

Ecosystem Approach to Fisheries Management

Managing fisheries and ecosystem interactions for social, economic and environmental benefits

LME: LEARN
POLICY BRIEF

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Context and importance of the problem

The majority of the world's fisheries are over exploited with the ecosystems that sustain them becoming increasingly degraded. Maintaining productive and sustainable fisheries is essential to feeding the planet's growing population while also supporting local livelihoods and commercial industries.

The most productive and accessible regions of the world's marine fisheries are Large Marine Ecosystems (LME) that join the land and the open ocean. Management of these expansive and diverse ecosystems and the fisheries they support requires effective cooperation between neighbouring and regional countries.

Box 1: Principles of EAFM

Fisheries should be managed to limit their impacts on the ecosystem to the extent possible taking in consideration the following:

1. Ecological relationships between harvested, dependent and associated species should be maintained
2. Management measures should be compatible across the entire distribution of the resources, which includes across jurisdictions and management plans
3. The precautionary approach should be applied because the knowledge on ecosystems is incomplete
4. Governance should ensure both human and ecosystem wellbeing and integrity (Garcia, 2003).





Figure 1: Fisheries management needs to consider the components of the ecosystem and their interactions. Source: Adapted from FAO EAF Nansen Project.

The Ecosystem Approach to Fisheries Management (EAFM) expands on fisheries management to include additional ecosystem considerations (Figure 1). This is proving successful at the LME scale when implemented through coordinated partnership between national bodies and managed at a regional-scale. The EAFM brings a more effective and holistic management approach to address the sustainability of fisheries, essentially focusing on the ecosystem rather than a particular target species. EAFM looks at the bigger picture and recognises that fish and fisheries are part of a broader ecosystem that includes where fish live as well as the people who benefit from catching, trading and eating fish.

World fisheries (marine and freshwater) supplied 170 million tonnes of wild caught and aquaculture-sourced fish and invertebrates in 2016 (Figure 2). The global consumption of caught fisheries food has increased from 20 million tonnes in 1950 to over 90 million tonnes in 2016 (FAO 2018). The global catch tonnage has plateaued since the early 1990s at around 90 million tonnes with aquaculture now providing near-equal supplies (80 million tonnes in 2016). Increasingly intense fishing pressures on target species results in stock numbers falling to unviable commercial levels. This is then followed by fishing down the food web to satisfy consumption and commercial demands. Over-exploitation across multiple trophic levels combined with environmentally damaging fishing practices, such as bottom trawling, results in a damaged environments that are less and less able to support productive fisheries. Taking an ecosystem approach to fisheries management therefore makes a lot of sense as does the cooperation between fishing industries. As the lifecycle needs and natural ranges of many target species are found across national borders, management at the LME scale ensures that a wholistic approach to maintaining a functional ecosystem is taken.

When managing fishery and aquaculture industries, decisions made to maximise the productivity of the whole industry are difficult and complex. This is especially true when environmental and fisheries objectives are perceived as different. EAFM allows strategic management decisions to be made that are coordinated under a productive and healthy LME. This is true both between species-specific fisheries industries and across national borders for the benefit of all. To successfully manage national fisheries and fish stocks into the future an EAFM approach at an LME level offers benefits for both environment and fishery management.

