward sorting and treatment. In the case of PPP Bajomulyo, the waste bags go to a collection point in Rembang village and then on to a plastics recycler in Surabaya (PT Pradha Karya Perkasa).

The above examples illustrate some of the common issues facing fishing ports in Indonesia. There is either a complete lack of or inadequate waste reception facilities. Where facilities have been provided, they are often not operational because the training or manpower to maintain these facilities is lacking.

In 2013 and 2014 MMAF and Agence Francaise de Development developed a project to conceptualize the notion of an ecofishing port and to apply this concept to a shortlist of Indonesian ports for a total budget of USD 107 million. The main issues to be addressed by the Ecofishing Port Project were to:

- Improve the efficiency of port operations by ensuring that physical flows and technical design support coherent port activities;
- Enhance environmentally friendly standards and approaches;
- Apply the principle of forward flow to prevent cross-contamination of products and preserve the products' initial quality; and
- Facilitate the monitoring of product unloading and traceability, and the improvement of production conditions.

Launch of the Ecofishing Ports Project was postponed until 2020, with three fishing ports (PPS Bitung, PPS Kendari and PPS Belawan) selected by MMAF for implementation of the project.

In several ports it was reported that a waste-manifest program for the fishing fleet was implemented in 2019/2020, but it appears that this program is no longer operating. In the initial phase, the waste-manifest program provided trash bags and required all fishers to bring back all of the waste onboard to the fishing port after each fishing trip. PPS Kendari is one of the few ports where this program continues to be operational with over six tonnes of trash collected from participating vessels and taken to landfill since July 2020.

Port Authorities are required to monitor port waste and report issues as part of their monthly Security, Neatness, Cleanliness, Beauty, and Work Safety (K5, *Keamanan, Ketertiban, Kebersihan, Keindahan, dan Keselamatan Kerja*) report. This initiative could be expanded to include the management of EOLFG and potentially ALDFG gathered as part of a 'Fishing for Litter' scheme that encourages fishers to bring ashore solid waste encountered while fishing.

Recommendations

This chapter presents recommendations (Table 17) for enhancing the prevention, mitigation and curing of ALDFG in Indonesia. Recommendations have been informed by the gear-specific assessment of risks of ecological impact (Section 5), existing initiatives to address ALDFG and EOLFG in Indonesia (Section 6), and global experience and best practices (Annex 8).

For each recommended intervention, an indication is presented of its feasibility to be implemented successfully in Indonesia. Based on expert judgement, a score of high, medium or low was awarded to each recommendation for its relevance, acceptability, enforceability and benefit-cost (rationale for the awarded scores are presented in Annex 11).

Relevance refers to the degree to which the proposed intervention is appropriate for the context and needs in Indonesia. A high relevance rating is awarded to proposed interventions that address issues and needs that have been explicitly identified by the Government of Indonesia.

Acceptability refers to the degree to which the proposed intervention is likely to meet the needs of and be accepted by Government of Indonesia and other key stakeholders. A high acceptability rating is awarded if the proposed intervention aligns with existing government strategic targets and/or regulatory frameworks, or if there is evidence of similar interventions having been implemented.

Enforceability refers to the degree to which stakeholder uptake of the proposed intervention can be adequately monitored and enforced. A high enforceability rating is awarded if there is an existing institution with an appropriate mandate, if an existing legal framework exists or could be adapted, and if there are few logistical constraints for adequate monitoring and enforcement of relevant stakeholder behaviors.

Benefit-cost refers to the estimated cost of implementation relative to estimated impact on ALDFG reduction. A high benefit-cost rating is awarded if the proposed intervention is likely to deliver a significant reduction in ALDFG while implementation costs are low.

Most recommendations are highly relevant to Indonesia, but some present challenges for implementation. For example, Extended Producer Responsibility (EPR) schemes for fishing gear are being developed in some countries, but are complex and costly to develop and are most suited to consistent trading standards across a large trading block like the European Union rather than in individual countries where much of the gear may be imported.

Prioritization of each recommendation was informed by expert judgement on its feasibility and urgency. Each recommendation was awarded a score of 1 (high priority) or 2 (low priority). The resulting long list of recommendations, together with feasibility and prioritization scores, represent the expert judgements of the team involved in this study. To inform the development of a Fisheries and Aquaculture Plastic Action Plan, these recommendations should be reviewed via a wider expert solicitation exercise involving local experts, decision-makers and other stakeholders. In particular, consideration should be given to efficient and effective sequencing of interventions.

Table 17: Recommended actions to enhance ALDFG prevention, mitigation, retrieval and circular economy in Indonesia, with an indication of feasibility and priority.

ALDFG PREVENTION
Awareness Raising

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	MEDIUM
Acceptability	HIGH
Benefit-cost	HIGH

PRIORITY
1

SPECIFIC ACTIONS

ALDFG awareness campaign
Targeted awareness campaigns on ALDFG as an extension to and integrated with GOI actions on plastic marine debris. Focus on fishers and fishing communities. Linked to 'fishing for litter' and improved collection facilities and systems in ports.

ALDFG PREVENTION
Marine spatial planning

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	MEDIUM
Acceptability	HIGH
Benefit-cost	HIGH

PRIORITY
2

SPECIFIC ACTIONS

MSP is already well established and being actively implemented in Indonesia, which will help to reduce gear conflict that is beneficial in ALDFG prevention.

ALDFG PREVENTION
Vessel design

FEASIBILITY SCORE

Relevance	MEDIUM
Enforceability	HIGH
Acceptability	MEDIUM
Benefit-cost	LOW

PRIORITY
2

SPECIFIC ACTIONS

The inclusion of effective gear storage and loss-prevention should be included in the future design specifications for vessels over 30GT as part of future regulatory revisions.

ALDFG MITIGATION
Fishing gear design

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	LOW
Acceptability	MEDIUM
Benefit-cost	MEDIUM

PRIORITY
2

SPECIFIC ACTIONS

There is potential to regulate and incentivize the use of recycled material in fishing gear, but first there is a need to develop recycling infrastructure and markets before setting requirements and targets for use of recycled materials. Alternatives such as biodegradable materials are as yet unproven as effective alternatives to plastic, focus on encouraging repairability and recyclability off equipment placed on the market.

ALDFG MITIGATION
Gear marking

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	LOW
Acceptability	LOW
Benefit-cost	LOW

PRIORITY
2

SPECIFIC ACTIONS

The GGGI/FAO gear-marking project with Indonesian small-scale gillnet fishers highlighted the challenges of implementing gear marking to the extent pro-

posed by the FAO gear marking guidelines. Gear marking requirements should be made more prominent and consistent in legislation (e.g., related to MSP). Existing informal approaches and limited enforceability mean that formal gear marking requirements through regulation are not proposed as a priority in the short-term.

EOLFG-ALDFG MITIGATION
Integrate ALDFG into fisheries management

PRIORITY

2

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	LOW
Acceptability	LOW
Benefit-cost	HIGH

SPECIFIC ACTIONS

The integration of ALDFG into fisheries management should be progressed as part of future regulatory revisions when reporting and collection systems are established. Acceptability could be increased through an effective communications strategy and engagement of stakeholders.

EOLFG-ALDFG RETRIEVAL
ALDFG reporting programs

PRIORITY

1

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	HIGH
Acceptability	MEDIUM
Benefit-cost	MEDIUM

SPECIFIC ACTIONS

ALDFG Reporting

Improved reporting of ALDFG is identified as a priority to better manage ALDFG and detailed proposals are provided in Section 6.4.

EOLFG-ALDFG RETRIEVAL
ALDFG Recovery Programs

PRIORITY

1

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	HIGH
Acceptability	HIGH
Benefit-cost	HIGH

SPECIFIC ACTIONS

Ghost Gear Retrieval Task Force

Task Force providing direct logistics support to local fisher, community and dive groups under a national programme of coastal and offshore retrieval. Intensive retrieval activities result in higher volume of waste in a short space of time to make collection and transport to recyclers more viable. Target ALDFG hotspots determined by volume, risk and impact.

Fishing for Litter Scheme

Introduce 'fishing for litter' schemes incentivizing fishers at ports with significant trawl fisheries to participate, providing on-board bags and waste collection facilities in ports for marine litter, including ALDFG.

CIRCULAR ECONOMY
Circular Design

PRIORITY

1

FEASIBILITY SCORE

Relevance	HIGH
Enforceability	MEDIUM
Acceptability	MEDIUM
Benefit-cost	HIGH

SPECIFIC ACTIONS

Circular Fishing Gear Development

R&D of a fishing / aquaculture gear product that can use EOLFG and/or post-consumer waste from recycled material, which can itself be recycled. E.g., plastic from net waste molded into durable fishing floats / weights that can replace the use of waste drinks bottles that are often lost and contribute to marine debris.

CIRCULAR ECONOMY
Buy-back scheme

PRIORITY
1

FEASIBILITY SCORE

Relevance HIGH
Enforceability MEDIUM
Acceptability MEDIUM
Benefit-cost HIGH

SPECIFIC ACTIONS

Gear Supplier Buy-back Scheme
Develop an EOLFG buy-back scheme in association with Indonesian fishing gear providers with incentives to encourage discounts on new gear for fishers returning their own EOLFG to them.

[Note: this differs from the 'fishing for litter' scheme to tackle marine litter including ALDFG]

CIRCULAR ECONOMY
Recycling and treatment markets

PRIORITY
1

FEASIBILITY SCORE

Relevance HIGH
Enforceability HIGH
Acceptability MEDIUM
Benefit-cost HIGH

SPECIFIC ACTIONS

EOLFG Recycling & Treatment Incentives
Prices quoted by the few recyclers currently receiving fishing net waste, indicate marginal profitability. Provide incentives for recyclers to receive material from the operators and ports associated with the main EOLFG volumes, facilitated by improved gear separation, cleaning & delivery to reduce overheads. Build demand for recycled EOLFG material to improve prices.

This could be linked with buy-back scheme and with R&D circular design of fishing gear to develop an appropriate end-use for the resulting recycled material, e.g. production of durable floats and weights out of for fishing and aquaculture gear to replace the plastic bottles used currently.

CIRCULAR ECONOMY
Waste Reception Facilities

PRIORITY
1

FEASIBILITY SCORE

Relevance HIGH
Enforceability LOW
Acceptability LOW
Benefit-cost HIGH

SPECIFIC ACTIONS

EOLFG reception facilities
Port Reception Facilities are being progressed by GOI as part of MARPOL Annex V implementation. There is an associated need for separate, dedicated collection EOLFG facilities in and around key fishing ports with significant volumes of EOLFG. These facilities will enable the development of an EOLFG supply chain by being linked to an EOLFG collection system.

CIRCULAR ECONOMY
Engagement with waste operators

PRIORITY
1

FEASIBILITY SCORE

Relevance HIGH
Enforceability N/A
Acceptability HIGH
Benefit-cost HIGH

SPECIFIC ACTIONS

Development of an EOLFG supply chain
Engagement with waste operators, including financial incentives to develop linkages between the informal waste collectors, recyclers and plastics manufacturers to create an EOLFG value chain. Currently EoLFG collectors are neither organized nor registered. Engagement should result in organization of waste collectors e.g. under cooperation scheme with local authority; linked to introduction of waste reception facilities & incentive scheme to encourage collection as part of EOLFG supply chain.

CIRCULAR ECONOMY
Engagement with other stakeholders

PRIORITY

1

FEASIBILITY SCORE

Relevance
HIGH

Enforceability
N/A

Acceptability
HIGH

Benefit-cost
MEDIUM

SPECIFIC ACTIONS

The variety in volumes and plastic types of ALDFG and EOLFG material mean that it is important to integrate with the wider circular economy wherever possible to increase viability and interest in fishing gear waste.

CIRCULAR ECONOMY
Enabling gear repair activities

PRIORITY

2

FEASIBILITY SCORE

Relevance
MEDIUM

Enforceability
MEDIUM

Acceptability
MEDIUM

Benefit-cost
LOW

SPECIFIC ACTIONS

Gear repair occurs irrespective of ideal facilities being available.

Training fisher to enable them to repair, as has been carried out by GOI is a greater priority.

Gear repair facilities incorporated as part of fishing port development & regeneration.

CIRCULAR ECONOMY
Extended Producer Responsiblitiy (EPR) scheme

PRIORITY

2

FEASIBILITY SCORE

Relevance
HIGH

Enforceability
LOW

Acceptability
LOW

Benefit-cost
LOW

SPECIFIC ACTIONS

EPR schemes are proven to be very effective in certain sectors, but the fishing gear sector creates challenges for EPR, which does not appear feasible in the short-term until ALDFG is better monitored, collection systems and recycling markets are developed.

References

Aida, K.N., Agustang, A., Arlin, A. & Agustang, A.D.M. (2020). The patron-client relationship patterns in Siwa Lima fishermen community, Aru Islands district Maluku, Indonesia. International Journal of Scientific and Technology Research, 9(2), 74-77.

Andréfouët, S., Thomas, Y. & Lo, C. (2014). Amount and type of derelict gear from the declining black pearl oyster aquaculture in Ahe atoll lagoon, French Polynesia. Mar. Pollut. Bull., 83(1): 224-230.

Antonelis, K., Huppert, D., Velasquez, D. & June, J. (2011). Dungeness crab mortality due to lost traps and a cost-benefit analysis of trap removal in Washington State waters of the Salish Sea. North Am. J. Fish. Manag., 31 (5): 880–893. doi: 10.1080/02755947.2011.590113

APEC (2004). Derelict Fishing Gear and related marine debris: An educational outreach seminar among APEC partners. Fisheries Working Group

APEC/GGGI (2021) Managing Abandoned, Lost or Discarded Fishing Gear and Aquaculture Equipment in the APEC Region. MMAF, Indonesia questionnaire response.

Ayaz, A., Acarli, D., Altinagac, U., Ozekinci, U., Kara, A. & Ozen, O. (2006). Ghost fishing by monofilament and multifilament gillnets in Izmir Bay, Turkey. Fish. Res., 79: 267–271. doi: 10.1016/j.fishres.2006.03.029

Baeta, F., Jose Costa, M., & Cabral, H. (2009). Trammel nets ghost fishing off the Portuguese central coast. Fish. Res. 98: 33–39. doi: 10.1016/j. fishres.2009.03.009

Barclay, K., McClean, N., Adhuri, D.S., Sulu, R. & Fabinyi, M. (2020). Gender in tuna value chains: Case studies from Indonesia and Solomon Islands. SPC-The Pacific Community-Women in Fisheries. Information Bulletin, 31(9).

Barnes, D.K., Galgani, F., Thompson, R.C. & Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. Philos Trans R Soc Lond B Biol Sci 364(1526): 1985-1998. doi:10.1098/rstb.2008.0205

Bendell, L.I. (2015). Favored use of anti-predator netting (APN) applied for the farming of clams leads to little benefits to industry while increasing nearshore impacts and plastics pollution. Mar. Pollut. Bull., 91(1): 22-28.

Boren, L.J., Morrissey, M., Muller, C.G. & Gemmell, N.J. (2006). Entanglement of New Zealand fur seals in man-made debris at Kaikoura, New Zealand. Mar Pollut Bull 52(4): 442-446. doi:10.1016/j.marpolbul.2005.12.003

BPS (2019). Statistics of Fishing Ports 2018. Badan Pusat Statistik (Central Bureau of Statistics), Government of Indonesia.

Brown, J., Macfadyen, G., Huntington, T., M.J. \& Tumilty, J. (2005). Ghost Fishing by Lost Fishing Gear. Final Report to DG Fisheries and Maritime Affairs of the European Commission (Fish/2004/20). Institute for European Environmental Policy \& Poseidon Aquatic Resource Management Ltd.

Butler, C.B., Gutzler, B.C. & Matthews, T.R. (2018). Sublethal and lethal effects of confinement of Caribbean spiny lobsters, Panulirus argus, in ghost traps. Bull. Mar. Sci. 94(3): 1153-1169. doi: 10.5343/bms.2017.1137

CBD - Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel— GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pp.

Charter, M. & Carruthers, R. (2022). Products from waste fishing nets: accessories, clothing, footwear, home ware and recreation. Centre for Sustainable Design (CfSD)

Chen, W.-Q., Ciacci, L., Sun, N.-N., & Yoshioka, T. (2020). Sustainable cycles and management of plastics: A brief review of RCR publications in 2019 and early 2020. Resources, Conservation and Recycling 159; 104822. doi:10.1016/j.resconrec.2020.104822

Cho, D.-O. (2009). The incentive program for fishermen to collect marine debris in Korea. Mar Pollut Bull 58(3): 415-417. doi:10.1016/j.marpolbul.2008.10.004

Consoli, P., Romeo, T., Angiolillo, M., Canese, S., Esposito, V., Salvati, E., Scotti, G., Andaloro, F. & Tunesi, L. (2019). Marine litter from fishery activities in the Western Mediterranean Sea: The impact of entanglement on marine animal forests. Environ Pollut 249: 472-481. doi:10.1016/j.envpol.2019.03.072

Consoli, P., Sinopoli, M., Deidun, A., Canese, S., Berti, C., Andaloro, F. & Romeo, T. (2020). The impact of marine litter from fish aggregation devices on vulnerable marine benthic habitats of the central Mediterranean Sea. Mar Pollut Bull, 152, 110928. doi:10.1016/j.marpolbul.2020.110928

Dameron, O.J., Parke, M., Albins, M.A. & Brainard, R. (2007). Marine debris accumulation in the Northwestern Hawaiian Islands: an examination of rates and processes. Mar Pollut Bull, 54(4), 423-433. doi:10.1016/j.marpolbul.2006.11.019

De Alessi, M. (2014). Archipelago of Gear: The Political Economy of Fisheries Management and Private Sustainable Fisheries Initiatives in Indonesia. Asia & the Pacific Policy Studies, 1(3), 576-589. doi:10.1002/app5.40

DelBene, J.A., Bilkovic, D.M. & Scheld, A.M. (2019) Examining derelict pot impacts on harvest in a commercial blue crab Callinectes sapidus fishery. Mar. Pollut. Bull. 139, pp. 150-156. doi:10.1016/j.marpolbul.2018.12.014

Derraik, J.G.B. (2002). The pollution of the marine environment by plastic debris: a review. Mar. Pollut. Bull. 44:9, 842-852. doi: 10.1016/S0025-326X(02)00220-5

Dixon, C., Satria, F., Wudianto, Nurdin, E., Utama, A.A., Mahiswara, Toole, J., He, P. (2018). Gear Marking Pilot Study in Indonesian Small-Scale Gillnet Fisheries with Reference to FAO's Draft Guidelines on the Marking of Fishing Gear. FAO Fisheries and Aquaculture Technical Paper No.T632. Rome, FAO. 2018. 31 pp + appendices

Donohue, M.J., Boland, R.C., Sramek, C.M. & Antonelis, G.A. (2001). Derelict fishing gear in the northwestern Hawaiian Islands: diving surveys and debris removal in 1999 confirm threat to coral reef ecosystems. Mar Pollut Bull, 42(12), 1301-1312. doi:10.1016/s0025-326x(01)00139-4

Drinkwin, J. 2022. Reporting and retrieval of lost fishing gear: recommendations for developing effective programmes. Rome, Food and Agriculture Organization of the United Nations and International Maritime Organization of the United Nations. https://doi.org/10.4060/cb8067en

EIA. (2022). Convention on Plastic Pollution. Essential Elements: Fishing Gear. Environmental Investigation Agency.

English, E., Wagner, C. & Holmes, J. (2019). The Effects of Marine Debris on Beach Recreation and Regional Economies in Four Coastal Communities: A Regional Pilot Study. National Oceanic and Atmospheric Administration, Silver Spring, USA.

Enrichetti, F., Bavestrello, G., Betti, F., Rindi, F., Tregrosso, A. & Bo, M. (2021). Fate of lost fishing gears: Experimental evidence of biofouling colonization patterns from the northwestern Mediterranean Sea. Environ Pollut 268: 115746. doi:10.1016/j.envpol.2020.115746

Eunomia (2016). Plastics in the Marine Environment. Eunomia Research and Consulting, Bristol, UK

FAO (1978). FAO catalogue of fishing gear designs. Food and Agriculture Organization of the United Nations, Rome.

FAO (1982). Netting Materials for Fishing Gear. Gerhard Klust, Fishing News Books. Ltd.

FAO (1990) Fisherman's Workbook. Fisheries Department of the Food and Agriculture Organization of the United Nations, Rome.

FAO (2016a). Abandoned, lost and discarded gillnets and trammel nets: methods to estimate ghost fishing mortality, and the status of regional monitoring and management> Written by Eric Gilman, Francis Chopin, Petri Suuronen and Blaise Kuemlangan. FAO Fisheries and Aquaculture Technical Paper No. 600. Rome. Italy. 79 pp. ISBN 978-92-5-108917-0. http://www.fao.org/3/a-i5051e.pdf

FAO (2016b). Report of the Expert Consultation on the Marking of Fishing Gear, Rome, Italy, 4–7 April 2016. FAO Fisheries and Aquaculture Report No. 1157. Rome, Italy. http://www.fao.org/3/a-i5729e.pdf

FAO (2019b). Report of the Thirty-third Session of the Committee on Fisheries, Rome, Italy 9–13 July 2018. FAO Fisheries and Aquaculture, Report No. 1249. Food and Agriculture Organization of the United Nations, Rome.

FAO (2019b). Voluntary guidelines on the marking of fishing gear. Rome. 88 pp. License: CC BY-NC-SA 3.0 IGO. http://www.fao.org/3/ca3546t/ca3546t.pdf

Foley, C.J., Feiner, Z.S., Malinich, T.D. & Höök, T.O. (2018). A meta-analysis of the effects of exposure to microplastics on fish and aquatic invertebrates. Sci Total Environ 631-632: 550-559. doi:10.1016/j.scitotenv.2018.03.046

Franson, J.C., Hansen, S.P., Creekmore, T.E., Brand, C.J., Evers, D.C., Duerr, A.E. & DeStefano, S. (2003). Lead Fishing Weights and Other Fishing Tackle in Selected Waterbirds. Waterbirds 26(3): 345-352. doi:10.1675/1524-4695(2003)026[0345:lfwaof]2.0.co;2

GESAMP (2015). Sources, fate and effects of microplastics in the marine environment: a global assessment. Rep. Stud. GESAMP No. 90. IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, pp. 96.

GESAMP (2021). Sea-based sources of marine litter – a review of current knowledge and assessment of data gaps (second interim report of GESAMP Working Group 43, 4 June 2020). 110 pp. http://www.fao.org/3/cb0724en/cb0724en.pdf

Gilardi, K. V., Carlson-Bremer, D., June, J. A., Antonelis, K., Broadhurst, G., & Cowan, T. (2010). Marine species mortality in derelict fishing nets in Puget Sound, WA and the cost/benefits of derelict net removal. Mar Poll Bull 60: 376–382. doi: 10.1016/j.marpolbul.2009.10.016

Gilman, E. (2015). Status of international monitoring and management of abandoned, lost and discarded fishing gear and ghost fishing. Mar Policy 60: 225-239. doi:10.1016/j.marpol.2015.06.016

Gilman, E., Bigler, B., Muller, B., Moreno, G., Largacha, E., Hall, M., Poisson, F., Toole, J., He, P. & Chaing, W. (2018). Stakeholder Views on Methods to Identify Ownership and Track the Position of Drifting Fish Aggregating Devices Used by Tuna Purse Seine Fisheries with Reference to FAO's Draft Guidelines on the Marking of Fishing Gear. FAO Fisheries Circular 1163, Food and Agriculture Organization of the United Nations, Rome

Gilman, E., Humberstone, J., Wilson, J.R., Chassot, E., Jackson, A. & Suuronen, P. (2022). Matching fishery-specific drivers of abandoned, lost and discarded fishing gear to relevant interventions. Mar Policy 141, 105097. doi:10.1016/j.marpol.2022.105097

Gilman, E., Musyl, M., Suuronen, P., Chaloupka, M., Gorgin, S., Wilson, J. & Kuczenski, B. (2021). Highest risk abandoned, lost and discarded fishing gear. Nature Scientific Reports 11: 7195 . doi: 10.1038/s41598-021-86123-3

Glaser, M., Breckwoldt, A., Deswandi, R., Radjawali, I., Baitoningsih, W. & Ferse, S.C.A. (2015). Of exploited reefs and fishers – A holistic view on participatory coastal and marine management in an Indonesian archipelago. Ocean & Coastal Management, 116, 193-213. doi:10.1016/j.ocecoaman.2015.07.022

Global Ghost Gear Initiative (2021). Best Practice Framework for the Management of Fishing Gear. Prepared by Huntington, T. of Poseidon Aquatic Resources Management Ltd. for GGGI. 95 pp. plus appendices. https://www.ghostgear.org/s/GGGI-Best-Practice-Framework-for-the-Management-of-Fishing-Gear-C-BPF-2021-Update-FINAL.pdf

Good, T.P., June, J.A., Etnier, M.A. & Broadhurst, G. (2009). Ghosts of the Salish Sea: threats to marine birds in Puget Sound and the Northwest Straits from derelict fishing gear. Mar Ornithol 37: 67-76.

Good, T.P., June, J.A., Etnier, M.A. & Broadhurst, G. (2010). Derelict fishing nets in Puget Sound and the Northwest Straits: patterns and threats to marine fauna. Mar. Pollut. Bull. 60, 39-50. doi:10.1016/j.marpolbul.2009.09.005

Goodman, A.J., McIntyre, J., Smith, A., Fulton, L., Walker, T.R. \& Brown, C.J. (2021). Retrieval of abandoned, lost, and discarded fishing gear in Southwest Nova Scotia, Canada: Preliminary environmental and economic impacts to the commercial lobster industry. Mar Pollut Bull 171: 112766. doi:10.1016/j.marpolbul.2021.112766.

Gregory, M.R. (2009). Environmental implications of plastic debris in marine settings--entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. Philos Trans R Soc Lond B Biol Sci, 364(1526), 2013-2025. doi:10.1098/rstb.2008.0265

Gude, L., Pangemanan, J.F. & Lumenta, V. (2017). Analisis Peranan Perempuan pada Rantai Nilai Pemasaran Tuna Cakalang di Tempat Pelelangan ilkan (TPI) Aertembaga Kota Bitung. AKULTURASI (Jurnal Ilmiah Agrobisnis Perikanan), 5(9). doi:10.35800/akulturasi.5.9.2017.16988

Gündoğdu, S., Çevik, C. & Karaca, S. (2017). Fouling assemblage of benthic plastic debris collected from Mersin Bay, NE Levantine coast of Turkey. Mar Pollut Bull, 124(1), 147-154. doi:10.1016/j.marpolbul.2017.07.023

Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C. Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M. P., Perry, M.T., Selig, E.R., Spalding, M., Steneck, R., Watson, R. (2008). A Global Map of Human Impact on Marine Ecosystems. Science: 319:5865, 948-952. doi: 10.1126/science.1149345

Hanni, K.D. & Pyle, P. (2000). Entanglement of Pinnipeds in Synthetic Materials at South-east Farallon Island, California, 1976--1998. Mar Pollut Bull 40(12): 1076-1081. doi:10.1016/s0025-326x(00)00050-3

Hanni, K.D., Long, D.J., Jones, R.E., Pyle, P., Morgan, L.E., 1997. Sightings and strandings of Guadalupe fur seals in Central and Northern California, 1988–1995. Journal of Mammalogy 78 (2), 684–690.

Harrison, J.P., Sapp, M., Schratzberger, M. & Osborn, A.M. (2011). Interactions Between Microorganisms and Marine Microplastics: A Call for Research. Mar Tech Soc J, 45(2), 12-20. doi:10.4031/mtsj.45.2.2

He, P. & Suuronen, P. (2018). Technologies for the marking of fishing gear to identify gear components entangled on marine animals and to reduce abandoned, lost or otherwise discarded fishing gear. Mar Pollut Bull 129: 253-261. doi:10.1016/j.marpolbul.2018.02.033

He, P., Chopin, F., Suuronen, P., Ferro, R.S.T and Lansley, J. 2021. Classification and illustrated definition of fishing gears. FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. doi: 10.4060/cb4966en

Hong, S., Lee, J. & Lim, S. (2017). Navigational threats by derelict fishing gear to navy ships in the Korean seas. Mar Pollut Bull 119(2): 100-105. doi:10.1016/j.marpolbul.2017.04.006

Huntington, T (2019). Marine Litter and Aquaculture Gear –White Paper. Report produced by Poseidon Aquatic Resources Management Ltd for the Aquaculture Stewardship Council. 20 pp. https://www.asc-aqua.org/what-we-do/programme-improvements/gear-management/#marine-litter-and-aquaculture-gear-asc-white-paper

Huntington, T (2020). Best Practice Framework for the Management of Fishing Gear: September 2020 Update. Report produced by Poseidon Aquatic Resources Management Ltd for GGGI. 82 pp plus appendices. In press.

ICPC (2021). Fish Aggregation Devices: Risks to Submarine Cable Deployment and Operations: An Annex to Government Best Practices for Protecting and Promoting Resilience of Submarine Telecommunications Cables. International Cable Protection Committee, Portsmouth, UK.

IMO (2018) Action Plan to Address Marine Litter from Ships, Resolution MEPC.310(73), 26 October 2018. International Maritime Organization Marine Environmental Protection Committee. http://www.imo.org/en/MediaCentre/HotTopics/marinelitter/Documents/IMO%20marine%20litter%20action%20plan%20MEPC%2073–19-Add-1.pdf

Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R. & Law, K.L. (2015). Plastic waste inputs from land into the ocean. Science, 347(6223), 768-771. doi:10.1126/science.1260352

Jang, Y.C., Lee, J., Hong, S., Mok, J.Y., Kim, K.S., Lee, Y.J., Choi, H.W., Kang, H. & Lee, S. (2014). Estimation of the annual flow and stock of marine debris in South Korea for management purposes. Mar. Pollut. Bull., 86(1): 505-511.

Juan, R., Domínguez, C., Robledo, N., Paredes, B., Galera, S., \& García-Muñoz, R. A. (2021). Challenges and Opportunities for Recycled Polyethylene Fishing Nets: Towards a Circular Economy. Polymers 13(18): 3155. doi:10.3390/polym13183155

Jumadi, I.S., Pangemanan, J.F. & Tambani, G.O. (2017). Analisis Peran Perempuan dalam Rantai Nilai Ikan Kaleng Produk Tuna Cakalang di PT. Delta Pasific Indotuna di Kota Bitung Provinsi Sulawesi Utara. AKULTURASI (Jurnal Ilmiah Agrobisnis Perikanan), 5(9). doi:10.35800/akulturasi.5.9.2017.16986

Kaiser, M., Bullimore, B., Newman, P., Lock, K., Gilbert, S. (1996) Catches in 'ghost fishing' set nets. Mar. Ecol. Prog. Ser. 145, 11-16. doi:10.3354/meps145011

Kroodsma, D.A., Mayorga, J., Hochberg, T., Miller, N.A., Boerder, K., Ferretti, F., Wilson, A., Bergman, B., White, T.D., Block, B.A., Woods, P., Sullivan, B., Costello, C. & Worm, B. (2018). Tracking the global footprint of fisheries. Science 359:6378, 904-908. doi:10.1126/science.aao5646

Kuczenski, B., Vargas, C., Gilman, E., Musyl, M., Geyer, R. & Wilson, J. (2021). Plastic gear loss estimates from remote observation of industrial fishing activity. Fish., 23: 22-33. doi: 10.1111/faf.12596

Laist, D.W. (1996). Marine debris entanglement and ghost fishing: a cryptic and significant type of bycatch. Proceedings from Solving Bycatch: Considerations for Today and Tomorrow, September 25-27, 1995, Seattle, Washington.

Laist, D.W., 1997. Impacts of marine debris: entanglement of marine life in marine debris including a comprehensive list of species with entanglement and ingestion records. In: Coe, J.M., Rogers, D.R. (Eds.), Marine Debris: Sources, Impacts and Solutions, 99–139. Springer-Verlag, New York, NY

Lau, W.W.Y., Shiran, Y., Bailey, R.M., Cook, E., Stuchtey, M.R., Koskella, J., Velis, C.A., Godfrey, L., Boucher, J., Murphy, M.B., Thompson, R.C., Jankowska, E., Castillo, A., Pilditch, T.D., Dixon, B., Koerselman, L., Kosior, E., Favoino, E., Gutberlet, J., Baulch, S., Atreya, M.E., Fischer, D., He, K.K., Petit, M.M., Sumaila, U.R., Neil, E., Bernhofen, M.V., Lawrence, K. & Palardy, J.E. (2020). Evaluating scenarios toward zero plastic pollution. Science, 369(6510), 1455-1461. doi:10.1126/science.aba9475

Lee, J., Lee, J.S., Jang, Y.C., Hong, S.Y., Shim, W.J., Song, Y.K., Hong, S.H., Jang, M., Han, G.M., Kang, D. & Hong, S. (2015). Distribution and size relationships of plastic marine debris on beaches in South Korea. Arch. Environ. Contam. Toxicol., 69(3): 288-298

Levin, L.A., Ekau, W., Gooday, A.J., Jorissen, F., Middelburg, J.J., Naqvi, S.W.A., Neira, C., Rabalais, N.N. & Zhang, J. (2009). Effects of natural and human-induced hypoxia on coastal benthos. Biogeosciences, 6(10), 2063-2098. doi:10.5194/bg-6-2063-2009

Lusher, A.L., Hollman, P.C.H., Mendoza-Hill, J.J. (2017). Microplastics in fisheries and aquaculture: status of knowledge on their occurrence and implications for aquatic organisms and food safety. FAO Fisheries and Aquaculture Technical Paper. No. 615. Rome, Italy. http://www.fao.org/3/a-i7677e.pdf

Macfadyen, G., Huntington, T., and Cappell, R. (2009). Abandoned, lost or otherwise discarded fishing gear. UNEP Regional Seas Reports and Studies, No. 185; FAO Fisheries and Aquaculture Technical Paper, No. 523. ISBN 978–92-5–106196-1. United Nations Environment Programme and Food and Agriculture Organization of the United Nations, Nairobi and Rome.

