

Seas of Sustenance: Navigating 'Blue Food' for Indo-Pacific Food Security

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Introduction

Blue food' refers to seafood and other food derived from aquatic resources; in the Indo-Pacific region, surrounded by rich water bodies, the concept takes on particular cultural, economic, and ecological significance. Culturally, seafood holds deep-rooted traditions and is integral to the culinary heritage of coastal communities. Marine resources contribute to the region's economy through fishing, aquaculture, and related industries. Seafood is a rich source of essential nutrients like protein and omega-3 fatty acids and plays a vital role in ensuring food security and nutrition in coastal areas. Blue food also emphasises harnessing the potential of the region's marine resources and ecosystems to address the Sustainable Development Goals (SDGs) related to gender equality, no poverty, zero hunger, decent work, and reduced inequalities.¹ However, this would require a comprehensive approach integrating sustainable practices, technological innovations, and collaborative efforts among nations. The goal is to leverage the maritime environment to develop solutions that not only address the challenges posed by climate change but also ensure resilient and secure food supply for the diverse nations of the Indo-Pacific.

Sustainable development and food security are urgent global issues, especially in the Indo-Pacific region, where socioeconomic inequality, changing climate patterns, and population growth present massive obstacles.² The convergence of factors such as the rapidly growing population, complex geopolitics, economic disparities, and environmental degradation³ has led to food security and sustainable development becoming a priority in the region.⁴

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The Indo-Pacific is home to over half of the world's population, and this population is expected to grow remarkably in the next decades.⁵ This growing population is putting tremendous strain on food supplies.⁶ Further, crop yields are threatened by rising temperatures, shifting rainfall patterns, and the increasing frequency of extreme weather events, which disrupt agricultural operations. Food security is further threatened by protracted droughts, floods, and cyclones, which can cause crop failures and damage vital infrastructure.⁷ Pollution, overfishing, habitat loss, and deforestation are additional drivers of environmental degradation, jeopardising biodiversity and ecosystem health and impacting the availability of natural resources required for human survival and food production. Water scarcity is also emerging as a problem affecting both the agricultural and non-agricultural sectors in the region.⁸

In this context, the maritime resources of the Indo-Pacific hold significant potential for sustainable development.⁹ Blue food highlights the importance of marine-based food sources to enhance food security; blue economy promotes sustainable practices to harness marine resources for economic growth, job creation, and trade; and blue finance underscores the need for financial mechanisms to support sustainable blue initiatives and for investments in maritime sectors for long-term environmental and economic benefits.

The region's rich marine ecosystems can therefore be leveraged to address food security, foster economic development, and promote financial instruments to manage and protect the marine environment. Achieving a balance between economic growth and environmental conservation is vital for a sustainable future. Blue economy not only secures the availability of food from the oceans but also nurtures the planet's delicate ecosystems. This report conducts a literature review to examine how blue economy based on blue foods can contribute to food security and environmental sustainability. This paper derives from a previous publication on food security concerns across the Indo-Pacific.¹⁰

The Economy of Blue Food: Scope and Features

Blue foods are among the most highly traded food products globally,¹¹ playing a critical role in ensuring global food and nutrition security and providing livelihoods for millions of people. Approximately three billion people rely on blue foods for nearly 20 percent of their animal protein, and 10-12 percent of the global population depends on fishing for their livelihood.¹² The blue economy is centred on utilising resources from the ocean in order to ensure economic growth, social well-being, and environmental preservation. It involves adopting science-based management practices to ensure that marine resources are harvested at levels that allow for regeneration, safeguarding fish populations, and preserving the biodiversity of oceans. Blue economy also promotes sustainable seafood production to meet the dietary requirements of a growing global population while reducing the environmental impact of land-based protein sources.

Blue economy focuses on the relationship between people and the environment, particularly in coastal areas.¹³ While humans have lived near and depended on the ocean for thousands of years, blue economy seeks to integrate the ocean into every aspect of the economy, from the small-scale level to the national, to create an effective sustainable development strategy.