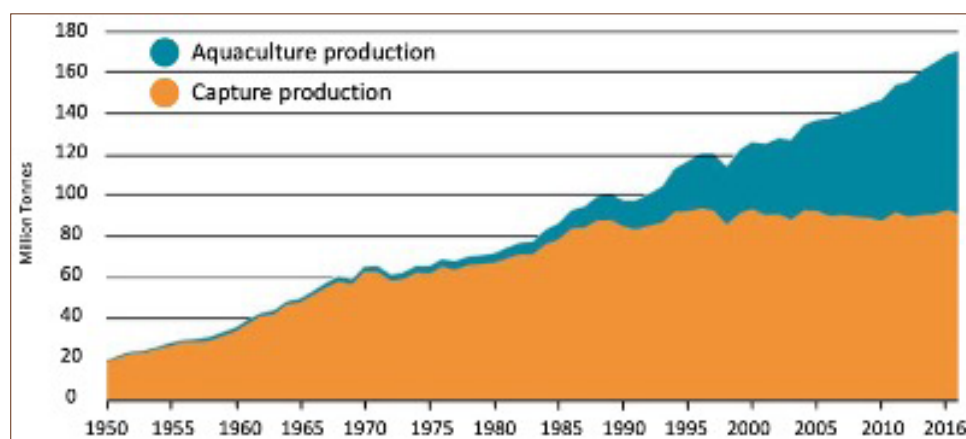


Figure 2: World capture fisheries and aquaculture production (adapted from: FAO, 2018) (note: excludes aquatic mammals, crocodiles, alligators and caimans, seaweeds and other aquatic plants).

Critique of Policy Options

EAFM breaks from conventional fisheries management which has not been very sustainable in many parts of the world and is unable to sustainably satisfy the increasing demand for ocean-based protein.

This is especially the case in multi-species/multi-gear tropical fisheries. Many existing marine management approaches and tools, such as Marine Spatial Planning (MSP), Marine Protected Areas (MPA), Coastal Resource Management (CRM), Integrated Coastal Zone Management (ICZM), and fisheries refugia are based on the “ecosystem approach” concept but were developed in parallel by different user groups with their own management interests. These approaches share many of the same principles and have many commonalities but the management focus or coverage can be different. The main differences relate primarily to the target for management (e.g. coastal resources vs. fisheries). From an EAFM perspective, some can be considered as management tools (e.g. MSP and MPA). The EAFM approach is especially suited in addressing fisheries resource and fisheries governance issues such as overcapacity, overfishing, illegal, unreported and unregulated fishing and use of destructive gears in a multi-user, multi-sectoral context.

Conventional fisheries management versus an ecosystem approach

Conventional fisheries management often deals with a limited set of threats and issues and often the cause of the problem is not addressed. Decision making is often guided by target species stock assessment, a process not well suited to multi-species, multi-gear fisheries and not factoring in influences from other users and sectors. Existing fisheries management may be conventional fisheries management (depending on the country or area) or may have adopted some aspects of EAFM, but still also have some aspects of conventional management. The reality is that fisheries often span multiple geographical jurisdictions. At the larger scale, fisheries may be transboundary and involve two or more countries in its management. At the national level, fisheries often straddle two or more provinces and/or districts and require cooperation and coordination of rules and regulations as well as in developing networks for monitoring and enforcement.

Taking an ecosystem approach to fisheries (EAF) uses an awareness of species and trophic interactions. This allows for simultaneous efforts to maintain ecosystems in good health while harvesting the vast resource of living marine creatures (Cury *et al.* 2016). As such, EAFM represents a move away from fisheries management that focuses on target species, towards a decision-making processes that balance environmental, human and social well-being. In order to achieve these, effective governance and improved management frameworks are often needed. Systems-thinking approach of EAFM can operate as a stand-alone policy or form part of a wider policy of Ecosystem Approach to Marine Management (EAMM).

Managing Fisheries as part of the Ecosystem

Implementing EAFM requires fisheries and environmental targets and goals to be set in partnership between sectoral agencies. In order for EAFM to be implemented at the LME level, the coordinated development of these goals between agencies within different jurisdictions is needed. EAFM is highly suited for adoption in national policy with the EAFM framework developed on the founding principles and conceptual goals emerging from sustainable development and is aimed at both human and ecosystem wellbeing (Connolly 2008).

EAFM can be used to evaluate, adapt, and enhance existing fisheries management plans as well as other types of natural resource management plans (e.g. coastal resource management) to make them more holistic and to encourage co-management. EAFM is a management approach developed specifically for fisheries and will complement many other management tools and approaches (MSP, CRM, ICZM).

Lastly, EAFM should engage both wild catch and aquaculture industries with aquaculture playing a larger and larger role in satisfying global demand for seafood (Figure 2). Global aquaculture is expected to grow over the next decade, accounting for about 60% of global seafood consumption (FAO 2018), and an EAFM allows sustainable practices in both wild catch and aquaculture industries to be maintained. As well as EAF the FAO has developed the ecosystem approach to aquaculture (EAA). This brings a wider framework

for the planning, development and management of sustainable fisheries and aquaculture, taking into consideration the effects of other sectors on fisheries and aquaculture and the effects of fisheries and aquaculture on the ecosystem. Effective integration of aquaculture, wild-catch and environmental concerns has been demonstrated at the LME level using Integrated Multi-Trophic Aquaculture (IMTA), as presented in Box 1 and Figure 3. This strengthens EAFM and ensures both fishery industry and environmental management are considered alongside one another.