MacMullen, P., Hareide, N., Furevik, D.M., Larsson, P., Tschernij, V., Dunlin, G., Revill, A., Pawson, M., Puente, E. & Uriarte, A. (2003). Study to Identify, Quantify and Ameliorate the Impacts of Static Gear Lost at Sea: EU Study Contract FAIR CT98-4338 Final Report. Prepared for the Commission of the European Communities by Sea Fish Industry Authority, Hull, UK.

Mariñoa, M., A. Breckwoldt, M. Teichberg, A. Kasec & H. Reuter (2019). Livelihood aspects of seaweed farming in Rote Island, Indonesia. Marine Policy 107 (2019) 103600 https://doi.org/10.1016/j.marpol.2019.103600

Matthews, T. and R. Glazer (2010). Assessing Opinions on Abandoned, Lost, or Discarded Fishing Gear in the Caribbean. GCFI: 62 (2010) In Proc. 62nd Gulf and Caribbean Fisheries Institute Nov 2 - 6, 2009 Cumana, Venezuela

McCauley, S., Bjorndal, K. (1999) Conservation implications of dietary dilution from debris ingestion: sublethal effects in post-hatchling loggerhead sea turtles. Conserv. Biol., 13(4): 925-929. doi: 10.1046/j.1523-1739.1999.98264.x

Miralles, L., Gomez-Agenjo, M., Rayon-Viña, F., Gyraitė, G. & Garcia-Vazquez, E. (2018). Alert calling in port areas: Marine litter as possible secondary dispersal vector for hitchhiking invasive species. Journal for Nature Conservation, 42, 12-18. doi:10.1016/j.jnc.2018.01.005

MMAF (2018). Marine and Fisheries in Figures 2018. Ministry of Marine Affairs and Fisheries, Government of Indonesia.

MoEF (2020) National Plastic Waste Reduction Strategic Actions for Indonesia. Ministry of Environment and Forestry, Republic of Indonesia https://wedocs.unep.org/bitstream/handle/20.500.11822/32898/NPWRSI.pdf?sequence=1&isAllowed=y

Moore, M.J., van der Hoop, J., Barco, S.G., Costidis, A.M., Gulland, F.M., Jepson, P.D., Moore, K.T., Raverty, S. & McLellan, W.A. (2013). Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma. Dis Aquat Org 103(3): 229-264. doi:10.3354/dao02566

MSC (2021). Fisheries Standard Review. Supporting the Prevention of Gear Loss and Ghost Fishing. Impact Assessment Report. By McLennan, S., Cappell, R., Huntington, T. Marine Stewardship Council, London.

Muawanah, U., Arthatiani, F.Y., Soedjarwo, P.A., Kurniasari, N., Sari, Y.D., Zulham, A., Koeshenderajana, S. & Hikmah, H. (2021). Small scale tuna fisheries profiles in the Indonesia archipelagic waters. IOP Conference Series: Earth and Environmental Science, 869(1), 012017. doi:10.1088/1755-1315/869/1/012017

Neish, I.C. (2013). Social and economic dimensions of carrageenan seaweed farming in Indonesia. In D. Valderrama, J. Cai, N. Hishamunda & N. Ridler, eds. Social and economic dimensions of carrageenan seaweed farming, pp. 61–89. Fisheries and Aquaculture Technical Paper No. 580. Rome, FAO. 204 pp .

Nishimura & Asahi (2014). Vietnam: Capacity Building Program for Promoting Private Sector Participation. Report to the Public-Private Infrastructure Advisory Facility (PPIAF). May 2014. https://ppiaf.org/documents/3660/download

NOAA (2015). Report on the Impacts of “Ghost Fishing” Via Derelict Fishing Gear. NOAA Marine Debris Program, Silver Spring, MD

NOAA (2016). Report on Marine Debris Impacts on Coastal and Benthic Habitats. National Oceanic and Atmospheric Administration Marine Debris Program, Silver Spring, MD

OECD (2021). Towards G7 Action to Combat Ghost Fishing Gear. OECD ENVIRONMENT POLICY PAPER NO. 25. 55 pp.

Orós, J., Montesdeoca, N., Camacho, M., Arencibia, A. & Calabuig, P. (2016). Causes of Stranding and Mortality, and Final Disposition of Loggerhead Sea Turtles (Caretta caretta) Admitted to a Wildlife Rehabilitation Center in Gran Canaria Island, Spain (1998-2014): A Long-Term Retrospective Study. PLOS ONE 11(2): e0149398. doi:10.1371/journal.pone.0149398

OSPAR. 2020. OSPAR Scoping Study on Best Practices for the Design and Recycling of Fishing Gear as a Means to Reduce Quantities of Fishing Gear Found as Marine Litter in the North-East Atlantic. OSPAR Commission, London.

Proctor, C., Natsir, M., Mahiswara, Widodo, A., Utama, A, Wudianto, Satria, F., Hargiyatno, I., Sedana, I., Cooper, S., Sadiyah, L., Nurdin, E., Anggawangsa, R., Susanto, K. (2019) A Characterisation of FAD-Based Tuna Fisheries in Indonesian Waters. ACIAR Project FIS/2009/059, Australian Centre for International Agricultural Research, Canberra. ISBN: 978-0-646-80326-5

Purwasih, J.D., Wibowo, B.A. & Triarso, I. (2016). Analisis perbandingan pendapatan nelayan pukat cincin (purse seine) dan pancing tonda (troll line) di PPP Tamperan Pacitan, Jawa Timur. Journal of Fisheries Resources Utilization Management and Technology, 5(1), 37-46.

Rech, S., Borrell, Y. & García-Vazquez, E. (2016). Marine litter as a vector for non-native species: What we need to know. Mar Pollut Bull, 113(1-2), 40-43. doi:10.1016/j.marpolbul.2016.08.032

Richardson, K, Hardesty, B.D., Wilcox, C. (2019). Estimates of fishing gear loss rates at a global scale: a literature review and meta-analysis. Fish and Fisheries 20:6, pp. 1218-1231. doi: 10.1111/faf.12407

Richardson, K., Gunn, R., Wilcox, C., Hardesty, B.D. (2018) Understanding causes of gear loss provides a sound basis for fisheries management. Mar. Policy, 96, pp. 278-284 doi: 10.1016/j.marpol.2018.02.021

Richardson, K., Hardesty, B., Vince, J., Wilcox, C. (2021) Global causes, drivers, and prevention measures for lost fishing gear. Front. Mar. Sci. 8, 690447. doi: 10.3389/fmars.2021.6900447

Richardson, K., Haynes, D., Talouli, A., & Donoghue, M. (2017). Marine pollution originating from purse seine and longline fishing vessel operations in the Western and Central Pacific Ocean, 2003–2015. Ambio, 46, 190–200. https://doi.org/10.1007/s13280-016-0811-8

Richardson, K., Wilcox, C., Vince, J., & Hardesty, B. D. (2021). Challenges and misperceptions around global fishing gear loss estimates. Marine Policy 129: 104522. doi: 10.1016/j.marpol.2021.104522

Rochman, C.M. (2015). The Complex Mixture, Fate and Toxicity of Chemicals Associated with Plastic Debris in the Marine Environment. In M. Bergmann, L. Gutow,\& M. Klages (Eds.), Marine Anthropogenic Litter (pp. 117-140). Springer International Publishing, Cham. doi:10.1007/978-3-319-16510-3_5

Rodrigues, F. L., Lourenço, R., Secchi, E. R., Kessler, F., & Proietti, M. C. (2019). Plastics in sea surface waters round the Antarctic Peninsula. Scientific Reports (Nature Publisher Group), 9(1).

Sancho, G., E. Puente, A. Bilbao, E. Gomez, & L. Arregi (2003). Catch rates of monkfish (Lophius spp.) by lost tangle nets in the Cantabrian Sea (northern Spain). Fisheries Research, 64: 129–139. https://www.sciencedirect.com/science/article/abs/pii/S0165783603002121

Satria, A. (2015). Pengantar sosiologi masyarakat pesisir. Jakarta, Indonesia: Bogor Agricultural Institute.

Scheld, A.M., D.M. Bilkovic, and K.J. Havens, K.J. (2016). The Dilemma of Derelict Gear. Scientific Reports 6, Article Number 19671. 7 pp.. http://www.nature.com/articles/srep19671

Sciortino, J.A. (2010). Fishing Harbour Planning, Construction and Management. Fisheries and Aquaculture Technical Paper 539. Food and Agriculture Organization of the United Nations

Simberloff, D., Martin, J.L., Genovesi, P., Maris, V., Wardle, D.A., Aronson, J., Courchamp, F., Galil, B., García-Berthou, E., Pascal, M., Pyšek, P., Sousa, R., Tabacchi, E. & Vilà, M. (2013). Impacts of biological invasions: what's what and the way forward. Trends Ecol Evol, 28(1), 58-66. doi:10.1016/j.tree.2012.07.013

Sinaga, H., Widiono, S. & Irnad, I. (2015). Pola Hubungan Patron-Klien Pada Komunitas Nelayan Di Kelurahan Malabro Kecamatan Teluk Segara Kota Bengkulu. Jurnal AGRISEP: Kajian Masalah Sosial Ekonomi Pertanian dan Agribisnis, 14(2), 167-176

Sinopoli, M., Cillari, T., Andaloro, F., Berti, C., Consoli, P., Galgani, F., Romeo, T. (2020). Are FADs a significant source of marine litter? Assessment of released debris and mitigation strategy in the Mediterranean Sea. J. Environ. Manag., 253, 109749. doi: 10.1016/j.jenvman.2019.109749

Stelfox, M., Hudgins, J. & Sweet, M. (2016). A review of ghost gear entanglement amongst marine mammals, reptiles and elasmobranchs. Mar Pollut Bull, 111(1-2), 6-17. doi:10.1016/j.marpolbul.2016.06.034

Stevens, B. (2021). The ups and downs of traps: environmental impacts, entanglement, mitigation and the future of trap fishing for crustaceans and fish. ICES J. Mar. Sci., 78, 584-596. doi: 10.1093/icesjms/fsaa135

Sumiono, B. (1997). Fishing activities in relation to commercial and small-scale fisheries in Indonesia. Proceedings from Regional Workshop on Responsible Fishing, Bangkok, Thailand, 24-27 June 1997. Southeast Asian Fisheries Development Center

Syarif, L.M. (2009). Promotion and Management of Marine Fisheries in Indonesia. In G. Winter (Ed.), Towards Sustainable Fisheries Law. A Comparative Analysis (p. 340). IUCN, Gland, Switzerland.

The Pew Charitable Trusts & SYSTEMIQ (2020). Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution. https://www.pewtrusts.org/-/media/assets/2020/07/breakingtheplasticwave_report.pdf

UNEA (2014). Resolution 1/6 Marine plastic debris and microplastics. Resolutions and decisions adopted by the United Nations Environment Assembly of the United Nations Environment Programme at its first session on 27 June 2014, Nairobi, Kenya. http://wedocs.unep.org/bitstream/handle/20.500.11822/17285/K1402364.pdf

UNEA (2016). Resolution 2/11 Marine litter and microplastics. Resolutions and decisions adopted by the United Nations Environment Assembly of the United Nations Environment Programme at its second session on 23-27 May 2016, Nairobi, Kenya. http://wedocs.unep.org/bitstream/handle/20.500.11822/11186/K1607228_UNEPEA2_RES11E.pdf

UNEA (2018). Resolution 3/7 Marine litter and microplastics. Resolutions and decisions adopted by the United Nations Environment Assembly of the United Nations Environment Programme at its third session on 4-16 December 2017, Nairobi, Kenya. https://wedocs.unep.org/bitstream/handle/20.500.11822/22773/K1800210%20-%20UNEP-EA-3-RES-7%20-%20Advance.pdf

UNSDG (2018). Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. Targets and Indicators of the United Nations Sustainable Development Goals. https://sustainabledevelopment.un.org/sdg14

USAID (2017) Value Chain Assessment: Bitung Indonesia. USAID Oceans and Fisheries Partnership.

van der Hoop, J.M., Moore, M.J., Barco, S.G., Cole, T.V.N., Daoust, P., Henry, A.G., Mcalpine, D.F., Mclellan, W.A., Wimmer, T. \& Solow, A.R. (2013). Assessment of Management to Mitigate Anthropogenic Effects on Large Whales. Conserv Biol 27(1): 121-133. doi:10.1111/j.1523-1739.2012.01934.x

Weißbach, G., Gerke, G., Stolte, A., & Schneider, F. (2022). Material studies for the recycling of abandoned, lost or otherwise discarded fishing gear (ALDFG). Waste Management & Research: The Journal for a Sustainable Circular Economy 40(7): 1039-1046. doi:10.1177/0734242x211052850

Werner, S., Budziak, A., Franeker, J.V., Galgani, F., Hanke, G., Maes, T., Matiddi, M., Nilsson, P., Oosterbaan, L., Priestland, E., Thompson, R., Veiga, J. & Vlachogianni, T. (2016). Harm caused by Marine Litter: MSFD GES TG Marine Litter - Thematic Report. JRC Technical report, EUR 28317 EN, 89. doi:10.2788/690366

Widodo, S. Suparman, S. (2013). Katalog alat penangkapan ikan Indonesia (Indonesian catalogue of fishing gears). DG Capture Fisheries, Ministry of Marine Affairs and Fisheries, Indonesia

Wilcox, C., Mallos, N.J., Leonard, G.H., Rodriguez, A. \& Hardesty, B.D. (2016). Using expert elicitation to estimate the impacts of plastic pollution on marine wildlife. Mar Policy 65: 107-114. doi:10.1016/j.marpol.2015.10.014

World Bank (2018). Indonesia Marine Debris Hotspot Rapid Assessment: Synthesis Report. World Bank Group and Coordinating Ministry of Marine Affairs, Government of Indonesia. https://documents1.worldbank.org/curated/en/983771527663689822/pdf/Indonesia-Marine-debris-hotspot-rapid-assessment-synthesis-report.pdf

World Bank (2022). Pre-Feasibility Study on the Management, Retrieval and Recycling of Used and Abandoned, Lost and Discarded Fishing Gear, and Inventory of Plastic Use and Loss from Aquaculture. World Bank, Jakarta

Zabka, T.S., Haulena, M., Puschner, B., Gulland, F.M.D., Conrad, P.A. \& Lowenstine, L.J. (2006). Acute Lead Toxicosis in a Harbor Seal (Phoca vitulina richardsi) Consequent to Ingestion of a Lead Fishing Sinker. J Wildl Dis 42(3): 651-657. doi:10.7589/0090-3558-42.3.651

ANNEX

ANNEX 1

Methodology

DEFINITIONS AND CLASSIFICATIONS USED IN THIS STUDY

ALDFG terminology

To develop working terms to serve the needs of this study, and to establish a common understanding of key terminology to support the ongoing development of measures to manage and address ALDFG in Indonesia, a review of the global literature on ALDFG was conducted to identify key terms. Definitions were developed, drawing particularly on information presented in the Voluntary Guidelines on the Marking of Fishing Gear (FAO, 2019b) that were developed via Expert and Technical Consultations in which Indonesia participated and adopted by the Food and Agriculture Organization of the United Nations at the 33rd session of the Committee on Fisheries in July 2018. Terms and definitions were translated into Bahasa Indonesia, consulted with stakeholders, and revised where necessary to enhance clarity and comprehension. The compatibility of terms and definitions with existing laws and regulations in Indonesia was reviewed.

Fishing gear typology

The International Standard Statistical Classification of Fishing Gear[36] (ISSFG) was adopted by the FAO Coordinating Working Party (CWP) on Fisheries Statistics at the 25th Session of CWP in Rome in 2016. Indonesia has a well-established system for the classification of fishing gears that is modelled on the ISSFG. The classification system is broadly structured into ten major gear categories with over 50 subcategories based on fishing gear configuration and mode of operation. A detailed description of the gear types used in Indonesia's fisheries is provided in Regulation of the Minister of Marine Affairs and Fisheries 18/PERMEN-KP/2021 on Deployment of Fishing Gears and Fishing Aids in the Fishery Management Areas of Indonesia and the High Seas. The fishing gear typology used in in this study is based on Ministerial Regulation 18/PERMEN-KP/2021 together with supplementary information from the ISSFG. Specific fishing gear design details were obtained from the Indonesian Catalogue of Fishing Gear Designs (Widodo & Suparman, 2013), and this information was used to derive estimates of the weights of fishing gears deployed.

Fishing vessel typology

Data published by MMAF and the Central Bureau of Statistics (BPS, *Badan Pusat Statistik*) were used to provide details on the composition of the Indonesian fishing fleet by vessel number and size class. Unpublished data obtained from MMAF's Satu Data information system were used to disaggregate the fleet by size class and gear type. Minor discrepancies were noted in the total numbers of vessels obtained from Satu Data compared to those reported in published reports (e.g., Kelautan Dan Perikanan Dalam Angka Tahun 2018), and minor adjustments were made to the number of vessels in each gear class to ensure consistency.

Fishing port typology

Indonesian has a well-established system for classifying its ports, outlined in Regulation of the Minister of Marine Affairs and Fisheries 8/PERMEN-KP/2012 on Fishing Ports. This classification system was used to categorize ports for the purpose of this study, and published data—particularly the publication Statistics of Fishing Ports 2018 (BPS, 2019)—were used to determine the distribution of fishing ports across Indonesia and the characteristics of their fishing fleets and catches.

[36] http://www.fao.org/cwp-on-fishery-statistics/handbook/capture-fisheries-statistics/fishing-gear-classification/en/

FIELD SURVEYS

Field surveys were carried out in selected ports to obtain primary data, stakeholder perceptions and observations about EOLFG and ALDFG rates, mechanisms and drivers.

Port selection

Ports were selected for field surveys from the list of all fishing ports in Indonesia. Several factors were considered to inform the selection of fishing ports (Table 18). Furthermore, ports were selected to include a range of different port typologies and, where appropriate, to encompass fisheries that are economically significant and/ or have been identified as priority fisheries by MMAF. Candidate ports were reviewed with MMAF, and 10 target fishing ports selected for field surveys (Table 19).

Table 18: Criteria considered in the selection of the ten ports where field surveys were conducted.

SURVEY OBJECTIVE	CONSIDERATIONS
Assessment of fishing gear quantity and diversity	• Numbers and sizes of boats using the port on a permanent basis. • Availability of support services for gear and vessel repair. • Number of fishing companies and/or boat operators within communities adjacent to the port. • Degree to which the fleets utilizing the port could be considered as representative of fleets in other ports. • Availability of detailed data on port operations and vessel operations, including availability of disaggregated data on fleets and fishing gears. • Accessibility for surveying. • Preference was given to ports where the size of fishing gears operated and the polymer content therein is very large (i.e., purse seine, trawls, large scale drift net); • Preference was given to ports dominated by fishing boats >100 GT.
Assessment of ALDFG retrieval and ghost fishing:	• Availability of detailed data on fishing ports, port operations, vessel operations, disaggregated data on fleets and fishing gears; • Presence of fishing fleets using the port on a permanent basis, with fleets resident year round; • Presence of large numbers of boats operating bottom fishing gears (bottom gill nets, traps); • Presence of local fishing associations that are well organized and provide a range of support services to their members; • Availability of support services for gear and vessel repair; • Availability of any evidence that fishers have expressed concerns over ghost fishing; • Accessibility for surveying; • Preference was given to fishing port in close proximity to the fishing grounds, with well-defined fishing grounds less than 200m deep, and with fishing grounds within or near to areas of ecological importance; • Preference was given to ports dominated by fishing boats 10-30 GT.
Assessment of small-scale retrieval and ghost fishing:	• Availability of detailed data on fishing ports, port operations, vessel operations, disaggregated data on fleets and fishing gears; • Presence of fishing fleets using the port on a permanent basis, with fleets resident year round; • Presence of large numbers of boats 20GT operating bottom fishing gears (bottom gill nets, traps); • Presence of local fishing associations that are well organized and that provide a range of support services to their members; • Availability of support services for gear and vessel repair; • Availability of any evidence that communities are broadly supportive of conservation and management approaches; • Accessibility for surveying; • Preference was given to fishing ports in close proximity to the fishing grounds, with well-defined fishing grounds that are less than 30m deep, and with fishing grounds adjacent to MPAs or areas of ecological importance; and • Preference was given to ports dominated by fishing boats 2-10 GT.

Table 19: Target ports selected for EOLFG and ALDFG field surveys.

PORT	PROVINCE	CATEGORY	NOTES
PPS Bitung	Sulawesi Utara	A	Ocean Fishing Ports are the largest ports and form the main gateways to the international export markets. Seven are currently operational. These ports have the capacity to shelter at least 100 fishing units over 60 GRT daily, mostly those operating in international or EEZ waters. The fish landing capacity is 200 t/day or 18,000-120,000 t/year. OFPs house general port facilities but also processing and cold storage facilities. Good choice if PPS quarterly reports and database on port/boat/gear is available. However, its merits compared to other Cat. A ports or Cat B ports in the Lautra area is not clear.
PPN Pekalongan	Jawa Tengah	B	Archipelagic Port are able to support 75 fishing vessels of 15-60 GT daily, that fish in archipelagic and EEZ waters. Daily fish landing capacity is around 40/50 t or 8,000-15,000 t on an annual basis. Currently, 16 of these ports exist which focus on local and export markets. Good choice if PPN quarterly reports and database on port/boat/gear is available
PPN Ambon	Maluku	B	Archipelagic Port Good choice if PPS quarterly reports and database on port/boat/gear is available
PPN Ternate	Maluku Utara	B	Archipelagic Port Good choice if PPS quarterly reports and database on port/boat/gear is available
PPN Tual	Maluku	B	Archipelagic Port Good choice if PPS quarterly reports and database on port/boat/gear is available
PPN Kupang	NTT	B	Archipelagic Port Good choice if PPS quarterly reports and database on port/boat/gear is available
PPN Bacan	Maluku	C	Coastal Fishing Ports (CFP) Can berth 50 vessels ranging from 5-15 GT daily for vessels that operate in coastal waters and archipelagic waters. At the moment there are 43 CFPs, which have a fish landing capacity of 15-20 t/day or 3,000-4,000 t/year. Landings mainly serve the domestic market. CFPs provide general port facilities. In some cases, processors located far away from the islands where these ports are located own mini plants close to these ports where they can freeze the landed fish and send it to larger factories in e.g., Java for further processing. However, in many cases there is a lack of infrastructure at these ports to ensure the cold chain.
PPN Sorong	Papua Barat	C	Coastal Port Good choice if PPS quarterly reports and database on port/boat/gear is available
PPI Daeo Majiko	Maluku Utara	D	Fish landing base Good choice if PPS quarterly reports and database on port/boat/gear is available
PP Merauke	Papua		Outer Ring Fishing Port (ORFP) located on the border between Indonesia and Papua New Guinea (PNG) and Australia has a strategic position and role in the development of capture fisheries in eastern Indonesia especially WPP RI – 718 Good choice if PPS quarterly reports and database on port/boat/gear is available. However, port is small and infrastructure may be lacking for any repair, recycle, and retrieval related work.

Stakeholder mapping and interviews

An initial stakeholder mapping was conducted for each port, in consultation with the local marine and fisheries service and harbormaster. The stakeholder mapping aimed to identify the key public sector stakeholders involved in fisheries, port, waste and environmental management, as well to determine the number of, and relationships between private sector stakeholders including:

- Local fishing gear manufacturers;
- Main fishing gear sales outlets;
- Fishers (e.g., informal classes of fishers by fishing method, scale or other informal grouping);
- Formal fisher groups / cooperatives;
- Fishing companies;
- Middle men;
- Buyers / Processors;
- Plastic waste collectors & recyclers; and
- NGOs involved in marine litter management.

During field surveys, semi-structured interviews (Annex 2) were conducted with stakeholders representing:

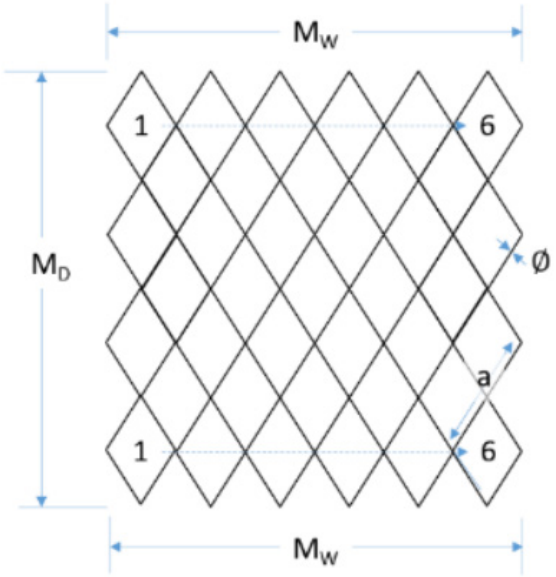
- Fishers (individuals and associations / cooperatives);
- Fishing gear manufacturers and gear sellers.
- Collectors /Disposal / recycling businesses / organizations / informal sector; and
- Public sector organizations involved in fishing gear recovery, recycling and disposal

PLASTIC WEIGHT ESTIMATIONS

Selection of fishing gear sub-categories for weight estimations
The fishing gear subcategories selected for weight estimations met one or more of the following criteria:

- The gear category has been identified as one generating high quantities of end-of-life fishing plastic materials (e.g., surrounding gear, trawls, seines, lift nets, longlines, gill and entangling nets);
- The number of fishing vessels in the subcategory exceeds 200 (0.1% of the national fleet);
- The combined weight of synthetic fishing gear materials used by a single vessel was expected to exceed 10kg; and
- Information was available on the materials used by vessels in a subcategory. Where such information was missing, the following procedure was followed:
  a. Gears similar in design were assigned to another subcategory (e.g., subcategories 08.4.01-08.4.05 were assigned to subcategory 08.0.3);
  b. Gears listed as "Not Specified" were given a nominal 10kg weight; and
  c. Dredges were omitted.

Applying these criteria, 3,228 of Indonesia's 171,733 inboard motorized fishing vessels (1.8%) were excluded from the analysis.



Netting Weight NW

$$NW = \left(\frac{\left(\left(\frac{M_{w1}}{M_{w2}}\right) * MD\right) * 2(a)}{1000000}\right) * 1/TR$$

Where:

M_{w1}	number of meshes across top of panel
M_{w2}	number of meshes across bottom of panel
M_D	number of meshes deep
a	stretched mesh length (mm)
Ø	twine diameter mm
TR	twine runnage (m/kg)

Figure 36: Formula for the calculation of netting weighting.

Weight of plastics in deployed fishing gears

Estimates of the weight of fishing gears used by individual vessels were informed by data available from the Indonesian Catalogue of Fishing Gear Designs (Widodo & Suparman, 2013) supplemented by information from manufacturers, technical references and field surveys. Data were compiled on the dimensions and weights of individual fishing components used at the vessel level. In two cases (Bouke ami and midwater trawl), data on fishing gear dimensions were obtained from the FAO Catalogue of Fishing Gear Designs (FAO, 1978).

Netting weights were derived by rearranging formulae described in FAO's Fisherman's Workbook (FAO, 1990). The material characteristics (twine diameter and runnage) were then used to convert netting areas into weights (Figure 36). A similar approach was used to calculate the weights of ropes and twines used in fishing gear construction. Weights of floats were obtained from fishing gear manufacturer's catalogues.
It was initially hoped that estimates of the weight of deployed fishing gears derived from surveys in the ten target ports could be extrapolated to estimate the weight of fishing gears across all fishing ports in Indonesia. However, the ten ports surveyed (Ambon, Brondong, Kejawanan Cirebon, Pelabuhan Ratu, Ternate, Bajomulyo, Muncar, Bitung, Cilacap and Kendari) contained only 19 of the more than 50 subcategories of fishing gear, including several from vessels without inboard engines. As a result, the 10 target ports were considered to not be representative of the entire Indonesian fishing fleet and these data were not extrapolated. Instead, published information on fishing gear designs were used together with statistics on vessel numbers (e.g., BPS, 2019) to estimate the weight of deployed gears for the Indonesian fishing fleet. Additionally, since no reliable disaggregated data were available on the numbers of outboard motorboats using different gear types, these were omitted from the estimate of weights.

Weight of plastics of replenished annually

The annual replenishment weight of materials provides a gross estimate (Figure 37) of the (i) weight of fishing gear disposed of ashore; and (ii) weights of fishing gears abandoned, lost or discarded at sea. Replenishment weights of plastic fishing gear materials are a function of the fishing method, fishing ground condition and boat operator behavior. Interviews were conducted with boat operators to obtain information about

the quantity of new fishing gear and fishing gear components purchased annually to replace gears that had been damaged or disposed of through operation. This information was combined was technical advice on specific replenishment rates obtained from fishing experts in Indonesia.

$$W_{FGR} = W_{FGL} + W_{ALDFG}$$

$$W_{FGR} - W_{FGL} = W_{ALDFG}$$

$$W_{FG} = [\sum W_{FGN} + \sum W_{FGR} + \sum W_{FGF}]$$

$$W_{FGR} = [\sum W_{FGN} + \sum W_{FGR} + \sum W_{FGF}] \; x \; RR$$

Where:

W_{FGR}	Weight of fishing gear replenished
W_{FGL}	Weight of end of life fishing gear landed
W_{ALDFG}	Weight of fishing gear left at sea
W_{FG}	Weight of fishing gear plastics
W_{FGR}	Weight of rope & twine
W_{FGN}	Weight of netting
W_{FGF}	Weight of floats
RR	Replenishment Rate %
W_{FGR}	Weight of Fishing gear replenished annually

Figure 37: Formulae used to derive weights of fishing gear plastics and the proxy value for ALDFG.

ASSESSMENT OF GEAR-SPECIFIC ALDFG RISK IN INDONESIA

A risk assessment was carried out for each fishing gear based on its relative vulnerability to damage or loss, its relative magnitude (i.e., the quantity of gear replenished annually), and its ecological impacts. The following assumptions guided the development of the risk assessment:

- EOLFG generation for a specific gear type and fleet is a function of:
  a. the numbers of vessels in the fleet; and
  b. the weights of fishing gear deployed by all vessels within the fleet.
- The annual weight of fishing gear replenished for a fleet is a function of:
  a. the EOLFG generated by the fishing fleet and landed ashore in a year; and
  b. the ALDFG generated by the fishing fleet and disposed of or left at sea.
- The likelihood and severity of fishing gear damage and/or gear loss within a fleet is a function of:
  c. the characteristics of fishing vessel operations for the fleet;
  d. the intrinsic characteristics of the fishing gear operated by a fleet, and
  e. the likelihood of the fishing gear from a fleet encountering the fishing gear of another.

Each fishing gear was assessed across three dimensions: (i) vulnerability to damage, abandonment, loss or discard, based on desk-based analysis; (ii) likelihood of impacts on commercial and vulnerable species and habitats, based on desk-based analysis; and (iii) quantity of end-of-life plastic material generated. Within each dimension, contributing variables were identified and scored from 1 (low) to 5 (high).

Vulnerability to damage and loss

Fourteen variables were identified that directly contribute to wear, tear and subsequent damage and/ or loss of fishing gears, leading to EOLFG and ALDFG (Box 2). In addition, two exogenous factors that are imposed on all fleets (severe weather and fleet separation,

Box 3) were also considered due to their influence on ALDFG generation. Each variable was scored from 1-5 for likelihood of occurrence and 1-5 for severity of impact, with the vulnerability of a fishing gear to a given variable indicated by the product of the likelihood x the severity (Table 20). The overall score of the vulnerability of a fishing gear to loss and damage was calculated as the average vulnerability across all variables.

Likelihood*	Severity* 1	2	3	4	5
5					
4					
3					
2					
1					

*Likelihood:
1. **Unlikely**. Unlikely to occur during regular fishing operations.
2. **Remote**. Unlikely, though possible, during regular fishing operations.
3. **Occasional**. Likely to occur occasionally during regular operations.
4. **Probable**. Will occur at a given time during fishing operations.
5. **Frequent**. Likely to occur / to be expected.

*Severity:
1. **Negligible**. No serious damage or loss of fishing gear.
2. **Marginal**. Minor fishing gear damage requiring on board repair completed without loss of fishing time. Minor scraps of netting and ropes generated.
3. **Moderate**. Serious damage to components and or partial loss of fishing gear. Significant pieces of netting missing or damaged beyond repair. On board repairs result in loss of fishing time to complete. Partial replacement of materials / components to replace damaged ones. Old net is repaired and re-used, but major scrap pieces generated.
4. **Critical**. Major fishing equipment damage and loss. Damaged gear is replaced for repair ashore or for salvaging useable components. New gear installed.
5. **Catastrophic.** Total loss of fishing gear. COmplete new gear installed. Old gear is damaged beyond repair.

Table 20: 5 x 5 risk matrix for the likelihood and severity of damage and loss.