The blue economy, valued at US\$1.5 billion as of 2010, is projected to grow to US\$2.5-3 trillion by 2030.^{14,15} In the Least Developed Countries and Small Island Developing States, blue economy is viewed as a viable option to alleviate poverty as well as to aid blue recovery from the COVID-19 pandemic.¹⁶ The African Union's Agenda 2063 regards the blue economy as the "new frontier of African renaissance".¹⁷

There has also been exponential growth in the past decade in various marine sectors such as seafood, which is the fastest growing food industry, and coastal tourism, the fastest growing tourism sector.¹⁸ Shipping accounts for 80 percent of global trade, while 70 percent of new oil and gas discoveries are offshore.¹⁹ More than 1.3 million km² of the seabed in Areas Beyond National Jurisdiction (ABNJ) is currently licensed for deep-sea mining (DSM) exploration.²⁰ Although this blue acceleration is focused on creating favourable conditions and new opportunities for a sustainable blue economy, climate change and rapidly changing geopolitics pose several risks for coastal communities.

The Role of Blue Food in the SDGs

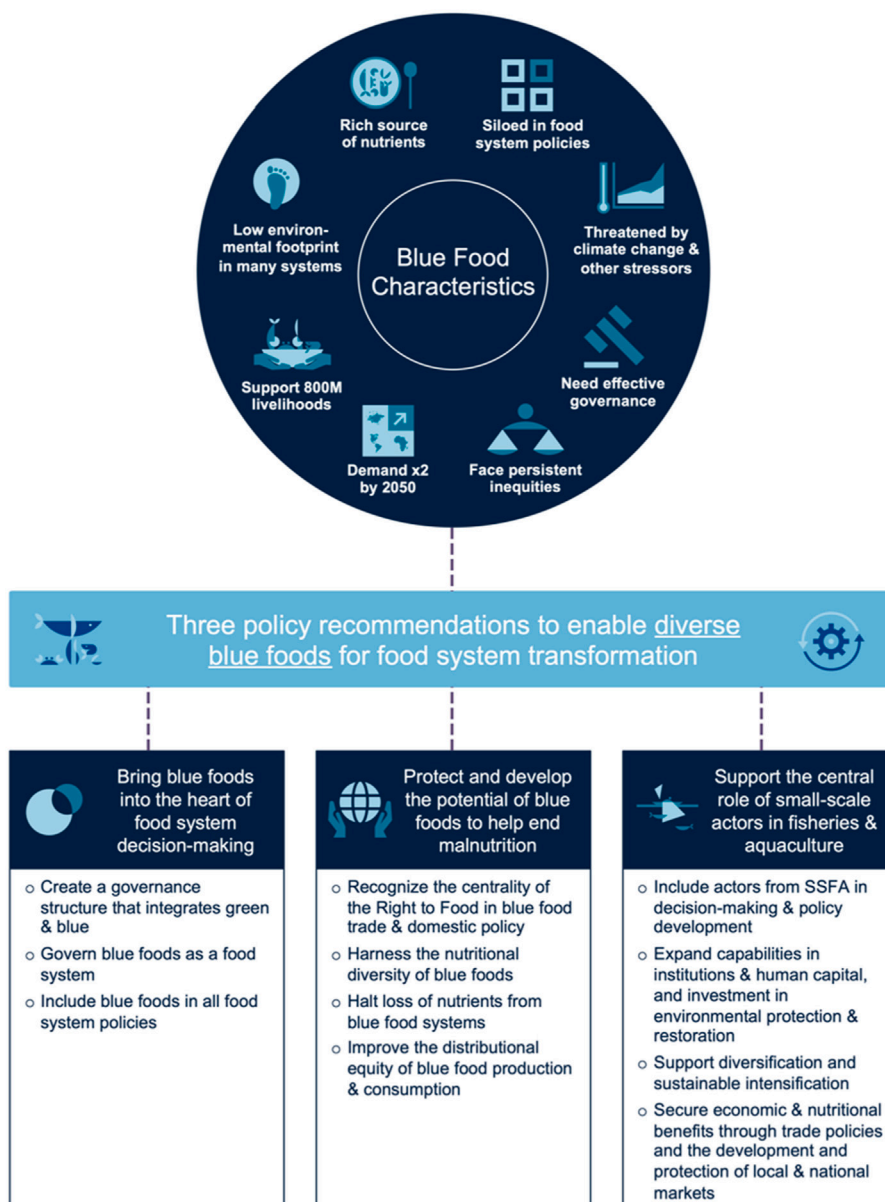
Blue foods can help achieve the no-poverty and zero-hunger SDGs by supporting a sustainable and equitable food system. Blue foods are rich in micronutrients and animal protein, which can help reduce infant and maternal mortality and improve cognitive function (SDG 2: Zero Hunger, SDG 3: Good Health and Well Being). Blue food can also enhance sustainable food production with low greenhouse gas (GHG) emissions (SDG 12: Responsible Consumption, SDG 14: Life under Water, SDG 15: Life on Land) and support livelihood for small-scale farmers (SDG 1: No Poverty, SDG 8: Decent Work and Economic Growth, SDG 10: Reduced Inequalities).^{21,22}