Box 2: IMTA to reduce fishing pressures for EAFM implementation

With the support of the GEF International Waters, Integrated Multi-Trophic Aquaculture (IMTA) has been implemented in the Yellow Sea, as well as other Large Marine Ecosystems, on an economically viable and sustainable path for blue and green growth. IMTA utilises species from different trophic levels being grown together in a way that not only produces food but also ensures that nutrients arising from fish farms are recycled naturally. IMTA not only closes the nutrient loop but also sequesters carbon and increases the incomes of coastal communities. IMTA makes economic, social and environmental sense. The Yellow Sea Fisheries Research Institute (YSFRI) of the Chinese Academy of Fishery Sciences found that the total annual value per hectare of kelp and abalone grown through IMTA is 3-4 times higher than the combined value of producing kelp and scallop as individual monocultures. Other studies of IMTA in areas beyond the Yellow Sea by the Republic of Korea's National Institute of Fishery Science (NIFS) on IMTA showed that sea cucumber grew 2.7 times faster, the survival rate of Korean rockfish increased by 33.4% (from 56.8% to 90.5%) and no fish disease was recorded compared to a 40% rate of disease in rockfish monocultures (GEF IW:LEARN 2018).

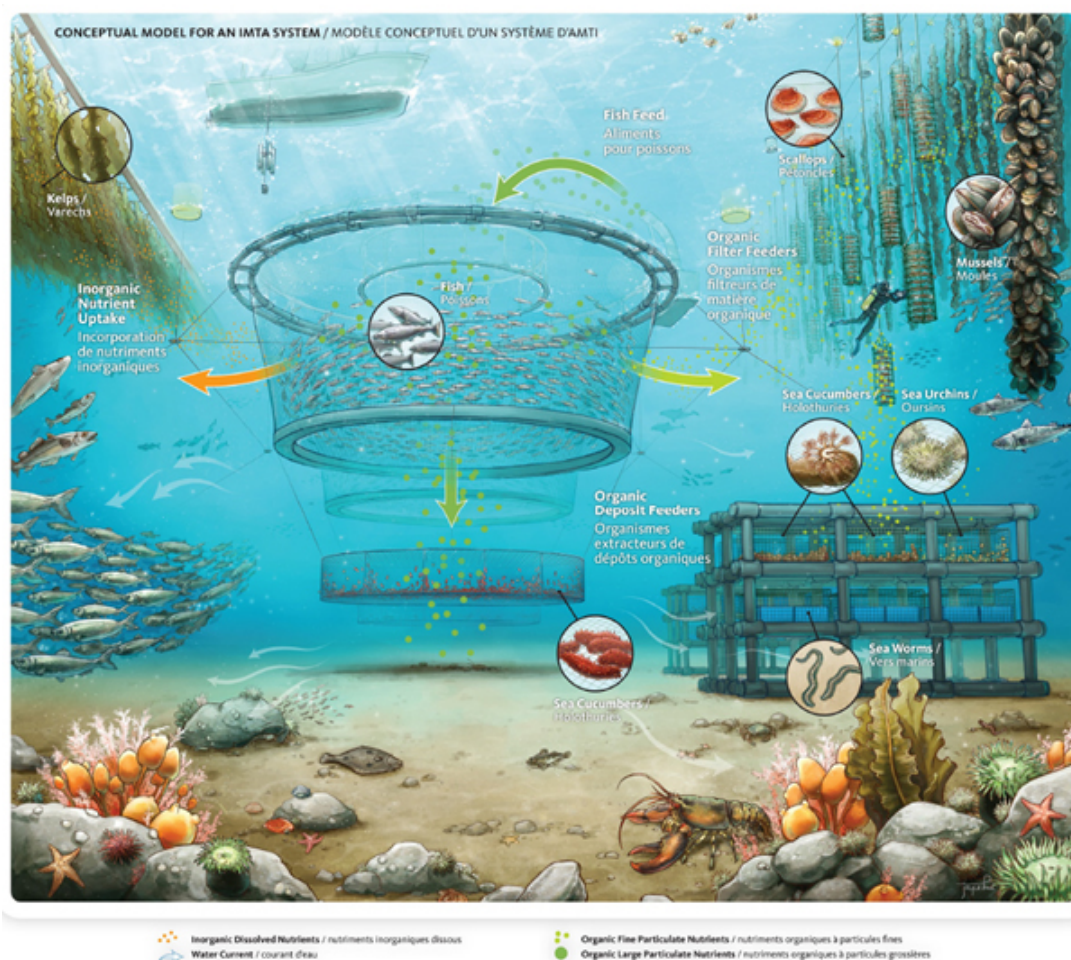


Figure 3:
A conceptual model of the IMTA system (source: Fisheries and Oceans Canada 2013)

Implementing EAFM

Implementing EAFM at an LME scale allows for both international and intranational coordination on fisheries and ecosystems. Importantly, EAFM builds on what is already in place:

- Builds on / improves existing management
- Strengthens agencies through better planning and cooperation
- Builds on and integrates co-management and other participatory approaches
- Uses traditional and scientific knowledge that already exists
- Improves human capacity in skills needed for sustainable management.

EAFM is an opportunity to improve the implementation of international treaties such as the FAO Code of Conduct for Responsible Fisheries, the United Nations Convention on the Law of the Sea, the Convention on Biological Diversity and the Ramsar Convention (Garcia 2003). Full ratification of existing treaties should be discussed as part of strengthening co-ordination between the bilateral or regional fisheries management and regional cooperation provides the opportunity to tailor them to regional guidelines. Creating a regional or LME Commission is recommended as this provides National Governments with a joint-platform to exchange domestic legislation and harmonise them to meet agreed-to regional standards.

Policy Recommendations

EAFM requires national leadership for policy development and a regional commitment to collaboration and implementation. This regional cooperation where the LME is shared between two or more countries is an essential part of the planning stage.

Effective EAFM and the benefits it offers (Box 1) can be developed using the following policy recommendations to help bring in EAFM effectively at a national and regional level:

- Identify the appropriate scale for EAFM and the suitable levels and processes at which management is applied. This will take into account the nature of the fishery and the people involved, as well as the issues being addressed. This can cover political, geographic, socioeconomic, and temporal scales. In many cases the LME boundary provides an ideal scale to identify who should be involved for effective regional EAFM design and implementation.
- Bring together the relevant agencies and stakeholders for both the EAFM design and implementation phases. These will be specific to the chosen scale but should include: Ministry of Fisheries, Ministry of Environment, Provincial Government, Local Government, industry associations (both wild catch and aquaculture), local fishing communities, local environmental groups, international/regional/local NGOs, development organizations, regional projects and research institutions.
- Facilitate active cooperation and coordination between the agency and stakeholder partners to ensure effective vertical and horizontal cooperation. Vertical cooperation is from the central state agencies down to the local levels. Horizontal cooperation is between the Ministry of Fisheries and Ministry of Environment within each country and between regional partners as well as across local, regional and international sectors and agencies. Cooperation and coordination should be at face-to-face regional meetings comprising working groups that integrate fisheries and environmental management and result in a concrete Management Plan as an output.

- Address multiple objectives in parallel. This approach takes account of the various objectives of different stakeholders and considers trade-offs. It also strives to balance the multiple, often conflicting, objectives relating to human and ecological well-being. A comprehensive and explicit consideration of all key components of a fishery or aquaculture system (ecological, social, economic and governance) as well as external drivers (e.g. climate change) should be made.
- Take a precautionary approach to deal with uncertainty or risk without delaying action because of a lack of full information and being risk averse. Existing knowledge on fisheries and the environment should be integrated by drawing on the vertical and horizontal cooperation and coordination across the LME, or chosen scale. Decision-making should be based on “best available knowledge”, including both scientific and traditional knowledge, with promotion of risk assessment and risk management, and recognition that in the absence of detailed scientific knowledge decisions must still be taken.
- Adopt good governance through agreement on the process for developing rules and regulations. These should ensure sustainable management of fisheries and the ecosystem and ensuring their compliance through a participatory process of agency and stakeholder partners that improves acceptance, transparency and accountability.
- Embrace adaptive management as a cyclical, iterative and systematic process for continually improving management. This process should include mechanisms for feedback loops at different time scales to adjust the management plan based on past and present observations and experiences.