Box 2: Operational variables contributing to fishing gear vulnerability to ALDFG

The likelihood and severity of fourteen operational and two exogenous variables were evaluated to assess the vulnerability of each fishing gear to ALDFG. These variables were:

- Wear & Tear from mechanical systems
- Wear and tear from towing over seabed
- Wear, tear, damage from unintended contact with seabed
- Contact with seabed obstructions
- Deployed fishing gear not retrieved
- Loss or damage resulting from other fleets on fishing grounds
- Fishing gear lost overboard
- One or more fishing gear units cannot be located at sea (lost)
- Poor handling and stowage of fishing gears
- Fishing gear material strength severely diminished
- Poor seamanship and navigation
- Noncompliance with Regulations
- Fishing equipment poorly maintained
- Crew poorly trained in gear maintenance
- Overcrowding of fishing grounds
- Severe weather events

Box 3: Exogenous variables contributing to fishing gear vulnerability to ALDFG

Fleet separation

This study did not identify any fisheries where zoning is employed. The absence of fleet separation allows passive and active vessels of different size and power to set their gears in the same fishing grounds with the prospect of mobile fishing gears running over anchored fishing gears such as pots, gillnets and set longlines. The likelihood and severity of such encounters is increased when fishing gears are poorly marked and/ or the passive fishing gear vessel is not attending their gear.

Extreme weather events

Generally larger vessels with access to weather information can take precautionary avoidance action including retrieval of fishing gear and moving to a safe distance from approaching weather systems. On the other hand, small-scale fisheries in remote areas may not be able to retrieve gear and store it safely ashore. Post Disaster Needs Assessment reports often identify small-scale coastal fishing communities in the front line of damage from severe weather and incurring significant losses.

Likelihood of ecological impacts

The four commonly accepted ecological impacts of ALDFG are: (i) ghost fishing; (ii) entanglement of marine life; (iii) rafting of invasive species; and (iv) smothering of habitats. In the absence of available data on the ecological impacts of ALDFG in Indonesia's fisheries, the likelihood of these impacts was scored from 1 (low) to 5 (high) based on a reviewed of published literature from comparable fisheries worldwide.

Quantity of end-of-life plastic material generated

The quantities of fishing gear netting, floats and ropes derived from the plastic weight estimations described previously were used to score each gear from low (1) to high (5) quantities of plastic material generated.

Overall risk rating

The overall relative risk rating (RR) was calculated for each gear type following the approach described by Gilman et al. (2021) and using the formula

$$RR = Q \times V + 2E$$

Where:

Q Quantity risk index;
V Vulnerability risk index; and
E Ecological risk index.

Ecological risk was assigned a weight of 2 to emphasize the adverse outcomes term and so reduce the likelihood of false negatives where gears with high relative risk are assigned low RR scores due to gear quantity underestimates.

DATA LIMITATIONS AND CAVEATS

There is limited availability of disaggregated data on the numbers of vessels, size of vessels and the types of fishing gear carried by each vessel for the 570 PPS, PPN, PPI and PPP ports distributed across Indonesia. The absence of such information prevents identification of those ports considered as high risk for EOLFG and ALDFG generation.

Similarly, the paucity of data on ALDFG, ALDAG, ghost fishing and ghost fishing related ecological impacts has constrained risk assessments. Assessments of the likelihood of ecological impacts in this study are derived from published literature on comparable fisheries, rather than from primary data on Indonesia's fisheries.

This study has focused on larger-scale fisheries, in part due to the limited availability of gear-disaggregated data on the small-scale components of the fleet. Targeting larger-scale fishing fleets is likely to be an efficient approach for initial ALDFG pilot project, due to the advantages associated with large numbers of vessels and large volumes of fishing gear waste being concentrated into defined locations (see Annex 10). While the contribution of individual small-scale vessels to ALDFG is undoubtably small, the large numbers of small-scale vessels operating in Indonesia mean that cumulative impacts are likely to be large. Further study into the dynamics of ALDFG and EOLFG generation within Indonesia's small-scale fisheries remains an urgent area for research.

Interview Questionnaires

FISHERS

Main gear type used

- Record (i) main and (ii) secondary (if present) gear types*.
- Describe typical gear unit e.g., number of net panels, mesh size, amount of head and foot ropes (m & diameter, number and distance between buoys, weights, (this should be recorded separately, not in the spreadsheet)
- Where is gear is bought from – manufacturers & sellers

Main fishing ground

1. Location (WPP / sea area)*
2. Distance & direction from port (nautical miles / km from port e.g., between 50 – 80 nm north of the port.
3. Water depth*: see Annex A: Lists
4. Substrate type*: see Annex A: Lists

Fishing patterns

1. Number of trips per year*: Annex A: Lists)
2. Duration of trip* (days)
3. Peak fishing season (month to month)
4. Low fishing season (month to month)
5. Non-fishing season (month to month)

Gear Damage

1. What types of fishing gear damage are most common during a fishing season?
   b. Damage from bad weather
   c. Damage from seabed
   d. Damage due to equipment failure
   e. Damage from big catch
   f. Gear is not damaged, just worn out and needs to be replaced
   g. Other
2. What do you do when gear is damaged?
   c. Throw in the sea
   d. Repair damage at sea and keep using
   e. Change to new fishing gear at sea
   f. Place gear in storage for repair later
   g. Return to fishing port for throw away
   h. Other
3. Which parts of the gear need to be replaced most often?
   d. Netting
   e. Ropes
   f. Floats
   g. Other

Gear Turn over and replacement

1. How long does a new fishing gear last?
   b. One trip
   c. One season
   d. one year,
   e. Other
2. How much money do you spend on replacement fishing gear a year?
3. If your gear is damaged, who does the repairs?
4. Roughly how much money do you spend on repairing fishing gear a year?
5. What % is materials
6. What % is labor
7. How many replacement gear units / components do you buy a year?
8. Where do you buy them from?
9. Would you be prepared to spend more on new fishing gear if it lasted longer?

Gear disposal

1. Where do you dispose of old fishing gear netting, ropes and floats and how much does it cost?
   b. Ashore in landfill
   c. Ashore in port
   d. Ashore at home e.g., via municipal solid waste facilities
   e. At sea discard
   f. At sea burning
   g. sell it to a gear recycling agent, or any other?
   h. Use at home for other purpose
   i. If used for other purpose, please specify

2. In making the decisions above, what influences your choice e.g., cost, easiness, operational factors. Other?
3. How do you make the decision to replace gear rather than repair it?
4. Who pays for waste gear collection and treatment/ disposal – what are the fees?

Gear management

1. Do you mark your gear? If so, how (e.g., mechanism, material, ID information included)
2. How do you prevent gear conflict e.g., other boats / fishers damaging your gear?
3. Do you reduce soak times specifically to reduce the risk of gear loss and how e.g., in bad weather / strong currents, other?

Gear loss / abandonment / discarding

1. In what circumstances / for what reasons do you lose fishing gear?
2. If you lose it, do you try to recover it? If so, how successful are you?
3. In what circumstances / for what reasons would you abandon fishing gear e.g., fishing without the right permit / permissions, logistical problems, etc.?
4. In what circumstances / for what reasons would you permanently discard fishing gear e.g., not enough storage space, damaged too much, cheaper than disposing on land, easier than disposing on land, or other?
5. What are the key factors that would encourage you to land damaged / old gear and to get it recycled or responsibly disposed of?

Please take photographs of vessels, gear storage units, gear disposal facilities in port.

FISHING GEAR MANUFACTURERS AND SELLERS

Try to visit the main fishing gear manufacturers and those selling or repairing fishing gear.

General Information

1. General profile of the business e.g., year when started, number of employees, number and location of main branches, any public sector investment / involvement in the business.
2. Do they offer 'end of life' recycling of products they sell? What is their view on their responsibility for collecting and disposing of old fishing gear responsibly? How might this work for them and what are the barriers to buy-back schemes?

Fishing gear characterization (at point of sale)

Ask for brochures / technical specifications & pricing for all key fishing gear components e.g.

1. Gillnet panels / sheets: filament / twine thickness, material, weight (kg / m2), mesh size, standard panel dimensions (e.g., no. of meshes high / deep or in meters, floatation needed (e.g., no. of floats per net panel), no. of panels used for a single complete gear unit), price sheets, meters of different sheeting types sold per year.
2. Seine net material: filament / twine thickness, material weight (kg / m2, mesh size, standard seine dimensions (e.g., no. of meshes high / deep or in meters, floatation needed (e.g., no. of floats per net panel), no. of panels used for a single complete gear unit), prices, no. of units sold per year.
3. Longlines: mainline thickness (mm), material type, branch line thickness (mm), material type, floatation needed (e.g., no. of floats per xx meters of main line), length of main line and number (and length) of branch lines used for a single complete gear unit), price sheets, meters of each line type sold a year.
4. Ropes: different diameters, materials used, process, no. of each sold a year.

5. Buoys: sizes, weights, material types, prices, no. of each sold a year.

If possible, use this to fill in the following two tables (we can do this if we have the information above):

1. Using **Table 15** overleaf, obtain the main characteristics and volumes of the fishing gears sold. Focus on gillnets, purse seines, ring nets, longlines and FADs. Only fill in the relevant tables for the fishing gear types made / sold by the manufacturer / sales outlet.
2. Using **Table 16**, obtain the quantity (in meters or number) of different gear components sold per year.

GILLNETS

Gear type / component	Length of one net panel (m)	No. floats	Netting Material runnage m/kg or diameter (mm)	Head rope dia (mm)	Mesh Size (mm)	Meshes in one net (width)	Meshes in one net (depth)	No. of panels that make a full gear set	Price per unit (IDR)	Units sold per year
Multi-filament gillnet										
Gillnet (Monofilament}										
Trammel net panels (x3)										

If necessary, add new rows e.g., for different sizes of net type

PURSE NETS

Gear type / component	Length of seine (m)	Depth of Seine (m)	Mesh Size mm	Netting Material runnage m/kg or diameter mm	Meshes in one panel (width)	Meshes in one panel (width)	# panels wide	# panels deep	No. Floats	Price per unit (IDR)	Units sold per year
Purse Seine											
Lampara											

SEINE NETS

Gear type / component	Length of Head rope (m)	Length of footrope (m)	No. meshes around body	Mesh Size in main part of net mm	Netting Material runnage m/kg or diameter mm	Codend netting dia (mm)	Codend netting mesh size (mm)	Length of Seine (m)	No. Floats	Price per unit (IDR)	Units sold per year
Boat seine (towed)											

FADS

Gear type / component	Weight of netting used (kg)	Is netting new or recycled? (Y or N)	Netting Material runnage m/kg or diameter mm	Drifting FAD / Anchored FAD?	Length of main rope (m)	Twine diameter (mm)	No. FADs per boat	No. Floats	Type of floats	Price per unit (IDR)	Units sold per year
FAD (anchored) buoy											
FAD (drift) buoy)											

LONG LINES

Gear type / component	Length of mainline	Mainline dia (mm)	No. Floats	Buoy line material	Buoy line length (m)	Price per unit (IDR)	Units sold per year
Longline (main line)							
Longline (branch line)							

LIFT NETS

Gear type / component	Length of Head rope (m)	Rope dia (mm)	Mesh Size in main part of net mm	Netting Material runnage m/kg or diameter mm	No. mesh-es around	Depth of net (m)	No. meshes around	No. Floats	Price per unit (IDR)	Units sold per year
Lift Nets										

SET NETS

Gear type / component	Boat GT Range	Length of set net (m)	Width of set net (m)	Depth of set net (m)	Netting Material runnage m/kg or diameter mm	Mesh size	No. Floats	Water depth	No. anchors	Price per unit (IDR)	Units sold per year
Set Nets											

H. POTS & TRAPS

Gear type / component	Boat GT Range	No. traps per boat	Is trap using synthetic netting (Y N)?	Buoy line dia	Mesh size	Netting Material runnage m/kg or diameter mm	No. Floats	Water depth (m)	No. anchors	Price per unit (IDR)	Units sold per year
Set Nets											

COMPONENT	SALES PER YEAR (meters / number)	MAIN PLASTIC TYPES	MAIN BRANDS
Rope (>50 mm)			
Rope (21 – 50 mm)			
Rope (10 – 20 mm)			
Rope (<10 mm)			
Buoys			
Other (describe)			
Other (describe)			
Other (describe)			

FISHING GEAR COLLECTORS / DISPOSAL / RECYCLING BUSINESSES / ORGANISATIONS / INFORMAL SECTOR

Fishing Gear Repair

1. How many fishing gear repair businesses
2. For each of these, record:
   a. Type of repairer (business, public agency, informal sector/individuals)
   b. Size of net repair yard (m2)
   c. Estimated volumes repaired / year (kg) by gear type
   d. Charging / pricing system
   e. Main clients
3. For each, record the main issues they have when operating:
   d. Available space?
   e. Arrangements with fishers –informal or regular arrangements and agreements in place?
   f. Economics of repair vs replacement e.g., point where repair becomes uneconomic (for different gear types / components / materials)
   g. If uneconomic, where is the gear disposed of?
   h. If disposed of, is the gear cleaned / disassembled / graded?
   i. Other?

Please take photographs of repair yards / facilities.

Fishing Gear Recycling

This is for anyone that is currently receiving damaged / end of life / recovered fishing gear.

1. Number of recycling operators (which are businesses, single operators / informal sector?)
2. Typical routes for recycling e.g., from fisher / port to first buyers of recycled material (network diagram showing different routes and indicating relative volumes).
3. Typical financial flows
   a. Is the raw material (fishing gear) purchased, provided free of charge or do the suppliers (e.g., fishermen / port authorities / others) pay for it to be recycled? Please give as much detail here as possible.
   b. Do they have any costs of the recycling process for different types of fishing gear and its initial condition? Again, please provide as much detail as possible.
4. Source and volume of material recycled in 2016, 2017, 2018 & 2019
   e. Please provide total volume of fishing gear for each of these years (even if zero)
   f. Please provide an estimate of the percentage composition of this by gear type. If this can be done by year even better, but otherwise get this for 2019 and ask if there is any trend in the raw material supply pattern.
5. Costs of (i) collection, (ii) transport (iii) cleaning, (iv) dismantling, (v) treatment (grinding etc.) and other costs?
6. Where are the opportunities to increase fishing gear recycling, e.g.:
   a. Fleet size
   b. Gear type
   c. other
7. What criteria, if any, do you have to accept fishing gear for recycling? (e.g., how clean, separated, only certain types?)
8. What prices are paid or charged for accepting the waste fishing gear? (differences between cleaned / dismantled / graded & whole)
9. Who cleans and dismantles the gear (e.g., fisher, middleman or recycler)
10. What plastic types or gear types cannot be recycled, (nylon, PP, PE), steel, lead in the raw material including impurities (contaminant)?
11. What happens to fishing gear components that cannot be recycled? (e.g., landfill, incineration)
12. What prices do you get for the recycled material (buyers, prices, description of downward supply chain)
13. What is the recycled gear used for? Is there any re-purposing (e.g., cleaned nets used for other purposes) or plastic pellets sold on to plastic manufacturers?
14. What is the yield: How much recycled plastic do you get per weight of fishing gear?
15. What are the main constraints / issues for your operation:
    a. Available space?
    b. Mixture of different components / plastics
    c. Bio-fouling and contamination of gear components
    d. Securing sufficient supply of raw material
    e. Seasonality of supply of raw material
    f. Technical issues in the recycling process (if possible, pinpoint issue to specific gear types / components)
    g. Sufficient market for recycled products
    h. Ensuing the business remains profitable.
    i. Other?

Please take photographs of recycling facilities, inc. raw material stores and recycled products.

From the answers, produce a recycling process flow diagram describing the stages from collection to sale of recycled material, showing the different likely routes in waste gear treatment.

Plastic recyclers (not currently taking fishing gear)

This option is for anyone that does recycling but do not currently use plastic waste materials from the fishing and aquaculture sectors.

1. Why do you currently not accept waste fishing / aquaculture gear? Possible reasons might include not economic to do so, supply rates are too low or irregular, the gears are too complex (e.g., mixed polymers, need to be broken down into constituent parts), the gear is to dirty / contaminated, the recycled materials are not in demand, technical issues, not in sufficient quantity etc., etc.

2. What would be needed to encourage you to start accepting plastic waste from the fishing sector, especially end of life / recovered fishing gear?

PUBLIC SECTOR ORGANIZATIONS INVOLVED IN FISHING GEAR RECOVERY, RECYCLING AND DISPOSAL

1. What are the current roles in fishing gear collection, retrieval and disposal?
2. What roles should (i) the private sector (ii) the public sector be taking in fishing gear

ANNEX 3

Gear-specific quantities and annual replenishment weights

FISHING VESSEL AND FISHING GEAR CHARACTERISTICS

FISIHING GEAR CLASSIFICATION				Notes	No. of vessels	% of total Indonesian fleet	% of total Indonesian fleet	GT Size	Weight of plastics deployed kg per vessel	Weight of plastics deployed per fleet (t)	% Weight of plastics deployed by Indonesian fleet	Wt. of netting deployed t	Wt. of floats deployed t	Wt. of ropes deployed t	Wt. of plastics replenished annualy - wear & tear by fleet t	Wt. of plastics replenished annually - annualized by fleet t	Quantity of FG Replen-ished
Indonesian Code	Fishing Gear Name (Indonesia)	Acronym	English Name	Notes				22	23	24	25	26	27	28	29	30	31
Purse Seines																	
01.1.1.1.	Pukat Cincin Pelagis Kecil dengan Satu Kapal	PS1-K	One Boat Operated Purse Seine*	1	3883	2.3%											
01.1.1.2	Pukat Cincin Pelagis Besar dengan Satu Kapal	PS1-B	One Boat Operated Purse Seine*	1	1428	0.8%		<30	4,701	34,253	40.8%	30,236	2,794	1,217			
01.1.1.2.2	Pukat Cincin Grup Pelagis Besar	PS2-B	Two Boats Operated Purse Seines*	1	498	0.3%	4.8%								7,081	13,824	VH
01.1.2.1	Pukat Cincin Grup Pelagis Kecil	PS2-K	Two Boats Operated Purse Seines*	1	1874	1.1%		>30	13,222	12,959	15.5%	11,466	1,058	433			
01.2	Jaring Lingkar Tanpa Tali Kerut	LA	Sorrounding Net Without Purse Line	1	582	0.3%											
Beach Seines																	
02.1	Pukat Tarik Pantai	SB	Beach Seine	2	1433	0.8%	0.8%	<5	44	63	0.1%	25	7	31	3	-	
Boat Seines																	
02.2.1	Dogot	SV-SDN	Danish Seine	2	2304	1.3%		<5	63	147	0.2%	96	1	50	29	35	
02.2.2	Pair Seines	SV-SPR	Boat Seine*	2	250	0.1%		-	-	-	-	-	-	-	-	-	L
02.2.3	Payang	SV-PYG	Boat Seine*	2	3911	2.3%	5.19%	<30	89	347	0.4%	317	-	31	35	42	
02.2.4	Cantrang	SV-CTG	Boat Seine*	2	1255	0.7%		<20	72	122	0.1%	73	17	32	3	4	
02.2.5	Lampara Dasar	SV-LDS	Boat Seine*	2	1016	0.6%		<20	114	116	0.1%	73	18	25	23	28	
Trawls																	
03.11	Pukat Hela Dasar Berpalang	TBB	Beam Trawl	3	13	0.0%		-	-	-	-	-	-	-	-	-	-
03.12	Pukat Hela Dasar Berpapan	OTB	Single Boat Bottom Otter Trawl	3	1058	0.6%		<30	142	206	0.2%	177	18	11	51	69	VL
03.12.1	Pukat Helas Dasar Udang, Pukat Udang	OTB-PU	Single Boat Bottom Otter Trawl*	3	959	0.6%	1.6%										
03.15	Pukat Hela Dasar Dua Kapal	PTB	Botton Pair Trawl	3	25	0.0%		-	-	-	-	-	-	-	-	-	-
03.2.3	Pukat Hela Pertengahan Udang	TMS	Shrimp Trawls	3	220	0.1%		<5	108	22	0.03%	22	1	1	6	7	VL
03.21	Pukat Hela Pertengahan Berpapan, Pukat Ikan	OTM	Single Boat Midwater Otter Trawl	4	526	0.3%		<5	73	39	0.05%	32	3	4	10	12	VL
Beach Seines																	
04.1	Penggaruk Berkapal	DRB	Towed Dredge	17	1135	0.7%	0.8%	-	-	-	-	-	-	-	-	-	-
04.2	Penggaruk Tanpa Kapal	DRH	Hand Dredge	17	293	0.2%		-	-	-	-	-	-	-	-	-	-

FISIHING GEAR CLASSIFICATION				Notes	No. of vessels	% of total Indonesian fleet	% of total Indonesian fleet	GT Size	Weight of plastics deployed kg per vessel	Weight of plastics deployed per fleet (t)	% Weight of plastics deployed by Indonesian fleet	Wt. of netting deployed t	Wt. of floats deployed t	Wt. of ropes deployed t	Wt. of plastics replenished annualy - wear & tear by fleet t	Wt. of plastics replenished annually - annualized by fleet t	Quantity of FG Replen-ished
Indonesian Code	Fishing Gear Name (Indonesia)	Acronym	English Name	Notes				22	23	24	25	26	27	28	29	30	31
Lift Nets																	
05.1	Anco	LNP	Portable lift net	18	49	0.0%		-	2	0.2	-	-	-	-	-	-	VL
05.2.1	Bagan Berperahu	LNB-BP	Boat operated lift net*	18	5019	2.9%	4.8%	<5	175	896	1.1%	823	26	47	90	105	L
05.2.2	Bouke Ami	LNB-BA	Boat operated lift net*	18	673	0.4%		<30	227	218	0.3%	155	0	62	22	25	VL
05.3	Bagan Tangkap	LNS	Shore-operated stationary lift net	18	2500	1.5%		<20	45	112	0.1%	92	0	20	11	13	VL
Falling Gear																	
06.1	Jala Jatuh Berkapal	FCN	Cast net	19	73	0.0%	0.6%	<30	161	20	0.02%	17	0	3	2.0	2.4	VL
06.9	Jala Tebar	FG	Fallinh gear not specified	19	955	0.6%		-	-	-	-	-	-	-	-	-	-
Gill and entangling nets																	
07.1	Jaring Insang Tetap, Jaring Liong Bun <600m	GNS	Set gillnet anchored	6	15207	0.6%	31.1%	<5	53	737	0.9%	106	133	498	221	295	M
07.1	Jaring Insang Tetap, Jaring Liong Bun <2500m	GNS	Set gillnet anchored					5-30	1,006	4,864	5.8%	2,978	261	1,625	1,459	1,946	H
07.2	Jaring Insang Hanyut <600m	GND	Drift gillnet	7	33259	19.4%		<5	241	13,617	16.2%	6,139	340	7,138	4,085	5,447	H
7.2	Jaring Gillnet Oseanik <2500m	GND	Drift gillnet					5-30	1,296	7,812	9.3%	3,325	621	3,866	2,344	3,125	H
7.2	Jaring Gillnet Oseanik <5000m	GND	Drift gillnet					>30	1,281	753	0.9%	339	19	395	226	301	M
07.3	Jaring Insang Lingkar	GNC	Encircling gillnet	8	3414	2.0%		-	-	-	-	-	-	-	-	-	-
07.4	Jaring Insang Berpancang	GNF	Fixed Fillnet (on stakes)		744	0.4%		-	-	-	-	-	-	-	-	-	-
07.5	Jaring Insang Berlapis, Jaring Klitil <600m	GTR	Trammel net	9	7684	4.5%		<5	64	962	1.1%	150	271	541	289	385	M
07.6	Jaring Insang Kombinasi dengan Trammel Net <600m	GTN	Combining gillnet-trammel net	9	7340	4.3%											
7	Jaring Insang				67648	31.1%		-	-	28,746	34.3%	13,039	1,645	14,062	8,624	11,498	VH
Pots and traps																	
08.1.1	Stationary Uncovered Pound Nets, Set Net	FPN-SN	Stationary uncovered pound net*	10	42	0.0%	6.2%	-	-	-	-	-	-	-	-	-	-
08.2	Bubu	FPO	Pot	11	15244	4.3%		<5	1,006	4,864	5.8%	2,978	261	1,625	1,459	1,946	M
08.3.0	Bubu Bersayap	FYK	Fyke net	20	420	0.2%		See below for combined weights of these sub categories									
08.4.1	Pukat Labuh	FSN-PL	Long bag set net	20	59	0.0%											
08.4.2	Togo	FSN-TG	Stow net*	20	388	0.2%											
08.4.3	Ambal	FSN-AB	Stow net*	20	575	0.3%											
08.4.4	Jermal	FSN-JM	Stow net*	20	1119	0.7%											
08.4.5	Pengerih	FSN-PG	Stow net*	20	162	0.1%											
08.5	Barriers, Fences, Weirs, Sero	FWR	Barrier, fence, weir	20	524	0.3%		-	-	-	-	-	-	-	-	-	-
08.6	Perangkap Ikan Peloncat	FAR	Aerial trap	-	0	0.0%		-	-	-	-	-	-	-	-	-	-
08.30, 08.0.01-08.4.05	Bubu Bersayap, Pukat Labuh, Togo, Ambai, Pengerih	KOM	FYK, FSN-PL, FSN-TG, AB, JM, PG		18532	6.2%		<5	46	123	0.1%	113	3	834	18	28	VL

FISHING VESSEL AND FISHING GEAR CHARACTERISTICS

FISIHING GEAR CLASSIFICATION				Notes	No. of vessels	% of total Indonesian fleet	% of total Indonesian fleet	GT Size	Weight of plastics deployed kg per vessel	Weight of plastics deployed per fleet (t)	% Weight of plastics deployed by Indonesian fleet	Wt. of netting deployed t	Wt. of floats deployed t	Wt. of ropes deployed t	Wt. of plastics replenished annualy - wear & tear by fleet t	Wt. of plastics replenished annually - annualized by fleet t	Quantity of FG Replen-ished
Indonesian Code	Fishing Gear Name (Indonesia)	Acronym	English Name	Notes				22	23	24	25	26	27	28	29	30	31
Hook and lines																	
09.1.1	Pancing Ulur (nontuna)	LHP-PUNT	Headline and hand operated polehand-line*	12	49	14.4%											
09.1.2	Pancing Ulur (tuna)	LHP-PUT	Headline and hand operated polehand-line*	12	5019	0.0%											
09.1.3	Pancing Benjoran	LHP-PJ	Headline and hand operated polehand-line*	12	673	1.8%											
09.1.4	Huhate	LHP-PH	Headline and hand operated polehand-line*	12	2500	0.7%		<5	5.5	173	0.21%	0	0	173	17	20	VL
09.1.5	Squid Angling, Pancing Cumi	LHP-SA	Squid Angling	12	49	1.1%											
09.2.1	Squid Jigging, Pancing Cumi Mekanis	LHM-PC	Squid Jigging	12	5019	0.2%											
09.2.2	Huhate Mekanis	LHM-HM	Mechanized lines and pole-handline*	12	673	0.0%											
09.31	Rawai Dasar <1000	LLS	Set longline					<5	55.3	295		0	28.2	266.4	26.6	35.5	VL
09.31	Rawai Dasar <2000	LLS	Set longline	13	8291	4.8%	30.2%	5-30	111.6	1,107	1.68%	0	15.6	1091.8	109.2	145.6	L
09.31	Rawai Dasar <10.000	LLS	Set longline					>30	375.3	5		0	0.1	5.3	0.5	0.7	VL
09.32.1	Rawai Hanyut<1000	LLD-RT	Drifting longlines*					<5	127	132		0	22.9	109.5	10.9	14.6	VL
09.32.1	Rawai Hanyut<2000	LLD-RT	Drifting longlines*	14	2501	1.5%		5-30	454	413	2.15%	0	60.0	352.7	35.3	47.0	VL
09.32.1	Rawai Hanyut<10.000	LLD-RT	Drifting longlines*					>30	454	1,261		0	152.7	1108.2	110.8	147.8	L
9.40			Vertical longlines	21				-	-	-	-	-	-	-	-	-	-
09.4.0.2	Rawai Cucut	LLD-RC	Drifting longlines*	14	673	0.3%		-	-	-	-	-	-	-	-	-	-
09.5	Tonda	LTL	Trolling line	16	2500	5.2%		<5	30	277	0.33%	0	0	276.9	27.7	36.9	VL
09.9.1	Pancing Layang-Layang	LX-LY	Hooks and lines*		269	0.2%		-	-	-	-	-	-	-	-	-	-
Miscellaneous gear																	
10.1	Tombak	HAR	Harpoon		67	0.0%		-	-	-	-	-	-	-	-	-	-
10.2.1	Ladung	MHI-LD	Miscellaneous gear*		202	0.1%		-	-	-	-	-	-	-	-	-	-
10.2.2	Panah	MHI-PN	Miscellaneous gear*		341	0.2%		-	-	-	-	-	-	-	-	-	-
10.5	Pukat Dorong	MPN	Pushnet		344	0.2%	0.7%	<5		9	0.01%	7	0	2	-	-	VL
10.6	Seser	MSP	Scoopnet		238	0.1%		<5	5.3	6	0.01%	5	0	1	-	-	VL
10.7	Muro Ami	MDR	Dive-in net		40	0.0%		-	-	-	-	-	-	-	-	-	-

ANNEX 4

Gear-specific weights of plastic deployed in Indonesia's fisheries

Category	Fishing Gear Code	Vessel Size	Vessel No.	Netting	Ropes	Floats	Total Tonnes
Surrounding Nets 01.0.0							
Surrounding Gear *Jaring Lingkar <500m*	01.0.0	GT <30	7,285	30,235,674	1,216,566	2,793,731	34,253
Surrounding Gear *Jaring Lingkar <1500m*	01.0.0	GT >30	980	11,466,425	433,176	1,058,439	12,959
Seines 02.0.0							
Beach Seine *Pukat Tarik Pantai*	02.1.0	GT <5	1,433	25,083	30,816	7,166	64
Danish Seine *Dogol*	02.2.1	GT <5	2,312	95,817	49,700	1,156	149
Boat Seine *Payang*	02.2.0.1	GT <5	3,912	316,903	30,517	0	351
Boat Seine *Cantrang <5GT*	02.2.0.2	GT <5	420	13,524	7,000	4,077	25
Beach Seine *Cantrang >5GT*	02.2.0.2	GT >5	1,124	59,007	25,120	12,925	98
Boat Seine *Lampara Dasar*	02.2.0.3	GT <10	1,016	73,241	24,786	17,878	117
Trawls 03.0.2							
Single boat bottom otter trawl *Pukat Hela Dasar Berpapan<10GT*	03.12	GT <10	2,040	175448	10200	17137	205
Single boat bottom otter trawl *Pukat Hela Dasar Berpapan>10GT*	03.12	GT>10	15	1,948	331	505	3
Shrimp trawls *Pukat Helas Pertengahan Udang*	03.2.3	GT <5	220	21,622	989	1,099	24
Single boat midwater otter trawl *Pukat Hela Pertengahan Berpapan, Pukat*	03.21	GT <5	526	31,919	4,049	2,629	39
Lift Nets							
Portable Lift Net *Anco*	05.1.0	GT <5	49	245	0	0	0
Boat operated lift net <5GT *Bagan Berperahu*	05.2.0.1	GT <5	5,122	822,886	47,381	25,611	896
Boat operated lift net *Bouke Ami*	05.2.0.2	GT <30	959	155,318	61,319	0	218
Shore-operated stationary lift net *Bagan Tancap*	05.3.0	GT <5	2,500	92,487	19,997	0	112
Falling Gear							
Cast net *Jala Jatuh Berkapal*	06.1.0	GT <30	123	16,785	3,085	0	20
Traps 08.0.1							
Pot *Bubu (600)*	08.2.0	GT <5	15,436	858,241	833,544	194,494	1,886
Fyke net *Bubu Bersayap*	08.3.0, 08.0.01-08.4.05	GT <5	2,723	112,532	6,983	3,050	123
Scoopnet *Seser*	08.9.02	GT <5	238	5,027	1,263	0	6

Category	Fishing Gear Code	Vessel Size	Vessel No.	Netting	Ropes	Floats	Total Tonnes
Hook and Lines							
Handline and hand operated *Pancing Ulur*	9.1	GT <5	31,398	172,687	0	0	173
Set longline *Rawai Dasar <1000*	09.3.0	GT <5	5,327	0	266,372	28,235	295
Set longline *Rawai Dasar<2000*	09.3.0	GT 5-30	2,951	0	1,091,775	76	1,092
Set longline *Rawai Dasar<10,000*	09.3.0	GT >30	14	0	5,315	76	5
Drifting longlines *Rawai Hanyut <1000*	09.4.0.1	GT <5	1,042	0	109,462	22,935	132
Drifting longlines *Rawai Hanyut <2000*	09.4.0.1	GT 5-30	909	0	352,654	59,988	413
Drifting longlines *Rawai Hanyut <10,000*	09.4.0.1	GT >30	694	0	1,108,200	152,664	1,261
Trolling line *Tonda/PLL*	09.6.0.1 - 09.9.01	GT<5	9,230	0	276,897	0	277
Miscellaneous 10.0.0							
Miscellaneous Miscellaneous	10.0.0	GT <5	610	0	18,291	0	18
Pushnet *Pukat Dorong*	10.5	GT <5	344	7,269	1,826	0	9

Category	Fishing Gear Code	Vessel Size	GT<5	GT 5-10	GT 10-20	GT 20-30	GT >30
Surrounding Nets 01.0.0							
Jaring Jangkar	01.0.0		1706	1782	2030	1766	980
Seines 02.0.0							
Beach Seine *Pukat Tarik Pantai*	02.1.0		1044	380	8	1	0
Danish Seine *Dogol*	02.2.1		1994	180	63	65	8
Boat Seine *Pair Seines*	02.2.2		104	78	68	0	0
Boat Seine *Payang*	02.2.0.1		2869	747	288	8	1
Boat Seine *Cantrang*	02.2.0.2		317	427	235	272	44
Boat Seine *Lampara Dasar*	02.2.0.3		369	399	248	0	0