Seafood, algae, and other aquatic organisms are nutritious and sustainable sources of food²³ and can contribute to diversifying global food supply, reducing pressure on traditional land-based agriculture, and ensuring a more resilient global food system. The sustainability of blue food is rooted in the capacity of marine ecosystems to regenerate, if managed responsibly. Moreover, it aligns with sustainable fisheries and aquaculture practices, promoting biodiversity conservation and minimising negative environmental impacts.²⁴

In addition to being essential for billions of people's food and nutrition security,^a blue foods are fundamental to the livelihoods, economies, and cultures of many riparian and coastal communities. Compared to foods derived from terrestrial animals, blue foods are diverse, rich in important micronutrients and fatty acids, and can be produced by using environmentally friendly methods. Therefore, they can contribute to food system transformation (see Figure 1). Thus, preserving the integrity and diversity of aquatic species and ecosystems requires acknowledging the significance of blue foods for food and nutrition security.

a Reliable access to a sufficient quantity of affordable, nutritious food.

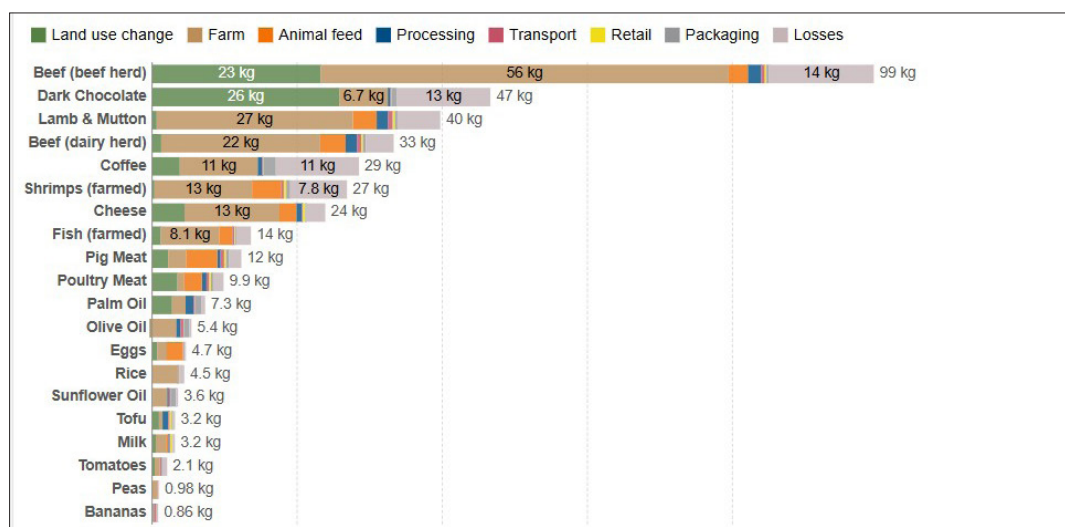
Figure 1: Role of Blue Food in the Global Food System