Case Study: The Yellow Sea



Figure 4:
The Yellow Sea LME is a productive shallow sea that covers 400,000 km²

The Yellow Sea, shared by the People's Republic of China and the Republic of Korea (Figure 4), have implemented EAFM in an effort to restore fish stocks in the LME. This UNDP/GEF project on sustainable use of the fish populations has included EAFM approaches such as restoring spawning and nursery grounds and setting up marine protected areas alongside pressure reduction measures such as through controlled fishing seasons and fishing boat buyback schemes. The inclusion of aquaculture within an effort to reduce fishing pressures has been successful in satisfying increasing demand for seafood. However, this resulted in negative environmental impacts because standard monoculture fish farming releases large amounts of organic waste from uneaten fish food and fish faeces into surrounding environments which can cause eutrophication or dead zones where no aquatic life are able to survive. This is where the ecosystem

approach offers a part towards sustainability and not shifting the problem. The EAFM approach was adapted to remedy this to include an ecosystem-based management approach for aquaculture in the Yellow Sea, termed integrated multi-trophic aquaculture (IMTA) methodology.

Policy to develop EAFM can also encourage a diversification of aquaculture species and industries while at the same time reducing the environmentally harmful outputs of aquaculture waste. In recognition of a lower fisheries yield, during the fish stock recovery period under EAFM, the People's Republic of China and the Republic of Korea implemented newly developed mariculture technology (IMTA) in the annual production of shellfish (molluscs) and marine benthic invertebrates (sea cucumbers). This preserved the ecosystem functions of the Yellow Sea and its ecosystem carrying capacity while satisfying the demand for seafood and supporting local industries. Informed by science, the optimal ecosystem conditions were determined and regional ecosystem objectives were set down. This then formed a basis for developing regional targets and the further management actions. By implementing those management actions, regional targets will be met and environmental stress will be reduced. Eleven tangible regional targets were identified to maintain the ecosystem's capacity to provide the four ecosystem services (provisioning, regulating, cultural and supporting) to the region and beyond. It provides adaptive ecosystem-based management actions to reach these targets. Increasing responsible aquaculture production can alleviate fisheries pressures as part of EAFM, allowing targeted species and the environment to recover from degradation and be managed sustainably. Adjacent land-based management includes a joint commitment to reduce nutrient discharges to the Yellow Sea by 10% every five years through enhanced wastewater treatment and the reduction of fertilizer use and industrial discharges.

This LME offers a good example of effective management structure and implementation that is required to operate at the ecosystem level (Figure 5).

