# **SUPPLEMENTARY MATERIALS**

**Maximizing the Potential of Sustainable Aquatic Food Systems for Global Food Security:   
Key Opportunities and Challenges**

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# Experimental procedures

## Defining key concepts

To make future scenario analyses meaningful, a refined target space had to be defined in order to produce a quantifiable and actionable, as well as communicable proposal (van Vuuren et al., 2022). Factors that have the potential to influence the sustainability of future aquatic food systems, were identified and discussed by the author group and sorted into four key concepts based on their main characteristics: safe and nutritious food, policy and social equity, environment and climate change, and circularity. These four key concepts were used to describe challenges and opportunities in the three case scenarios involving seaweed, bivalves and small-scale tuna, and inform how future adaptations may enhance sustainability.

## Sustainable development goals

The 17 SDGs consist of 169 targets and 232 indicators (UN, 2015b), which is too broad to be utilized in scenario analyses. The ‘Global Action Network for Sustainable Food from the Oceans and Inland Waters for Food Security and Nutrition’ developed a schematic seafood value chain that addressed key SDGs, as an input to the 2021 World Food Systems Summit (Norwegian Government, 2021). By adopting this approach, we highlight seven key SDGs in the aquatic food value chain: SDG 1 No Poverty, SDG 2 Zero Hunger, SDG 3 Good health and well-being, SDG 5 Gender equality, SDG 9 Industry, Innovation and Infrastructure, SDG 12 Responsible consumption and production, SDG 13 Climate action, and SDG 14 Life below water (UN, 2015b).

Literature review

Building on the framework developed by Arksey and O'Malley (2005), a scoping review methodology provides an evidence-based tool to explore key concepts of a given topic while limiting authorial bias. By conducting systematic searches and synthesizing existing evidence, a scoping review thus offers an opportunity to identify practical pathways of food systems and support policy development. The scoping review adhered to the PRISMA extension for scoping reviews (PRISMA-ScR) guidelines (Tricco et al., 2018).

Search strategy

A search strategy was developed to identify all available research pertaining to seaweed, bivalve and small-scale tuna food systems, with outcomes related to safe and nutritious food, policy and social equity, environment and climate change, or circularity. The terminology in each food system was expanded, including the taxa of the most harvested or farmed species of the respective case studies, as reported by the (FAO, 2018b, 2020). Additional terms, including “blue food,” “aquatic food” and “seafood” were included to broaden the search. A single string compiled of all three food systems were subsequently paired with AND "food system\*", yielding few results. While this may pinpoint that the contemporary use of food systems terminology is limited, additional records were needed to form a well-rounded review. The search string was therefore expanded to include AND “food system\*” OR "food security" OR "food insecurity" OR "food security and nutrition" OR "food and nutrition security". To ensure the reproducibility of literature searches, search strings were formatted for compatibility with each database and may be replicated in their entirety.

Inclusion criteria

1. Original peer-reviewed research articles or review of existing research articles reporting data pertaining to one or more of the case studies; seaweed, bivalves, or small-scale tuna fisheries.
2. Studies with outcomes related to one or more of the four key concepts derived from the food systems framework: safe and nutritious food, policy and social equity, environment and climate change, or circularity. Specific inclusion criteria were elaborated for each concept (Table 1):

**Table 1:** Specific inclusion criteria.

|  |  |  |  |
| --- | --- | --- | --- |
| **Safe and nutritious food** | **Policy and social equity** | **Environment and climate change** | **Circularity** |
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| Studies reporting data on **nutrients** in seaweed, bivalves, or tuna. | Studies reporting data on **food access**, both direct (access to seaweed, bivalves, or tuna) and indirect access to food through work in the aquatic food systems value chain. | Studies reporting on the effect of **climate change** and seaweed, bivalve or, tuna production and/or harvest. | Studies reporting data on **food waste, by-catch and discards** in seaweed, bivalve, or small-scale tuna food systems. |
| Studies reporting data on **contaminants** and **biohazards** in seaweed, bivalves, or tuna. | Studies concerning **policy** and regulations related to seaweed, bivalve, or small-scale tuna production and/or harvest. | Studies reporting on the effects of **anthropogenic activity** on seaweed, bivalve, or tuna production and/or harvest. | Studies reporting on **nutrient-circularity** in seaweed, bivalve, and small-scale tuna food systems and effects on other food systems. |
|  | Studies reporting on **social equity** in small-scale or industrial-scale seaweed, bivalve, or tuna production and/or harvest. | Studies reporting on the **ecological sustainability** of seaweed, bivalve, and small-scale tuna food systems. |  |

Exclusion criteria

For an article to be excluded from this scoping review, it had to meet one of the following exclusion criteria:

1. Studies published prior to 2014
2. Studies in languages other than English
3. Other publication types than peer-reviewed original research articles or reviews (e.g., books, short communications, reports)
4. Studies where neither of the case studies are included in the results.
5. Studies with outcomes that are not related to one or more of the four key concepts derived from the food systems framework. For example, country-specific studies where the outcome is not applicable in a wider geographical context, technical studies (e.g., use of specific fishing gear), methodological studies (e.g., focused on analytical methods used for analyses of nutrients, contaminants, or fisheries performance) or studies addressing outcomes of COVID-19.