Category	Fishing Gear Code	Vessel Size	GT<5	GT 5-10	GT 10-20	GT 20-30	GT >30
Trawls 03.0.0							
Beam trawl *Pukat Hela Dasar Berpalang*	03.11		13	0	0	0	0
Single boat bottom otter trawl *Pukat Hela Dasar Berpapan*	03.12		871	172	15	0	0
Single boat bottom otter trawl *Pukat Hela Dasar Udang, Pukat Udang*	03.12.1		705	254	0	0	0
Bottom pair trawl *Pukat Hela Dasar Dua Kapal*	03.15		14	11	0	0	0
Shrimp trawls *Pukat Hela Pertengahan Udang*	03.2.3		212	8	0	0	0
Single boat midwater otter trawl *Pukat Hela Pertengahan Berpapan, Pukat Ikan*	03.21		461	62	1	2	0
Pushnet *Pukat Dorong*	03.9.0.1		220	102	22	0	0
Dredges 04.0.0							
Towed dredges *Penggaruk Berkapal*	04.1.0		929	195	11	0	0
Hand dredges *Penggaruk Tanpa Kapal*	04.2.0		49	0	0	0	0
Lift Nets 05.0.0							
Portable lift net *Anco*	05.1.0		2481	1536	409	0567	130
Boat operated lift net *Bagan Berperahu*	05.2.0.1		223	2	0	262	471
Boat operated lift net *Bouke Ami*	05.2.0.2		2130	348	22	0	0
Shore-operated stationary lift net *Bagan Tancap*	05.3.0		14	11	0	2	97
Falling Gear 06.0.0							
Cast net *Jala Jatuh Berkapal*	06.1.0		910	43	0	1	2
Falling gear not specified *Jala Tebar*	06.9		11566	2437	1004	157	65
Gillnets and entangling Nets 07.0.0							
Set gillnet anchored *Jaring Insang tetap, Jaring Liong Bun*	07.1		11566	2437	1004	157	65
Drift gillnet *Jarinf Insang Hanyut, Jaring Gillnet Oseanik*	07.2.0		21244	9706	929	871	588
Encircling gillnet *Jaring Insang Lingkar*	07.2.0.1		2258	782	290	80	21
Fixed fillnet (on stakes) *Jaring Insang Berlapis, Jaring Klitik*	07.3		481	111	98	48	18

Category	Fishing Gear Code	Vessel Size	GT<5	GT 5-10	GT 10-20	GT 20-30	GT >30
Trammel net *Jaring Insang Berlapis, Jaring Klitik*	07.4		5823	1784	45	32	4
Combined gillnet-trammel net *Jaring Insang Kombinasi dengan Trammel Net*	07.5		6386	806	142	1	15
Traps 08.0.0							
Stationary uncovered pound net *Stationary uncovered pound net, Set Net*	08.1.0		42	0	0	0	0
Pot *Bubu*	08.2.0		11815	2771	413	74	364
Fyke net *Bubu Bersayap*	02.2.2		396	23	0	0	0
Long bag set net *Pukat Labuh*	02.2.0.1		59	0	0	0	0
Stow net *Togo*	02.2.0.2		386	2	0	0	0
Stow net *Ambai*	02.2.0.3		468	107	0	0	0
Stow net *Jermal*	02.1.0		1100	19	0	0	0
Stow net *Pengerih*	02.2.1		114	48	0	0	0
Barrier, fence, weir *Barriers, Fences, Weirs, Sero*	02.2.2		495	29	0	0	0
Drive-in net *Muro Ami*	02.2.0.1		19	21	0	0	0
Scoopnet *Seser*	08.9.0.2		181	57	0	0	0
Hooks and Lines 09.0.0							
Handline and hand operated polehandline *Pancing Ulur (nontuna)*	09.1.0.1		19508	3678	1236	257	46
Handline and hand operated poleand-line *Pancing Berjoran*	09.1.0.2		2122	777	85	128	16
Handline and hand operated *Huhate*	09.1.0.3		40	110	250	774	235
Squid angling *Squid Angling, Pancing Cumi*	09.1.0.4		1221	538	20	19	37
Squid jigging *Pancing Cumi Mekanis*	09.0.2.1		246	45	0	0	9
Set longline *Rawai Dasar*	09.3.0		5327	2488	463	10	5
Drifting longlines *Rawai Tuna*	09.4.0.1		941	516	97	161	251
Drifting longlines *Rawai Cucut*	09.4.0.2		102	39	256	126	156

Category	Fishing Gear Code	Vessel Size	GT<5	GT 5-10	GT 10-20	GT 20-30	GT >30
Trolling Line *Tonda*	09.6.0.1		4798	2229	1037	797	99
Fishing with kite *Pancing Layang-Layang*	09.9.0.1		259	10	0	0	0
Miscellaneous Gears 10.0.0							
Harpoon *Tombak*	10.1.0		65	2	0	0	0
Ladung *Ladung*	10.0.0.1		83	114	5	0	0
Panah *Panah*	10.0.0.2		339	2	0	0	0

ANNEX 5

ALDFG Risk Assessment - scoring tables

Table 21: Gear-specific scorings for the likelihood of damage and loss.

Code	English Name	Indonesian Name	Variables*															Likelihood
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01 ENCIRCLING NETS																			
01.1.1	Single vessel purse seine	Pukat Cincin Pelagis Kecil Dengan Satu Kapal	2	2	1	1	1	1	1	1	3	3	2	2	1	1	3	2	1.7
01.1.2	Group operated purse seines	Pukat Cincin Gruo Pelagis Besar	2	2	1	1	1	1	1	1	3	3	2	2	1	1	3	2	1.7
02 SEINE NETS																			
02.1	Beach Seine	Pukat Tarik Pantai	1	2	2	2	1	1	1	1	1	2	3	2	1	1	3	2	1.6
02.2.1	Danish Seine	Dogol	3	4	1	2	1	3	1	1	3	3	3	3	2	3	3	2	2.4
02.2.3	Boat Seine*	Payang	3	1	1	1	1	1	1	1	3	2	3	3	2	3	3	2	1.9
02.2.4	Boat Seine*	Cantrang	3	3	3	3	1	2	1	1	3	3	3	3	2	3	3	2	2.4
02.2.5	Boat Seine*	Lampara Dasar	2	3	3	3	1	2	1	1	3	2	3	3	2	2	3	2	2.2
03 TRAWLS																			
03.1.2	Demersal otter trawl	Pukat Hela Dasar Berpapan	3	3	4	3	1	3	1	1	3	4	3	3	2	3	3	2	2.6
03.2.1	Midwater otter trawl	Pukat Hela Pertengahan Berpapan	3	3	4	3	1	2	1	1	3	4	3	3	2	3	3	2	2.6
03.2.3	Shrimp trawls	Pukat Hela Pertengahan Udang	3	1	1	1	1	1	1	1	3	3	3	3	2	1	3	2	1.9
05 LIFT NETS																			
05.1	Portable lift net	Anco	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1.1
05.2.1	Boat Oerated lift net*	Bagan Berperahu	2	1	1	1	1	1	1	1	2	1	2	2	2	2	3	2	1.6
05.2.2	Boat Oerated lift net*	Bouke Ami	2	1	1	1	1	1	2	1	2	1	2	2	2	2	3	2	1.6
05.3	Shore-operated stationary lift net	Bagan Tancap	2	1	1	1	1	1	1	1	2	2	2	2	2	2	3	2	1.6
06 FALLING GEAR																			
06.1	Cast net	Jala Jatuh Berkapal	2	1	1	1	1	1	1	1	2	2	3	2	2	2	3	2	1.7
07 GILLNETS AD ENTANGLING NETS																			
07.1	Set gillnet anchored <600m	Jaring Insang Tetap, Jaring Liong Bun <600m	3	4	4	3	3	3	1	3	3	4	3	3	3	3	3	2	3.0
07.1	Set gillnet anchored <2,500m	Jaring Insang Tetap, Jaring Liong Bun <2,500m	3	4	4	3	3	3	1	3	3	4	3	3	3	3	3	2	3.0
07.2	Drift gillnet	Jaring Insang Hanyut <600m	3	1	1	1	2	2	1	3	3	3	3	3	3	2	3	2	2.2
07.2	Drift gillnet <2,300m	Jaring Gillnet Oseanik <2,500m	3	1	1	1	2	2	1	3	2	3	3	3	2	2	3	2	2.1
07.2	Drift gillnet <5,000m	Jaring Gillnet Oseanik <5,000m	3	1	1	1	2	2	1	3	2	3	3	3	2	2	3	2	2.1
07.5	Trammel net	Jaring Insang Berlapis	3	3	3	3	3	3	2	3	2	4	3	2	2	3	3	2	2.8
08 POTS AND TRAPS																			
08.2	Pot	Bubu	2	3	1	3	4	4	3	5	3	3	3	3	3	3	3	2	3.0
09 HOOK AND LINES																			
09.1.1	Handline and hand operated poleand-line*	Pancing Ulur (nontuna)	1	1	1	1	1	1	1	1	3	3	3	2	3	1	3	2	2.1
09.3	Set longlines <1,000	Rawal Dasar <1,000	1	3	1	1	1	3	1	1	1	3	3	2	2	1	3	2	1.9
09.3	Set longlines <2,000	Rawal Dasar <2,000	1	3	1	1	1	3	1	1	1	3	3	2	2	1	3	2	1.9
09.3	Set longlines <10,000	Rawal Dasar <10,000	1	3	1	1	1	3	1	1	1	3	3	2	2	1	3	2	1.9
09.4	Drift longlines <1,000	Rawal Hanyut <1,000	1	3	2	1	1	3	2	1	1	3	3	2	2	1	3	2	1.8
09.4	Drift longlines <2,000	Rawal Hanyut <2,000	1	3	2	1	1	3	2	1	1	3	3	2	2	1	3	2	1.8
09.4	Drift longlines <10,000	Rawal Hanyut <10,000	1	3	2	1	1	3	2	1	1	3	3	2	2	1	3	2	1.8
09.5	Trolling line	Tonda	1	1	1	1	1	1	1	1	1	3	3	2	2	1	3	2	1.6
10 MISCELLANEOUS OTHER GEAR																			
10.5	Pushnet	Pukat Dorong	3	1	1	1	1	1	1	1	1	3	3	2	2	1	3	2	1.7
10.6	Scoopnet	Seser	1	1	1	1	1	1	1	1	1	3	3	2	2	1	3	2	1.6

* Description of variables:
1. Wear & tear from mechanical systems.
2. Wear and tear from towing over seabed.
3. Wear, tear and damage from unintended contact with seabed.
4. Contact with seabed obstructions.
5. Deployed fishing gear not retrieved.
6. Loss or damage resulting from other fleets on fishing grounds.
7. Fishing gear lost overboard.
8. One or more fishing gear units cannot be located at sea (lost).
9. Poor handling and stowage of fishing gears.
10. Fishing gear material strength severely diminished.
11. Fishing equipment poorly maintained.
12. Crew poorly trained in gear maintenance.
13. Poor seamanship and navigation.
14. Overcrowding of fishing grounds (fleet separation)
15. Non-compliance with regulations.
16. Severe weather events.

Table 22: Gear-specific scorings for the severity of damage and loss.

Code	English Name	Indonesian Name	Variables*															Severity
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
01 ENCIRCLING NETS																			
01.1.1	Single vessel purse seine	Pukat Cincin Pelagis Kecil Dengan Satu Kapal	2	2	3	3	3	1	3	3	3	3	3	1	3	3	3	1	2.5
01.1.2	Group operated purse seines	Pukat Cincin Gruo Pelagis Besar	1	2	3	3	3	1	3	3	3	3	3	1	3	3	3	1	2.4
02 SEINE NETS																			
02.1	Beach Seine	Pukat Tarik Pantai	1	2	2	1	1	1	2	2	1	2	2	2	1	1	3	1	1.6
02.2.1	Danish Seine	Dogol	2	3	4	4	3	3	3	3	3	3	3	3	3	3	3	1	2.9
02.2.3	Boat Seine*	Payang	2	3	5	4	3	3	2	1	2	3	2	2	3	3	3	1	1.6
02.2.4	Boat Seine*	Cantrang	2	3	3	3	3	3	2	1	2	3	3	3	3	3	3	1	2.6
02.2.5	Boat Seine*	Lampara Dasar	2	3	3	3	3	3	2	1	2	3	3	3	3	3	3	1	2.6
03 TRAWLS																			
03.1.2	Demersal otter trawl	Pukat Hela Dasar Berpapan	3	3	4	4	4	3	1	2	3	3	3	2	3	3	3	1	2.8
03.2.1	Midwater otter trawl	Pukat Hela Pertengahan Berpapan	3	3	4	3	4	3	1	1	3	3	2	2	3	3	3	1	2.6
03.2.3	Shrimp trawls	Pukat Hela Pertengahan Udang	3	4	5	4	4	3	1	1	2	3	2	2	4	3	3	1	2.8
05 LIFT NETS																			
05.1	Portable lift net	Anco	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1.1
05.2.1	Boat Oerated lift net*	Bagan Berperahu	2	1	2	1	2	1	2	1	2	2	2	2	2	1	3	1	1.7
05.2.2	Boat Oerated lift net*	Bouke Ami	2	1	1	1	1	1	1	1	2	2	2	2	2	1	3	1	1.5
05.3	Shore-operated stationary lift net	Bagan Tancap	1	1	1	1	1	1	1	1	2	2	2	2	2	1	3	1	1.4
06 FALLING GEAR																			
06.1	Cast net	Jala Jatuh Berkapal	2	1	1	1	1	1	1	1	2	2	2	2	2	1	3	1	1.5
07 GILLNETS AD ENTANGLING NETS																			
07.1	Set gillnet anchored <600m	Jaring Insang Tetap, Jaring Liong Bun <600m	3	2	4	4	4	4	1	5	2	2	3	3	4	4	4	3	3.2
07.1	Set gillnet anchored <2,500m	Jaring Insang Tetap, Jaring Liong Bun <2,500m	3	2	4	4	4	4	1	5	2	2	3	3	4	4	4	3	3.2
07.2	Drift gillnet	Jaring Insang Hanyut <600m	3	1	1	1	3	3	1	5	2	2	3	3	4	2	3	1	2.4
07.2	Drift gillnet <2,300m	Jaring Gillnet Oseanik <2,500m	3	1	1	1	3	3	1	3	2	2	3	3	3	2	3	1	2.2
07.2	Drift gillnet <5,000m	Jaring Gillnet Oseanik <5,000m	3	1	1	1	3	3	1	3	2	2	3	3	3	2	3	1	2.2
07.5	Trammel net	Jaring Insang Berlapis	2	3	3	4	4	5	3	4	2	2	3	3	4	4	4	3	3.3
08 POTS AND TRAPS																			
08.2	Pot	Bubu	2	3	1	2	5	4	3	4	4	2	3	3	4	4	4	3	3.2
09 HOOK AND LINES																			
09.1.1	Handline and hand operated poleand-line*	Pancing Ulur (nontuna)	1	1	1	1	1	1	1	1	2	3	2	2	2	1	4	1	1.9
09.3	Set longlines <1,000	Rawal Dasar <1,000	1	3	1	1	1	3	1	1	2	3	3	2	2	3	3	1	2.3
09.3	Set longlines <2,000	Rawal Dasar <2,000	1	3	1	1	1	3	1	1	2	3	3	2	2	3	3	1	2.2
09.3	Set longlines <10,000	Rawal Dasar <10,000	1	3	1	1	1	3	1	1	2	3	3	2	2	3	3	1	2.2
09.4	Drift longlines <1,000	Rawal Hanyut <1,000	1	3	2	1	1	3	2	1	2	3	3	2	2	1	3	1	2.2
09.4	Drift longlines <2,000	Rawal Hanyut <2,000	1	3	2	1	1	3	2	1	2	3	3	2	2	1	3	1	2.2
09.4	Drift longlines <10,000	Rawal Hanyut <10,000	1	3	2	1	1	3	2	1	2	3	3	2	2	1	3	1	2.2
09.5	Trolling line	Tonda	1	1	1	1	1	1	1	1	1	3	2	1	1	1	3	1	1.3
10 MISCELLANEOUS OTHER GEAR																			
10.5	Pushnet	Pukat Dorong	3	3	3	3	1	1	3	1	1	3	2	2	2	2	3	1	2.1
10.6	Scoopnet	Seser	1	1	1	2	1	1	1	1	1	1	1	1	1	1	3	1	1.2

* Description of variables:
1. Wear & tear from mechanical systems.
2. Wear and tear from towing over seabed.
3. Wear, tear and damage from unintended contact with seabed.
4. Contact with seabed obstructions.
5. Deployed fishing gear not retrieved.
6. Loss or damage resulting from other fleets on fishing grounds.
7. Fishing gear lost overboard.
8. One or more fishing gear units cannot be located at sea (lost).
9. Poor handling and stowage of fishing gears.
10. Fishing gear material strength severely diminished.
11. Fishing equipment poorly maintained.
12. Crew poorly trained in gear maintenance.
13. Poor seamanship and navigation.
14. Overcrowding of fishing grounds (fleet separation)
15. Non-compliance with regulations.
16. Severe weather events.

Table 23: Gear-specific scorings for the overall vulnerability to damage and loss.

			Variables*																
Code	English Name	Indonesian Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Vulnerability
01 ENCIRCLING NETS																			
01.1.1	Single vessel purse seine	Pukat Cincin Pelagis Kecil Dengan Satu Kapal	4	4	3	3	3	1	3	3	3	9	9	2	6	3	9	2	4.2
01.1.2	Group operated purse seines	Pukat Cincin Gruo Pelagis Besar	2	4	3	3	3	1	3	3	3	9	9	2	6	3	9	2	4.1
02 SEINE NETS																			
02.1	Beach Seine	Pukat Tarik Pantai	1	4	4	2	1	1	2	2	1	4	6	4	1	1	9	2	2.5
02.2.1	Danish Seine	Dogol	6	12	4	8	3	9	3	3	9	9	9	9	6	9	9	2	7.0
02.2.3	Boat Seine*	Payang	6	3	5	4	3	3	2	1	6	6	6	6	6	9	9	2	5.1
02.2.4	Boat Seine*	Cantrang	6	9	9	9	3	6	1	1	6	9	9	9	6	9	9	2	6.2
02.2.5	Boat Seine*	Lampara Dasar	4	9	9	9	3	6	1	1	6	6	9	9	6	6	9	2	5.8
03 TRAWLS																			
03.1.2	Demersal otter trawl	Pukat Hela Dasar Berpapan	6	9	16	12	4	9	1	2	9	12	9	6	6	9	9	2	7.2
03.2.1	Midwater otter trawl	Pukat Hela Pertengahan Berpapan	6	9	16	9	4	6	1	1	9	12	6	6	6	9	9	2	6.6
03.2.3	Shrimp trawls	Pukat Hela Pertengahan Udang	6	4	5	4	4	3	1	1	6	9	6	6	8	3	9	2	5.2
05 LIFT NETS																			
05.1	Portable lift net	Anco	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	2	1.2
05.2.1	Boat Oerated lift net*	Bagan Berperahu	4	1	2	1	2	1	2	1	4	2	4	4	4	2	9	2	2.6
05.2.2	Boat Oerated lift net*	Bouke Ami	4	1	1	1	1	1	2	1	4	2	4	4	4	2	9	2	2.4
05.3	Shore-operated stationary lift net	Bagan Tancap	2	1	1	1	1	1	1	1	4	4	4	4	4	2	9	2	2.3
06 FALLING GEAR																			
06.1	Cast net	Jala Jatuh Berkapal	4	1	1	1	1	1	1	1	4	4	6	4	4	2	9	2	2.5
07 GILLNETS AD ENTANGLING NETS																			
07.1	Set gillnet anchored <600m	Jaring Insang Tetap, Jaring Liong Bun <600m	9	8	16	12	12	12	1	15	6	8	9	9	12	12	12	6	9.8
07.1	Set gillnet anchored <2,500m	Jaring Insang Tetap, Jaring Liong Bun <2,500m	9	8	16	12	12	2	1	15	6	8	9	9	12	12	12	6	9.8
07.2	Drift gillnet	Jaring Insang Hanyut <600m	9	1	1	1	6	6	1	15	6	6	9	9	12	4	9	2	5.3
07.2	Drift gillnet <2,300m	Jaring Gillnet Oseanik <2,500m	9	1	1	1	6	6	1	9	4	6	9	9	6	4	9	2	4.6
07.2	Drift gillnet <5,000m	Jaring Gillnet Oseanik <5,000m	9	1	1	1	6	6	1	9	4	6	9	9	6	4	9	2	4.6
07.5	Trammel net	Jaring Insang Berlapis	6	9	9	12	12	15	6	12	4	8	9	6	8	12	12	6	9.1
08 POTS AND TRAPS																			
08.2	Pot	Bubu	4	9	1	6	20	16	9	20	12	6	9	9	12	12	12	6	9.6
09 HOOK AND LINES																			
09.1.1	Handline and hand operated poleand-line*	Pancing Ulur (nontuna)	2	1	1	2	4	9	6	1	6	9	6	4	6	1	12	2	4.0
09.3	Set longlines <1,000	Rawal Dasar <1,000	6	1	3	2	6	9	2	3	2	9	9	4	4	3	9	2	4.5
09.3	Set longlines <2,000	Rawal Dasar <2,000	6	1	3	2	3	9	2	3	2	9	9	4	4	3	9	2	4.4
09.3	Set longlines <10,000	Rawal Dasar <10,000	6	1	3	2	3	9	2	3	2	9	9	4	4	3	9	2	4.4
09.4	Drift longlines <1,000	Rawal Hanyut <1,000	6	1	3	3	2	2	3	3	2	9	9	4	4	1	9	2	3.8
09.4	Drift longlines <2,000	Rawal Hanyut <2,000	6	1	3	3	2	2	3	3	2	9	9	4	4	1	9	2	3.8
09.4	Drift longlines <10,000	Rawal Hanyut <10,000	6	1	3	3	2	2	3	3	2	9	9	4	4	1	9	2	3.8
09.5	Trolling line	Tonda	1	1	1	1	1	1	1	1	1	9	6	2	2	1	9	2	2.1
10 MISCELLANEOUS OTHER GEAR																			
10.5	Pushnet	Pukat Dorong	9	3	3	3	1	1	3	1	1	9	6	4	4	2	9	2	3.6
10.6	Scoopnet	Seser	1	1	1	1	1	1	1	1	1	3	3	2	2	1	9	2	1.9

* Description of variables:
1. Wear & tear from mechanical systems.
2. Wear and tear from towing over seabed.
3. Wear, tear and damage from unintended contact with seabed.
4. Contact with seabed obstructions.
5. Deployed fishing gear not retrieved.
6. Loss or damage resulting from other fleets on fishing grounds.
7. Fishing gear lost overboard.
8. One or more fishing gear units cannot be located at sea (lost).
9. Poor handling and stowage of fishing gears.
10. Fishing gear material strength severely diminished.
11. Fishing equipment poorly maintained.
12. Crew poorly trained in gear maintenance.
13. Poor seamanship and navigation.
14. Overcrowding of fishing grounds (fleet separation)
15. Non-compliance with regulations.
16. Severe weather events.

Table 24: Gear-specific scorings for the likelihood of ecological impacts arising from ALDFG.

Code	English Name	Indonesian Name	Variables 1	2	3	4	Impact
01 ENCIRCLING NETS							
01.1.1	Single vessel purse seine	Pukat Cincin Pelagis Kecil Dengan Satu Kapal	1	1	3	3	2.0
01.1.2	Group operated purse seines	Pukat Cincin Gruo Pelagis Besar	1	1	3	3	2.0
02 SEINE NETS							
02.1	Beach Seine	Pukat Tarik Pantai	1	1	1	2	1.2
02.2.1	Danish Seine	Dogol	1	1	1	3	1.5
02.2.3	Boat Seine*	Payang	1	2	1	3	1.8
02.2.4	Boat Seine*	Cantrang	1	2	1	3	1.8
02.2.5	Boat Seine*	Lampara Dasar	1	2	2	3	2.0
03 TRAWLS							
03.1.2	Demersal otter trawl	Pukat Hela Dasar Berpapan	1	2	3	3	2.2
03.2.1	Midwater otter trawl	Pukat Hela Pertengahan Berpapan	1	2	2	3	2.0
03.2.3	Shrimp trawls	Pukat Hela Pertengahan Udang	1	2	2	3	2.0
05 LIFT NETS							
05.1	Portable lift net	Anco	1	1	1	1	1.0
05.2.1	Boat Oerated lift net*	Bagan Berperahu	1	1	1	3	1.5
05.2.2	Boat Oerated lift net*	Bouke Ami	1	1	1	3	1.5
05.3	Shore-operated stationary lift net	Bagan Tancap	1	1	1	2	1.2
06 FALLING GEAR							
06.1	Cast net	Jala Jatuh Berkapal	1	1	1	2	1.2
07 GILLNETS AD ENTANGLING NETS							
07.1	Set gillnet anchored <600m	Jaring Insang Tetap, Jaring Liong Bun <600m	5	5	2	3	3.8
07.1	Set gillnet anchored <2,500m	Jaring Insang Tetap, Jaring Liong Bun <2,500m	5	5	2	3	3.8
07.2	Drift gillnet	Jaring Insang Hanyut <600m	4	5	2	2	3.2
07.2	Drift gillnet <2,300m	Jaring Gillnet Oseanik <2,500m	4	5	2	2	3.2
07.2	Drift gillnet <5,000m	Jaring Gillnet Oseanik <5,000m	4	5	2	2	3.2
07.5	Trammel net	Jaring Insang Berlapis	5	5	2	2	3.5
08 POTS AND TRAPS							
08.2	Pot	Bubu	5	2	3	1	2.8
09 HOOK AND LINES							
09.1.1	Handline and hand operated poleand-line*	Pancing Ulur (nontuna)	1	1	1	1	1.0
09.3	Set longlines <1,000	Rawal Dasar <1,000	1	3	1	1	1.5
09.3	Set longlines <2,000	Rawal Dasar <2,000	1	3	1	1	1.5
09.3	Set longlines <10,000	Rawal Dasar <10,000	1	3	1	1	1.5
09.4	Drift longlines <1,000	Rawal Hanyut <1,000	1	3	2	1	1.8
09.4	Drift longlines <2,000	Rawal Hanyut <2,000	1	3	2	1	1.8
09.4	Drift longlines <10,000	Rawal Hanyut <10,000	1	3	2	1	1.8
09.5	Trolling line	Tonda	1	1	1	1	1.0
10 MISCELLANEOUS OTHER GEAR							
10.5	Pushnet	Pukat Dorong	1	1	2	3	1.8
10.6	Scoopnet	Seser	1	1	1	1	1.0

* Description of variables:
1. Gosht fishing
2. Entanglement of marine life
3. Rafting of invasive species
4. Smothering of habitats

ANNEX 6

ALDFG Risk Assessment – rationale and explanatory notes

EXPLANATORY NOTES FOR LIKELIHOOD AND SEVERITY OF GEAR BECOMING ALDFG

Potential for EOLFG and ALDFG Generation

Fishing Gear Classification		Wear & Tear from mechanical systems	Wear and tear from towing on seabed	Wear, tear, damage from unintended contact with seabed	Contact with seabed obstructions	Deployed fishing gear not retrieved	Deliberate setting of fishing gear on man made structures	Loss or damage resulting from other fleets on fishing grounds	Fishing gear lost overboard	One or more fishing gear units cannot be located at sea (lost)
Indonesian Code	**Fishing Gear Name**									
01	**Surrounding gear**	Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Likelihood =2 Severity = 2	Gear is not towed over seabed. Lower section may be hauled across seabed when setting in shallow water. Increased abrasion in lower sections of net leading to weakened mesh braking strength and rope fatigue. Likelihood =2 Severity = 2	May occur when setting in shallow water. Increased abrasion in lower sections of net leading to weakened mesh braking strength and rope fatigue. Likelihood =1 Severity = 3	May occur when setting in shallow water. Increased abrasion in lower sections. High strain on ropes when hauling may lead to major structural damage to netting and ropes. Likelihood =2 Severity = 3	Not applicable. Vessel always attached to fishing gear Likelihood =0	May occur when setting on rumpon, anchored FADs, ocean buoys and wrecks. High strain on ropes when hauling may lead to major structural damage to netting and ropes. Likelihood =1 Severity = 3	Not applicable to this gear type Likelihood =1 Severity = 1	High weight of fishing gear make this type of loss unlikely Likelihood =0	Not applicable to this gear type. Likelihood =0
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Wind and current may push net into propellor leading to net and propulsion system damage. Incorrrect hauling of seine can lead to high strain on netting and net burst. Likelihood =2 Severity = 3	Onboard mechanized hauling systems can lead to high abrasion resistance. Likelihood =2 Severity = 3	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =2 Severity = 3	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =2 Severity = 3	Poor seamanship can lead to setting in areas where damage to gear is likely to occur or to increased risk of self inflicted damages. Damage can range from minor to major structural damage. Likelihood =1-2 Severity = 3	Fishing gear well monitored and damage / loss from other vessels unlikely. Setting and retrieval time is low. Purse seiners are often equipped with sophisticated navigation equipment which reduce likelihood of encounters with other vessels. Likelihood =1 Severity = 3	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =3	Vessel can take avoidance actions to minimize risk of damage. Likelihood =3 Severity = 1	
02.1	**Beach seines**	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Handhauled systems unlikely to exceed breaking strains of netting materials. Likelihood =1-2 Severity = 1-2	Gear is towed over seabed. Mesh and rope abrasion in lower sections of net can lead to weakened mesh braking strength and rope fatigue. However, mets usually set on clean ground. Likelihood =4 Severity = 1-2	May occur if setting is in an area where seabed topography is unknown. Likelihood =1 Severity = 2-3	May occur if setting is in an area where seabed topography is unknown. Likelihood =1 Severity = 3	Gear is typically set in areas where retrieval is highly likely. Likelihood =0	Not applicable to this gear type. Likelihood =0	Beach seines operate in isolation of other gear tyes. Likelihood =0	May occur during setting. But since gear is set in shallow water and to shore, gear can be retrieved. Likelihood =2 Severity = 1	Not applicable to this gear type Likelihood =0
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Minimal impacts associated with this variable. Likelihood =2 Severity = 1	Hauling over seabed will lead to abrasion of netting and ropes. Knotted netting may result in knot abrasion and reduced mesh breaking strength. Likelihood =4 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. Likelihood =4 Severity = 1	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =2 Severity = 2	Beach seines operate in isolation and in relatively shallow water. . Loss / damage from from poor seamanship navigation is unlikely. Likelihood =1 Severity = 1	Beach seines operate in isolation of other gear tyes. Loss / damage from from overcrowding unlikely for gear type Likelihood =1 Severity =1	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 2	Not applicable. Gear usually stored after use. Likelihood =0	

Boat Seines										
02.2.1	Danish seines	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Likelihood =2 Severity = 3	Gear is towed over seabed. Relatively high rates of wear and tear anticipated especially in lower sections of net. Mesh abrasion and weakened mesh breaking strength lead to higher rate of replacement and early onset damage to netting. Likelihood =5 Severity = 2	Gear is designed to operate in seabed contact. PE material has high abrasion resistance to accommodate regular contact. Likelihood =2 Severity = 4	Danish seines are designed for relative smooth seabed and lighter materials are used. Nets are not designed to absorb load from contat with seabed obstructions. Minor - major structural damage can occur to net dues to contact with obstructions. Likelihood =3 Severity = 4	Not applicable. Vessel always attached to fishing gear. Likelihood =0	Likely event if seabed topography is not kown. Can occur due to setting on wrecks with major structual damage likely. Vessels equipped with instrumentation to detect type of seabed and GPS/chart plotter can miniimize occurrence. Likelihood =1 Severity = 2	Poorly marked passive gears such as pots and gillnets (and associated anchors) may be encountered. Size and weight of seine usualy results in low-moderate damage to seine. Likelihood =4 Severity = 2	Seine is attached tp vessel at all times. This type of loss is highly unlikely. Extreme weather may events may result in gear loss overboard if not properly stowed. Likelihood =1 Severity = 2	Dhan marker disconnecting from net is unlikely event. Likelihood =1 Severity = 4
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may push net into propellor during hauling or shooting leading to net and propulsion system damage. Likelihood =2 Severity = 1	Poorly maintained hauling systems can lead to excessive abrasion of netting and ropes and reduced mesh breaking strength. Likelihood =2 Severity = 3	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to unexpected net and rope failure and increased levels of net and rope damage. Likelihood =2 Severity = 3	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =2 Severity = 3	Poor seamanship can lead to setting in areas where damage to gear is likely to occur or to increase risk of self inflicted damages. Damage can range from minor to major structural damage of fishing gear Likelihood =2 Severity =3	Lack of zoning for active (trawls, seines) and passive fleets (set gillnets, pots) can lead to high numbers of gear encounters. Level of damage / lossepends on the size / type of gear, material properties etc. Likelihood =4 Severity = 2	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =5 Severity = 2	Vessel can take avoidance actions to minimize risk of damage. Likelihood =0	
02.2.3	Pelagic seines	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		See above. Pelagic seines are typically comprised of PA. Material is relatively light. Wear and tear reduce knot strength and mesh strength. High wear and tear can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Likelihood =4 Severity = 3	Gear is not designed to towed on seabed. Major structual damage to net likely when gear is in contact with seabed. Likelihood =2 Severity = 4	Catastrophic damage to gear likely. Contact with seabed is avoided. Likelihood =2 Severity = 5	Catastrophic damage to gear likely. Contact with seabed obstructions are avoided. Likelihood =1 Severity = 5	Not applicable. Vessel always attached to fishing gear Likelihood =0	Likely event if seabed topography is not kown. Can occur due to setting on wrecks, ocean buoys Rumpon with major structual damage likely. Vessels equipped with instrumentation to detect type of seabed and GPS/chart plotter can miniimize occurrence. Likelihood =1 Severity = 5	Fishing gear is typically operated off the seabed and minimal encounter with other gears is anticipated. Likelihood =2 Severity = 3	Seine is attached tp vessel at all times. This type of loss is highly unlikely. Extreme weather may events may result in gear loss overboard if not properly stowed. PA netting may result in gear sinking rather than drifting. Likelihood =0	Not applicable to this gear type. Likelihood =0
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may push net into propellor during hauling or shooting leading to net and propulsion system damage. Likelihood =2 Severity = 2	Hauling over seabed will lead to abrasion of netting and ropes. Knotted netting may result in knot abrasion and reduced mesh breaking strength. Likelihood =1 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to unexpected net and rope failure and increased levels of net and rope damage. Likelihood =2 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =2 Severity = 2	Poor seamanship can lead to setting in areas where damage to gear is likely to occur or to increase risk of self inflicted damages. Damage can range from minor to major structural damage of fishing gear Likelihood =1 Severity = 2	Lack of zoning for active (tawls, seines) and passive fleets (set gillnets, pots) can lead to high numbers of gear encounters. However, since net is used pelagically, likelihood of encounter and subsequent damage is reduced. Likelihood =1 Severity = 1	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 2	Vessel can take avoidance actions to minimize risk of damage	

