

MarineFuture 2025: Aquaculture and Marine Ecosystem Sustainability

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Biophoton Generators Enhance Germination, Preserve Produce, and Boost Fermentation: A New Frontier in Quantum Agriculture

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Abstract

Biophoton energy, coherent light emitted by biological systems, has emerged as a novel force in optimizing agricultural processes. This article presents compelling multi-domain findings on the biological benefits of strong biophoton fields applied across plants, animals, produce, beverages, and microbial systems. In plant studies, seeds exposed to six Tesla BioHealers showed significantly faster germination and more vigorous growth compared to controls. Animal models, including chickens, cats, dogs, and horses, demonstrated improved coat quality, alertness, and vitality after just two weeks of biophoton exposure. In food preservation experiments, fruits and vegetables maintained or increased their life force energy over five days, while untreated controls declined. Commercial beverages such as spring water, juice, and nutritional supplements exhibited dramatic gains in life force energy up to 100K units after 48 hours in a biophoton field, with the elevated energy maintained for months. Remarkably, fermentation activity surged after biophoton exposure, with revived bubbling in previously inactive tanks, higher alcohol yields, and stable batch quality reported by small-scale producers. Together, these results suggest that biophoton technology offers a sustainable, non-chemical, and non-invasive approach to enhancing vitality, efficiency, and quality across agricultural and biological systems. The cross species, cross-function evidence points toward a new paradigm quantum agriculture, in which light-based bioenergetics may be harnessed to optimize productivity, resilience, and energetic integrity in food and farming. These findings invite collaboration across agricultural sciences, biotechnology, and regenerative systems to translate this emerging technology into scalable real-world applications.

Keywords: Biophoton Energy, Quantum Agriculture, Plant Vitality, Food Preservation, Fermentation Enhancement, Animal Wellness

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Influence of Solvents on the Extraction Efficiency and Biological Activity of Marbled Eel Mucus

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Abstract

Marbled eels are migratory between freshwater, brackish, and saltwater environments. Eel mucus contains biological components that are essential in protecting against environmental pathogens. The biological activity of mucus depends on endogenous and exogenous factors. This study aimed to determine the influence of solvents in extracting bioactive compounds from marbled eel mucus for aquaculture and human healthcare applications. The results show that different solvents affect the composition and biological activity of the extract from marbled eel mucus. The extracts have 19-23 other peaks of compounds, with retention times ranging from 0.8 to 60.0 minutes on high-performance liquid chromatography (HPLC). The selective extraction rate of components (% area) has significant differences between extracts with different solvents. The eel mucus extracted with acetone solvent exhibited the highest biological activity in all tests: $IC_{50} = 36.603$ mg/mL and $SC\% = 98.424\%$ at 100 mg/mL for antioxidant activity; Antibacterial activity was demonstrated against *S. aureus* ($IC_{50} = 65.00 \pm 3.01$ μ g/mL) and *B. subtilis* ($IC_{50} = 112.00 \pm 7.89$ μ g/mL); The ability to inhibit human skin cancer cells ($IC_{50} = 465.96 \pm 8.54$ μ g/mL) and normal cells ($IC_{50} = 453.36 \pm 17.88$ μ g/mL). Extracts extracted with n-Hexane solvent showed higher safety for cells than extracts from other solvents ($IC_{50} = 632.43 \pm 18.80$ μ g/ml, higher than the value $IC_{50} = 545.25 \pm 26.36$ μ g/ml for skin cancer cells). These results provide essential data for selecting and applying products derived from extracts of marbled eel mucus in the future, sparking excitement and optimism about this research's potential impact on aquaculture and human health care.

