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Ensuring marine fish in food systems sustainability – A roadmap for India

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Background

Food systems from marine and coastal environment will play a crucial role in our sustainable future, encompassing various activities related to everything from production to consumption, and have far-reaching outcomes related to nutrition, public health, food security, social and economic prosperity, and environmental sustainability. Marine and coastal food systems are in a way very important to achieving multiple Sustainable Development Goals (SDGs) such as poverty (Goal 1), hunger (Goal 2), good health and well-being (Goal 3), decent work and economic growth (Goal 8), reduced inequalities (Goal 10), responsible consumption and production (Goal 12), climate action (Goal 13), life below water (Goal 14), and partnerships for the goals (Goal 17).

Key roles of marine and coastal food systems

The key roles of marine and coastal food systems in shaping a sustainable future include:

- **Providing healthy and affordable protein:** Sea foods are rich in protein, vitamins, minerals, and healthy fats, making them an important source of nutrition. They are also relatively affordable, particularly for low-income populations.
- **Supporting livelihoods**: The culture and capture marine fisheries sectors offer employment opportunities for millions of people worldwide. They contribute to economic growth and poverty reduction, especially in coastal communities.
- **Protecting the environment:** Sustainable management of marine and coastal food systems can help conserve fish stocks and minimize pollution. The environment can be safeguarded by implementing responsible marine fishing practices and sustainable mariculture methods.
- **Building resilience:** marine and coastal food systems can be more resilient to various challenges, such as climate change and economic downturns. Diversifying production, improving infrastructure, and enhancing capacity can enhance resilience.
- **Economic powerhouse and reducing inequalities:** The culture and capture marine fisheries contribute significantly to the global economy and have the potential to reduce inequalities. These sectors provide income and employment opportunities for marginalized groups, including women and youth.

Recognizing the importance of these systems in achieving sustainable development goals is crucial, as they play a vital role in ensuring food security, promoting good health, and supporting economic prosperity. We can harness their potential for a more equitable and resilient future by managing marine and coastal food systems sustainably and fostering inclusive practices.

Challenges in marine/ coastal food systems

Marine and coastal food systems play a critical role in global food security and nutrition, providing protein and essential nutrients to billions of people. However, these systems are threatened by

overfishing, pollution, and climate change, jeopardizing their sustainability and ability to meet the needs of a growing population.

- **Overfishing**: Depletion of fish stocks due to excessive fishing, leading to the collapse of populations and negative impacts on local communities.
- **Pollution**: Contamination of aquatic habitats from agricultural runoff, industrial waste, and sewage, rendering them unsuitable for marine life and making fish unsafe to consume.
- **Climate change**: Changes in ocean temperatures and acidity affecting fish growth and reproduction, as well as the spread of invasive species that compete with native fish for resources.
- **Illegal, unreported, and unregulated (IUU) fishing**: Illegally catching fish without permits or reporting, contributing to overfishing, depletion of stocks, and loss of income for legitimate fishers.
- **Market access challenges**: Difficulties faced by aquatic food producers in accessing markets due to high transportation costs, trade barriers, and lack of market information.
- **Inequitable access to resources**: Unequal distribution of resources such as finance, technology, and training, hindering the adoption of sustainable practices and productivity improvement.
- **Social and environmental impacts**: Negative consequences of aquatic food production, including pollution, habitat destruction, and displacement of local communities.
- **Weak enforcement of regulations**: Ineffective enforcement of regulations, often due to limited resources, corruption, or lack of political will, resulting in unsustainable practices.
- **Inadequate data and information**: Insufficient data availability on fish stocks, fishing efforts, and environmental conditions, hampering informed decision-making for effective management.

Marine and coastal fisheries roadmap for India

Despite their inherent challenges, India's marine and coastal food systems possess immense potential to drive a sustainable and equitable global food system. A compelling illustration of this lies in the example below. Being tropical marine fisheries, India has an astonishing array of fish species exceeding 750 in number on an average, representing a rich and biodiverse resource. However, most of these species still need to be explored and utilized, presenting a unique opportunity for innovative exploration and sustainable harvesting practices. Table 1 illustrates the approximate percentage of tropical fish species that comprise the global fisheries catch.

Table 1 shows the approximate percentage of tropical fish species that make up the global fisheries catch.

Group	Species in India		World Diversity (approx.)	% India
	Marine	1,936		
	Fresh water	892		
	Brackish water	132		

Finfish*	Fresh water - Brackish water- Marine	197	35,797	8.90
	Total	3,157		
Crustaceans	Marine	2,439	47,000	6.26
	Fresh water	504		
	Total	2,943		
Molluscs	Marine	3,827	85,000	6.50
	Fresh water	1700		
	Total	5,527		
Echinoderms	765		7,000	10.93
Sponges	493		5,000-10,000	-
Seaweeds	844		20,000	4.22
*Besides 3,157 species, -470 exotic finfish species are also reported from Indian waters				

We only use a few diverse species available in India's capture fisheries. Table 2 shows the probable percentage of biodiversity of marine harvest fisheries in India.