02.2.4	**Cantrang**	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Cantrang seines are typically comprised of PE knotted netting (floating). Material is relatively light but designed to operate on smooth seabeds. Wear and tear reduce knot strength and mesh strength. High wear and tear can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Likelihood =2 Severity = 3	Gear is towed over smooth seabed. Relatively high rates of wear and tear anticipated especially in lower sections of net. Mesh abrasion and weakened mesh breaking strength lead to higher rate of replacement and early onset damage to netting. Likelihood =5 Severity = 2	May occur if setting is in an area where seabed topography is unknown. High levels of damage expected if seabed is not smooth. Potential for unintended contact can be reduced by use of instrumentation. Likelihood =3 Severity = 3	Danish seines are designed for relative smooth seabed and lighter materials are used. Nets are not designed to absorb load from contat with seabed obstructions. Minor - major structural damage can occur to net dues to contact with obstructions. Likelihood =1 Severity = 3	Not applicable. Vessel always attached to fishing gear Likelihood =0	Likely event if seabed topography is not kown. Can occur due to setting on wrecks, ocean buoys Rumpon with major structual damage likely. Vessels equipped with instrumentation to detect type of seabed and GPS/chart plotter can miniimize occurrence. Likelihood =1 Severity = 4	Poorly marked passive gears such as pots and gillnets (and associated anchors) may be encountered. Size and weight of seine usualy results in low-moderate damage to seine. Vessels towing nets may actively avoid santrang to reduce likelihood of collision. Likelihood =3 Severity = 3	Seine is attached tp vessel at all times. This type of loss is highly unlikely. Extreme weather may events may result in gear loss overboard if not properly stowed. PA netting may result in gear sinking rather than drifting. Likelihood =0	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may push net into propellor during hauling or shooting leading to net and propulsion system damage. Likelihood =2 Severity = 2	Hauling over seabed will lead to abrasion of netting and ropes. Knotted netting may result in knot abrasion and reduced mesh breaking strength. Likelihood =5 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to unexpected net and rope failure and increased levels of net and rope damage. Likelihood =3 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =2 Severity = 2	Poor seamanship can lead to setting in areas where damage to gear is likely to occur or to increase risk of self inflicted damages. Damage can range from minor to major structural damage of fishing gear Likelihood =1 Severity = 2	Lack of zoning for active (tawls, seines) and passive fleets (set gillnets, pots) can lead to high numbers of gear encounters. Level of damage / lossepends on the size / type of gear, material properties etc. Likelihood =4 Severity = 2	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 2	Vessel can take avoidance actions to minimize risk of damage Likelihood=0	
02.2.5	**Lampara Dasar (mini trawl)**	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Mini trawl is a relatively small net used close to shore in shallow water. Although small in size, wear and tear from mechanical hauling can result in wear and tear leading to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Likelihood =2 Severity =2	Gear is towed over smooth seabed at relatively slow speed. Moderate rates of wear and tear anticipated especially in lower sections of net. Mesh abrasion and weakened mesh breaking strength lead to higher rate of replacement and early onset damage to netting. Likelihood =5 Severity = 2	May occur if setting is in an area where seabed topography is unknown. Minor to major structural damage can occur. Likelihood =2 Severity = 2	May occur if setting is in an area where seabed topography is unknown. However, slow speed of towing may limit the level of damage. Likelihood =3 Severity = 2	May ocdcur when gear held fast on seabed. Likelihood =1 Severity = 4	Likely event if seabed topography is not kown. Can occur due to setting on rough seabed with major structual damage likely. Likelihood =1 Severity = 3	Poorly marked passive gears such as pots and gillnets (and associated anchors) may be encountered. Likelihood =3 Severity = 3	Lampara dasar is attached tp vessel at all times. This type of loss is highly unlikely. Extreme weather may events may result in gear loss overboard if not properly stowed. Likelihood =1 Severity = 2	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may push net into propellor during hauling or shooting leading to net and propulsion system damage. Likelihood =2 Severity = 3	Hauling over seabed will lead to abrasion of netting and ropes. Knotted netting may result in knot abrasion and reduced mesh breaking strength. Low towing speed may limit type of damage encountered. Likelihood =5 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to unexpected net and rope failure and increased levels of net and rope damage. Likelihood =2 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =2 Severity = 2	May ocdcur when gear held fast on seabed. Likelihood =1 Severity = 4	Lack of zoning for active (tawls, seines) and passive fleets (set gillnets, pots) can lead to high numbers of gear encounters. Level of damage / lossepends on the size / type of gear, material properties etc. Likelihood =4 Severity = 2	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 2	Vessel can take avoidance actions to minimize risk of damage	

Trawls										
'03.2	Single boat bottom otter trawl	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength and rope fatigue. Likelihood =2 Severity = 2	Gear is towed over a range of seabeds at relatively high speed. Moderate-high rates of wear and tear anticipated especially in lower sections of net. Mesh abrasion and weakened mesh breaking strength lead to higher rate of replacement and early onset damage to netting. Likelihood =5 Severity =3	Unintended setting of net on seabed obstructions can result in structural damage. However, some trawls are specifically designed for such types of set. Likelihood =3 Severity = 3	Some trawls are specifically designed for such types of set. Likelihood =3 Severity = 3	Not applicable. Vessel always attached to fishing gear. Catastrophic loss may occur when setting in deepwater on seamounts. Likelihood =1 Severity = 3	Some trawls are specifically designed for such types of set. However, high levels of wear and tear and early onset of reduce knot and mesh breaking strength expected. Major structural damage is possible with some fishers balancing risk (high damage) and reward (high catch) for such sets. Likelihood =1 Severity = 3	Poorly marked passive gears such as pots and gillnets (and associated anchors) may be encountered. Power of vessel and strength of netting materials may reduce damage to own gear. Major damage and loss may occur to encountered gears. Likelihood =3 Severity = 3	Trawl is attached to vessel at all times. This type of loss is highly unlikely. Extreme weather may events may result in gear loss overboard if not properly stowed. Likelihood =0	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may push net into propellor during hauling or shooting leading to net and propulsion system damage. Likelihood =2 Severity = 3	Hauling over any type of seabed will lead to abrasion of netting and ropes. Knotted netting may result in knot abrasion and reduced mesh breaking strength. High levels of wear and tear generated when fishing on rough ground leading to early onset damage to netting and ropes. Likelihood =5 Severity = 3	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =3 Severity = 3	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =2 Severity = 2	Poor seamanship can lead to setting in areas where damage to other vessel gear is likely to occur or to self inflicted damages. Damage can range from minor to major structural damage of fishing gear. Relatively high towing speeds increase severity of damages. Likelihood =1 Severity = 3	Lack of zoning for active (tawls, seines) and passive fleets (set gillnets, pots) can lead to high numbers of gear encounters. Level of damage / loss depends on the size / type of gear, material properties etc. However, catastrophic loss to gillnets and pots can occur when encountered. Likelihood =3 Severity = 3	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 2	Vessel can take avoidance actions to minimize risk of damage	
'03.3	Single boat midwater otter trawl	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength and rope fatigue. Likelihood =2 Severity = 2	Gear is not designed to towed on seabed. Major structual damage to net likely when gear is in contact with seabed. Likelihood =1 Severity = 5	Gear is not designed to towed on seabed. Major structual damage to net likely when gear is in contact with seabed. Midwater trawlers are often equipped with sophisticated navigation and seabed detection equipment which reduce likelihood of such events. Likelihood =1 Severity = 5	Gear is not designed to towed on seabed. Major structual damage to net likely when gear is in contact with seabed. Midwater trawlers are often equipped with sophisticated navigation and seabed detection equipment which reduce likelihood of such events. Likelihood =1 Severity = 5	Not applicable for most types of trawling. Vessel always attached to fishing gear. Catastrophic loss may occur when setting in deepwater on seamounts. Likelihood =1 Severity = 3	Gear is not designed to towed over solid structures. Major structual damage to net likely when gear is in contact with seabed. Midwater trawlers are often equipped with sophisticated navigation and seabed detection equipment which reduce likelihood of such events. Likelihood =1 Severity = 5	Fishing gear is typically operated off the seabed and minimal encounter with other gears is anticipated. Midwater trawlers are often equipped with sophisticated navigation equipment which reduce likelihood of encounters. Likelihood =1 Severity = 2	Trawl is attached tp vessel at all times. This type of loss is highly unlikely. Extreme weather may events may result in gear loss overboard if not properly stowed. Likelihood =1 Severity = 3	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may push net into propellor during hauling or shooting leading to net and propulsion system damage. Likelihood =1 Severity = 3	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =2 Severity = 3	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =3 Severity = 3	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. However, high level of investment usually results in well trained crews being employed. Likelihood =1 Severity = 2	Poor seamanship can lead to setting in areas where damage to other vessel gear is likely to occur or to self inflicted damages. Damage can range from minor to major structural damage of fishing gear. Relatively high towing speeds increase severity of damages. Likelihood =1 Severity = 3	Fishing gear well monitored and damage / loss from other vessels unlikely. Setting and retrieval time is low. Midwater trawlers are often equipped with sophisticated navigation equipment which reduce likelihood of encounters. Likelihood =1 Severity = 5	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 2	Vessel can take avoidance actions to minimize risk of damage	

Lift Nets										
05.1	Anco	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Systems often hand operated. Wear and tear can be effectively managed. Likelihood =1 Severity = 1	Not applicable to this gear type. Likelihood =0	Minimal likelihood and minimal consequences Likelihood =1 Severity = 0	Minimal likelihood and minimal consequences Likelihood =1 Severity = 1	Highly unlikey in regular operations Likelihood =1 Severity = 1	Highly unlikey in regular operations Likelihood =0	Highly unlikey in regular operations Likelihood =0	Highly unlikey in regular operations Likelihood =0	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Likelihood =1 Severity = 1	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =1 Severity = 1	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. Likelihood =1 Severity = 1	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =1 Severity = 1	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 1	Not applicable. Gear usually stored after use	
05.2.1	Bagan Berperahu	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Low levels of mechanized hauling. Low rates of wear and tear anticipated. Likelihood =1 Severity = 1	Not applicable to this gear type. Likelihood =0	Minimal likelihood and minimal consequences Likelihood =1 Severity =1	Highly unlikey in regular operations Likelihood =1 Severity =1	Highly unlikey in regular operations Likelihood =1 Severity =1	Highly unlikey in regular operations Likelihood =1 Severity =1	Highly unlikey in regular operations. Vessels operate in isolation using light to aid in attraction. Likelihood =1 Severity =1	Highly unlikey in regular operations. Likelihood =1 Severity =1	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased wear and tear during hauling. Damage from minor to moderate. Likelihood =1 Severity =2	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =2 Severity =3	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =3 Severity =2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity =2	Not applicable to this gear type.	Not applicable to this gear type.	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 1	Vessel can take avoidance actions to minimize risk of damage	
05.2.2	Bouke Ami	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue Likelihood =1 Severity =2	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Highly unlikey in regular operations Likelihood =0	Highly unlikey in regular operations Likelihood =0	Highly unlikey in regular operations. Vessels operate in isolation using light to aid in attraction. Likelihood =0	Highly unlikey in regular operations Likelihood =0	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased wear and tear during hauling. Damage from minor to moderate. Likelihood =1 Severity =2	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =4 Severity =2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =3 Severity =2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =2 Severity =2	High level of investment usually results in well trained crews being employed. Likelihood =1 Severity =2	Not applicable to this gear type. Likelihood =0	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 1	Vessel can take avoidance actions to minimize risk of damage	

05.3	Bagan Tancap	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Low levels of mechanized hauling. Low rates of wear and tear anticipated. Likelihood =2 Severity =1	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Highly unlikey in regular operations. Vessels operate in isolation using light to aid in attraction. Likelihood =1 Severity = 1	Highly unlikey in regular operations Likelihood =0	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased wear and tear during hauling. Likelihood =1 Severity =1	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =4 Severity =1	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =3 Severity =2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =2 Severity =1	Not applicable to this gear type.	Not applicable to this gear type.	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 1	Possible structural damage to anchored structure. Nets can be battended down to reduce risk of damage.	
Falling gear										
06.1	Jala Jatuh Berkapal	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue Likelihood =4 Severity =1	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Highly unlikey in regular operations. Vessels operate in isolation using light to aid in attraction. Likelihood =1 Severity = 1	Highly unlikey in regular operations Likelihood =1 Severity = 1	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased risk of net loss Likelihood =1 Severity = 2	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =4 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =3 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity = 2	High level of investment usually results in well trained crews being employed. Likelihood =1 Severity = 2	Not applicable to this gear type. Likelihood =0	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity = 1	Vessel can take avoidance actions to minimize risk of damage	

Gill and entangling nets										
07.1	**Set anchored gillnets**	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Nets operate through stealth are are made of very light materials. Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Mesh damage through excessive loading, abrasion can result in early onset wear and tear. Likelihood =4 Severity = 4	Gear is not designed to be towed over seabed. Footrope and lower meshes may be abraided through seabed contact durting retrieval. Increased abrasion in lower sections of net leading to weakened mesh braking strength and rope fatigue are likely. Severity of problem increases with net let length. Likelihood =5 Severity = 2	Low breaking strain of netting and rope materials likely from unintended contact with seabed. Severity of problem increases with seabed roughness, Footrope and lower meshes may be abraided through seabed contact durting retrieval. Major structural damage can occur when nets are in contact rocky seabeds. Increased abrasion in lower sections of net leading to weakened mesh braking strength and rope fatigue are likely. Severity of problem increases with net let length. Catastrophic loss can occur when set on rough grounds. Likelihood =3 Severity = 4	Low breaking strain of netting and rope materials likely from unintended contact with seabed. Major structural damage can occur when nets are in contact rocky seabeds. Increased abrasion in lower sections of net leading to weakened mesh braking strength and rope fatigue are likely. Severity of problem increases with net let length. Catastrophic loss can occur when set on rough grounds. Likelihood =4 Severity =5	Fishing gear operates without attendance of vessel. Major loss can occur due to poor navigation, king tides, incorrect length adjustment of bouy lines. Major loss can also occur due to other vessels colliding with gear, setting on rough ground. Likelihood =4 Severity = 5	Major loss can occur when setting on man made structures. Reasons for setting may include; poor navigation, and risk taking. Likelihood =3 Severity = 4	Fishing gear operates without attendance of vessel. Major loss and damage can result from deploying nets where other vessels are operating (eg senes, trawls, pot). Type of loss can be minor to catastrophic. Risk of loss can be reduced when gear is highly visible (marked) Likelihood =5 Severity = 4	May occur due to bad weather and when anchor lines are too short when setting in areas with high tides and strong currents. Likelihood =3 Severity = 4	May occur due to bad weather and when anchor lines are too short when setting in areas with high tides and strong currents. May also occur due to poor navigation, other vessel colliding with gear or vandalism. Likelihood =4 Severity = 4
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased risk of nets being washed overboard. Likelihood =1 Severity = 2	UV and abrasion can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =5 Severity = 3	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses Likelihood =3 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity = 2	Gillnets and entangling nets are highly vulnerable to damage. Poor seamanship (linked to risk taking) can lead to setting in areas where damage to other vessel gear is likely to occur or to self inflicted damages. Damage can range from minor to major structural damage of fishing gear. Likelihood =3 Severity = 2	Overcrowding of fishing grounds and lack of fleet separation leads to different fleets encountering each other. Encounters and damage / loss associated with non fishing vessels may also occur. Encounters results "lose-lose" situations. However, the light materials used in gillnet construction typcailly result in major structural damage to nets. Likelihood =4 Severity = 5	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Coastal set gillnets highly vulnerable to major damage and total loss. Offshore gillnet vessels can take avoidance action.	
07.2	**Drift gillnets**	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Nets operate through stealth are are made of very light materials. Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Mesh damage through excessive loading, abrasion can result in early onset wear and tear. Likelihood =4 Severity = 2	Nets are typically operated off seabed. Likelihood of occurrence is low. If contact with rough seabed occurs major structural damage and loss of nets can occur. However, fishers typically avoid such situations. Likelihood =1 Severity = 2	Nets are typically operated off seabed. Nets are typically operated off seabed. Likelihood of occurrence is low. If contact with rough seabed occurs major structural damage and loss of nets can occur. However, fishers typically avoid such situations. Likelihood =1 Severity = 4	Nets are typically operated off seabed. Nets are typically operated off seabed. Likelihood of occurrence is low. If contact with rough seabed occurs major structural damage and loss of nets can occur. However, fishers typically avoid such situations. Likelihood =1 Severity = 4	Fishing gear usually operates with attendance of vessel and likelihood of self inflicted loss is low. Setting ets in close proximity to other vessel can result in gear overun and net damage. Damage and partial loss of geasr may occur in severe weather. Relative to anchored set gillnets the likelihood of damage from encounters with other vessels or seabed are very low. Likelihood =2 Severity = 2	Highly unlikey in regular operations Likelihood =0	Other vessel encounters are likely. Gear marking and radio beacons can reduce likelihood of such encounters. Poor setting practices (against fleet rules for set direction) may increase likelihood of crossing gears. Likelihood =3 Severity =3	Highly unlikey in regular operations Likelihood =0	May occur due to extreme weather where load on gear components results in failure (portion of net drifts away) or when other vessels collide with gear.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased risk of nets being washed overboard. Likelihood =1 Severity = 1	UV and abrasion can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =4 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses Likelihood =3 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity = 2	Gillnets and entangling nets are highly vulnerable to damage. Damage and loss can occur when a vessel does not set acording to fleet guidelines (direction of set) or when not maintaining a regular visual or radar watch. Damage can range from minor to major structural damage of fishing gear. Likelihood =3 Severity = 4	Overcrowding of fishing grounds and lack of fleet separation leads to different fleets encountering each other. Encounters results "lose-lose" situations. However, the light materials used in gillnet construction typcailly result in major structural damage to nets. Likelihood =3 Severity = 2	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Vessel can take avoidance actions to minimize risk of damage	

07.5-07.6	**Trammel nets**	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Nets operate through stealth are are made of very light materials. Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength., float damage and rope fatigue. Mesh damage through excessive loading, abrasion can result in early onset wear and tear. Likelihood =4 Severity = 2	Gear is not designed to be towed over seabed. Footrope and lower meshes may be abraided through seabed contact durting retrieval. Increased abrasion in lower sections of net leading to weakened mesh braking strength and rope fatigue are likely. Severity of problem increases with net let length. Likelihood =4 Severity = 3	Low breaking strain of netting and rope materials likely from unintended contact with seabed. Severity of problem increases with seabed roughness, Footrope and lower meshes may be abraided through seabed contact durting retrieval. Major structural damage can occur when nets are in contact rocky seabeds. Increased abrasion in lower sections of net leading to weakened mesh braking strength and rope fatigue are likely. Severity of problem increases with net let length. Catastrophic loss can occur when set on rough grounds. Likelihood =3 Severity = 4	Reduced breaking strain of netting and rope materials likely from unintended contact with seabed. Major structural damage can occur when nets are in contact rocky seabeds. Increased abrasion in lower sections of net can lead to reduced mesh breaking strength and rope fatigue. Severity of problem increases with net let length. Catastrophic loss can occur when set on rough grounds. Likelihood =4 Severity = 5	Fishing gear operates without attendance of vessel. Major loss can occur due to poor navigation, king tides, incorrect length adjustment of bouy lines. Major loss can also occur die to other vessels colliding with gear, setting on rough ground. Likelihood =4 Severity = 4	Major loss can occur when setting on man made structures. Reasons for setting may include; poor navigation, and risk taking. Likelihood =3 Severity = 4	Fishing gear operates without attendance of vessel. Major loss and damage can result from deploying nets where other vessels are operating (eg senes, trawls, pot). Type of loss can be minor to catastrophic. Risk of loss can be reduced when gear is highly visible (marked) Likelihood =4 Severity =4	May occur due to bad weather and when anchor lines are too short when setting in areas with high tides and strong currents. Likelihood =1 Severity = 2	May occur due to bad weather and when anchor lines are too short when setting in areas with high tides and strong currents. May also occur due to poor navigation, other vessel colliding with gear or vandalism. Likelihood =3 Severity =3
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased risk of nets being washed overboard. Likelihood =1 Severity = 2	UV and abrasion can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =3 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =3 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity = 2	Gillnets and entangling nets are highly vulnerable to damage. Poor seamanship (linked to risk taking) can lead to setting in areas where damage to other vessel gear is likely to occur or to self inflicted damages. Damage can range from minor to major structural damage of fishing gear. Likelihood =3 Severity = 2	Overcrowding of fishing grounds and lack of fleet separation leads to different fleets encountering each other. Encounters and damage / loss associated with non fishing vessels may also occur. Encounters results "lose-lose" situations. However, the light materials used in gillnet construction typcailly result in major structural damage to nets. Likelihood =3 Severity = 4	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Coastal set trammel nets highly vulnerable to major damage and total loss. Offshore trammel net vessels can take avoidance action.	
Pots and traps										
08.2	**Pots**	**Wear & Tear from mechanical systems**	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Highly mechanized hauling systems place nets, ropes and floats under high load can lead to mesh abrasion and weakened mesh breaking strength and rope fatigue. Pot ropes and anchor lines can be abaided and fatigues and rope breaking strain diminshed during hauling. Likelihood =4 Severity = 2	Gear is designed to operate pasively but pots can be towed over seabed during retrieval. Where pot mesh and frames are connstructed from light plastics, materials may become abrided and weakned. Increased abrasion leads to early onset wear and tear. Severity of problem increases with numbers of pots on a line. Likelihood =3 Severity = 2	Low breaking strain of pot netting and rope materials from hauling over seabed can result in material fatigue and early onset break. . Severity of problem increases with seabed roughness, Major structural damage can occur when pots are in contact rocky seabeds. Severity of problem increases with number of posts in mainline. Catastrophic loss can occur when set on rough grounds. Likelihood =3 Severity =4	Major structural damage to pots can occur when pots are in contact with seabed obstructions. Severity of problem increases with number of posts in mainline. Catastrophic loss can occur when set on rough grounds. Likelihood =3 Severity = 4	Fishing gear operates without attendance of vessel. Major loss can occur due to poor navigation, king tides, incorrect length adjustment of bouy lines. Major loss can also occur due to other vessels colliding with gear, setting on rough ground. Risk of loss increases with soak time and number of pots deployed. Pots made from light construction materials may be particularly susceptible. to damage. Low replacement costs and time required to repair may result in a "throw away and replace" culture. Likelihood =5 Severity = 4	Major loss can occur when setting on man made structures. Reasons for setting may include; poor navigation, and risk taking. Pots made from light construction materials may be particularly susceptible. Low replacement costs and time required to repair may result in a "throw away and replace" culture. Likelihood =1 Severity = 4	Fishing gear operates without attendance of vessel. Major loss and damage can result from deploying nets where other vessels are operating (eg seines, trawls, pot). Type of loss can be minor to catastrophic. Risk of loss can be reduced when gear is highly visible (marked). Low replacement costs and time required to repair may result in a "throw away and replace" culture. Likelihood =3 Severity = 4	May occur due to bad weather and when anchor lines are too short when setting in areas with high tides and strong currents. Likelihood =1 Severity = 2	May occur due to bad weather and when anchor lines are too short when setting in areas with high tides and strong currents. May also occur due to poor navigation, other vessel colliding with gear or vandalism. Likelihood =4 Severity =4
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased risk of pots being washed overboard. Likelihood =1 Severity = 2	UV can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Low replacement costs and time required to repair may encourage a "throw away and replace" culture. Likelihood =4 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Pots designed from steel with high iron content and covered in plastic may hide corrosion problems. Likelihood =4 Severity = 4	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity = 2	Pots constructed from light steel and plastic netting are highly vulnerable to damage. Poor seamanship (linked to risk taking) can lead to setting in areas where damage to other vessel gear is likely to occur or to self inflicted damages. Damage can range from minor to major structural damage of fishing gear. Likelihood =4 Severity = 3	Overcrowding of fishing grounds and lack of fleet separation leads to different fleets encountering each other. Encounters and damage / loss associated with non fishing vessels may also occur. Encounters results "lose-lose" situations. However, the light materials used in pot construction typcailly result in major structural damage to nets. Likelihood =4 Severity = 4	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Coastal pots highly vulnerable to major damage and total loss. Offshore vessels can take avoidance action. Likelihood =1 Severity =4	

		Wear & Tear from mechanical systems	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
08.3.0, 08.0.01-08.4.05	**Bubu Bersayap, Pukat Labuh, Togo, Ambai, Pengerih**	Hand hauled systems unlikely to exceed breaking strains of netting materials. Likelihood =1 Severity = 1	Gear is designed to operate pasively but in areas of relatively strong current. Abrasion of lower panels from sand and mud can rresult in abrasion. . Increased abrasion leads to early onset wear and tear. Likelihood =5 Severity = 2	Not applicable to this gear type.	Not applicable to this gear type.	Fishing gears may fall into disrepair and be abandoned by the operator. Likelihood =1 Severity = 4	Not applicable to this gear type. Likelihood =0	Highly unlikey in regular operations Likelihood =0	Highly unlikey. Gear is set and fixed in the water. Likelihood =0	Highly unlikey in regular operations. Extreme weather events (storm surges aetc may result in major structural damage and loss. Likelihood =0
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Highly unlikey in regular operations Likelihood =1 Severity = 1	UV and abrasion can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =4 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =3 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity = 2	Likelihood =1 Severity = 1	Not applicable to this gear type. Likelihood =0	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Coastal fyke and stow nets highly vulnerable to major damage and total loss. Offshore vessels can take avoidance action.	
Hook and lines										
		Wear & Tear from mechanical systems	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
09.1-09.2	**Handlines mechanized handlines**	Hand hauled systems unlikely to exceed breaking strains of lines Likelihood =1 Severity = 1	Highly unlikey in regular operations Likelihood =1 Severity = 1	Line break Likelihood =2 Severity = 1	Line break Likelihood =1 Severity = 1	Partial loss of line and lures is possible during regular operations Likelihood =3 Severity = 1	Partial loss of line and lures is possible during regular operations Likelihood =3 Severity = 1	Minimal loss of line Likelihood =1 Severity = 1	Minimal Likelihood =1 Severity = 1	Not applicable to this gear type.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Minimal Likelihood =1 Severity = 1	UV and abrasion can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =5 Severity = 2	Line break Likelihood =1 Severity = 1	Increased rates of wear and tear leading to damage Likelihood =2 Severity = 1	Minimal loss of line and lures Likelihood =1 Severity = 1	Minimal loss of line and lures Likelihood =4 Severity = 1	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Loss of shore based gear and boats (small scale) Likelihood =3 Severity = 3	
		Wear & Tear from mechanical systems	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
09.3	**Set longlines**	Highly mechanized hauling systems place ropes under high load can lead to rope fatigue and weakened breaking strength. float damage and rope fatigue. Monofilament lines are particularly vulnerable to abrasion. Likelihood =5 Severity = 2	Gear is not designed to be towed over seabed. main line and snoods may be abraided through seabed contact durting retrieval. Increased abrasion can lead to weakened braking strength and rope fatigue. Severity of problem increases with rope let length. Likelihood =5 Severity = 2	Gear is not designed to be towed over seabed. main line and snoods may be abraided through seabed contact durting retrieval. Increased abrasion can lead to weakened braking strength and rope fatigue. Severity of problem increases with rope let length. Likelihood =5 Severity = 2	Low breaking strain ofropes and twines may break under excessive loading suring hauling. Major structural damage can occur when ropes and twines are in contact rocky seabeds. Increased abrasion ireduces breaking strength and rope fatiguey. Severity of problem increases withrope length. Catastrophic loss can occur when set on rough grounds. Likelihood =5 Severity = 3	Fishing gear operates without attendance of vessel. Partial break occurs often.Major loss can occur due to poor navigation, king tides, incorrect length adjustment of bouy lines. Major loss can also occur due to other vessels colliding with gear and or setting on rough ground. Risk of loss increases with soak time and length of line deployed. Likelihood =3 Severity = 2	Major loss can occur when setting on man made structures. Reasons for setting may include; poor navigation, and risk taking. lines made from monofilament may be particularly susceptible. Likelihood =3 Severity = 3	Fishing gear operates without attendance of vessel. Major loss and damage can result from deploying lines where other vessels are operating (eg seines, trawls, pot). Type of loss can be minor to catastrophic. Risk of loss can be reduced when gear is highly visible (marked). Likelihood =3 Severity = 3	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	May occur due to bad weather and when anchor lines are too short when setting in areas with high tides and strong currents. May also occur due to poor navigation, other vessel colliding with gear or vandalism. Partial loss is also possible if multiple sets of gear are laid out.
		Poor handling and stowage of fishing gears	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Sea state may lead to increased risk of lines and floats being washed overboard. Likelihood =1 Severity = 2	UV and abrasion can reduce strength of netting and ropes over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. Likelihood =5 Severity = 2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =5 Severity = 2	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =3 Severity = 2	Poor seamanship (linked to risk taking) can lead to setting in areas where damage to other vessel gear is likely to occur or to self inflicted damages. Damage can range from minor to major structural damage of fishing gear. Likelihood =3 Severity = 2	Overcrowding of fishing grounds and lack of fleet separation leads to different fleets encountering each other. Encounters and damage / loss associated with non fishing vessels may also occur. Encounters results "lose-lose" situations. Likelihood =4 Severity = 3	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Coastal set longlines are vulnerable to major damage and total loss. Offshore vessels can take avoidance action. Likelihood =2 Severity =4	