Literature search

Literature searches for peer-reviewed articles were conducted in the following electronic databases by A.E.H and an independent librarian: Web of Science (Clarivate), ASFA: Aquatic Sciences and Fisheries Abstracts (ProQuest), and PubMed®(Medline). Acknowledging the HLPE report of 2014 as a landmark in recognizing the role of aquatic foods towards achieving food and nutrition security (HLPE, 2014), the timespan was limited to 2014- February 2022. After removing duplicates, 643 unique articles were uploaded to the systematic review software Rayyan (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016).

Study selection

Study selection was subsequently performed in two stages. Initially, a double-blinded screening of titles and abstracts according to a priori inclusion and exclusion criteria were performed by A.E.H and L.M, and disagreements were resolved by M.W.M. The primary screening yielded 155 articles for full text screening, including articles that either met all inclusion criteria or where eligibility could not be established based on title and abstract solely. Screening of full-text articles was performed individually by A.E.H, L.M and M.W.M, and disagreements were resolved by group consensus. The number of articles excluded at each stage of the screening process and specific exclusion criteria are presented in the PRISMA flow diagram (Figure 3).

Diagram

Description automatically generated

**Figure 3:** PRISMA flow diagram. Adapted from Page et al. (2021).

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# Classification of opportunities and challenges for each case study

Tables of the opportunities and challenges identified in the scoping review, and how these have been grouped and given simpler topic names used in plotting of figures 4 – 6.