Keywords: Solvents, Mucus Extract, Efficiency, Bio-compounds and Bioactive

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Analysis Of Lvctl3 Gene Transcription Encoding C-Type Lectin from White-Leg Shrimp (*Litopenaeusvannamei*) Infected Black Gill Disease

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Abstract

C-type lectin is crucial for the innate immune response in white-leg shrimp (*Litopenaeus vannamei*), particularly during pathogenic infections. The expression of C-type lectin genes is upregulated in response to bacterial and viral pathogens. This study aimed to investigate the expression of the LvCTL3 gene, which encodes C-type lectin, in white-leg shrimp (*Litopenaeus vannamei*) affected by black gill disease in Hue City, Vietnam. Using real-time PCR with specific primers for LvCTL3 and an actin reference gene, gene expression was analyzed across six shrimp tissues: intestine, stomach, hemocytes, gills, and muscle. The results revealed that LvCTL3 gene transcription was highest in the intestine of shrimp with black gill disease, underscoring the pivotal role of LvCTL3 in the shrimp's immune defense mechanism.

Keywords: Black Gill, C-Type Lectin, Gene Encoding, LvCTL3 Gene, White Leg Shrimp

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Facilitating Coastal Communities through Modular Artificial Reefs: A Scalable and Accessible Design Approach in Thailand

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Abstract

In regions where technical infrastructure and financial capacity are limited, conventional artificial reef (AR) solutions remain largely inaccessible to coastal communities. This study introduces a community-oriented design model for modular artificial reefs (MARs) that promotes decentralized marine restoration by enabling individual users and local groups to participate directly in reef deployment. Developed within a design thinking framework, the MARs system emphasizes lightweight construction, standardized interlocking modules, and environmentally sustainable materials. Prototypes were tailored for transport by small boats and manual installation without the need for cranes, scuba compressors, or other specialized equipment. A pilot project implemented in Chumphon Province, Thailand, demonstrated the feasibility of grassroots-led deployment with local divers and stakeholders. By prioritizing ease of use, adaptability to site-specific marine conditions, and replicability, the project proposes an inclusive reef restoration model capable of supporting marine biodiversity while fostering long-term stewardship among coastal populations. The study contributes a scalable and adaptable design strategy for empowering under-resourced communities in Southeast Asia to reclaim agency in marine conservation.

Keywords: Modular Artificial Reefs, Community-Based Restoration, Decentralized Deployment, Sustainable Coastal Design

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Effectiveness of *Wedelia Chinensis* Extract Supplementation on the Histology of Hepatopancreas of White-Leg Shrimp (*Penaeus vannamei*) Experimentally Infected with AHPND-Causing *Vibrio Parahaemolyticus*

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Abstract

This study aimed to evaluate the effects of *Wedelia chinensis* extract (WCE) supplementation on the histological changes of the hepatopancreas of white-leg shrimp (*Penaeus vannamei*) experimentally infected with *Vibrio parahaemolyticus* causing acute hepatopancreatic necrosis disease (AHPND). White-leg shrimp with an average weight of 1.5 - 2.0 g/individual was randomly placed into 12 Fiber plastic tanks (50 shrimp/120 L tank) and fed with basal diet (Control) or with basal diet supplementation with WCE at three different concentrations: 31.25 mg.L⁻¹; (312.5 mg.L⁻¹ or 625 mg.L⁻¹ for the first 7 days and then fed with basal diet for the next 7 days, and repeated with the same experimental diets for the following 7 days. An experimental challenge with *V. parahaemolyticus* was introduced on day 14. Sample for histological was conducted on day 0, day 7, and day 14 after challenge. In addition, in the challenge test against *Vibrio parahaemolyticus* at day 8, histological changes of hepatopancreas (HP) of shrimp fed on WCE treatment were not observed while shrimp fed basal diet clearly showed histopathological characteristics of AHPND such as pale or yellow HP, massive necrosis in tubules and star-shaped polygonal structures of the lumen disappeared. The results indicate that the WCE supplementation has positive affects on the shrimp's health and reduces the damage of the shrimp's hepatopancreas infected with AHPND-causing *Vibrio parahaemolyticus*.