		Wear & Tear from mechanical systems	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Minimal	Not applicable to this gear type.	Not applicable to this gear type.	Not applicable to this gear type.	Not applicable to this gear type.	Not applicable to this gear type.	Minimal loss of line	Minimal loss of line	Loss of lure is a likely event but weight of loss is very minimal
09.5	**Trolling lines**	**Poor handling and stowage of fishing gears**	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Minimal Likelihood =1 Severity = 1	UV and abrasion can reduce strength of lines over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. But overall impact is minimal Likelihood =1 Severity = 1	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =1 Severity = 1	Extending the working life of fishing gear requires regular inspection for wear and tear of working components (netting, ropes etc). Failure to inspect and detect high levels of wear and tear can lead to premature damage and replenishment of worn components. Likelihood =1 Severity = 1	Minimal loss and damage Likelihood =1 Severity = 1	Minimal loss and damage Likelihood =1 Severity = 1	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types Likelihood =1 Severity = 1	Vessel can take avoidance actions to minimize risk of damage Likelihood =1 Severity = 1	
Miscellaneous gear										
		Wear & Tear from mechanical systems	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Mechanized hauling systems place ropes under high load can lead to rope fatigue and weakened breaking strength. float damage and rope fatigue. Likelihood =3 Severity = 2	Gear is towed over smooth seabed at relatively slow speed. Moderate rates of wear and tear anticipated especially in lower sections of net. Mesh abrasion and weakened mesh breaking strength lead to higher rate of replacement and early onset damage to netting. Likelihood =4 Severity = 2	Gear is designed to operate in seabed contact. PE material has high abrasion resistance to accommodate regular contact. Likelihood =3 Severity =3	May occur when setting in shallow water. Increased abrasion in lower sections. High strain on ropes when hauling may lead to major structural damage to netting and ropes Likelihood =2 Severity = 4	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. If occurs, then major structural damage and loss of gear is possible. Likelihood =0	Minimal Likelihood =1 Severity = 1	Highly unlikey in regular operations Likelihood =0	Not applicable to this gear type.
10.4	**Push net**	**Poor handling and stowage of fishing gears**	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		UV and abrasion can reduce strength of lines over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. But overall impact is minimal Likelihood =2 Severity = 1	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =4 Severity =2	Plastics deteriorate under UV light and from abrasion and exceeding safe working loads. Improper inspection of netting materials may lead to net and rope failure. High levels of mechanization can accelerate such proceses. Likelihood =3 Severity = 2	Poor seamanship (linked to risk taking) can lead to sdrift of lines into areas where other vessels are operating. Damage can range from minor to major structural damage of fishing gear. Likelihood =3 Severity = 2	Overcrowding of fishing grounds and lack of fleet separation leads to different fleets encountering each other. Likelihood =3 Severity = 2	Overcrowding of fishing grounds and lack of fleet separation leads to different fleets encountering each other. Encounters and damage / loss associated with non fishing vessels may also occur. Encounters results "lose-lose" situations. Likelihood =1 Severity = 1	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =4	Vessel can take avoidance actions to minimize risk of damage	
		Wear & Tear from mechanical systems	**Wear and tear from towing on seabed**	**Wear, tear, damage from unintended contact with seabed**	**Contact with seabed obstructions**	**Deployed fishing gear not retrieved**	**Deliberate setting of fishing gear on man made structures**	**Loss or damage resulting from other fleets on fishing grounds**	**Fishing gear lost overboard**	**One or more fishing gear units cannot be located at sea (lost)**
		Minimal Likelihood =1 Severity = 1	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Not applicable to this gear type. Likelihood =0	Likelihood =1 Severity =1	Not applicable to this gear type.
10.6	**Scoop net**	**Poor handling and stowage of fishing gears**	**Fishing gear material strength severely diminished**	**Fishing equipment poorly maintained**	**Crew poorly trained in gear maintenance**	**Poor seamanship and navigation**	**Overcrowding of fishing grounds**	**Non ccompliance with Regulations**	**Extreme weather events (cyclone, storm surge)**	
		Not applicable to this gear type. Likelihood =1 Severity =1	UV and abrasion can reduce strength of lines over time. Failure to inspect, detect and replace worn / degraded materials can lead to minor-moderate gear damage. But overall impact is minimal Likelihood =4 Severity =1	Plastics deteriorate under UV light . Likelihood =4 Severity =1	Likelihood =1 Severity =1	Likelihood =1 Severity =1	Likelihood =1 Severity =1	Absence of enforcement can lead to improper disposal of plastics at sea. Large weight of fishing materials implies higher levels of disposal than for lighter gear types. Likelihood =4 Severity =1	Vessel can take avoidance actions to minimize risk of damage	

Governance context of Indonesia's fisheries

CLASSIFICATION OF FISHING GEARS

Fishing Gear	Fishing Gear Code
Surrounding Nets (Jaring lingkar)	01.0.0
Surrounding net with purse line (Jaring lingkar bertali kerut)	**01.1.0**
One boat operated purse seines (Pukat cincin dengan satu kapal)	01.1.1
One boat operated purse seines –small (Pukat cincin pelagis kecil dengan satu kapal)	01.1.1.1
One boat operated purse seines –large (Pukat cincin pelagis besar dengan satu kapal)	01.1.1.2
Two boats operated purse seines (Pukat cincin dengan dua kapal)	01.1.2
Ring netter –small (Pukat cincin grup pelagis kecil)	01.1.2.1
Seine Nets (Pukat Terik)	02.0.0
Beach Seines Pukat tarik pantai)	**02.1.0**
Boat or vessel seines (Pukat tarik berkapal)	**02.2.0**
Danish Seines (Dogol)	02.2.1
Scottish seines	02.2.2
Pair Seines	02.2.3
Payang	02.2.0.1
Cantrang	02.2.0.2
Lampara dasar	02.2.0.3
Trawls	03.0.0
Bottom trawls (Pukat hela dasar)	**03.1.0**
Beam trawls (Pukat hela dasar berpalang)	03.1.1
Otter trawls (Pukat hela dasar berpapan)	03.1.2
Shrimp trawls (Pukat hela dasar udang)	03.1.3
Midwater trawls	**03.2.0**
Single Boat midwater trawls (Pukat hela pertengahan berpapan)	03.2.1
Dredges (Penggaruk)	04.0.0
Boat dredges (Penggaruk berkapal)	**04.1.0**
Hand dredges (Penggaruk tanpa Kapal)	**04.2.0**
Lift Nets (Jaring Ingkat)	05.0.0
Portable lift nets	**05.1.0**
Boat operated lift nets	**05.2.0**
Bagan berperahu	05.2.0.1
Bouke ami	05.2.0.2
Shore operated stationary lift net	**05.3.0**

Fishing Gear	Fishing Gear Code
Falling Gears (Alat Yang Dijatuhkan Atau Ditebarkan)	06.0.0
Cast nets	**06.1.0**
Gillnets and Entangling Nets (Jaring Insang)	07.0.0
Set gillnets – anchored (Jaring insang tetap)	**07.1.0**
Jaring liong bun	07.1.0.1
Driftnets	**07.2.0**
Jaring gillnet oseanik	07.2.0.1
Encircling gillnets (Jaring insang lingkar)	**07.3.0**
Fixed gillnets on stakes (Jaring insang berpancang)	**07.4.0**
Trammel nets (Jaring insang berlapis)	**07.5.0**
Jaring klitik	07.5.0.1
Combined gillnets-trammel net	**07.6.0**
Traps (Perangkap)	08.0.0
Stationary uncovered pound nets	**08.1.0**
Set net	08.1.0.1
Pots (Bubu)	**08.2.0**
Fyke nets (Bubu bersayap)	**08.3.0**
Stow nets	**08.4.0**
Long bag set net (Pukat labuh)	08.4.0.1
Togo	08.4.0.2
Ambai	08.4.0.3
Jermal	08.4.0.4
Pengerih	08.4.0.5
Barriers, fences, weirs	**08.5.0**
Sero	08.5.0.1
Aerial traps	**08.6.0**
Muro ami	08.9.0.1
Seser	08.9.0.2
Hooks and Lines	09.0.0
Handlines and pole-lines/hand operated	09.1.0
Pancing ulur	09.0.0.1
Pancing berjoram	09.0.0.2
Huhate	09.0.0.3
Squid angling	09.0.0.4
Handlines and pole-lines/mechanized	09.2.0
Squid jigging	09.2.0.1
Huhate mekanis	09.2.0.2
Set longlines (Rawai desar)	09.3.0
Drifting longlines (Rawai hanyut)	09.4.0
Rawai tuna	09.4.0.1
Rawai cucut	09.4.0.2
Trolling lines (Tonda)	09.6.0
Pancing laying-layang	09.9.0.1
Grappling and wounding (Alat Penjepit Dan Melukai)	**10.0.0**
Harpoons	10.1.0
Ladung	10.0.0.1
Panah	10.0.0.2

FISHING GEARS PERMITTED IN EACH FISHERY MANAGEMENT AREA AND FISHING ZONE

(Note: Original file in Indonesian)

JALUR PENANGKAPAN IKAN DAN ALAT PENANGKAPAN IKAN
DI WILAYAH PENGELOLAAN PERIKANAN NEGARA REPUBLIK INDONESIA DAN LAUT LEPAS

No	ALAT PENANGKAPAN IKAN										KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan			Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
						Statis	Pasif	Aktif																								
1	**JARING LINGKAR (*SURROUNDING NETS*)**			-	01																										
	1.1	jaring lingkar bertali kerut (*purse seine*)		PS	01.1																										
		1.1.1	pukat cincin dengan satu kapal (*one boat operated purse seine*)	PS1	01.1.1																										
			1.1.1.1 pukat cincin pelagis kecil dengan satu kapal	PS1-K	01.1.1.1			√	*mesh size* kantong ≥ 1 inci dan panjang Tali Ris Atas ≤ 300 m	Rumpon dan/atau lampu ≤ 4.000 watt	DL	√	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN											KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan				Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ARPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
							Statis	Pasif	Aktif																								
										mesh size kantong ≥ 1 inci dan panjang Tali Ris Atas ≤ 400 m	Rumpon dan/atau lampu ≤ 8.000 watt	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
										mesh size kantong ≥ 1 inci dan panjang Tali Ris Atas ≤ 600 m	Rumpon dan/atau lampu ≤ 16.000 watt	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
		1.1.1.2	pukat cincin pelagis besar dengan satu kapal	PS1-B	01.1.1.2			√		*mesh size* kantong ≥ 3 inci dan panjang Tali Ris Atas ≤ 700 m	Rumpon dan/atau lampu ≤ 16.000 watt	DL	DL	DL	√	DL	DL	DL	√	DL	DL	DL	√	√	DL	DL	DL	√	DL	√	√	DL	
										mesh size kantong ≥ 3 inci dan panjang Tali Ris Atas ≤ 1.500 m	Rumpon dan/atau lampu ≤ 16.000 watt	DL	DL	DL	DL	√	DL	DL	DL	√	√	DL	√	√	DL	DL	DL	√	DL	√	√	DL	
		1.1.1.3	Pukat cincin teri dengan satu kapal	PS1-T	01.1.1.3			√		*mesh size* kantong ≥ 4 mm dan panjang Tali Ris Atas ≤ 300 m	-	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	Dioperasikan pada musim teri
	1.1.2	pukat cincin dengan dua kapal (*two boats operated purse seine*)		PS2	01.1.2																											
		1.1.2.1	pukat cincin pelagis kecil dengan dua kapal	PS2-K	01.1.2.1			√		*mesh size* kantong ≥ 1 inci dan panjang Tali Ris Atas ≤ 400 m	-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	DL	√	√	√	√	DL	√	DL	DL	√	

No	ALAT PENANGKAPAN IKAN						Sifat API				ABPI	KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan				Singkatan	Kode	Statis	Pasif	Aktif	Ukuran selektivitas dan kapasitas API		TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
										mesh size kantong ≥ 1 inci dan panjang Tali Ris Atas ≤ 600 m	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	DL	DL	√	DL	DL	DL	DL	DL	DL	DL	DL	
			1.1.2.2	pukat cincin pelagis besar dengan dua kapal	PS2-B	01.1.2.2			√	*mesh size* kantong ≥ 3 inci dan panjang Tali Ris Atas ≤ 2.000 m	-	DL	DL	DL	DL	√	DL	DL	DL	√	√	DL	√	√	DL	DL	DL	DL	DL	√	√	√	daerah penangkapan ikan di ZEE Indonesia dan Laut Lepas
	1.2	jaring lingkar tanpa tali kerut (*sorrounding net without purse line*)			LA	01.2			√	*mesh size* kantong ≥ 1 inci dan panjang Tali Ris Atas ≤ 150 m	-	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	DL	√	DL	DL	√	
2	**PUKAT TARIK (*SEINE NETS*)**				-	02																										
	2.1	pukat tarik pantai (*beach seine*)			SB	02.1			√	*mesh size* kantong ≥ 1 inci dan panjang Tali Ris Atas ≤ 300 m	-	√	√	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	kapal digunakan hanya untuk melingkarkan jaring dari dan menuju pantai
	2.2	pukat tarik berkapal (*boat seine*)			SV	02.2																										
		2.2.1	dogol (*danish seine*)		SV-SDN	02.2.1			√	*mesh size* kantong ≥ 1 inci, panjang Tali Ris Atas ≤ 40 m, dan panjang tali selambar ≤ 300 m	-	DL	DL	√	DL	DL	DL	DL	√	DL	DL	√	DL	DL	√	√	√	√	√	DL	DL	√	kantong bagian atas menggunakan jendela bermata jaring persegi (*square mesh window*)

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI										KETERANGAN
	Pengelompokan		Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
					Statis	Pasif	Aktif																								
	2.2.2	*pair seine*	SV-SPR	02.2.2	DILARANG DIOPERASIKAN PADA SEMUA JALUR PENANGKAPAN IKAN																											
	2.2.3	Payang	SV-PYG	02.2.3			√	*mesh size* kantong ≥ 2 inci dan panjang Tali Ris Atas ≤ 120 m, kecuali *mesh size* payang teri ≥ 4 mm	-	DL	√	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	payang teri dioperasikan sesuai musim teri
								mesh size kantong ≥ 2 inci dan panjang Tali Ris Atas ≤ 150 m	-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	DL	√	√	DL	√	DL	DL	DL	DL	DL	DL	
								mesh size kantong ≥ 2 inci dan panjang Tali Ris Atas ≤ 200 m	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	DL	√	DL	DL	DL	DL	DL	DL	
	2.2.4	cantrang	SV-CTG	02.2.4			√	*mesh size* kantong ≥ 2 inci, panjang Tali Ris Atas ≤ 60 m, dan panjang tali selambar	-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	DL	DL	DL	DL	√	DL	DL	DL	DL	DL	DL	kantong bagian atas menggunakan jendela bermata jaring persegi (*square mesh uindouj*.

No	ALAT PENANGKAPAN IKAN			Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI										KETERANGAN
						Statis	Pasif	Aktif			TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
									≤ 1.000 m untuk setiap sisi																								
									mesh size kantong ≥ 2 inci, panjang Tali Ris Atas ≤ 90 m, dan panjang tali selambar ≤ 1.800 m untuk setiap sisi	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	DL	DL	DL	√	√	DL	DL	DL	DL	DL	DL	• kantong bagian atas menggunakan jendela bermata jaring perseg (*square mesh window*) • daerah penangkapan ikan pada ZEE Indonesia di WPPNRI 711.
		2.2.5	lampara dasar	SV-LDS	02.2.5	DILARANG DIOPERASIKAN PADA SEMUA JALUR PENANGKAPAN IKAN																									
3	**PUKAT HELA (*TRAWLS*)**			-	03																										
	3.1	pukat hela dasar berpalang (*beam trawl*)		TBB	03.11	DILARANG DIOPERASIKAN PADA SEMUA JALUR PENANGKAPAN IKAN																									
	3.2	pukat hela dasar berpapan (*single boat bottom otter trawl*)		OTB	03.12																										
		3.2.1	pukat hela dasar udang	OTB-PU	03.12.1			√	*mesh size* kantong ≥ 1,75 inci dan panjang Tali Ris Atas ≤ 30 m	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	DL	DL	DL	DL	DL	DL	DL	DL	DL	√	• dilengkapi alat pemisah penyu (*turtle excluder device*) • kapal > 30 GT dapat dioperasikan pada isobat minimal 10 meter
	3.3	pukat hela kembar berpapan (*twin bottom otter trawl*)		OTT	03.13	DILARANG DIOPERASIKAN PADA SEMUA JALUR PENANGKAPAN IKAN																							

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI										KETERANGAN
	Pengelompokan		Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
					Statis	Pasif	Aktif																							
	3.4	pukat hela dasar dua kapal (*bottom pair trawl*)	PTB	03.15	DILARANG DIOPERASIKAN PADA SEMUA JALUR PENANGKAPAN IKAN																									
	3.5	pukat hela pertengahan berpapan (*single boat midwater otter trawl*)	OTM	03.21																										
		3.5.1 pukat ikan	OTM-PI	03.21.1			√	ukuran *mesh size* (kantong) ≥ 2 inch dan tali ris atas ≤60 m	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	DL	DL	DL	DL	DL	DL	DL	• daerah penangkapan ikan di ZEE Indonesia; • dilarang dioperasikan dengan: a. menggunakan alat-alat tambahan berupa bola gelinding (*bobbin*) dan/atau rantai pengejut (*tickler chain*); b. bagian atas kantong rangkap; dan/atau c. menggunakan gawang (*beam*) dan palang rentang (*rig*).
	3.6	pukat hela pertengahan dua kapal (*midwater pair trawl*)	PTM	03.22	DILARANG DIOPERASIKAN PADA SEMUA JALUR PENANGKAPAN IKAN																									

No	ALAT PENANGKAPAN IKAN										KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan			Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
						Statis	Pasif	Aktif																								
4	**PENGGARUK (*DREDGES*)**			-	04																											
	4.1	penggaruk berkapal (*towed dredge*)		DRB	04.1			√	bukaan mulut panjang ≤ 2,5 m dan tinggi ≤ 0,5 m	-	DL	√	DL	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
	4.2	penggaruk tanpa kapal (*hand dredge*)		DRH	04.2			√	bukaan mulut panjang ≤ 2,5 m dan tinggi ≤ 0,5 m	-	DL	DL	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	dioperasikan tanpa menggunakan kapal
5	**JARING ANGKAT (*LIFT NETS*)**			-	05																										
	5.1	anco (*portable lift net*)		LNP	05.1		√		panjang ≤ 10 m, dan lebar ≤ 10 m	-	DL	DL	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	dioperasikan tanpa menggunakan kapal
	5.2	jaring angkat berperahu (*boat-operated lift net*)		LNB	05.2																										
		5.2.1	bagan berperahu	LNB-BP	05.2.1		√		*mesh size* ≥ 1 mm, panjang ≤ 12 m, dan lebar ≤ 12 m	lampu ≤ 2.000 watt	DL	√	DL	DL	DL	DL	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	termasuk bagan apung tanpa kapal
									mesh size ≥ 1 mm, panjang ≤ 20 m, dan lebar ≤ 20 m	lampu ≤ 2.000 watt	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
									mesh size ≥ 1 mm, panjang	lampu ≤ 2.000 watt	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI										KETERANGAN
	Pengelompokan			Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
						Statis	Pasif	Aktif																							
									≤ 30 m, dan lebar ≤ 30 m																							
									mesh size ≥ 2.5 inci, panjang ≤ 30 m, dan lebar ≤ 30 m	lampu ≤ 16.000 watt	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
		5.2.2	bouke ami	LNB-BA	05.2.2		√		*mesh size* ≥ 1 inci, panjang ≤ 20 m, dan lebar ≤ 20 m	lampu ≤ 8.000 watt	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
									mesh size ≥ 1 inci, panjang ≤ 30 m, dan lebar ≤ 30 m	lampu ≤ 16.000 watt	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
	5.3	bagan tancap (*shore-operated stationary lift net*)	LNS	05.3	√				*mesh size* ≥ 1 mm, panjang ≤ 10 m, dan lebar ≤ 10 m	lampu ≤ 2.000 watt	DL	DL	DL	DL	DL	√	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	dioperasikan tanpa menggunakan kapal
6	**ALAT YANG DIJATUHKAN ATAU DITEBARKAN (*FALLING GEARS*)**			-	06																										
	6.1	jala jatuh berkapal (*cast net*)		FCN	06.1		√		*mesh size* ≥ 1 inci, panjang ≤ 20 m, dan lebar ≤ 20 m	lampu ≤ 16.000 watt	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN								KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI										KETERANGAN
	Pengelompokan		Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
					Statis	Pasif	Aktif																							
	6.2	jala tebar (*falling gear not specified*)	FG	06.9		√		luasan jaring ≤ 20m²	-	DL	DL	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	dioperasikan tanpa menggunakan kapal
7	**JARING INSANG (*GILLNETS AND ENTANGLING NETS*)**		-	07																										
	7.1	jaring insang tetap (*set gillnet (anchored)*)	GNS	07.1		√		*mesh size* ≥ 2 inci dan panjang Tali Ris Atas ≤ 500 m	-	DL	√	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
								mesh size ≥ 2 inci dan panjang Tali Ris Atas ≤ 1.000 m;	-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
								mesh size ≥ 13 inci dan panjang Tali Ris Atas ≤ 2.500 m	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	√	
	7.2	jaring insang hanyut (*drift gillnet*)	GND	07.2		√		*mesh size* ≥ 1,5 inci dan panjang Tali Ris Atas ≤ 500 m	-	DL	√	DL	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
								mesh size ≥ 1,5 inci dan	-	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan		Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
					Statis	Pasif	Aktif																									
								panjang Tali Ris Atas ≤ 1.000 m																									
								mesh size ≥ 1,5 inci dan panjang Tali Ris Atas ≤ 2.500 m	-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
								mesh size ≥ 4 inci dan panjang Tali Ris Atas ≤ 2.500 m	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	√	paling banyak 4 set (dioperasikan terpisah) dan dilengkapi radio *buoy* untuk setiap set
	7.3	jaring insang lingkar (*encircling gillnet*)	GNC	07.3			√	*mesh size* ≥ 1,5 inci dan panjang Tali Ris Atas ≤ 600 m	-	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
	7.4	jaring insang berpancang (*fixed gillnet (on stakes)*)	GNF	07.4	√			*mesh size* ≥ 1,5 inci dan panjang Tali Ris Atas ≤ 300 m	-	DL	√	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	
	7.5	jaring insang berlapis (*trammel net*)	GTR	07.5		√		*mesh size* ≥ 1,5 inci dan panjang Tali Ris Atas	-	√	√	√	DL	DL	√	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan		Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
					Statis	Pasif	Aktif																								
								≤ 500 m																							
	7.6	*combined gillnet-trammel net*	GTN	07.6		√		*mesh size* ≥ 1 inci dan panjang Tali Ris Atas ≤ 1.000 m	-	√	√	√	DL	DL	√	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
										DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√		
8	**PERANGKAP (*TRAPS*)**		-	08																										
	8.1	*stationary uncovered pound net*	FPN	08.1																										
		8.1.1 *set net*	FPN-SN	08.1.1	√			panjang penaju ≤ 400 m, *mesh size* penaju ≥ 8 inci	-	√	√	DL	DL	DL	√	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√		
								panjang penaju ≤ 600 m, *mesh size* penaju ≥ 8 inci	-	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√		
								panjang penaju ≤ 1.500 m, *mesh size* penaju ≥ 8 inci	-	DL	DL	DL	√	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√		
	8.2	bubu (*pot*)	FPO	08.2		√		jumlah bubu ≤ 300 buah	-	√	√	√	DL	DL	√	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
									-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√		
									-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√		

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan		Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
					Statis	Pasif	Aktif																									
	8.3	bubu bersayap (*fyke net*)	FYK	08.3	√			*mesh size* ≥ 1 inci dan panjang Tali Ris Atas ≤ 50 m	-	√	√	√	DL	DL	√	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
	8.4	*stow net*	FSN	08.4																											
		8.4.1 pukat labuh (*long bag set net*)	FSN-PL	08.4.1	√			*mesh size* ≥ 1 mm dan panjang Tali Ris Atas ≤ 30 m	-	DL	DL	√	DL	DL	DL	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
								mesh size ≥ 1 mm dan panjang Tali Ris Atas ≤ 60 m	-	DL	DL	DL	√	DL	DL	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
		8.4.2 Togo	FSN-TG	08.4.2	√			*mesh size* ≥ 1 inci dan panjang Tali Ris Atas ≤ 20 m	-	√	√	√	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
		8.4.3 Ambai	FSN-AB	08.4.3	√			*mesh size* ≥ 1 inci dan panjang Tali Ris Atas ≤ 20 m;	-	√	√	√	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN										KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan			Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
						Statis	Pasif	Aktif																								
		8.4.4	Jermal	FSN-JM	08.4.4	√			*mesh size* ≥ 1 inci, panjang ≤ 10 m, dan lebar ≤ 10 m	lampu ≤ 2.000 watt	DL	DL	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	dioperasikan tanpa menggunakan kapal
		8.4.5	Pengerih	FSN-PG	08.4.5	√			*mesh size* ≥ 1 inci dan panjang Tali Ris Atas ≤ 50 m	-	√	√	√	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	
	8.5	*barrier, fence, weir*		FWR	08.5																										
		8.5.1	Sero	FWR-SR	08.5.1	√			panjang penaju ≤ 100 m	-	√	√	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	
	8.6	perangkap ikan peloncat *(aerial trap)*		FAR	08.6																										
9	**PANCING (*HOOKS AND LINES*)**			-	09																										
	9.1	*handline and hand operated pole-and-line*		LHP	09.1																										
		9.1.1	pancing ulur nontuna	LHP-PUNT	09.1.1		√		-	Rumpon	√	√	√	DL	DL	√	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
		9.1.2	pancing ulur tuna	LHP-PUT	09.1.2		√		-	Rumpon	DL	√	√	DL	DL	√	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan			Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
						Statis	Pasif	Aktif																							
											DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	DL	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	√	
	9.1.3	pancing berjoran		LHP-PJ	09.1.3		√		-	Rumpon	√	√	√	DL	DL	√	√	√	DL	DL	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	
	9.1.4	Huhate		LHP-PH	09.1.4			√	-	Rumpon	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	
	9.1.5	pancing cumi *(squid angling)*		LHP-SA	09.1.5		√		-	lampu ≤ 8.000 watt	DL	DL	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	
										lampu ≤ 8.000 watt	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
										lampu ≤ 16.000 watt	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
	9.2	*mechanized lines and pole-and-line*		LHM	09.2																									
		9.2.1	pancing cumi mekanis *(squid jigging)*	LHM-PC	09.2.1			√	-	lampu ≤ 8.000 watt	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan			Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
						Statis	Pasif	Aktif																								
										lampu ≤ 16.000 watt	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
	9.2.2	huhate mekanis		LHM-HM	09.2.2			√	-	Rumpon	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
											DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
	9.3	rawai dasar (*set longline*)		LLS	09.31		√		jumlah mata pancing ≤ 10.000	-	√	√	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	komponen cadangan di atas kapal hanya untuk mengganti komponen utama yang rusak meliputi cadangan siap pakai berupa tali cabang (*branch line*) sebesar 25% dari jumlah mata pancing yang diizinkan dan cadangan
									jumlah mata pancing ≤ 10.000	-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	
									jumlah mata pancing ≤ 10.000	-	DL	DL	DL	DL	√	DL	DL	DL	√	DL	√	√	√	√	√	√	√	√	√	√	
	9.4	rawai hanyut (*drifting longline*)		LLD	09.32																										
	9.4.1	rawai tuna		LLD-RT	09.32.1		√		jumlah mata pancing ≤ 2.500	-	DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	dilengkapi radio *buoy*
									jumlah mata pancing ≤ 2.500		DL	DL	DL	DL	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	√	√	
	9.5	tonda (*trolling line*)		LTL	09.5			√	jumlah tonda ≤ 10 buah	-	DL	√	√	DL	DL	DL	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	

No	ALAT PENANGKAPAN IKAN									KAPAL PERIKANAN					JALUR PENANGKAPAN					WPPNRI											KETERANGAN
	Pengelompokan		Singkatan	Kode	Sifat API			Ukuran selektivitas dan kapasitas API	ABPI	TM	sd. 5 GT	>5-10 GT	>10-30 GT	>30 GT	IA	IB	II	III	Laut Lepas	571	572	573	711	712	713	714	715	716	717	718	
					Statis	Pasif	Aktif																									
										DL	DL	DL	√	DL	DL	DL	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
	9.6	pancing layang-layang	LX-LY	09.9.1		√		-	-	√	√	DL	DL	DL	√	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
10	**ALAT PENANGKAPAN IKAN LAINNYA (*MISCELLANEOUS GEARS*)**		-	10																										
	10.1	tombak (*harpoon*)	HAR	10.1		√		-	-	√	√	√	DL	DL	√	√	√	DL	DL	√	√	√	√	√	√	√	√	√	√	√	tombak ikan paus hanya untuk nelayan di wilayah Lamalera dan Lamakera, Provinsi Nusa Tenggara Timur
	10.2	Ladung	MHI-LD	10.2.1		√		-	-	√	√	DL	DL	DL	√	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
	10.3	Panah	MHI-PN	10.2.2		√		-	-	√	√	DL	DL	DL	√	√	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	
	10.4	pukat dorong (*pushnet*)	MPN	10.5			√	*mesh size* kantong ≥ 1 mm	-	DL	DL	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	dioperasikan tanpa menggunakan kapal
	10.5	*muro ami (drive-in net)*	MDR	10.7	**DILARANG DIOPERASIKAN PADA SEMUA JALUR PENANGKAPAN IKAN**																										
	10.6	Seser (*scoopnet*)	MSP	10.6			√	*mesh size* ≥ 3 mm	-	DL	DL	DL	DL	DL	√	DL	DL	DL	DL	√	√	√	√	√	√	√	√	√	√	√	dioperasikan tanpa menggunakan kapal

DISTRIBUTION OF FISHING PORTS ACROSS FISHERY MANAGEMENT AREAS

No.	WPP-NRIName	Fishing Port Class/Type																		
		Oceanic Fishing Port (PPS)			Sub-total	Archipelagic Fishing Port (PPN)			Sub-total	Coastal Fishing Port (PPP)			Sub-total	Fish Landing Place (PPI)					Sub-total	Total all Fishing Port	Rank by Fishing Port Number
		Management Authority				Management Authority				Management Authority				Management Authority							
		Cgovt.	Prov	Distrc		Cgovt.	Prov.	Distrc.		Cgovt.	Prov.	Distrc.		Cgovt.	Prov.	Distrc.	Coopertv.	Private			
1	WPP-NRI 571	1			1		1		1						15	43			58	60	6
2	WPP-NRI 572	1	1		2	1			1		5		5		4	147			151	159	1
3	WPP-NRI 573	1			1	3			3		8		8		4	118	1		123	135	3
4	WPP-NRI 711					3			3	1	2		3		2	67		2	71	77	5
5	WPP-NRI 712	1			1	4			4		20	2	22		3	140	4		147	174	2
6	WPP-NRI 713														7	75			82	82	4
7	WPP-NRI 714	1			1	2			2							31			31	34	8
8	WPP-NRI 715					1			1		3		3		2	47			49	53	7
9	WPP-NRI 716	1			1	1			1		2	1	3			22			22	27	9
10	WPP-NRI 717														1	6			7	7	10
11	WPP-NRI 718															6			6	6	11
Total		6	1		7	15	1		16	1	40	3	44		38	702	5	2	747	814	

Data source: Marine and Fisheries in Figures 2018

Global experiences and best practices for ALDFG & fishing gear waste management

Global experiences and best practices for ALDFG and fishing gear waste management are presented in this annex.

MONITORING ALDFG

Any attempts to manage and address ALDFG will first require an understanding of the scale and sources of ALDFG. The current study has, by necessity, undertaken ad hoc surveys and data collection to inform the estimates of ALDFG and EOFLG quantities and types presented in this report. However, ad hoc monitoring is unlikely to be sufficient to provide the information needed to inform the design of and monitor the effectiveness of ALDFG management strategies. Instead, regular processes for routine data collection should be developed as a key component of the ALDFG management systems that are developed.

A mass-balance approach is one possible strategy for estimating ALDFG volumes. This requires monitoring of the weight of new gears purchased (e.g., via manufacturer or supplier reporting requirements established as a part of extended producer responsibility schemes) and the weight of gears removed from the environment as waste (e.g., via port waste reporting). The difference between these two volumes is the amount of ALDFG entering the environment. Targets to reduce ALDFG can then be set on both sides of the equation, by reducing the number of new gears purchased (e.g., by improving gear design, minimizing losses and increasing reuse), and by increasing the collection rates for fishing gear waste.

[37] Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment. http://data.europa.eu/eli/dir/2019/904/oj

[38] Directive (EU) 2019/883 of the European Parliament and of the Council of 17 April 2019 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC. http://data.europa.eu/eli/dir/2019/883/oj

[39] European Commission Implementing Decision of 31.5.2021 laying down the format for reporting data and information on fishing gear placed on the market and waste fishing gear collected in Member States and the format for the quality check report in accordance with Articles 13(1)(d) and 13(2) of Directive (EU) 2019/904 of the European Parliament and of the Council. https://ec.europa.eu/oceans-and-fisheries/publications/decision-laying-down-format-reporting-data-and-information-fishing-gear-placed-market_en

This is the approach adopted by the European Union (EU) to support the implementation of its Single Use Plastics Directive (SUP Directive[37]) and Port Reception Facilities Directive (PRF Directive[38]) in relation to fishing gear. The SUP Directive targets the ten single-use plastic products most often found on Europe's beaches and seas, as well as ALDFG due to its significant impact on marine life. The PRF Directive is the EU's implementation of the IMO's MARPOL Annex V obligations to manage garbage from ships by improving the availability and use of facilities in ports for waste, including fishing gear. The SUP and PRF Directives complement each other, with the introduction of extended producer responsibility (EPR) schemes for the financing of waste from fishing gear. The reporting requirements for EU Member States under these directives have recently published,[39] including guidance on how fishing gear placed on the market and waste fishing gear is to be quantified, and with the intention of setting collection targets in the future.

MANAGING PLASTIC WASTE FROM FISHERIES AT SEA

As recognized by Macfadyen *et al* (2009) and operationalized by the GGGI's best practices for the management of fishing gear (GGGI 2017a, 2017b & 2021a), as a general principle it is more cost-effective to focus first on policies and practices that prevent plastic waste entering the marine environment before looking at its mitigation or recovery. Using GGGI's Best Practice Framework for the Management of Fishing Gear (C-BPF) as a starting point, Table 25 summarizes the main ways in which ALDFG can be managed by: (i) first preventing ALDFG generation (i.e., by reducing rates of abandonment, loss and discard); (ii) then mitigating the effects of ALDFG on the marine environment; and finally (iii) implementing policy approaches to recover ALDFG from marine habitats. Additional details of one example of an important preventative measure—gear marking—are presented in Box 4.

Box 4: Requirements in Taiwan fisheries for the marking of gillnets, reporting of lost gillnets, and disposal of EOLFG.

The government of Taiwan has taken significant steps to promote gear marking in local fisheries, in particular within their demersal gillnet fishery. This fishery makes up the majority of fishing in Taiwanese waters with 10,186 (7,662 full-time and 2,524 part-time) of the 21,908 registered fishing vessels in the country using various types of gillnets.

The Taiwan National Fisheries Agency (https://en.fa.gov.tw) has proposed a requirement for gillnets to be marked with the vessel registration number on marker buoys, demersal floats that hold the gillnet aloft in the water, and on the weights that hold the bottom of the gillnet to the seabed (for demersal gillnets). This additional set of marking guidelines means that, if a net or piece of net snags or is otherwise lost during fishing operations, there is a high likelihood that it can be identified and traced back to the source fishery and vessel.