## Seaweed

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** | **Topic\_old** | **Topic** | **SDG** |
| Opportunities | Omega-3 | Proteins & Nutrients | 1 |
| Opportunities | Vitamin B12 | Proteins & Nutrients | 1 |
| Opportunities | Plant-based protein | Proteins & Nutrients | 1 |
| Opportunities | Minerals | Proteins & Nutrients | 1 |
| Opportunities | Enhance nutrition security | Proteins & Nutrients | 1 |
| Opportunities | Omega-3 | Proteins & Nutrients | 2 |
| Opportunities | Vitamin B12 | Proteins & Nutrients | 2 |
| Opportunities | Plant-based protein | Proteins & Nutrients | 2 |
| Opportunities | Minerals | Proteins & Nutrients | 2 |
| Opportunities | Enhance nutrition security | Proteins & Nutrients | 2 |
| Opportunities | Omega-3 | Proteins & Nutrients | 3 |
| Opportunities | Vitamin B12 | Proteins & Nutrients | 3 |
| Opportunities | Plant-based protein | Proteins & Nutrients | 3 |
| Opportunities | Minerals | Proteins & Nutrients | 3 |
| Opportunities | Enhance nutrition security | Proteins & Nutrients | 3 |
| Opportunities | Use as agricultural fertilizer | Fertilizer | 1 |
| Opportunities | Use as agricultural fertilizer | Fertilizer | 2 |
| Opportunities | Use as agricultural fertilizer | Fertilizer | 3 |
| Opportunities | Use as agricultural fertilizer | Fertilizer | 5 |
| Opportunities | Use as agricultural fertilizer | Fertilizer | 12 |
| Opportunities | Use as agricultural fertilizer | Fertilizer | 13 |
| Opportunities | Use as agricultural fertilizer | Fertilizer | 14 |
| Opportunities | Use in animal and fish feed | Feed | 1 |
| Opportunities | Use in animal and fish feed | Feed | 2 |
| Opportunities | Use in animal and fish feed | Feed | 3 |
| Opportunities | Use in animal and fish feed | Feed | 5 |
| Opportunities | Use in animal and fish feed | Feed | 12 |
| Opportunities | Use in animal and fish feed | Feed | 13 |
| Opportunities | Use in animal and fish feed | Feed | 14 |
| Opportunities | Include in multi-trophic aquaculture | Multithropic aquaculture | 1 |
| Opportunities | Include in multi-trophic aquaculture | Multithropic aquaculture | 2 |
| Opportunities | Include in multi-trophic aquaculture | Multithropic aquaculture | 3 |
| Opportunities | Include in multi-trophic aquaculture | Multithropic aquaculture | 5 |
| Opportunities | Include in multi-trophic aquaculture | Multithropic aquaculture | 12 |
| Opportunities | Include in multi-trophic aquaculture | Multithropic aquaculture | 13 |
| Opportunities | Include in multi-trophic aquaculture | Multithropic aquaculture | 14 |
| Opportunities | Contribute to food security and nutrition | Food security and nutrition | 1 |
| Opportunities | Contribute to food security and nutrition | Food security and nutrition | 2 |
| Opportunities | Contribute to food security and nutrition | Food security and nutrition | 3 |
| Opportunities | Contribute to food security and nutrition | Food security and nutrition | 5 |
| Opportunities | Contribute to food security and nutrition | Food security and nutrition | 12 |
| Opportunities | Contribute to food security and nutrition | Food security and nutrition | 13 |
| Opportunities | Contribute to food security and nutrition | Food security and nutrition | 14 |
| Opportunities | Constant demand | Economy | 1 |
| Opportunities | Constant demand | Economy | 2 |
| Opportunities | Constant demand | Economy | 3 |
| Opportunities | Constant demand | Economy | 5 |
| Opportunities | Constant demand | Economy | 12 |
| Opportunities | Constant demand | Economy | 13 |
| Opportunities | Constant demand | Economy | 14 |
| Opportunities | Low startup cost | Low startup cost | 5 |
| Opportunities | Low startup cost | Low startup cost | 12 |
| Opportunities | Low startup cost | Low startup cost | 13 |
| Opportunities | Low startup cost | Low startup cost | 14 |
| Opportunities | Implement the ecosystem approach to aquaculture (policy) | Within planetary boundaries | 12 |
| Opportunities | Implement the ecosystem approach to aquaculture (policy) | Within planetary boundaries | 13 |
| Opportunities | Implement the ecosystem approach to aquaculture (policy) | Within planetary boundaries | 14 |
| Opportunities | Stimulate local/rural ecomomies | Stimulate local/rural ecomomies | 5 |
| Opportunities | Stimulate local/rural ecomomies | Stimulate local/rural ecomomies | 12 |
| Opportunities | Stimulate local/rural ecomomies | Stimulate local/rural ecomomies | 13 |
| Opportunities | Stimulate local/rural ecomomies | Stimulate local/rural ecomomies | 14 |
| Opportunities | Adding value to seaweed products | Economy | 5 |
| Opportunities | Adding value to seaweed products | Economy | 12 |
| Opportunities | Adding value to seaweed products | Economy | 13 |
| Opportunities | Adding value to seaweed products | Economy | 14 |
| Opportunities | Rapid biomass increase | Rapid biomass increase | 5 |
| Opportunities | Rapid biomass increase | Rapid biomass increase | 12 |
| Opportunities | Rapid biomass increase | Rapid biomass increase | 13 |
| Opportunities | Rapid biomass increase | Rapid biomass increase | 14 |
| Opportunities | Reduce eutrophication | Reduce eutrophication | 5 |
| Opportunities | Reduce eutrophication | Reduce eutrophication | 12 |
| Opportunities | Reduce eutrophication | Reduce eutrophication | 13 |
| Opportunities | Reduce eutrophication | Reduce eutrophication | 14 |
| Opportunities | Reduce harmful algal blooms by seaweed cultivation | Reduce harmful algal blooms | 5 |
| Opportunities | Reduce harmful algal blooms by seaweed cultivation | Reduce harmful algal blooms | 12 |