Keywords: Herb, Penaeid Shrimp, Bacteria, Vibriosis, Early Mortality Syndrome

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Novel Technology of Free-Living Protozoans as Bioindicators and Bioremediation Tools in the Coastal Zone of South West Coast of India

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Abstract

The use of free-living protozoan communities has benefited in perfectly characterizing and monitoring the prevailing environmental conditions of aquatic habitats and a particular community of organism may be useful as an environmental indicator due to many reasons. In the present study, 19 species of free-living protozoans have been identified and characterised from this Coastal zone. A total of 15 testacid rhizopods belonging to 2 orders, 6 families and 9 genera were recorded. And the ciliates of 3 orders, 3 families were recorded. Among the testaceous rhizopods 1 species from Arcellidae family, 5 from Centropyxidae, 1 species from Nebelidae, 6 from Difflogidae belonging to the Class Lobosea and 2 species from the Class Filosea belonging to Cyphoderiidae and Euglyphidae families were identified. Some of these free-living forms have given certain insights of the prevailing ecological conditions of this coastal area thus acting as perfect Bioindicators. *Euglypha tuberculata* reported in the present study is a species of wide tolerance and survives in diverse habitats. Similarly, *Cryptodifflogia oviformis* which was reported for the first time in India in this study prefers dryer environments. Due to its small size, this species mainly feeds on bacteria and yeasts, their high abundance explains active decomposition process in the area. The diversity of the free-living ciliates in the study area included species belonging to 3 genera namely *Euplotes*, *Tachysoma* and *Coleps* and they were pollution indicators possessing the property of heavy metal uptake. The water quality analysis and heavy metal analysis also proved the waters of this coastal area are highly polluted with heavy metal concentrations. These free-living protozoans serve as good bioindicators reflecting the natural ecological conditions prevailing in this coastal zone. They can also be effective bioremediation tools that can be applied to solve the heavy metal pollution crisis of the marine water

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Codon-Optimized LvCTL3 Expression to Enhance Disease Resistance in *Litopenaeus vannamei*

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Abstract

C-type lectins (CTLs) are critical components of the shrimp innate immune system, contributing to pathogen recognition, immune activation and microbial homeostasis. Among these, LvCTL3, a key C-type lectin in the whiteleg shrimp (*Litopenaeus vannamei*), is highly expressed in immune-related tissues, including the hepatopancreas and hemocytes. LvCTL3 supports innate immunity by recognizing pathogens, agglutinating bacteria (e.g., *Vibrio* spp., *Bacillus subtilis*), and aiding in the clearance of bacteria and viruses, such as white spot syndrome virus. In this study, the codon-optimized sequence of LvCTL3 for *Escherichia coli* expression was synthesized, cloned and expressed in *E. coli* BL21 (DE3) using the pCold DNA cold-shock expression system. High-level expression of the LvCTL3 protein was confirmed through SDS-PAGE and Western blot analysis with Anti-His Tag antibodies. The purified recombinant LvCTL3 protein was incorporated into basal diets to evaluate its effects on immune parameters, growth performance, and disease resistance in *L. vannamei* against Acute Hepatopancreatic Necrosis Disease causing *Vibrio parahaemolyticus*. Successful functional expression of LvCTL3 demonstrates its potential as a dietary supplement to enhance disease resistance in industrial shrimp aquaculture.

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Conservation and Community Engagement: Integrating Faith-based Approaches into Sustainability Goals

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Abstract

On 25th September 2015, the 193 countries of the UN General Assembly adopted the 2030 development agenda titled Transforming the World: the 2030 Agenda for Sustainable Development. It Includes a set of 17 Sustainable Development Goals (SDGs) to end poverty, fight inequality and justice and to tackle the climate change by 2030. Now, it is less than five years and a long way to go. To achieve the goals, apart from the support by governments, legal adjustments, leadership, funding etc., faith-based approaches by local communities also play a pivotal role in achieving the goals. India is a country with varied agro-climatic conditions, diverse culture, thousands of languages and dialects, all major religions or faiths of the world, have always respected the nature for its sustenance and development. As only two things viz., fear and faith work in this world. Hence, it is of prime importance to understand how faith-based approaches and community engagement can help in achieving sustainable goals specially where marine ecosystem conservation is concerned. The present paper deals with various religious faiths in India, available in literature, in achieving the SDGs.