Taiwan's fisheries management is divided into local and national regulations, leading to some confusion over which set of rules applies in which area. Four local governments requested that there be a single set of regulations, as it was difficult for fishers to follow different sets of regulations that vary by region. In response, the Taiwan National Fisheries Agency has developed a single national regulation for gear marking and reporting of lost gillnets. These new national regulations came into effect in 2021, following a 6-month implementation period to allow fishers to adapt to the new regulations. Fishers must report any gear losses as a condition of license, and those that willingly report are not penalized. The gear marking requirements is proving extremely important for data gathering and for identifying IUU gear, as well as for identifying which fisher has lost the net. Fishers who do not properly mark their gear, or who do not willingly report lost gears can be subject to fines of up to 150,000 TWD (5,000 USD). Due to the high number of artisanal gillnet fishers in Taiwan, it is anticipated that enforcement will remain challenging, but this is a significant step by the Taiwan National Fisheries Agency to develop solutions to this issue.

In addition, the Taiwan National Fisheries Agency has designated storage sites in every port for fishers to deposit their EOLFG. In the past, there was no collection or recycling channel for fishing nets, which were typically sent for incineration. The new storage sites have enabled the Ocean Conservation Administration (https://www.oca.gov.tw/en/) to develop a system for collecting EOLFG and recycling it locally, creating a circular solution for this waste material.

Table 25: Examples of global policy and management mechanisms to address ALDFG.

POLICY AREA	MANAGEMENT MECHANISMS	INTERNATIONAL EXAMPLES	REFERENCES
Prevention: Preventing gear loss to the marine environment			
Marine spatial planning	Zoning to reduce (i) gear-conflict between fishers & (ii) gear interactions from other marine users. Communication protocols to warn other sea users of static gear hazards.	**Indonesia**: Decree of the Minister of Marine Affairs and Fisheries 2/ PERMEN-KP/2015 on the Prohibition of the Usage of Trawl and Seine Nets in Indonesia Fishery Management Area may have reduced gear conflict and loss due to trawler interactions.	Richardson et al (2018) GGGI (2017b, 2021a)
Third party certification for responsible fishing.	Encouraging fisheries to undergo third party certification e.g., MSC, Fairtrade, FoS) or to enter Fisheries Improvement Projects (FIPs)	**Global**: Friend of the Sea ecolabel includes requirements for ALDFG avoidance and recovery. The Marine Stewardship Council is expected to include assessment of Ghost Gear within its revised standard from 2022.	FriendoftheSea.org MSC.org
Awareness building	Awareness campaigns to build an understanding of the impacts of ALDFG and how this can be reduced by responsible fishing management. Work with local and gear-based fishing associations & NGOs to develop codes of good practice that minimizes ALDFG.	**US**: NOAA/Ocean Conservancy Council "Keep the Coast Clear Campaign". https://www.noaa.gov/stories/marine-debris-problem-you-can-get-your-arms-around **Global**: 2017 International Coastal Cleanup. (Ocean Conservancy): https://oceanconservancy.org/trash-free-seas/international-coastal-cleanup/	NOAA, US Ocean Conservancy
Vessel design	Ensuring fishing vessels have sufficient space & equipment to store, deploy, retrieve and stow used fishing gear.	**Norway**: Deep-sea gillnetters deliberately discarded hundreds of kilometers of bottom-set gillnets each year as (i) there was insufficient storage space on board and (ii) the nets they used were easily damaged and cheaply replaced.	FANTARED, 2003
Mitigation: Reducing the Impact of ALDFG on the marine environment			
Fishing gear design	Use of non-entangling gears and FADs. Where appropriate, use of biodegradable components that reduce ghost fishing & habitat damage.	**US**: Use of "ropeless" gear, "weak" ropes, sleeves and time tension line cutters (TTLC) to reduce the potential for entanglement with fishing gear, especially from ropes used to mark and haul pots and traps.	ISSF, 2019; OSPAR, 2020;
Gear marking	Mandatory marking and identification of fishing gear and its components.	See Box 4 – marking gillnets in Taiwan.	Dixon *et al*, 2018; FAO, 2019b; GGGI, 2021a
Integrate ALDFG management into licensing & IUU prevention	Include details of fishing gear and marking required in fisheries licensing systems and develop non-compliance sanctions systems. Recover ALDFG associated with IUU fishing operations.	**Global**: Potential link between IUU fishing activities and a heightened risk of ALDFG. A combination of intelligence-based information and risk assessment could be used to identify IUU fishing hotspots and to predict where illegally placed gear and gear lost through resulting gear conflict might occur.	GGGI (2021a)

POLICY AREA	MANAGEMENT MECHANISMS	INTERNATIONAL EXAMPLES	REFERENCES
Recovery: Enabling the removal of ALDFG from the marine environment			
ALDFG reporting programs	Obligation to report ALDFG System for reporting, recording and communicating the loss or abandonment of fishing gear.	**EU**: Obligation to attempt to recover and report ALDFG if not successful. GGGI has developed a Ghost Gear Reporter phone app allowing anyone to report location of ALDFG: https://www.ghostgear.org/	EC Control Regulation 1224/2009 GGGI, 2021
ALDFG recovery programs	Vessel operators should have the facilities, equipment and training to locate and recover lost or abandoned fishing gear where possible. Third party (fishery, government or citizen) clean-up operations on beaches or in sub-sea ALDFG accumulation 'hotspots.	**UK**: Fishing for Litter: Europe-wide initiative for fishers to bring waste collected in nets back to shore: China: Dive-for-love Diver recovery of ALDFG on reefs **Korea**: fishers are paid $10 for every 100litre sack of retrieved waste & gear. Considered successful (over 66,000t recovered in 10 years), but costly and does not incentivize behavior change. **Canada**: Ghost Gear Fund supporting retrieval and collection initiatives.	http://www.fishingforlitter.org.uk/ https://chinadialogueocean.net/5843-five-ways-to-tackle-ghost-fishing-gear/ Cho, 2009 DFO, Canada, 2021

RE-USE, RECYCLING AND THE CIRCULAR ECONOMY FOR PLASTICS FROM FISHERIES WASTE

The development of the circular economy offers tremendous potential to address ALDFG. This, in conjunction with optimizing landfill management, will help to substantially reduce the amount of plastics that end up as marine plastic litter. When implemented in conjunction with measures to strengthen the management of marine-based sources of marine litter, and with cleanup operations, plastic pollution of the oceans may be reduced and eventually prevented (UNIDO 2019).

The circular economy represents an alternative, more sustainable model to the traditional linear economy. In the linear economy, products follow a path from make, to use, to disposal (Figure 38). In contrast, a circular economy is restorative and regenerative by design, keeping resources in use for as long as possible, extracting the maximum value from them whilst in use, and then recovering and regenerating products and materials at the end of their service life. In a circular economy the value of products and materials is maintained for as long as possible. As a result, a circular economy offers a way to improve competitiveness and resource efficiency.

The unique characteristics of plastics enable them to make a major contribution towards the circular economy, and the tran-

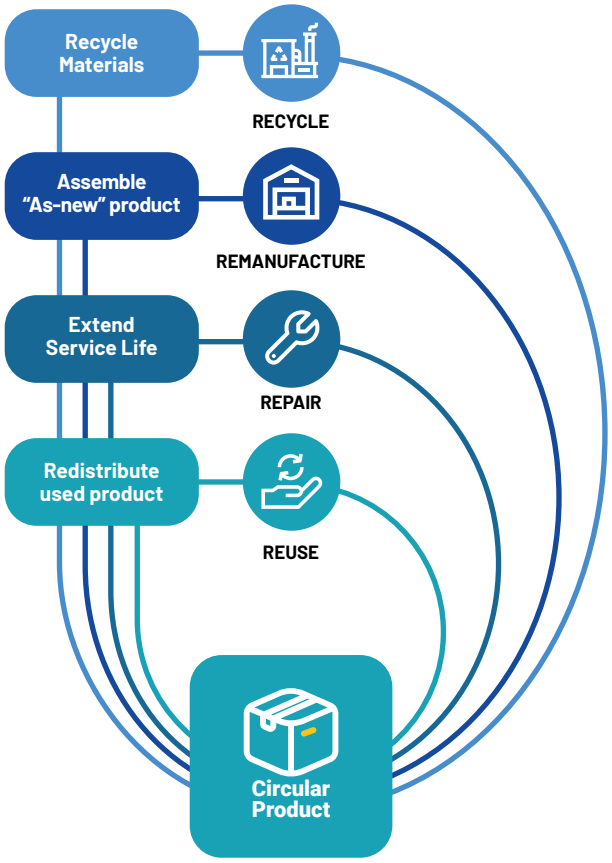


Figure 38: Production in a circular economy. Source: Oceanwise

sition to more sustainable and resource efficient development. A circular economy for plastics requires systems-level thinking across multiple sectors and industries—including the fisheries and aquaculture sectors—and collaboration between public and private sectors.

Policy measures can accelerate the development of the circular economy by creating incentives for innovation in the design of existing and new products, and supporting businesses and startups in fields related to biodegradable and compostable plastics. To be effective, policies should aim to foster supply-side motivation for circular product designs as well as demand-side preference for the resulting products. This includes creating new markets for recycled and bio-based plastics; applying differentiated taxes to virgin and recycled plastics; introducing standards for recycled content; improving information about recycled content in products; and enhancing consumer education and awareness about these issues.

Furthermore, policies that support the development and operation of infrastructure and facilities for the collection and separation of waste streams, while empowering local authorities with adequate financial and technical resources for waste management, are likely to stimulate product designs that are easier to recycle (UNIDO, 2019).

In the **production phase**, improved management of plastic raw materials helps to eliminate material losses into wastewater streams and oceans, which in turn improve manufacturing efficiency and productivity through the implementation of cleaner production methods that minimize leakage of plastic raw materials and industrial plastic waste into the environment.

In the **use phase**, suppliers and customers should be led towards choices that support circular economy practices, including by opting out of single-use / short-term use plastic products, and by supporting waste management systems that can collect, sort, separate and effectively recycle plastics. Potential mechanisms include enforcing bans and/or levies on plastic products that are not compatible with the circular economy, applying fines or penalties in cases of non-compliance, and implementing deposit return schemes to reduce single-use and short-lived plastic product use.

At the **end of the first life**, products should have pathways that can be followed before they become waste. These include reuse with or without repairs or refurbishment; recycling for secondary materials for the same type of use; up-cycling to higher value uses; or down-cycling to alternative use. Though often overlooked, the **informal sector** plays an important role in the circular economy through the collection and segregation of scrap plastic and other materials. Policies that recognize and protect the livelihoods, health and safety of informal waste collectors are essential.

Extended Producer Responsibility (EPR) schemes help to support the development of products designed for recyclability, as well as improved collection and consolidation of waste streams to support recycling operations. Easily understood labelling schemes help consumers to contribute effectively to waste management objectives. EPR schemes can also help to regulate the use of certain materials, in products, including hazardous materials that can contaminate waste and pose an obstacle to reuse and recycling initiatives.

It is almost impossible to eliminate all waste from product cycles, and eventually a waste fraction will require **final disposal**. Disposal options include safe landfills or elimination (e.g., via controlled incineration of hazardous materials that contain plastic fractions). Designing out waste to retain plastics within the economy; regaining the value embodied in plastics that have leaked out of the economy as waste; and continuing efforts to recover plastics already in the oceans or accumulated around beaches, ports and coastal waters emerge as strategies that deserve consideration on the way to a circular plastics economy and an end to the global marine plastic litter challenge.

Circular Ocean (http://www.circularocean.eu/) is a good example of an organization that is developing the circular economy within the fisheries sector through their work with communities to manage discarded fishing nets during the phases of recovery, recycling, and reuse, and the development of novel and robust business opportunities that are environmentally sustainable and enhance income generation (Figure 39). Other global examples of the circular economy within the fisheries sector are presented in Table 26.

Figure 39: There is potential for robust and environmentally sustainable business opportunities to be developed at multiple stages within the circular economy for discarded fishing nets. Source: Circular Ocean.

Table 26: Examples of global policies and measures to support the circular economy within the fishery sector.

POLICY AREA	GENERAL MEASURES	FISHERIES / AQUACULTURE SECTOR SPECIFIC	REFERENCES AND EXAMPLES
Circular Design	Public measures • Eco-design standards: Policy measures setting plastic material and design standards to improve repair, recyclability and minimize overall environmental footprint • Recycling content standards: Requiring a certain level of recycled material to be used in plastic applications. Potential incentives or penalties could be levied on the producers and importers of plastic products to meet their recycled content levels. • Develop alternative materials • Product design innovation – e.g., mono-polymer applications, re-usability • Removal of non-recyclable plastics Private measures • Cross/ inter industry standards: common standards, for plastics materials and packaging to improve recyclability • Repair/replace contracts	**Research and development** of low-cost gear marking, identification, lighting and traceability technologies. Pilot projects to demonstrate and improve research outputs for subsequent mainstreaming. **Gear design** allowing repair and replacement of components instead of full replacement. Gear service agreements – repair/replacement services for major fishing gear components. **Use of biodegradable plastics** in fisheries **Gear repair activities** – provision of repair facilities at ports.	**Global:** OSPAR report on design and recycling of fishing gear materials: https://www.ospar.org/documents?v=42718 **UK:** Net Tag low-cost acoustic tags: https://www.ncl.ac.uk/press/articles/archive/2019/04/nettag/ **Europe:** Service contracts with trawl & seine net manufacturers to repair/replace damaged and EOLFG **Korea:** eco-friendly buoys https://www.ajudaily.com/view/20200528084937232 **Korea:** financed R&D and commercial trials on alternative fishing materials. Materials close to 50% durability of plastics.
Single Use Plastics (SUPs) Reducing problematic and unnecessary SUPs	Public measures • Taxes and levies on SUPs- Taxes and/or levies imposed on manufacturers, retailers or consumers for use of specific types of single-use plastic elements, including; plastic bags, straws, cups and polystyrene food packaging. • Bans on SUPs - Ban on manufacturing, distribution and import of defined problematic and unnecessary single-use plastic products and packaging • Ban on primary micro plastics <5mm Private measures • Remove non-recyclable plastics from packaging • Develop alternative materials	**Reduced use of SUP in fisheries and aquaculture** (e.g., use of plastic bags for catch preservation in snapper fisheries) Ensure adequate waste facilities in ports (see waste collection below) Awareness-raising to change culture of SUP disposal at sea.	**Europe:** Single Use Plastics Directive and Port Reception Facilities Directive, including fishing gear. https://ec.europa.eu/newsroom/mare/items/628060/en
Extended Producer Responsibility (EPR)	Public measures • Packaging material fees • Deposit return schemes • Gear buy back • Plastic credits system -Management Producers meet their obligations by purchasing recycling certificates issued by accredited re-processors or recyclers based on the amount of plastic waste recycled Private measures • Pre-competitive voluntary EPR: Commit to bold collection targets for end-of-life plastic, Align on the governance certification cross or inter-industry	**Reporting** on fishing gear placed on the market and waste gear collected **Supply chain traceability** e.g., embedding traceability into ropes (e.g., via color coding), nets and buoys, data encoding (ownership / traceability) **Traceability**: Manufacturers embed traceability into their products by marking them with manufacturer name, year of manufacture, type of product and production batch	**Global**: Plastics Policy Playbook on design parameters for a national level EPR frameworks. https://oceanconservancy.org/wp-content/uploads/2019/10/Plastics-Policy-Playbook-10.17.19.pdf **Asia**: WWF EPR Plastic Packaging Waste proposals in Asia: https://wwf.panda.org/discover/knowledge_hub/all_publications/?356332/Extended-Producer-Responsibility-Project

POLICY AREA	GENERAL MEASURES	FISHERIES / AQUACULTURE SECTOR SPECIFIC	REFERENCES AND EXAMPLES
			Malaysia Plastic Pact: http://mpma.org.my/v4/wp-content/uploads/2019/11/11-Malaysia-Plastics-Pact.pdf https://www.eco-business.com/opinion/waste-not-want-not-malaysia-moves-to-become-a-leader-in-tackling-plastic-waste/
Buy back schemes	With the increasing adoption of life cycle analyses by manufacturers and their incorporation into corporate and social responsibility initiatives, there is considerable potential for manufacturers to become more involved in facilitating the responsible use and end of life treatment of their products.	**Gear buy-back schemes/discounted new gear**: One simple approach is for manufacturers to buy-back old gear (for refurbishment or recycling) and discount this value against the purchase of near gear. Investment in sorting and collection systems for old gear and its valuation. **Deposit schemes** (for some gear types): Some discrete gear components, such as plastic pots and buoys, could attract an end-of-life refund when returned to the manufacturer or their agent.	**Korea**: https://marinedebris.noaa.gov/file/2197/download?token=K6JWiyI4
Develop recycling and treatment markets	Public measures • Incentives for recycling industry: Financial instruments such as credits, deductions, tax exemptions, as well as shortened depreciation lifetime, are designed to stimulate growth of the plastic recycling industry • Sustainable conversion and offtake markets: Incentives in the form of subsidies, tax exemptions for intake of low-value, non-recyclable plastic to stimulate their sustainable end-of-life treatment markets. • Preferential procurement • Virgin material tax • Support for Research and Development to identify solutions Private measures • Invest in recycling capacity: develop and scale the recycling industry.	**Development of collection and segregation facilities, recycling and treatment markets and value chains for end-of-life fishing gear materials** e.g., nylon fishing nets and other types of nets and ropes (e.g., PP, LDPE) Financial incentives likely needed to encourage fishing gear recycling as not a clean, single plastic high volume source for recyclers. Fishing for litter schemes that support at sea collection and link with port collection and onward treatment. Circular Economy Initiatives can combine collection, recycling, re-use and awareness, e.g. The Ocean Clean Up and Odyssey Innovation.	**Global**: The Ocean Clean Up- technology-driven recovery of marine litter at the Great Pacific Garbage Patch and river collectors https://theoceancleanup.com/ **UK**: Odyssey Innovation https://www.odysseyinnovation.com/ Collects and recycles fishing nets from ports to produce kayaks which are then used for 'paddle for plastic' awareness-raising. **South America**: Bureo Netplus material from recycled fishing nets https://bureo.co/pages/netplus **Philippines**: Net-works system for fisher recovery and recycling into carpet tiles https://net-works.com/
Waste Collection & management	Public measures: • Packaging materials free • Deposit return schemes • Plastic credits / Packaging recovery note • Pay as you throw (Polluter Pays Principle) • Municipal collection points • Source segregation - Rules to mandate or incentivize waste stream separation at the source of generation.	**Ports Reception Facilities** - Disposal solution for fishing gear when it can no longer be used or repaired. Public sector authorities should work with ports authorities and private sector to build port reception facilities for end-of-life fishing gear and assist the port in transporting the recyclable material to the recycler.	**North West Pacific**: Port Reception Facilities in NOWPAP region: https://wedocs.unep.org/bitstream/handle/20.500.11822/26213/port_rec_facilities.pdf?sequence=1&isAllowed=y **Korea**: Floating receptacles for marine litter, buy-back programme includes reception facilities.

POLICY AREA	GENERAL MEASURES	FISHERIES / AQUACULTURE SECTOR SPECIFIC	REFERENCES AND EXAMPLES
	Public/ private measures • Material Recovery Facilities (MRF) • Blended financing instruments • Disposal fees		OSPAR recommendation on handling plastic garbage in the fishing industry. Vietnam: Fishing port facilities based on Sciortino (2010)
Informal sector engagement in waste collection, sorting and segregation	Public measures: • Provide occupational cards to waste collectors • Align with independent waste collectors' associations through public-private partnerships • Clarify ownership rights on recyclable waste collection • Waste collector livelihood improvement programs • Provide working capital to waste collector microenterprises • Provision of land, utilities, equipment and primary collection (through e.g., drop off points) Private measures • Waste banks and incentivized collection of problematic plastic) • Corporate Social Responsibility (CSR) funds to NGOs for independent waste collector welfare projects • Help entrepreneurs establish a formal banking and tracking system • Non-profit organizations can provide technical support, help establish collectives and ensure social inclusion.	**Engage Informal Sector** in Ports Waste Management and Recycling systems / End-of-life fishing gear disposal facilities – for collection, sorting and segregation. Organizing collection systems (mobilizing fishermen associations, creating collection points) for end-of-life gear. 1. Provide the informal sector workforce with information, skills, technology, and equipment through existing support organizations; 2. Expand informal sector processing capacity by financing equipment; and 3. Stabilize the prices paid for low-value plastics at a level that will encourage collection	**S E Asia**: Supporting the Informal Waste Sector https://pacecircular.org/sites/default/files/2021-02/FINAL-Informal-Sector-Report_compressed.pdf **Indonesia**: Informal plastic collection innovation challenge https://www.weforum.org/agenda/2021/06/innovators-indonesia-waste-informal-sector/ App-based platforms for informal waste collection: Duitin Indonesia https://duitin.id/ **Octopus**: an end-to-end recyclable waste logistic platform, currently operating in six cities in Indonesia from South Sulawesi, Bali to West Java with more than 9000 waste collectors using their app. They provide a solution for recycling industries to acquire their materials
Outreach, education, capacity development and stakeholder engagement	• Consumer awareness for behavior change – e.g., use of digital platforms • Cross sectoral awareness – government/ private sector, fisheries/ environment/ pollution control/ waste management, Cross-value chain collaboration. • Knowledge repository • Standard operating procedures for local governments to reduce the technical capability required	**Develop cross-sectoral awareness-building,** information, communication and management platforms in both government and private sector. Target campaigns to high-risk groups (near waterways) and fisheries sector to improve waste segregation by the fisheries and aquaculture sectors.	**Indonesia**: Ocean Plastic Prevention Accelerator is a social innovation ecosystem builder program that fosters a collaborative network https://www.oppa.id/ Kenya: Ocean Sole collects discarded flip-flops to produce art, removing marine plastics, giving local employment, raising awareness. https://oceansoleonline.com/
Policy development and implementation (governance)	• Development of National Policies -– coherent, integrated, open and adaptable, allocated funding, transparent and traceable, data driven, circular economy focused • Enforcement of laws and policies, • Municipal Unions	National and sub-national Action Plans and Strategies for Reducing Marine Debris National Plan of Action. Collective structures established by neighboring fishing ports to build economies of scale in waste management activities.	**Indonesia**: National Action Plan on Marine Debris National Action Plan on Plastic Pollution – see following section

MARPOL ANNEX V

At the international level, the International Maritime Organization (IMO) is the United Nations agency with competency in marine pollution matters. Over the years, the IMO has developed various instruments to manage pollution from ships. One of the key instruments related to the prevention of plastic pollution from all seagoing vessels is the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V.

MARPOL is the main international convention the addresses the prevention of pollution of the marine environment by ships from operational or accidental causes. MARPOL entered into force in 1983 and includes binding regulations that aim to prevent and minimize pollution from ships, whether accidental or arising from routine operations. MARPOL currently consists of six technical Annexes that address various categories of pollutants. Annex V addresses the pollution by garbage from ships, and entered into force in 1988.

MARPOL Annex V addresses the various types of garbage that are generated by vessels, and prohibits the discharge of all garbage into the sea, with limited exceptions. MARPOL Annex V applies to all vessels flagged under the 156 countries that are signatories to the convention, including fishing and recreational vessels, irrespective of size or where they sail. A notable feature of Annex V is the complete ban imposed on the disposal into the sea of all forms of plastics, although there are some exceptions relating to fisheries including loss of fishing gear which is addressed under Regulation 10.6 and concerns issues of safety to the vessel and crew.

This section considers whether MARPOL Annex V, in its current form, is sufficiently robust to provide a framework for reducing the risk of plastics generated by fishing vessels from entering the marine environment. The efficacy of MARPOL Annex V to manage marine plastic pollution from EOLFG and ALDFG is reviewed and, where deficiencies are identified, proposals are presented to find an Indonesian solution that is tailored to the specific needs and existing infrastructure. Three aspects of Annex V that relate to plastic pollution from fishing operations are considered:

1. the requirements for vessels to carry and fill out a garbage record book (GRB) (Regulation 10.3);
2. the landing and disposal of fishing gears considered as garbage[40] in port reception facilities (Regulation 8); and
3. the reporting of lost and accidentally discharged fishing gear (Regulation 10.6).

GARBAGE RECORD BOOK (REGULATION 10.3)

MARPOL Annex V applies to all vessels flagged under the 156 signatory countries that are to the convention, including fishing and recreational vessels, irrespective of size or where they sail. However, the level of reporting detail (if any) differs depending on the vessel size.

Vessels smaller than 100 GT are not required to have a garbage management plan. Vessels between 100 and 400 GT are required to carry a garbage management plan on board, which includes written procedures for minimizing, collecting, storing, processing and disposing of garbage, including the use of the equipment on board. Vessels larger than 400 GT (which may include some fishery supply boats, fish carriers and bunker boats) or vessels certified to carry 15 or more persons engaged in voyages to ports in other MARPOL signatory countries, offshore terminals and fixed or floating platforms are required to carry a Garbage Record Book and to record all disposal and incineration operations.

Garbage records must include: (i) a record of the date, time, and position of the vessel; (ii) a description of the garbage incinerated or discharged, including estimated amount; and (iii)

[40] MARPOL Annex V defines garbage as including all kinds of food, domestic and operational waste, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically.

be signed by the master of the ship. The Garbage Record Book must be kept for a period of two years after the date of the last entry. If ship personnel can adequately account for all their garbage, they are unlikely to be wrongly penalized for discharging garbage when they have not done so. MARPOL Annex V Appendix 2 provides a standard form for a Garbage Record Book which includes entries for plastics, including fishing gear waste.

Table 6 provides a breakdown of Indonesian fishing fleet by vessel size. In 2016 only 858 of Indonesia's 171,744 motorized fishing vessels were larger than 100 GT and hence required to have a garbage management plan. No fishing vessels were larger than 400 GT and hence required to carry and fill out a garbage record book. In its present form, the requirements to carry and fill out a GRB under MARPOL Annex V Regulation 10.3 do not apply to Indonesia's 171,744 inboard or 181,178 outboard motor vessels.

PORT RECEPTION FACILITIES (REGULATION 8)

The effectiveness of any ship to comply with the discharge requirements of MARPOL depends largely upon the availability of adequate port reception facilities. MARPOL Annex V Regulation 8 requires signatory states to provide adequate reception facilities at ports and terminals for the reception of garbage.
Government of Indonesia Regulation 81/2012 on Domestic Waste Management requires all public ports to conduct waste separation, waste collection and temporary waste storage. Subsequent waste treatment should include compaction, composting, recycling and energy recovery.

Presidential Regulation 83/2018 on Marine Debris Management addresses the management of plastic waste from maritime activities and outlines targets to establish waste reception facilities at 112 public ports, establish waste handling facilities at 23 PPN and PPS, and to implement ISO 14001 Environmental Management standards in 67 public ports and 22 PPN/PPS. MMAF, the Ministry of Environment and Forestry (MoEF) and local governments are also obliged to develop Standard Operating Procedures for the operation of 'eco-friendly fisheries and aquaculture'. While Government Regulation 81/2012 and Presidential Regulation 83/2018 address some larger ports (including full coverage of Indonesia's PPS and PPN), there are few waste reception or management facilities present in most of the smaller PPI and PPP. Given that most of Indonesia's fishing capacity consists of vessels smaller than 30 GT, this lack of infrastructure and facilities is a concern.

REPORTING OF LOST FISHING GEAR (REGULATION 10.6)

Regulation 10.6 of Annex V requires fishing vessels to report the accidental loss or discharge of fishing gears which pose a significant threat to the marine environment or navigation. However, when initially introduced, Annex V provided insufficient guidance on: (i) what size and/or type of gear represents a significant threat to the marine environment; (ii) the roles and responsibilities of the coastal and flag States; (iii) how the information was to be reported; and (iv) what actions might need to be taken once reported.

Some of the concerns raised with respect to a lack of detail on types of losses to report were addressed when IMO published guidelines for the implementation of MARPOL Annex V via Resolution MEPC.219(63)[41] and Resolution MEPC.295(17) [42] which state:

- The **accidental loss or discharge of fishing gear** which is required to be reported by regulation 10.6 of MARPOL Annex V should be determined specifically by the coastal State. For such determination, the government is encour-

[41] RESOLUTION MEPC.219(63) (adopted on 2 March 2012). 2012 Guidelines for the Implementation of MARPOL Annex V. https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.219(63).pdf
[42] RESOLUTION MEPC.295(71) (adopted on 7 July 2017). 2017 Guidelines for the Implementation of MARPOL Annex V. https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.295(71).pdf

aged to consider various factors including: (i) the amount of the gear lost or discharged and (2) the conditions of the marine environment where it was lost or discharged. Comprehensive consideration is needed on the characteristics of the gear that was lost, including types, size (weight and/or length), quantity, material (especially whether synthetic/plastic or not), and buoyancy. In addition, governments should consider the impact of the fishing gear in different locations in order to assess whether the lost gear represents a significant threat to the marine environment or navigation, taking into account the vulnerability of habitat and protected species to gear interactions. Governments are encouraged to report to IMO their measures taken for this issue with a view to promoting information sharing and opinion exchange among governments and relevant International Organizations. Further, governments are encouraged to report to IMO progress made in implementing these measures, including summaries of where gear was lost and, if applicable, actions taken to address the gear loss;

- **Examples of lost or abandoned fishing gear** which could be considered to pose a significant threat to the marine environment include whole or nearly whole large fishing gear or other large portions of gear. In determining the threat to the marine environment, governments should give careful consideration to the impact of gear in sensitive areas, such as coral reefs, and in areas where interactions would have higher risks of detrimental impacts, such as foraging or breeding areas for protected species;
- **Governments are encouraged to develop communication frameworks** to enable the recording and sharing of information on fishing gear loss where necessary in order to reduce loss and facilitate recovery of fishing gear. Governments are further encouraged to develop frameworks to assist fishing vessels in reporting the loss of gear to the flag State and to a coastal State. Such frameworks should take into consideration implementation challenges in small scale and artisanal fisheries and recreational operations. The fishing industry, relevant international organizations and governments are encouraged to undertake such research, technology development, information sharing and management measures as may be needed to minimize the probability of loss, and maximize the probability of retrieval of fishing gear from the sea; and
- Governments should encourage vessel operators to **implement appropriate onboard storage and handling of fishing gear** and should also consider relevant guidance from FAO and IMO.

The 2017 Guidelines also included examples of lost or abandoned fishing gear which could be considered to pose a significant threat to the marine environment, including whole or nearly whole large fishing gear or other large portions of gear. To date, few reports have been filed with IMO, calling into question the merit of Regulation 10.6 in its present form. Some IMO members have been considering changes to both Regulation 10.6 and the reporting requirements. For example, it has been proposed to make reporting of accidental loss or discharge of fishing gears mandatory and to remove the term "significant threat to the environment" from the text of Regulation 10.6. While there is growing support among IMO members for mandatory reporting of lost gears, the consensus-based approach to IMO procedures makes it difficult to say with certainty if or when such changes to Regulation 10.6 will occur. Moreover, unless concurrent changes are also made to require vessels <400GT to maintain a garbage record book, the possibility will remain for Indonesia's fishing vessels to dispose of their plastic waste without record keeping (albeit illegally).

RELEVANCE TO INDONESIA'S FISHERIES

MARPOL Annex V reporting regulations are not suited to Indonesian fishing vessels. Annex V specifies different reporting requirements for vessels <100 GT, <400 GT and >400 GT. These differences were intended for merchant ships, where the degree of reporting reflected the relative numbers of merchant ships in each size class. Almost all of Indonesia's fishing vessels are smaller than 400 GT, and below the threshold for detailed reporting on the quantity of waste generated and the location and method of disposal.

- Key deficiencies that limit the applicability of ANNEX V to address plastic leakage from Indonesia's fishing operations include:
- a non-requirement to carry and fill out a GRB by all Indonesian fishing vessels due to vessels sized <400GT;
- no mandatory requirement for Indonesian fishing vessel operators to report all lost fishing gear and fishing gear accidentally discharged; and
- limited guidance in Annex V on how lost fishing gears and fishing gears accidentally discharged overboard should be reported.

In its present form, MARPOL Annex V is not sufficiently tailored to Indonesia's fishing operations and practices and has limited application to reduce plastic leakage from Indonesian fishing operations. As a consensus-based organization, changes to MARPOL Annex V require agreement among the Members before adoption. Amending the Annex to reduce the size of vessels mandated to carry and fill out garbage record books or to make reporting of lost fishing gear mandatory will require consensus. Such processes can take an extended time to complete, and the final amendments may not be precisely suited to Indonesia's fishery specific problems.

On the other hand, Indonesia has benefitted from the guidance provided on port reception facilities which have been established at the 23 PPN/PPS ports, and this may provide a reasonable foundation for follow up work on EOLFG and ALDFG reporting.

Reporting and monitoring of EOLFG and ALDFG

ALDFG represents a significant risk to Indonesia marine natural resources. The findings of this study have shown that: (i) a significant quantity of fishing gear is deployed into the marine environment by Indonesian fishing vessels; (ii) a significant proportion of this gear is replenished annually due to wear and tear, damage and loss; and (iii) that those fishing gear materials that end up as ALDFG may cause adverse ecological impacts through ghost fishing, entanglement, rafting of invasive species and smothering of sensitive marine habitats. This study also noted that, due to the absence of a robust shore-side monitoring and reporting system in fishing ports, it is not currently possible to separate out the quantities of waste fishing gear materials that are disposed of ashore (EOLFG) from those that are disposed of at sea (ALDFG).