| Opportunities | Reduce harmful algal blooms by seaweed cultivation | Reduce harmful algal blooms | 13 |
| Opportunities | Reduce harmful algal blooms by seaweed cultivation | Reduce harmful algal blooms | 14 |
| Opportunities | Provide habitat structure for other species (farming equipment) | Multiculture | 5 |
| Opportunities | Provide habitat structure for other species (farming equipment) | Multiculture | 12 |
| Opportunities | Provide habitat structure for other species (farming equipment) | Multiculture | 13 |
| Opportunities | Provide habitat structure for other species (farming equipment) | Multiculture | 14 |
| Opportunities | Non- fed aquaculture | Non-fed aquaculture | 12 |
| Opportunities | Non- fed aquaculture | Non-fed aquaculture | 13 |
| Opportunities | Non- fed aquaculture | Non-fed aquaculture | 14 |
| Opportunities | Stimulate local fish abundance | Stimulate local fish abundance | 12 |
| Opportunities | Stimulate local fish abundance | Stimulate local fish abundance | 13 |
| Opportunities | Stimulate local fish abundance | Stimulate local fish abundance | 14 |
| Opportunities | Prevent seashore erosion (farming equipment) | Prevent seashore erosion | 12 |
| Opportunities | Prevent seashore erosion (farming equipment) | Prevent seashore erosion | 13 |
| Opportunities | Prevent seashore erosion (farming equipment) | Prevent seashore erosion | 14 |
| Opportunities | Sustainable harvest | Sustainable harvest | 12 |
| Opportunities | Sustainable harvest | Sustainable harvest | 13 |
| Opportunities | Sustainable harvest | Sustainable harvest | 14 |
| Opportunities | Multisectoral production (e.g. on offshore wind farms) | Multisectorial production | 12 |
| Opportunities | Multisectoral production (e.g. on offshore wind farms) | Multisectorial production | 13 |
| Opportunities | Multisectoral production (e.g. on offshore wind farms) | Multisectorial production | 14 |
| Opportunities | Carbon sequestration | Environment and climate | 13 |
| Opportunities | Carbon sequestration | Environment and climate | 14 |
| Opportunities | Capture finite nutrients (such as Phosphourus) | Environment and climate | 13 |
| Opportunities | Capture finite nutrients (such as Phosphourus) | Environment and climate | 14 |
| Challenges | Nutrient variation between and within species | Species variation, nutrients | 1 |
| Challenges | Nutrient variation between and within species | Species variation, nutrients | 2 |
| Challenges | Nutrient variation between and within species | Species variation, nutrients | 3 |
| Challenges | Pollutants, toxins and microplastics | Species variation, contaminants | 1 |
| Challenges | Pollutants, toxins and microplastics | Species variation, contaminants | 2 |
| Challenges | Pollutants, toxins and microplastics | Species variation, contaminants | 3 |
| Challenges | Harmful algal blooms | Harmful algal blooms | 1 |
| Challenges | Harmful algal blooms | Harmful algal blooms | 2 |
| Challenges | Harmful algal blooms | Harmful algal blooms | 3 |
| Challenges | Disease outbreaks | Disease outbreaks | 1 |
| Challenges | Disease outbreaks | Disease outbreaks | 2 |
| Challenges | Disease outbreaks | Disease outbreaks | 3 |
| Challenges | Disease outbreaks | Disease outbreaks | 13 |
| Challenges | Disease outbreaks | Disease outbreaks | 14 |
| Challenges | Immature/missing policy and management | Management and policy | 1 |
| Challenges | Immature/missing policy and management | Management and policy | 2 |
| Challenges | Immature/missing policy and management | Management and policy | 3 |
| Challenges | Immature/missing policy and management | Management and policy | 13 |
| Challenges | Immature/missing policy and management | Management and policy | 14 |
| Challenges | Global expansion outside Asia | Scaling up | 1 |
| Challenges | Global expansion outside Asia | Scaling up | 2 |
| Challenges | Global expansion outside Asia | Scaling up | 3 |
| Challenges | Global expansion outside Asia | Scaling up | 13 |
| Challenges | Global expansion outside Asia | Scaling up | 14 |
| Challenges | Nutrient depletion from seaweed cultivation | Nutrient depletion | 1 |
| Challenges | Nutrient depletion from seaweed cultivation | Nutrient depletion | 2 |
| Challenges | Nutrient depletion from seaweed cultivation | Nutrient depletion | 3 |
| Challenges | Nutrient depletion from seaweed cultivation | Nutrient depletion | 13 |
| Challenges | Nutrient depletion from seaweed cultivation | Nutrient depletion | 14 |
| Challenges | Women's decision power in management and policy | Gender equality | 5 |
| Challenges | Consumer acceptance | Consumer acceptance | 12 |
| Challenges | Fluctuating price and market | Price and market | 12 |
| Challenges | Compromising nearshore wildlife habitats | Protection area | 12 |
| Challenges | Compromising nearshore wildlife habitats | Protection area | 13 |
| Challenges | Compromising nearshore wildlife habitats | Protection area | 14 |
| Challenges | Harmful algal blooms | Harmful algal blooms | 13 |
| Challenges | Harmful algal blooms | Harmful algal blooms | 14 |
| Challenges | Unsustainable harvest | Unsustainable harvest | 14 |
| Challenges | Loss of native seaweed stocks | Loss of species | 14 |
| Challenges | Algal drifts (acting as an invasive species) | Invasive species | 14 |
| Challenges | Seafloor shading detrimental to benthic ecosystems | Ecosystem | 14 |
| Challenges | Marine mammal entanglement | Ecosystem | 14 |
| Challenges | Seaweed sensitivity to ocean warming | Climate | 14 |
| Challenges | Breeding | Production | 14 |
| Challenges | Pathogen management | Production | 14 |