Source: Tigchelaar et al. (2022)²⁵

The rapid population growth in the Indo-Pacific region has increased the pressure on food resources. Efforts to reduce hunger in the region have also slowed in the past few years, with the number of undernourished people increasing by 26 million people in 2020 and 2021.²⁶ In 2021, the region had 396 million people living without enough food, with the majority (331.6 million people) in South Asia. According to the Food and Agriculture Organization (FAO), as of 2022, about 460 million people in the region were living with severe food insecurity, while another 586 million were living with moderate food insecurity.²⁷

Figure 2: GHG Emissions Across the Supply Chain from Foods



Source: Suri and Ray (2022)²⁸

As illustrated in Figure 2, there are significant differences in the GHG emissions for blue foods and red meats. While farmed shrimps emit 27 kg CO₂eq per kg of food, fish farming emits 14 kg CO₂eq. On the other hand, beef from a beef herd has emissions of 99 kg CO₂eq, primarily due to land use change and farming practices, making it one of the highest emitters. Lamb and mutton follow, with 40 kg CO₂eq, and beef from a dairy herd emits 33 kg CO₂eq. Poultry meat emits 9.9 kg CO₂eq, while pig meat emits 12 kg CO₂eq. Blue foods have a much lower environmental footprint compared to red meats like beef and lamb, making them the more sustainable option. Blue foods also have competitive or lower emissions to pork and poultry. These differences highlight the potential of blue foods to contribute to more sustainable food systems, especially given the increasing global demand for protein sources and the urgent need to mitigate climate change impacts.

Blue Food Initiatives in the Indo-Pacific

Blue food initiatives in the Indo-Pacific region have gained traction due to the region’s rich marine resources and growing awareness of sustainable food production. Table 1 highlights some successful initiatives and diverse approaches adopted by countries in the Indo-Pacific to promote sustainable blue food production and the conservation of marine resources.

Table 1: Successful Blue Food Initiatives in the Indo-Pacific

Country and Initiative	Key Elements
Indonesia’s Blue Economy Initiative ²⁹	Indonesia has implemented various policies and programmes to promote sustainable fisheries and develop sustainable aquaculture practices, conduct marine spatial planning to protect marine ecosystems, and promote responsible fishing practices among local communities.
Australia’s Marine Stewardship Council (MSC) Certification ³⁰	Many Australian fisheries have obtained MSC certification, indicating their adherence to sustainable fishing practices. This certification not only ensures the sustainability of fish stocks but also helps promote these products in international markets.
Marine Protected Areas (MPAs) in the Pacific Islands ³¹	Several Pacific Island nations have established MPAs to conserve marine biodiversity and promote sustainable fisheries. These MPAs protect critical habitats and support local communities through sustainable fishing practices and ecotourism.
Aquaculture Development in Vietnam ³²	Vietnam has seen significant growth in sustainable aquaculture, especially in shrimp and fish farming. The adoption of best practices, such as improved feed management and water quality monitoring, has helped reduce environmental impacts while boosting production.
India’s Blue Revolution ³³	India launched the Blue Revolution initiative to enhance sustainable aquaculture and fisheries management. This includes promoting the adoption of technology in aquaculture, improving infrastructure for fish processing and storage, and implementing policies to curb illegal fishing practices.