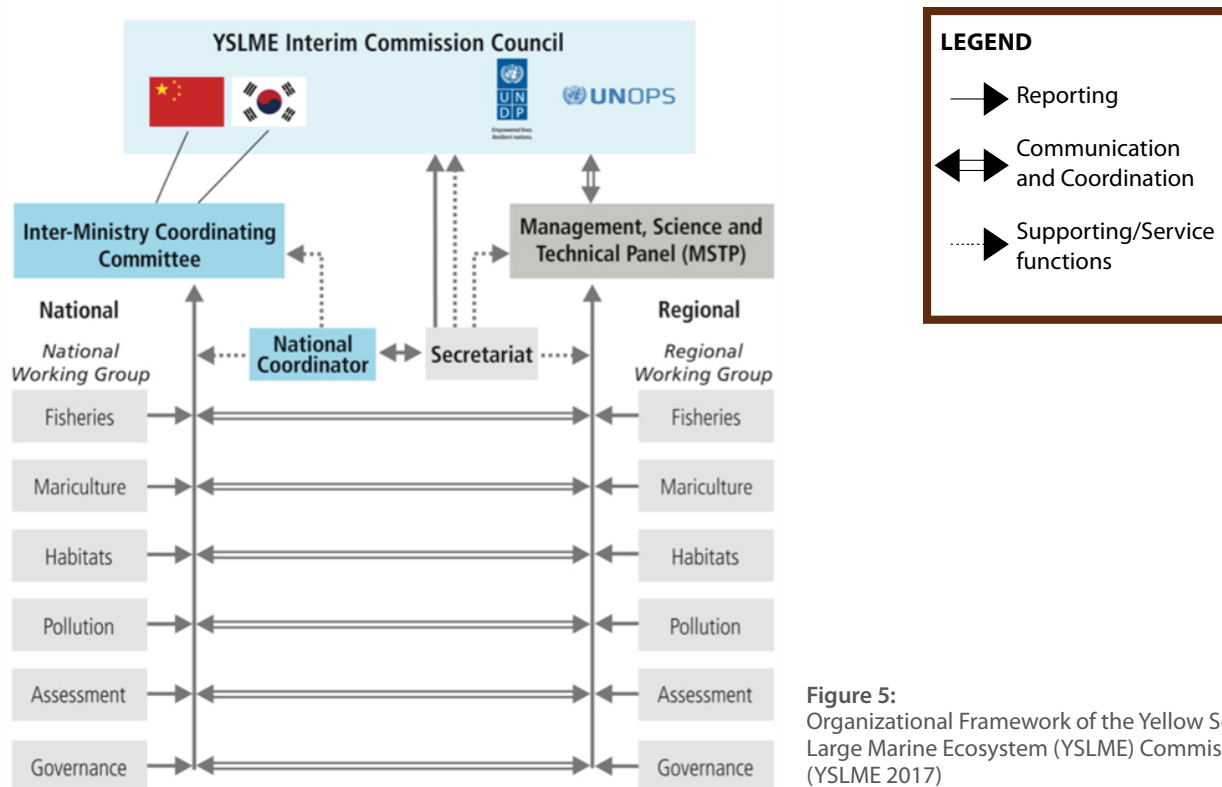


Figure 5: Organizational Framework of the Yellow Sea Large Marine Ecosystem (YSLME) Commission (YSLME 2017)

Regional cooperation in the Yellow Sea is facilitated by through the Inter-ministry Coordinating Committee which co-ordinates national activities among relevant national ministries and institutions. This has ensured coordinated implementation of national efforts in line with regional EAFM directions and objectives. The National Working Groups are responsible for the design and implementation of management actions at the national level. The regionally focused Management, Science and Technical Panel provides the Regional Working Groups with managerial, scientific, and technical guidance and the Interim Commission Council with managerial, scientific, and technical advice. The working groups plan, co-ordinate and manage project activities at a regional level under the respective areas of Fish Stocks, Sustainable Mariculture, Habitat Conservation, Pollution Reduction, Monitoring and Assessment, and Governance. Each is responsible for the status of their topic, identifying issues, developing strategies and engaging relevant

stakeholders. The overarching goal of each group is to use expert knowledge and skills within their specific competencies to improve the ecosystem carrying capacity of the Yellow Sea. Each group has their own Terms of Reference which outlines specific objectives and tasks. It is this integrated and bidirectional communication and coordination at the regional and national levels that ensures effective EAFM in the YSLME. Management decisions that affect fisheries, the broader ecosystem and habitats, and the people who benefit from harvesting, trading and eating fish require such a regional and coordinated approach

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GEF LME:LEARN

GEF LME: LEARN is a program to improve global ecosystem-based governance of Large Marine Ecosystems and their coasts by generating knowledge, building capacity, harnessing public and private partners and supporting south-to-south learning and north-to-south learning. A key element of this improved governance is main-streaming cooperation between LME, MPA, and ICM projects in overlapping areas, both for GEF projects and for non-GEF projects. This Full-scale project plans to achieve a multiplier effect using demonstrations of learning tools and toolboxes, to aid practitioners and other key stakeholders, in conducting and learning from GEF projects. This global project is funded by the Global Environmental Facility (GEF), implemented by the United Nations Development Programme (UNDP), and executed by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization. The GEF LME:LEARN's Project Coordination Unit (PCU) is headquartered at UNESCO-IOC's offices in Paris.

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