The adage 'you can't manage what you can't measure" holds true for EOLFG and ALDFG. The ad hoc surveys conducted during this study have revealed the extent and urgency of this issue, and have helped to inform next steps. However, to achieve the Government of Indonesia's ambitious objectives to reduce marine debris, a regular process for monitoring is needed to (i) improve understanding of the key issues, drivers, and 'hotspots' of EOLFG and ALDFG generation; and (ii) evaluate the efficacy and efficiency of management interventions. Given its importance as a key cross-cutting action and a precursor to the success of several other management measures, this Annex describes a proposed approach for reporting and monitoring of EOLFG and ALDFG, and outlines a strategy for piloting and evaluation.

There is a need for an Indonesian solution to waste fishing gear reporting and monitoring. International conventions and agreements such as MARPOL provide a framework for addressing ALDFG. However, clauses relating to reporting and monitoring have limited applicability in Indonesia because the majority of fishing vessels are below the threshold sizes regulated by the convention (Annex 9). Notwithstanding this, if Indonesia wishes to improve the reporting requirements of its national fleet—and especially those vessels operating within Indonesia's EEZ—the GOI may choose to develop national policy, laws and regulations that go beyond the requirements of MARPOL Annex V and that would be applicable to any fishing vessel within Indonesia's maritime jurisdiction. The development of such regulatory measures requires robust evidence of the types, sources and magnitude of ALDFG and its associated ecological impacts. However, the availability of such evidence is currently limited and, given Indonesia's vast and complex fisheries, this should be seen as a red flag that has potential to inhibit the ability to allocate and prioritize investments into ALDFG management effectively.

Integrating a mass balance approach to EOLFG and ALDFG reporting into existing systems and infrastructure offers an effective solution while minimizing barriers to initiation. In order to differentiate the weights of EOLFG that are landed and disposed of ashore from those that are disposed of at sea (ALDFG), a strategy is need for monitoring the quantity of new gears that are deployed (e.g., via manufacturer or supplier reporting requirements established as a part of extended producer responsibility schemes) and the quantity of gears removed from the environment as waste (e.g., via port waste reporting). The difference between these two quantities provides an estimate of the amount of leakage in the form of ALDFG. These estimates could be further improved if: (i) a system is put in place for vessels to report lost fishing gears, possibly integrated into existing fishery logbook and reporting systems; and (ii) compliance with waste fishing gear landing and reporting requirements is made a condition of the license to fish. A skeleton design for a mass balance approach to monitoring weights of gear deployed, weights of EOLFG landed and properly disposed, and weights of ALDFG is depicted in Figure 40.

A differentiated approach is required for reporting and monitoring of ALDFG in small- and large-scale fisheries. Electronic reporting has potential to provide an efficient and effective solution to the challenges of monitoring fishing gear quantities throughout their lifecycle and by the various stakeholders involved (Table 27). To minimize setup and operational overheads, e-reporting of ALDFG should be integrated into existing systems where feasible. An essential first step in the design and implementation of an e-reporting strategy for ALDFG, existing information and e-reporting systems should be identi-

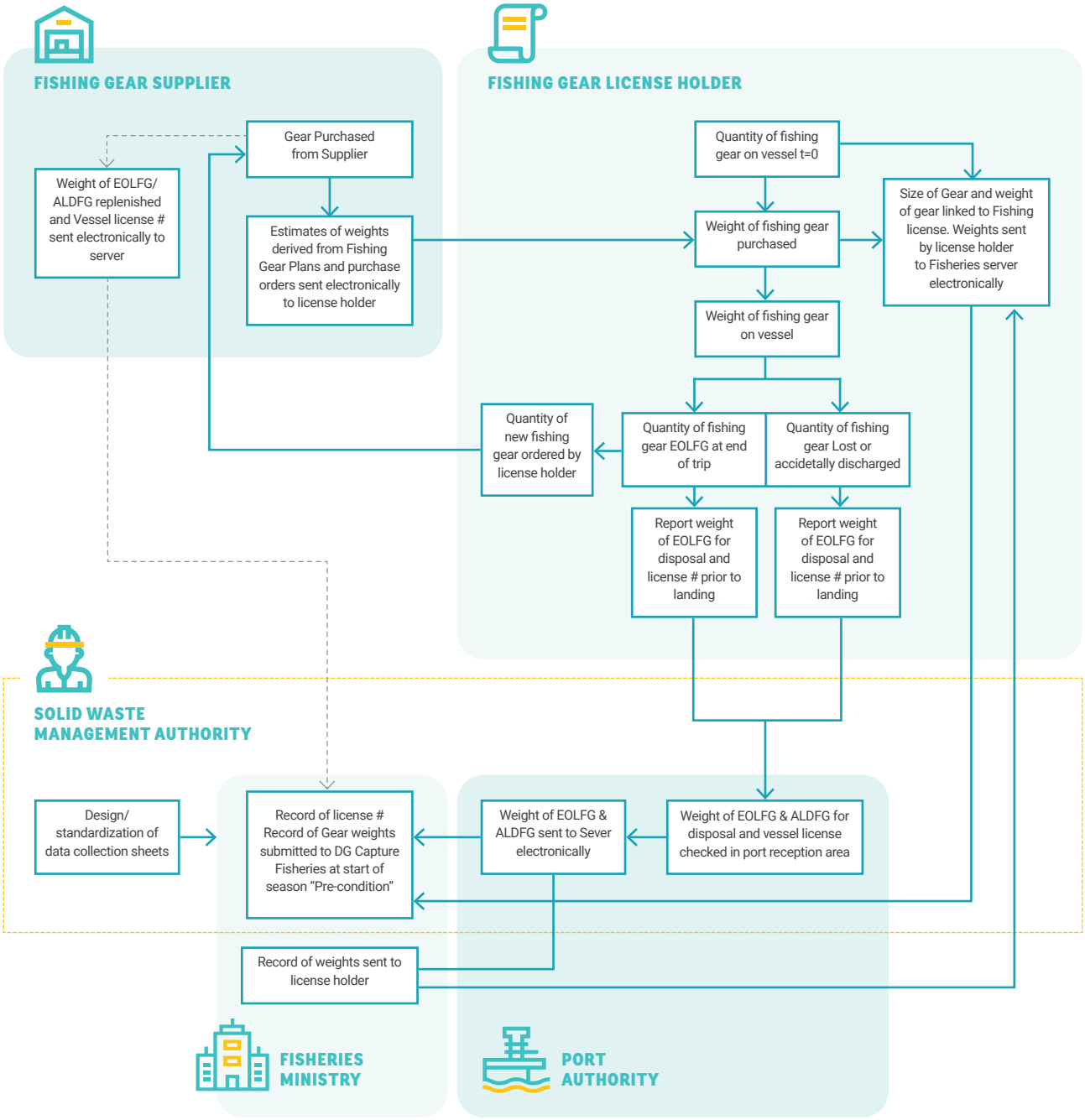


Figure 40: Outline of a mass balance approach to monitoring and reporting EOLFG and ALDFG.

fied and reviewed. This includes current logbook and electronic logbooks which could be extended to facilitate reporting of fishing gear loading and decommissioning by vessel skippers, as well as fishery information systems currently used by marine and fishery services to manage data on fishery landings and fishery licenses. Similarly, the applicability of extended producer responsibilities schemes to be applied to manufacturers and suppliers of fishing gears in Indonesia to encourage greater transparency and accountability with regard to plastic components. Piloting of e-reporting strategies should consider the need for a differentiated approach within small- and large-scale fisheries. While the number of fishing vessels and fishing capacity of the Indonesian fleet is greatest amongst vessels smaller than 30 GT, the high diversity of vessels and fishing gears operating in Indonesia's 357 PPIs, coupled with the different types of management authority controlling licenses and ports is likely to make the logistics of managing a pilot extremely complicated. Moreover, since there are already some port reception facilities within PPSs and PPNs, establishing a pilot in these ports where prior experience exists is likely to be most efficient in the short term, and enable approaches to be trialed and validated before replication to more the more complex context of the PPIs.

Table 27: Five principal actors play an essential role in a successful gear reporting system.

Fishing gear suppliers	• Provide feedback to the vessel license holder on the weights of plastic materials purchased. This information is provided electronically to the license holder broken down by netting, ropes and floats based on a request for purchase basis. A duplicate of the plastic weight information and the license holder could also be sent electronically to fisheries (a check and balance).
Fishing vessel license holders	• Prior to commencement of the first trip on a new license, the dimensions and weights of the fishing gear to be deployed during fishing operations (baseline weight) are submitted electronically. Such information can be provided to the license holder by the fishing gear supplier, but it is the responsibility of the license holder to confirm the dimensions and weights and submit the information. This will be the baseline against which EOLFG and ALDFG and replenishments will be measured. • Prior to commencement of any subsequent trip, the weights of all fishing gear purchased as a result of wear and tear, loss, abandonment and discarding incurred during a fishing trip is to be submitted electronically. • Prior to commencement of any subsequent trip, the weights of all fishing gear placed on the vessel from all other sources (personal gear store, etc.) where no electronic receipt is available are to be submitted electronically. • Prior to arrival at any landing port, the license holder is required to inform the port authority of arrival and to declare any plastic EOFLG and ALDFG materials to be offloaded for disposal. There will be no requirement to weigh any EOLFG or retrieved ALDFG. This will be the responsibility of the port authority. • Prior to arrival at any landing port, the license holder is required to inform the port authority of any fishing gear that is to be removed from the vessel for repair.
Port authority	• Make available, maintain and operate a secure area of the port for: (i) offloading of plastics from vessels, and (ii) weighing offloaded plastics by fishing vessels. • Ensure the vessel requesting offload of EOLFG and retrieved ALDFG is met promptly and is proving a berthing spot for rapid offload of materials. • Record the license number of the vessel and the weights of plastics offloaded according to floats, ropes, twines and netting. • Submit the recorded weights electronically to fisheries and provide the license holder with a copy of such weights. • Maintaining a safe record of all vessels, license numbers, and EOLFG / ALDFG weights offloaded. • Participate in the design and overall management of the pilot.
Fisheries authority	• Provide overall technical leadership for the pilot. • Liaise with fishing gear suppliers and license holders involved in the pilot. • Coordinate the work of the principal actors and lead the drafting of templates for collection of information on fishing gears, EOLFG and retrieved ALDFG. • Lead the technical work on compilation and analysis of data on EOLFG and retrieved ALDFG plastic fishing gear materials.
Solid waste management authority	• Provide guidance on templates for collection of data on plastics from fishing operations. • Provide feedback on weights of EOLFG and ALDFG materials dispatched for disposal in landfill etc. • Provide technical support in design and overall management of the pilot.

An initial pilot could be completed within six PPS and PPN class fishing ports over a two-year period. A pilot should be designed to encompass fishing gears that: (i) have a high weight of plastic content, are likely to be landed ashore at the end of life, and are a candidate for recycling (e.g., purse seine and drift gillnets); and (ii) have a high risk of causing ecological impact when abandoned, lost or otherwise discarded (e.g., set anchored gillnets, set plastic pots and set longlines). Ports with high production volumes, and hence high numbers of fishing vessels, fishing gears and generated fishing gear waste should be prioritized. The top five provinces (Jawa Barat 13 percent, Aceh 11.3 percent, Jawa Timur 11.2 percent, Jawa Tengah 8 percent and Banten 5.1 percent) account for 54.7 percent of Indonesia's annual fish capture production suggesting that candidate ports for piloting an ALDFG reporting system might be selected from these provinces, and in particular from ports in Java province which accounts for around 30 percent of Indonesia's capture fisheries production (BPS, 2019). Within these top five provinces, there a three PPS, three PPN, 18 PPP and over 300 PPI (Table 28). The island of Java, bounded predominantly by WPP 712 and WPP 573 stands out as a candidate area to trial an EOLFG/ALDFG monitoring and reporting pilot given the comparatively short distance to Jakarta and the likelihood for logistical support and technical backstopping from the capital. Candidate fishing ports include: PPS Cilacap, PPS Nizam Zachman Jakarta, PPN Palabuhanratu, PPN Prigi, PPN Pekalongan, PPN Karangantu, PPN Kejawanan, PPN Brondong and PPN Muara Angke. It is suggested that a minimum of 100-150 vessels are required for the pilot across for all six ports (average 16-25 vessels per

[43] The approach adopted in other countries is to focus on fisher experience and knowledge of clean up rather than seeking to understand the underlying science of where and how gears are lost.

port), distributed equally amongst across purse seine, drift gillnet, set anchored gillnet, set anchored trammel net, crustacean pot, and longlines gears. A minimum of 15-20 vessels per gear subcategory should enable trends between fleets as well as between vessels within a specific gear subcategory to be monitored. Pre-conditions for establishing a pilot should include: (i) collection of disaggregated port data to confirm the suitability of candidate fishing ports; (ii) dialogues between the GOI (MMAF and port authorities) and vessel operators to define the framework under which the pilot would operate; (iii) development and testing of the protocols for e-reporting and e-monitoring; (iv) field evaluations of the baseline weights of the gears involved in the pilot; (v) agreed terms and conditions for carrying out the trials between the parties (port authority, MMAF, vessel operators, and other relevant stakeholders).

Table 28: Number and types of ports in the top five landing provinces.

PROVINCE	OCEAN FISHING PORT (PPS)	ARCHIPELAGIC FISHING PORT (PPN)	COASTAL FISHING PORT (PPP)	FISH LANDING BASE (PPI)
West Java	0	1	3	44
Aceh	1	0	0	113
East Java	1	1	5	50
Central Java	1	1	9	67
Banten	0	1	1	25
DKI Jakarta	1	0	0	1

Preventative and curative measures tailored to the local context are likely to be a more effective strategy for PPP and PPI class fishing ports. Such measures should aim to incentivize a "whole community approach" to participation in marine pollution mitigation rather than focusing on enforcing a community sub-group's compliance with applicable international or national ALDFG regulations. Pilots could be established in 20 PPP/ PPI fishing ports to develop and evaluate strategies. As a pre-condition, ports should have secure fenced areas for unloading, sorting, weighing and safe disposal of EOLFG and retrieved ALDFG. Such facilities could also consider weighing, sorting and safe disposal of fuel oils and other hazardous materials used by small-scale fishers. For potential ALDFG management strategies could be considered:

- **Establish a Ghost Gear Fund for ALDFG retrieval involving fishers [Curative].** Fishing for Litter schemes have grown in popularity and are relatively simple to introduce. Under such a program a fund ("ghost gear fund") is made available to fishers to go out and retrieve lost gear.[43] It is recommended that a cost-sharing approach be applied to use of the fund, similar to approaches implemented by the Government of Canada.
- **Engage the coastal fishing community in small fishing port waste cleanup and proper disposal [Preventative].** NGOs and other advocacy groups have demonstrated their capacity to engage with and provide value added in beach cleanup, ghost gear retrieval and safe disposal of such gears.
- **Develop community awareness about EOLFG/ALDFG best practices [Preventative].** These actions should aim to provide information, communication and management platforms to both government and community with targeted campaigns in and around small fishing ports and especially in schools targeting youth, the next generation of fishers.
- **Provision of secure EOLFG / ALDFG reception bins in small ports [Curative].** Experience from other countries has shown that retrieved gear is often comprised of a highly mixed material that contains metal anchors, chains, organic matter such as mussels and dead fish and other marine litter as well as nets, ropes, float and sink lines. A pilot to assess the merits of setting up a secure area for EOLFG waste receiving and storage bins would allow the fine tuning of a small port marine litter program to be developed.

Rationale for the feasibility and prioritisation of recommendations

POLICY AREA

ALDFG PREVENTION

Marine spatial planning: Zoning or communication protocols to reduce gear conflict, interactions with other marine users.

FEASIBILITY SCORE	COMMENT
Relevance HIGH	The high rank of relevance and acceptability relates to the commitment of Indonesia government following the UU No. 27/2007 and following the implementation and technical in Ministerial level, and provincial level through *RZWP3K*. The planning, strategy, objective/target, implementation team are already settled and provided by Directorate General of Marine Spatial Management, intense coordination, and communication within the relevant stakeholder, such as Directorate General of Capture Fisheries and Directorate General of Marine Resources and Fisheries Surveillance.
Acceptability HIGH	
Enforceability MEDIUM	Regarding the needs of additional support program and intense collaboration from national level with the Provincial and Regency/District level government. This will be required to manage and cover the enforcement activities due to the remote area location. Local communities' engagement such as *kelompok masyarakat pengawas/Pokmaswas* are an option to support the surveillance and enforcement activities.
Benefit-cost HIGH	MSP framework is already well developed and established; it would not take a lot to factor in ALDFG considerations within the standard review cycle.

POLICY AREA

ALDFG PREVENTION

Vessel design: e.g. ensuring fishing vessels have sufficient space & equipment to store, deploy, retrieve and stow used fishing gear

FEASIBILITY SCORE	COMMENT
Relevance MEDIUM	As per the ministerial decree (Ministerial Decree Number 29 of 2021), only explained the 5 GT, 10 GT and 30 GT vessels. For vessels, less than 5 GT and above 30 GT, it is not well explained under this regulation which the relevance to Indonesia is given to **medium scale**
Acceptability MEDIUM	The larger class of vessels (above 30GT) is managed under the central government, while the vessels below 30 GT are under the governor's authority. Specifically, in terms of terminology of "Small Scale Fisherman" referred to the regulation, there are two categories of the small scale fishers which are in National law number 45 of 2009 said that the small scale vessels used ≤5GT vessels while in Ministerial Regulation number 58 of 2020 concerning the capture fisheries business concerning the capture fisheries business, the small scale is the fishers that used ≤10 GT vessels. In conclusion, the **acceptability is medium** because there is a need to consider specific regulation that mainly described the "vessel design" in further detail and combined with the available SNIs for the fishing vessels, Currently, there are two standards of the vessels construction based on the SNIs include the construction of purse seiner 75-150 GT and 75-150 GT of tuna long-liner (for the other type of fishing vessel is not available yet on the SNIs). And also, there is a need to consider the terminology of small scale fisherman.

Enforceability HIGH	In terms of the vessels design, the enforceability for all the vessels class is same as this is mandated (required) through the PERMEN 23/2021 for the vessels to get the legal operation standard of fishing vessels and other fishing license or permit.
Benefit-cost LOW	Changing the design of the vessels is costly and there regulation in Indonesia allowed the changing of the vessels (see the Ministerial Regulation number 5 of 2019 – paragraph 10 point (1.c) physical changes of the fishing vessels.

POLICY AREA

ALDFG PREVENTION

Awareness raising: Campaigns for fishers and public. Develop codes of practice

FEASIBILITY SCORE	COMMENT
Relevance HIGH	The high rank for relevance, enforceability and benefit-cost relates to the Fishery Extension or *Penyuluh Perikanan*, this unit is a legal position that is already regulated by ministerial regulation. The budget allocation for additional activities must be planned and approved during the discussion of budget allocations at the beginning of the year or the previous year where the budget comes from the Central Budget, De-concentration to the provincial government or external parties with a cooperation scheme. The enforceability is medium - As being part of the National Implementing Team of the National Action Plan of PERPRES 83 of 2018, the MMAF is already undertaking numerous awareness-raising efforts as described earlier.
Acceptability HIGH	
Enforceability MEDIUM	
Benefit-cost HIGH	

POLICY AREA

ALDFG MITIGATION

Fishing gear design: e.g. Non-entangling gears and FADs, biodegradable or more recyclable components.

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia is high – by considering the list of fishing gear designs that include in SNIs and combined with the Indonesia Catalogue of fishing gear design categorized as "high rank" (high relevance to Indonesia). Also considered the newly ratified regulation of Ministerial Regulation number 18 of 2021 combined with the new plan regarding the "*Perikanan Terukur*", it is clear for the "spatial distribution of each fishing gear that permitted operated per WPP by each type of fishing gear, GT class, and the fishing zone would be highly relevant to Indonesia related to the feasibility of ALDFG measures towards developing the circular economy for fishing gear in Indonesia.
Acceptability MEDIUM	Acceptability is medium – Some fishing gear has already been defined in regulation, but there is a need to update the new list of SNIs per each fishing gear with further detail. In the newly ratified regulation of Ministerial Regulation Number 18 of 2021, there is no mention of "biodegradable or more recyclable components". There is a need to consider adding these specific elements or derivative regulations. The significant change compared to the previous regulation
Enforceability LOW	Enforceability is low – as the newest ratified regulation has recently launched in 2021, so the government will be required to evaluate the progress in upcoming years regarding the effectiveness of this regulation being implemented in Indonesian fisheries sectors. Due to the increasing fishing effort, the vessels might use more than one fishing gear in their trip.
Benefit-cost MEDIUM	Benefit-cost is medium – we consider the given rank for this is medium because it is likely that the changes of the government regulation would much impacted to the fisheries sectors in Indonesia and for the new initiative in developing the biodegradable or more recyclable components of fishing gears might need a high cost.

POLICY AREA

ALDFG MITIGATION

Gear marking: Owner identification of fishing gear and its components

FEASIBILITY SCORE	COMMENT
Relevance HIGH	There is a lot of zonation and differentiation of management by gear types, but as yet limited regulatory requirements for gear marking beyond that contained within PP 27 /2021 and PP 18/2021.

Acceptability LOW	Indonesia through the pilot project of FAO partnered with GGGI to implement the pilot project on gear marking in small-scale fisheries in Indonesia in 2017. In general if we will implementing the specific regulation on gear marking it will be low in acceptability due to implementation barrier for the massive distribution of Indonesia Archipelago area for small-scale fishing vessels.
Enforceability LOW	Large sections of the fleet are located far from technical implementation unit/ *Unit Pelaksana Teknis*-UPT level government agency, limiting enforceability by the authority and jurisdiction from Regency or District marine and fisheries agency or officer regarding the new law or regulation. Law or *Undang-Undang*/UU No. 23/2014 concerning Local Government, the regency/district level only has a mandate regarding the fisheries only to socialize and increase awareness of the fishing community and support the auction fish operation. There is no role or actions related to enforcement. Enforcement and management under the provincial government.
Benefit-cost LOW	It will take a lot of effort since there is no top tier hierarchy regulation that can be as guidance to legalize this action as mandatory in Indonesia area. The best approach will be as the Pilot Project with a scheme section in the Oceanic Fishing Port (PPS) level and the lowest tier level of fishing port in regency/district government.

POLICY AREA

ALDFG MITIGATION

Integrate EOLFG and ALDFG management into fisheries management:
Include gear details, loss reporting, recovery requirements.

FEASIBILITY SCORE	COMMENT
Relevance HIGH	**Relevance to Indonesia and Benefit-Cost is High** – as this also has been agreed within the several initiative and action plan of GOI both in collaboration and coordination inter-governmental, bilateral, multilateral and international NGOs. It shows how the government is concerned about marine debris and its management. In conclusion, the rank of relevance to Indonesia is high. To be noted that, it strictly depends on the national and provincial level governments' commitment to develop and formulate the regulations, socialization, and implementation. **Acceptability and enforceability are low** - due to the time costs in identifying where to amend and then the time and procedures involved in changing regulations.
Acceptability LOW	
Enforceability LOW	
Benefit-cost HIGH	

POLICY AREA

ALDFG RETRIEVAL

EOLFG-ALDFG reporting programs: Recording, reporting and communicating ALDFG incidents

FEASIBILITY SCORE	COMMENT
Relevance HIGH	**Relevance to Indonesia is high** – currently there is not a regulation that requires ALDFG reporting in Indonesia. However, the GOI has already started the program of marine debris related issues (and ALDFG is mention under this) and ALDFG reporting programs needs to be added in the regulation. The ALDFG reporting program should be added as a part of the GOI program on marine debris of President Regulation Number 83 of 2018 concerning the marine debris management as part of the current reporting system expected under this regulation (paragraph 9).
Acceptability MEDIUM	**Acceptability is Med** – Linked with the GOI plan on marine debris management, this would be accepted by the GOI in integrating or adding to vessel reporting programs/systems or ongoing program on https://sampahlaut.id/data-spasial/#tab-id-1 and https://sipsn.menlhk.go.id/sipsn/# for vessels >30GT.
Enforceability HIGH	**Enforceability is high** – if part of the regulation (Ministerial Regulation of Coordinating Ministry for Maritime and Investments Affairs number 69 of 2019) and applied to vessels over 30GT, enforceability should be high.
Benefit-cost MEDIUM	**Benefit-cost is medium** - because the current regulation does not yet specifically and technically explain the ALDFG reporting programs so a follow-up regulation needed and the cost of implementing across Indonesia is high

POLICY AREA

ALDFG RETRIEVAL

ALDFG Recovery Programs: Provision of equipment and training to locate and retrieve gear. Clean-up operations

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia, acceptability, and enforceability is high – As mandated through the President Regulation Number 83 of 2018 concerning marine debris management, the MMAF is responsible for national movement on beach clean-up. By integrating the ALDFG recovery programs into the program of MMAF, it will highly the support the MMAF.
Acceptability HIGH	
Enforceability HIGH	
Benefit-cost HIGH	Benefit-cost is high - the implementation and action related to the clean-up generally are focused on the marine litter or debris initiated by the NGOs, government, and other initiatives in Indonesia. Clean-up operations (e.g., CITARUM River Clean Up Actions) have been effective if well-targeted. Possible to target ghost gear high risk areas and tourism hotspots (reefs).

POLICY AREA

CIRCULAR ECONOMY

Enabling gear repair activities – e.g. provision of repair facilities at ports.

FEASIBILITY SCORE	COMMENT
Relevance MEDIUM	Relevance to Indonesia, acceptability, and enforceability are medium – Most of the fishers that conduct the repair activities are usually used the open space or open area in the port or even in front of their docking location. For the broken piece of gear, the fishers might replace or repair their gear firstly before they decided to throw it away. Then if all the fishing ports in Indonesia (538 ports) have repair facilities, then the waste as resulted from the unused gear in the repairing process can be centralized in this facility then all the waste can be easy to be monitored. Also, if the waste of gear is accepted by the collectors in the port/land so the fishers might choose to bring the waste of the fishing scrap to the collector (refer to point 13 below on Recycling and treatment markets).
Acceptability MEDIUM	
Enforceability MEDIUM	
Benefit-cost LOW	Benefit-cost is low - by considering the investment in building the repair facilities is high and the cost-benefit of this parameter is low. The fishers mostly do the repair activities without using the repair facilities in the ports. As the fishers will repair the gear depending on the available space/area in the ports and they not only do the repair in the port because they repaired the gear themselves at home.

POLICY AREA

CIRCULAR ECONOMY

Circular Design: Research and development of design to aid re-use/repair/recycling.

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia is high – the R&D of design to aid re-use/repair/recycling is lacking. Generally, most of the research is concerned with "marine debris" and not yet focused on ALDFG. Engage with recyclers for a future pilot project that specialized to do the pilot project related to the R&D on the design to aid re-use/repair/recycling things. As the MMAF task within the PERPRES 83 of 2018, the MMAF is expected to do the research on marine debris pollution and its impact (11 WPPs), we can suggest including the R&D specialized on the re-use/repair/recycling as a part of this program. ALDFG that cannot be processed to re-use and repair could be useful as an input material for waste into the energy under President Regulation Number 35 of 2018 concerning the Acceleration of Development of Waste Treatment Installation Into Electricity based on Environmentally Friendly Technology.
Acceptability MEDIUM	Acceptability and enforceability are medium – the rank for these categorized as the medium because we consider that R&D capacity on fishing gear is limited, specifically on how to re-use/repair/recycling.
Enforceability MEDIUM	
Benefit-cost HIGH	Benefit-cost is high - The model developed and regulations concerning circular design, both in research and development of designs to aid re-use, repair/recycling, are highly needed to be implemented across Indonesia. The cost for this is high because the R&D will require several iterations before we get the ideal model to applicable and replicated in Indonesia (include the pilot study). In addition, we identified if this program is successful in the future, the cost-benefit will be high.

POLICY AREA

CIRCULAR ECONOMY

Extended Producer Responsibility (EPR) scheme:
e.g. tax on producers and/or collection and treatment.

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia is high - There are some companies that have already started implementing the EPR scheme in a voluntary basis (PT Kemasan Ciptatama Sempurna (KCS), GO-JEk, Djournal Coffee, and The Body Shop) BUT there is no fishing gear producer participating in this. If the GoI is willing to implement the EPR scheme, the cost will be high for this. The EPR is a good scheme to realize zero waste to landfills. Related to the tariff could integrate the regulation of Ministerial Regulation of Ministry of Home Affairs Number 7 of 2021.
Acceptability LOW	Acceptability, enforceability and benefit-cost are low – no fishing gear producers participated in this EPR scheme. It is likely that the producers might worried about the cost if they implemented the EPR scheme. So we consider that there is a need for having a win-win solution to bridge/accommodate between the interests of protection on the one hand, and the investment economic climate on the other.
Enforceability LOW	
Benefit-cost LOW	

POLICY AREA

CIRCULAR ECONOMY

Buy-back scheme:
e.g., Deposit and return schemes (strengthening the link between gear suppliers and users)

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia is high – In general, the buy-back scheme from the gear suppliers and users could be strengthen if the MMAF have their owned regulation (through Directorate General Regulation, or other relevant regulation under the MMAF) that specifically required the fishing gear producers/supplier to implement the buy-back scheme (producers-supplier-users) in supporting the current regulation of Ministerial Regulation of Ministry of Environment and Forestry Number P.75/MENLHK/SETJEN/KUM.1/10/2019 on the roadmap in reducing the waste by the producers. In conclusion, the buy-back scheme is highly relevant to Indonesia as it will increase the willingness of end-consumers or users to transfer their waste into the money (waste to money).
Acceptability MEDIUM	Acceptability and enforceability are medium – there is no fishing gear factory/producers that participated in giving their owned roadmap in reducing their waste for 2020-2029 program to the MoEF-Indonesia.
Enforceability MEDIUM	
Benefit-cost HIGH	Benefit-cost is high – it seems that this is likely feasible and would have an impact

POLICY AREA

CIRCULAR ECONOMY

Recycling and treatment markets:
Collection facilities incentives for recycling and treatment markets value chains for EOLFG materials

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia is high – this will be highly relevant to Indonesia and feasible in developing the circular economy for fishing gear in Indonesia as it would be have a high added values (waste to money) and this could be used as a trigger in activating the new business model both in recycle and treatment markets.
Acceptability MEDIUM	Acceptability is medium – most recycling and treatment markets are not currently receiving ALDFG, although the waste of fishing gear and other materials in supporting the fishing activities categorized as a marine plastic debris.
Enforceability HIGH	Enforceability is high – the GOI under the RAN PSL had been strategically made the national team called "*Tim Koordinasi Nasional Penangan Sampah Laut*"
Benefit-cost HIGH	Benefit-cost is high – the investment in the recycling and treatment facilities represents a high cost, to include the financial incentives to develop markets for recycling and treatment of fishing gear compared to other plastic waste, but market development will be needed for actions to be sustainable beyond project interventions.

POLICY AREA

CIRCULAR ECONOMY

Port Reception Facilities: Separate port reception facilities for end-of-life fishing gear and assist the port in transporting the recyclable material to the recycler.

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia is high: by enabling specific ALDFG facilities in the port, it will trigger and stimulate the business player on the waste sectors (related to the ALDFG waste) to be operated and invest their business in the port by enabling the third party cooperation (joint cooperation). Also, it is noted that the MARPOL Annex V yet to be fully implemented, but separate facilities would help with the above buy-back and recycling initiatives.
Acceptability LOW	Acceptability and enforceability are low ranking – as most of the end-of-life fishing gear needs to be managed and regulated with the proper guidelines and follow-up regulation. We also noticed as a lesson learned of two plastic recycler facilities in the fishing port of PPS Kendari and PPS Bitung are not fully be operated due to operational issues and other administration issues.
Enforceability LOW	
Benefit-cost HIGH	Benefit-cost – this will need significant investment (exclude the assisting cost in supporting the port in transporting the recyclable material to the recycler).

POLICY AREA

CIRCULAR ECONOMY

Engagement with waste operators:
Improving links and support to informal waste collection sector, cross-sectoral links to improve viability

FEASIBILITY SCORE	COMMENT
Relevance HIGH	Relevance to Indonesia, acceptability, enforceability, and benefit-cost are high: by enabling specific ALDFG facilities in the port, it will trigger and stimulate the business player on the waste sectors (related to the ALDFG waste) to be operated and invest their business in the port by enabling the third party cooperation (joint cooperation). Also, it is noted that the MARPOL Annex V yet to be fully implemented, but separate facilities would help with the above buy-back and recycling initiatives. The engagement with waste operator is highly relevant to Indonesia in order to support the circular economy for fishing gear in Indonesia, and the cost benefit for this is categorized as high. Although there is a gap in the supply chain of waste (those involved in solid-waste management need to be part of the EOLFG-ALDFG supply chain.
Acceptability LOW	
Enforceability N/A	
Benefit-cost HIGH	

POLICY AREA

CIRCULAR ECONOMY

Engagement with other stakeholders: e.g., government and private sector.

FEASIBILITY SCORE	COMMENT
Relevance HIGH	The coordination, meeting and communication between private sector can be establish and provide during the regular meeting forum and workshop of the related RFMO. The regular meeting, forum and workshop can be a platform in between Indonesia government with private sector including the NGO, Academic and local communities to discuss, sharing and develop the action regarding the fisheries issue and challenge. Indonesia government can also support and working together with the private sector in order to comply with the RFMO requirement if the RFMO has the new initiate or program to achieve.
Acceptability LOW	
Enforceability N/A	
Benefit-cost MEDIUM	

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