Source: Authors’ own

Blue Finance: Unlocking the Potential of Blue Food Across the Food Value Chain

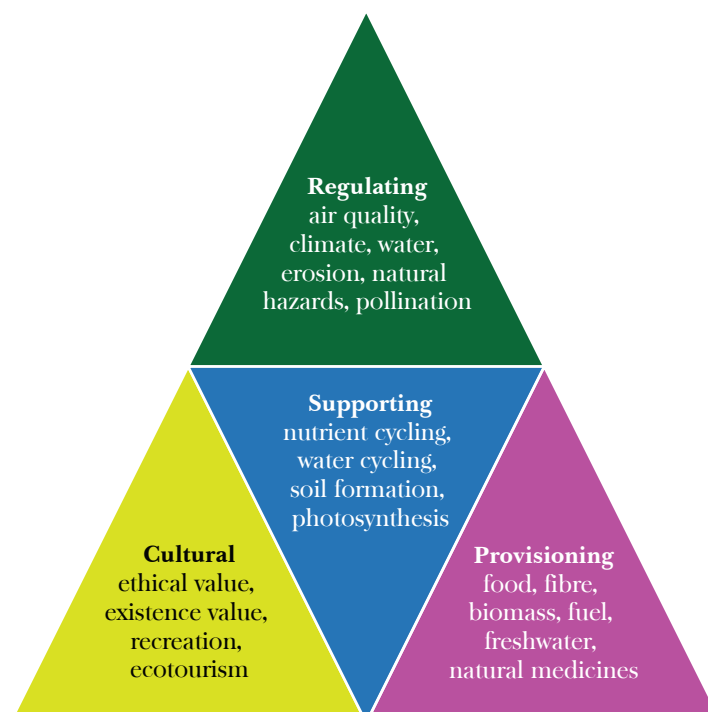
Blue finance is a strategic approach aimed at harnessing the potential of blue foods throughout the food value chain, from production to consumption, thus promoting sustainability, resilience, and prosperity in coastal and marine ecosystems while meeting the growing demand for nutritious and environmentally friendly food sources.³⁴ This financial mechanism plays a pivotal role in promoting sustainable practices, driving economic growth, and ensuring the long-term viability of marine resources. One of its primary focuses is on aquaculture, with investments directed towards adopting advanced technologies like recirculating aquaculture systems (RAS) and integrated farming practices,³⁵ which boost productivity and minimise environmental impact by optimising resource utilisation and reducing waste. Sustainable aquaculture practices can ease the pressure on wild fish stocks and mitigate the environmental impacts of food production.³⁶ Promoting responsible aquaculture and fisheries management can ensure the long-term viability of aquatic resources and protect marine ecosystems.

By leveraging technology and innovation in the production, processing, and distribution of blue foods, stakeholders across the food value chain can unlock new opportunities for growth and development. By harnessing the nutritional, economic, and environmental advantages of blue foods, it is possible to create a more resilient and sustainable food system that promotes human health, economic development, and environmental conservation.

Ecosystem Approach to Aquaculture

The ecosystem services framework categorises the benefits of ecosystems into four main categories: provisioning, supporting, regulating, and cultural services³⁷ (see Figure 3). These services are interconnected and highlight the role of aquaculture within ecosystems and human societies.

Figure 3: The Millennium Ecosystem



Source: Millennium Ecosystem Assessment³⁸

- **Provisioning services:** Aquaculture directly provides food in the form of fish and shellfish and supports livelihoods for millions of people worldwide. In coastal areas, small-scale fish farms provide income and employment opportunities for local communities.
- **Supporting services:** Aquaculture systems, such as oyster reefs and fish ponds, can serve as habitat for various species, contributing to biodiversity maintenance. They can also help cycle nutrients such as nitrogen and phosphorus within ecosystems, which benefits water quality and supports natural productivity.
- **Regulating services:** Water quality improvement through Integrated Multi-Trophic Aquaculture (IMTA) utilises species that can improve water quality by consuming excess nutrients or pollutants. Properly managed aquaculture systems can reduce the spread of diseases by implementing biosecurity measures and sustainable stocking densities.
- **Cultural services:** Aquaculture is often deeply rooted in cultural traditions and practices. For example, pearl farming has cultural significance in many regions and is tied to local identities. Activities such as ecotourism around fish farms and visits to aquaculture-based cultural sites could also enhance the recreational and aesthetic experiences of communities and visitors.