## Bivalves

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** | **Topic\_old** | **Topic** | **SDG** |
| Opportunities | Omega-3; vitamin B12; minerals | Nutrients and minerals | 2 |
| Opportunities | Omega-3; vitamin B12; minerals | Nutrients and minerals | 3 |
| Opportunities | Aquaculture expansion in the Global South | Expansion Global South | 1 |
| Opportunities | Aquaculture expansion in the Global South | Expansion Global South | 2 |
| Opportunities | Mitigate eutrophication; Increased microfaunal abundance and biodiversity | Mitigate eutrophication | 13 |
| Opportunities | Mitigate eutrophication; Increased microfaunal abundance and biodiversity | Mitigate eutrophication | 14 |
| Opportunities | Mitigate harmful algal blooms | Mitigiate harmful algal blooms | 3 |
| Opportunities | Mitigate harmful algal blooms | Mitigiate harmful algal blooms | 13 |
| Opportunities | Mitigate harmful algal blooms | Mitigiate harmful algal blooms | 14 |
| Opportunities | Adaptive planning sensitive to location; Species-specific adaptive planning | Location sensitive daptive planning | 14 |
| Opportunities | Capture and recycle finite nutrients | Capture and recycle finite nutrients | 2 |
| Opportunities | Capture and recycle finite nutrients | Capture and recycle finite nutrients | 12 |
| Opportunities | Capture and recycle finite nutrients | Capture and recycle finite nutrients | 13 |
| Opportunities | Include in multi-trophic aquaculture | Multi-trophic aquaculture | 12 |
| Opportunities | Co-culturing with fed species | Multi-trophic aquaculture | 13 |
| Opportunities | Use as fertilizer (shells) | Shells as fertilizer | 2 |
| Opportunities | Use as fertilizer (shells) | Shells as fertilizer | 12 |
| Opportunities | Use as poultry supplement (shells) | Recycle shell | 12 |
| Opportunities | Use as poultry supplement (shells) | Recycle shell | 14 |
| Opportunities | Low entry cost | Low entry cost | 1 |
| Opportunities | Low entry cost | Low entry cost | 2 |
| Opportunities | Low entry cost | Low entry cost | 5 |
| Opportunities | Implementing social challenges in policy | Implement social challenges in policy | 2 |
| Opportunities | Implementing social challenges in policy | Implement social challenges in policy | 5 |
| Opportunities | Implementing social challenges in policy | Implement social challenges in policy | 12 |
| Opportunities | Womens empowerment | Womens empowerment | 5 |
| Opportunities | Carbon sequestration; returning shells to the marine environment | Carbon sequestration | 12 |
| Opportunities | Carbon sequestration; returning shells to the marine environment | Carbon sequestration | 13 |
| Opportunities | Carbon sequestration; returning shells to the marine environment | Carbon sequestration | 14 |
| Challenges | Microplastics (from both production and packaging); Anthropogenic pollution (PAHs, pharmaceuticals, pesticides); Paralytic shellfish toxins; Variation in depuration rate (Intraspecies) | Pollutants and toxins | 3 |
| Challenges | Microplastics (from both production and packaging); Anthropogenic pollution (PAHs, pharmaceuticals, pesticides); Paralytic shellfish toxins; Variation in depuration rate (Intraspecies) | Pollutants and toxins | 14 |
| Challenges | Lacking robust policy; Certification not adapted to the Global South; Low adaptive capacity in bivalve aquaculture in the Global South | Poor local management | 2 |
| Challenges | Lacking robust policy; Certification not adapted to the Global South; Low adaptive capacity in bivalve aquaculture in the Global South | Poor local management | 5 |
| Challenges | Nutrient variation between species; Nutrient reduction from ocean acidification and warming | Nutrient variation | 2 |
| Challenges | Nutrient variation between species; Nutrient reduction from ocean acidification and warming | Nutrient variation | 3 |
| Challenges | Increased microdebris and human pathogen contamination from urbanization | Urbanization | 2 |
| Challenges | Increased microdebris and human pathogen contamination from urbanization | Urbanization | 14 |
| Challenges | Low edible yield of bivalves | Low edible yield | 2 |