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Groups	**No. of Species**		**% of Total Species Diversity**
	Total No.	**Commercially Exploited**	
Finfish (Elasmobranchs, Teleosts incl. Ornamental)	1936	1211	62.55
Crustaceans	2439	94	3.85
Molluscs	3827	95	2.49
Echinoderms*	765	32	3.10
Sponges*	486	-41	8.44
Seaweeds	844	60	7.11
*Many species under Indian Wildlife Protection Act			

India's average annual fish production stands at around 3.5 million metric tons (MMT), but there still needs to be more potential in utilizing unconventional and underutilized resources. The community structure of fish species has undergone significant changes in recent years, and this presents an opportunity for deep-sea fisheries, specifically mesopelagic fisheries. Table 3 illustrates the potential

harvestable yield of Indian marine fisheries, highlighting some of the major resources from the deep sea that can contribute sustainably to India's marine fisheries.

Table 3 shows some of the major identified resources which can contribute to Indian marine fisheries from the deep sea

Deep Sea Resources		
Groups	**Estimated Potential**	**Estimated Value (Rs)**
Oceanic Squid (*Sthenoteuthis oualaniensis*)	0.63MMT	8000 Million
Oceanic Tuna	0.213 MMT	35000 Million
Tuna like Fishes	33,000 T	6000 Million
Mesopelagic Fishes	1.7 MMT	
Ribbon Fish (*Trichiurus auriga*)	0.3 MMT	

Strategies for transforming marine and coastal food systems

In order to achieve the Sustainable Development Goals (SDGs) through the transformation of marine and coastal food systems, key strategies include:

1. Sustainable management and governance to protect fish stocks and aquatic biodiversity.
2. Climate-resilient aquaculture techniques to adapt to climate change and reduce environmental impact.
3. Harnessing innovation and technology for improved practices in fisheries and aquaculture.
4. Building inclusive value chains to support small-scale fishers and marginalized communities.
5. Promoting sustainable seafood consumption through awareness campaigns and traceability systems.

Implementing these strategies will contribute to a sustainable, equitable, resilient aquatic food system aligned with the SDGs.

Charting the future of marine and coastal food systems for sustainable development

Marine and coastal food systems are critical for global food security and livelihoods, addressing malnutrition, poverty, inequity, and climate crises. Interlinked with the Sustainable Development Goals, they offer pathways to poverty reduction, improved health, and climate change mitigation. However, these systems face environmental and socio-economic pressures, including overfishing, pollution, climate change, and governance issues. Urgent transformation is needed to secure a sustainable and equitable global system. This requires sustainable management, climate-resilient aquaculture, technology adoption, inclusive value chains, and responsible consumption. A paradigm shift is necessary, recognizing aquatic foods as vital ecosystem components. Collaboration among stakeholders is crucial for policy alignment and equitable development. The transformation aims to create resilient, sustainable, and equitable systems, nourishing a growing population and benefiting

society, the economy, and the planet. It is a necessity, demanding collective action, innovation, and commitment. The health of people, the economy, and the planet is intertwined with the health of marine and coastal food systems. Acting now will ensure a thriving future for all.

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Management of Moisture Stress in Brinjal under Tropical Island Ecosystem

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In Andaman and Nicobar islands, vegetables crops are cultivated during post monsoon period (Nov – May) and experience severe water stress during reproductive stages. Under this context, the field experiments were conducted to study the effect of moisture stress management practices on growth, yield attributes and yield of brinjal (CIARI Brinjal 2) during dry periods (Oct-Mar) of 2022 and 2023. The experiment was laid out in strip plot design with three horizontal treatments (Surface irrigation+residue mulch, Drip+plastic mulch, Sub-surface drip irrigation) and four vertical treatments (Hydrogel, hydrogel + K spray, hydrogel + Ca spray, hydrogel + K & Ca spray) in three replications. The irrigation was given through drip, subsurface drip and surface irrigation. Pusa hydrogel was applied through seedling dipping. The fertilizer was given as per the recommended dose (200: 100:100 NPK kg/ha). Foliar spray of Potassium Nitrate, Calcium Nitrate was done at flowering and 15 days after the first spray. In Okra, drip irrigation with plastic mulching recorded maximum no. of fruits (10.6), fruit weight (67.8 g) which resulted in higher yield (717 g/plant, 11.2 t/ha) followed by sub-surface drip irrigation. Application of hydrogel + K & Ca foliar spray recorded maximum no. of fruits (10.5), fruit weight (67.1 g) which resulted in higher yield (709 g/plant, 11.1 t/ha) and at par with hydrogel + K spray. Higher relative leaf water content (56.2 %) and total chlorophyll (2.47 mg g-1) and lesser membrane stability index (40.4) and proline content (4.51 (µmol/g.fw) were recorded in drip irrigation +plastic mulching. Similarly, higher relative leaf water content (55.2 %) and total chlorophyll (2.43 mg g-1) and lesser membrane stability index (41.4) and proline content (4.43 (µmol/g.fw) were recorded in hydrogel + foliar spray of K & Ca. Higher water use efficiency (325 kg/ha-cm) was observed in drip irrigation + plastic mulch. The maximum net return (₹4,60,200) was recorded in drip irrigation + plastic mulch which was followed by sub-surface drip irrigation. Similarly, maximum net return (₹4,70,133) was recorded in the treatments which received hydrogel + foliar spray of K & Ca. Hence, it can be concluded that drip irrigation + mulching, application of hydrogel and foliar spray of K and Ca is best option to mitigate the moisture stress in brinjal under island condition.

Keywords: Moisture stress, drip irrigation, mulching, foliar spray and brinjal.

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Unveiling the Present Status and Potential of Post Harvest Management of Horticultural Crops in India

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