The effective management of aquaculture involves balancing these services to ensure sustainability, biodiversity conservation, and socio-economic benefits for communities.

Table 2 highlights some blue finance capital types and investment models.³⁹ Examples from the Indo-Pacific showcase diverse blue finance initiatives that catalyse sustainable growth, conservation, and social impact in the blue food sector.

Table 2: Blue Finance Capital Types and Investment Models

Type of Capital and Sources		
Type of Capital	Process	Initiatives
Equity Financing	Raising funds by selling shares of ownership in aquaculture or fisheries enterprises. Investors receive dividends or capital gains based on the company's performance.	A venture capital firm invests in a sustainable shrimp farming startup in Indonesia, expecting returns from the company's growth and profitability. ⁴⁰
Debt Financing	Loans, bonds, and other debt instruments to fund blue food projects. Financial institutions provide capital that must be repaid with interest over time.	A development bank offers a low-interest loan to a fish processing facility in the Philippines to upgrade its infrastructure and expand operations. ⁴¹
Grants and Subsidies	Governments, NGOs, and international organisations offer grants and subsidies to support initiatives that promote sustainability, innovation, and social impact in the blue food sector.	A marine conservation organisation provides a grant to a community-based aquaculture project in Fiji to implement eco-friendly practices and improve livelihoods. ⁴²
Impact Investment	Investing capital with the intention of generating positive social and environmental impact alongside financial returns. Impact investors support projects that address challenges such as overfishing, habitat degradation, and poverty alleviation.	An impact investment fund invests in a sustainable tuna fishery in Papua New Guinea, aiming to improve fishing practices, conserve marine resources, and empower local communities. ⁴³
Crowdfunding	Blue finance leverages crowdfunding platforms to raise capital from individual investors, often in exchange for rewards or equity. Crowdfunding campaigns can support aquaculture startups, conservation projects, and community initiatives.	A crowdfunding campaign raises funds for a coral reef restoration project in Thailand, engaging donors globally to contribute to marine conservation efforts. ⁴⁴

Investment Models		
Type of Investment Model	Process	Initiative
Public-Private Partnerships (PPPs)	Collaboration between government entities, private sector companies, and sometimes NGOs to finance and manage blue food projects.	A PPP in Malaysia establishes a sustainable aquaculture zone with government support for infrastructure development, private sector investment in farming operations, and NGO involvement in environmental monitoring and community engagement. ⁴⁵
Supply Chain Financing	Financial support to actors along the blue food supply chain, from producers to processors to distributors.	A seafood retailer in Singapore offers financing options to small-scale fishers in Indonesia, enabling them to access markets, improve product quality, and receive fair prices for their catch. ⁴⁶
Green Bonds	Financial instruments used to raise capital for environmentally friendly projects, including those in the blue food sector. Investors purchase bonds, and the proceeds fund initiatives such as sustainable aquaculture, marine conservation, and climate-resilient fisheries.	A green bond issuance finances a mangrove restoration and sustainable aquaculture project in the Philippines, attracting investments from institutional investors committed to environmental sustainability. ⁴⁷
Blended Finance	Combines public and private sector capital to address financing gaps and mobilise investment for the SDGs.	A blended finance facility in Indonesia supports small-scale fishers by providing concessional loans, technical assistance, and market linkages, leveraging both public funding and private sector investments to promote inclusive and environmentally responsible fisheries. ⁴⁸