| Challenges | Low edible yield of bivalves | Low edible yield | 3 |
| Challenges | Low edible yield of bivalves | Low edible yield | 12 |
| Challenges | Shell waste and valorization | Biproduct valorisation | 12 |
| Challenges | Women's decision power in management and policy | Womens decision power | 2 |
| Challenges | Women's decision power in management and policy | Womens decision power | 5 |
| Challenges | Women's decision power in management and policy | Womens decision power | 12 |
| Challenges | Loss of knowledge on traditional production | Loss of traditional knowledge | 2 |
| Challenges | Loss of knowledge on traditional production | Loss of traditional knowledge | 3 |
| Challenges | Loss of knowledge on traditional production | Loss of traditional knowledge | 12 |
| Challenges | Loss of knowledge on traditional production | Loss of traditional knowledge | 14 |
| Challenges | Low species diversity in aquaculture | Low species diversity | 2 |
| Challenges | Low species diversity in aquaculture | Low species diversity | 3 |
| Challenges | Low species diversity in aquaculture | Low species diversity | 12 |
| Challenges | Low species diversity in aquaculture | Low species diversity | 14 |
| Challenges | Introduction of non-native species | Non-native species | 14 |
| Challenges | Mass-mortality outbreaks | Mass-mortality outbreaks | 1 |
| Challenges | Mass-mortality outbreaks | Mass-mortality outbreaks | 2 |
| Challenges | Mass-mortality outbreaks | Mass-mortality outbreaks | 3 |
| Challenges | Mass-mortality outbreaks | Mass-mortality outbreaks | 14 |
| Challenges | Global market share of large producers | Large producers in global market | 1 |
| Challenges | Global market share of large producers | Large producers in global market | 2 |
| Challenges | Global market share of large producers | Large producers in global market | 5 |
| Challenges | Global market share of large producers | Large producers in global market | 12 |
| Challenges | Depletion of bethic ecosystems (bivalve excrements); Loss of shells as structural components in the marine environment | Depletion benthic ecosystems | 2 |
| Challenges | Depletion of bethic ecosystems (bivalve excrements); Loss of shells as structural components in the marine environment | Depletion benthic ecosystems | 3 |
| Challenges | Depletion of bethic ecosystems (bivalve excrements); Loss of shells as structural components in the marine environment | Depletion benthic ecosystems | 12 |
| Challenges | Depletion of bethic ecosystems (bivalve excrements); Loss of shells as structural components in the marine environment | Depletion benthic ecosystems | 14 |
| Challenges | Marine mammal entanglement (farming equipment) | Marine mammal entangelment | 14 |
| Challenges | Occupance of ocean space | Ocean space competition | 2 |
| Challenges | Occupance of ocean space | Ocean space competition | 3 |
| Challenges | Occupance of ocean space | Ocean space competition | 14 |
| Challenges | Loss of suitable ocean space due to climate change; More frequent mass mortalities due to climate change; Certain species will outperform others in future climate scenarios; Sensory changes in bivalves from ocean acidification | Climate change affect productivitiy | 2 |
| Challenges | Loss of suitable ocean space due to climate change; More frequent mass mortalities due to climate change; Certain species will outperform others in future climate scenarios; Sensory changes in bivalves from ocean acidification | Climate change affect productivitiy | 3 |
| Challenges | Loss of suitable ocean space due to climate change; More frequent mass mortalities due to climate change; Certain species will outperform others in future climate scenarios; Sensory changes in bivalves from ocean acidification | Climate change affect productivitiy | 13 |
| Challenges | Loss of suitable ocean space due to climate change; More frequent mass mortalities due to climate change; Certain species will outperform others in future climate scenarios; Sensory changes in bivalves from ocean acidification | Climate change affect productivitiy | 14 |

## Tuna

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** | **Topic\_old** | **Topic** | **SDG** |
| Opportunity | Distant water fleets and transhipment | Distant water fleets & transhipment | 1 |
| Opportunity | Distant water fleets and transhipment | Distant water fleets & transhipment | 5 |
| Opportunity | Distant water fleets and transhipment | Distant water fleets & transhipment | 12 |
| Opportunity | Tuna canning (food and local employment) | Tuna canning | 1 |
| Opportunity | Tuna canning (food and local employment) | Tuna canning | 2 |
| Opportunity | Tuna canning (food and local employment) | Tuna canning | 3 |
| Opportunity | Tuna canning (food and local employment) | Tuna canning | 5 |
| Opportunity | Tuna canning (food and local employment) | Tuna canning | 12 |
| Opportunity | Improve traditional processing methods | Improve processing methods | 1 |
| Opportunity | Improve traditional processing methods | Improve processing methods | 3 |
| Opportunity | Improve traditional processing methods | Improve processing methods | 5 |
| Opportunity | Improve traditional processing methods | Improve processing methods | 12 |
| Opportunity | Improve traditional processing methods | Improve processing methods | 13 |
| Opportunity | Retain non-targeted tunas locally | Retain non-targeted tunas locally | 2 |
| Opportunity | Retain non-targeted tunas locally | Retain non-targeted tunas locally | 3 |
| Opportunity | Retain non-targeted tunas locally | Retain non-targeted tunas locally | 5 |
| Opportunity | Proteins & Nutrients | Proteins & Nutrients | 2 |
| Opportunity | Proteins & Nutrients | Proteins & Nutrients | 3 |
| Opportunity | Use tuna trimmings in fishmeal | Reallocate tuna to boost local FS | 2 |
| Opportunity | Use tuna trimmings in fishmeal | Reallocate tuna to boost local FS | 3 |
| Opportunity | Reallocate tuna resources to boost local food security (PICTs) | Reallocate tuna to boost local FS | 2 |
| Opportunity | Reallocate tuna resources to boost local food security (PICTs) | Reallocate tuna to boost local FS | 3 |
| Opportunity | Major source of income for 50% of people in PICTs | Major source of income | 5 |
| Opportunity | Major source of income for 50% of people in PICTs | Major source of income | 12 |
| Opportunity | Area Closures and fish aggregating devices benefiting SSFs | Area Closures and FADs | 5 |
| Opportunity | Area Closures and fish aggregating devices benefiting SSFs | Area Closures and FADs | 14 |
| Opportunity | Certification of tuna (MSC, Fair trade etc) | Certification of tuna | 5 |
| Opportunity | Certification of tuna (MSC, Fair trade etc) | Certification of tuna | 12 |
| Opportunity | Certification of tuna (MSC, Fair trade etc) | Certification of tuna | 13 |
| Opportunity | Certification of tuna (MSC, Fair trade etc) | Certification of tuna | 14 |
| Opportunity | Increase intersectoral collaboration | Adapt tuna policy & collaboration | 12 |
| Opportunity | Adapt tuna policy at country basis | Adapt tuna policy & collaboration | 13 |
| Opportunity | Adapt tuna policy at country basis | Adapt tuna policy & collaboration | 14 |
| Opportunity | Increase tuna fisheries monitoring, research and capacity building | Monitor & manage fisheries & climate | 13 |
| Opportunity | Increase tuna fisheries monitoring, research and capacity building | Monitor & manage fisheries & climate | 14 |
| Opportunity | Refine climate assessment models and tools for future projections | Monitor & manage fisheries & climate | 13 |
| Opportunity | Refine climate assessment models and tools for future projections | Monitor & manage fisheries & climate | 14 |
| Opportunity | Implementing maximum sustainable yield strategy | Monitor & manage fisheries & climate | 14 |
| Opportunity | Geographic shifts in tuna populations | Monitor & manage fisheries & climate | 13 |
| Opportunity | Geographic shifts in tuna populations | Monitor & manage fisheries & climate | 14 |
| Opportunity | Strengthen climate resilience strategies | Monitor & manage fisheries & climate | 13 |
| Opportunity | Lower wild-fish input in aquafeed | Lower wild-fish input in aquafeed | 14 |
| Challenge | Food waste (bycatch, onboard waste, waste during processing) | Food waste | 1 |
| Challenge | Food waste (bycatch, onboard waste, waste during processing) | Food waste | 2 |
| Challenge | Large-scale tuna processors (market & price) | Large-scale processors dominate | 1 |
| Challenge | Large-scale tuna processors (market & price) | Large-scale processors dominate | 5 |
| Challenge | Large-scale tuna processors (market & price) | Large-scale processors dominate | 12 |
| Challenge | Unstable catch rates | Unstable catch rates | 1 |
| Challenge | Unstable catch rates | Unstable catch rates | 2 |
| Challenge | Unstable catch rates | Unstable catch rates | 3 |
| Challenge | Unstable catch rates | Unstable catch rates | 5 |
| Challenge | Population growth (PICTs) | Population growth | 1 |
| Challenge | Population growth (PICTs) | Population growth | 2 |
| Challenge | Population growth (PICTs) | Population growth | 3 |
| Challenge | Population growth (PICTs) | Population growth | 12 |
| Challenge | Population growth (PICTs) | Population growth | 13 |
| Challenge | Population growth (PICTs) | Population growth | 14 |
| Challenge | Allocation of more subsidies to the industrial sector (vs SSF) | Inbalance in subsidies towards industry | 1 |