Source: Authors' own

Challenges to Adopting Blue Food for Food Security

Adopting blue food to achieve food security has several challenges. For one, overfishing and illegal, unreported, and unregulated (IUU) fishing are exacerbating the decline of fish stocks and ecosystem degradation⁴⁹ by undermining fisheries management and sustainability efforts. Rising sea temperatures, ocean acidification, extreme weather events, and sea-level rise are also disrupting fisheries, aquaculture operations, and coastal communities. Pollution from land-based sources, including plastic waste, agricultural runoff, and industrial pollutants, also contributes to marine pollution and habitat degradation, which affects water quality, marine biodiversity, and the health of aquatic species. Limited infrastructure, inadequate technology, and access to market facilities further hinder the efficiency and competitiveness of blue food value chains. Increasing demand for marine resources in the Indo-Pacific region could lead to resource competition and conflicts among stakeholders, including fishers, aquaculture operators, coastal communities, and industrial sectors. Lastly, coastal communities and small-scale fishers are vulnerable to socioeconomic challenges, including poverty, food insecurity, lack of alternative livelihoods, and social inequities.⁵⁰

Therefore, implementing pollution control measures, promoting sustainable land-use practices, and enhancing waste management are essential to safeguard blue food environments, necessitating a holistic approach that integrates environmental sustainability, social equity, economic resilience, and cultural considerations in blue food governance and management strategies across the Indo-Pacific.

Policy Interventions to Promote Blue Food

Policy interventions in the Indo-Pacific to promote blue food for food security involve a combination of regulatory measures, incentives, and strategic planning.

Establishing a Robust Regulatory Framework

Nurturing sustainable blue food production in the Indo-Pacific region requires a comprehensive regulatory framework. Governments should prioritise the development of policies that support sustainable fisheries management, marine conservation, and responsible aquaculture practices. This includes setting clear guidelines for fishing quotas, protecting critical marine habitats, and enforcing measures to combat IUU fishing. Additionally, governments should invest in research and innovation to advance aquaculture technologies, ensuring the long-term sustainability and health of marine resources.


Providing Incentives and Building Capacity

There is a need to create a supportive financial and educational environment that encourages sustainable practices. Financial incentives such as grants, low-interest loans, and subsidies should be offered to projects that demonstrate a commitment to sustainability and innovation within the blue food sector. For instance, development banks could provide concessional loans to aquaculture projects that adopt ecofriendly practices, and impact investors could support fisheries that aim to improve environmental stewardship and social equity. These financial mechanisms can lower the entry barriers for small-scale fishers and aquaculture operators, promoting broader participation and investment in sustainable blue food production.

Capacity building is equally crucial to empower local communities and stakeholders with the skills and knowledge necessary to thrive on a livelihood based on blue foods. This can be achieved through extensive training programmes, technical assistance, and educational initiatives tailored to the needs of the blue food sector. For example, workshops on sustainable fishing practices, aquaculture management, and marine conservation can enhance the expertise of fishers and aquaculture farmers, enabling them to adopt and implement best practices. Additionally, partnerships between the government, NGOs, and educational institutions can facilitate the dissemination of knowledge and technology, fostering a more informed and capable workforce that can drive the blue economy forward.

Promoting Market Development and Environmental Sustainability

Developing markets for blue foods is vital for ensuring economic viability and long-term sustainability. Policymakers should focus on creating market opportunities for blue food products by supporting infrastructure development, improving access to markets, and promoting the nutritional and environmental benefits of blue foods. Initiatives such as the issuance of blue bonds can attract investments dedicated to funding marine and ocean-based projects. Additionally, environmental sustainability should be at the core of market development strategies, ensuring that blue food production minimises ecological footprints and supports the regeneration of marine ecosystems.

By focusing on these three key areas, policymakers can create a conducive environment for the growth of the blue food ecosystem in the Indo-Pacific towards contributing to enhanced food security and sustainable development in the region. 

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