| Challenge | Allocation of more subsidies to the industrial sector (vs SSF) | Inbalance in subsidies towards industry | 5 |
| Challenge | Allocation of more subsidies to the industrial sector (vs SSF) | Inbalance in subsidies towards industry | 14 |
| Challenge | The blue economy paradox (jointly achieve sustainability and economic growth) | Sustainability & economic growth | 1 |
| Challenge | The blue economy paradox (jointly achieve sustainability and economic growth) | Sustainability & economic growth | 2 |
| Challenge | The blue economy paradox (jointly achieve sustainability and economic growth) | Sustainability & economic growth | 3 |
| Challenge | The blue economy paradox (jointly achieve sustainability and economic growth) | Sustainability & economic growth | 5 |
| Challenge | The blue economy paradox (jointly achieve sustainability and economic growth) | Sustainability & economic growth | 12 |
| Challenge | The blue economy paradox (jointly achieve sustainability and economic growth) | Sustainability & economic growth | 13 |
| Challenge | The blue economy paradox (jointly achieve sustainability and economic growth) | Sustainability & economic growth | 14 |
| Challenge | Pollutants, toxins and microplastics | Obesity, diseases, pollutant & toxins | 3 |
| Challenge | Obesity, non-communicable diseases in PICTs | Obesity, diseases, pollutant & toxins | 3 |
| Challenge | Management trade-offs between sectors | Manage sectoral trade-offs | 1 |
| Challenge | Management trade-offs between sectors | Manage sectoral trade-offs | 2 |
| Challenge | Management trade-offs between sectors | Manage sectoral trade-offs | 3 |
| Challenge | Management trade-offs between sectors | Manage sectoral trade-offs | 5 |
| Challenge | Management trade-offs between sectors | Manage sectoral trade-offs | 12 |
| Challenge | Management trade-offs between sectors | Manage sectoral trade-offs | 13 |
| Challenge | Management trade-offs between sectors | Manage sectoral trade-offs | 14 |
| Challenge | Transshipment (lost employment days, catches and revenue) | Transshipment: loss of jobs & revenue | 1 |
| Challenge | Transshipment (lost employment days, catches and revenue) | Transshipment: loss of jobs & revenue | 5 |
| Challenge | Transshipment (lost employment days, catches and revenue) | Transshipment: loss of jobs & revenue | 14 |
| Challenge | Recapture more likely for industrial vessels | More recapture for industrial vessels | 1 |
| Challenge | Recapture more likely for industrial vessels | Recapture more likely for industrial vessels | 5 |
| Challenge | Recapture more likely for industrial vessels | Recapture more likely for industrial vessels | 14 |
| Challenge | Food security missing in policy | Food security missing in policy | 2 |
| Challenge | Food security missing in policy | Food security missing in policy | 3 |
| Challenge | Reduced local tuna availability and access (PICTs) | Geographic shifts & reduced tuna catches | 1 |
| Challenge | Reduced local tuna availability and access (PICTs) | Geographic shifts & reduced tuna catches | 2 |
| Challenge | Reduced local tuna availability and access (PICTs) | Geographic shifts & reduced tuna catches | 3 |
| Challenge | Reduced local tuna availability and access (PICTs) | Geographic shifts & reduced tuna catches | 5 |
| Challenge | Reduced local tuna availability and access (PICTs) | Geographic shifts & reduced tuna catches | 14 |
| Challenge | Geographic shifts in tuna populations | Geographic shifts & reduced tuna catches | 13 |
| Challenge | Geographic shifts in tuna populations | Geographic shifts & reduced tuna catches | 14 |
| Challenge | Reduced catches due to climate change | Geographic shifts & reduced tuna catches | 13 |
| Challenge | Economic aspects (revenue) take priority in policy | Profit takes priority in policy | 1 |
| Challenge | Economic aspects (revenue) take priority in policy | Profit takes priority in policy | 2 |
| Challenge | Economic aspects (revenue) take priority in policy | Profit takes priority in policy | 3 |
| Challenge | Economic aspects (revenue) take priority in policy | Profit takes priority in policy | 5 |
| Challenge | Economic aspects (revenue) take priority in policy | Profit takes priority in policy | 12 |
| Challenge | Economic aspects (revenue) take priority in policy | Profit takes priority in policy | 13 |
| Challenge | Economic aspects (revenue) take priority in policy | Profit takes priority in policy | 14 |
| Challenge | Inability to adopt certification schemes in the Global South | Inability to adopt certification schemes in the Global South | 13 |
| Challenge | Inability to adopt certification schemes in the Global South | Inability to adopt certification schemes in the Global South | 14 |
| Challenge | Tuna resource management informed by distant water nations (in PICTs) | Tuna management steered by distant water nations | 13 |
| Challenge | Tuna resource management informed by distant water nations (in PICTs) | Tuna management steered by distant water nations | 14 |
| Challenge | Illegal, unregulated and undocumented fishing | IUU fishing & Tuna ranching | 14 |
| Challenge | Tuna ranching | IUU fishing & Tuna ranching | 14 |
| Challenge | Environmental footprint of species for luxury markets | Overexploitation & ecological footprint | 14 |
| Challenge | Overexploitation of tuna stocks | Overexploitation & ecological footprint | 14 |
| Challenge | Aquatic ecosystem disruptions due to extensive harvest | Overexploitation & ecological footprint | 14 |