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Driving Sustainable Mineral Supply Chains in Asia: Practical Pathways for Decarbonisation, Ecosystem Resilience & Legal Compliance

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Abstract

The surge in demand for critical minerals—key to Asia’s clean energy transition—has intensified mining operations, creating challenges where commercial goals, legal compliance, and sustainability intersect. This session explores how mining companies and investors, especially private equity, adopt emission-cutting technologies like solar, wind, and biofuels within stringent ESG frameworks and evolving legal landscapes governing biodiversity, indigenous rights, and community engagement.

The discussion highlights how legal frameworks shape investment decisions and operational strategies, emphasizing that evolving regulations require proactive risk management to prevent liabilities and strengthen accountability. It examines how stewardship principles and mandatory ESG disclosures influence capital flow, guiding private equity’s due diligence, governance, and long-term value creation.

Participants will learn how legally informed investments create competitive advantage by aligning financial returns with sustainability, balancing regulatory compliance with commercial opportunity. This integrated legal and investment approach drives sustainable mining, enhancing environmental resilience, securing social license to operate, and meeting fiduciary duties in a fast-changing market.

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Eco-Friendly Hull Cleaning and Biofouling Management: Engineering Solutions for a Sustainable Blue Economy

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Abstract

In a world racing toward decarbonisation and sustainable ocean industries, eco-friendly hull cleaning and biofouling management have emerged as pivotal themes for blue economy advancement. Marine biofouling—the relentless buildup of algae, barnacles, and microorganisms on ship hulls—creates far-reaching challenges for maritime transport, from increased fuel consumption to greenhouse gas emissions and the global dispersal of invasive species. Recognizing these threats, marine engineering is pivoting from chemical-intensive antifouling solutions to holistic maintenance strategies that blend innovative materials, automation, and ecological responsibility. This presentation explores the transformative impact of sustainable hull cleaning—a practice at the crossroads of operational efficiency and marine conservation. Fuel efficiency in shipping can be boosted by up to 35% simply through regular, effective hull maintenance, cutting both costs and emissions in line with global sustainability targets such as the International Maritime Organization’s GHG strategy. Moreover, new antifouling coatings formulated without biocides and toxins, along with robotic hull cleaning systems, prevent harmful runoff and shield delicate marine ecosystems from the long-term impact of chemical pollution. A central concern is the role of hull cleaning in controlling marine biosecurity. Ship hulls serve as vectors for invasive species, with far-reaching ecosystem consequences in port cities and protected waters. By combining real-time sensor networks and digital monitoring tools, marine engineers are revolutionizing maintenance timing, minimizing invasive spread, and ensuring compliance with increasingly rigorous regulatory frameworks. These innovations also enable ports and shipowners to automate hull inspections, verify cleaning outcomes, and maintain industry-wide excellence in eco-friendly practices. From a marine engineering cadet’s viewpoint, eco-friendly hull cleaning is more than a technical challenge—it embodies the spirit of stewardship and innovation that defines the future of ocean enterprise. Collaboration among engineers, regulators, and scientists is driving a shift towards green hull maintenance as the new norm, positioning the maritime industry as a leader in sustainable transport. Eco-friendly hull cleaning stands as a practical, high-impact solution for the blue economy, blending technology and conservation to make ocean transport cleaner, safer, and smarter for the decades ahead.

Keywords: Sustainable Hull Cleaning, Biofouling Management, Marine Environmental Protection, Energy Efficiency in Shipping, Eco-Friendly Antifouling Technology

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Coastal Aquaculture in Bangladesh: A Challenge

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Abstract

Bangladesh has an inland water area of about 4.72 million ha and almost 118,813 sq. km in the Bay of Bengal. In 2023-24, the fisheries sector contributes 2.53% to the national GDP, 22.26% to the agricultural GDP, and more than 0.91% to the total export earnings. A study was conducted to get an accurate picture of the catch and catch composition of the fish population, using a semi-structured questionnaire, and primary data was collected by focus group discussion (FGD), local ecological knowledge (LEK), and direct interviews with the individuals, publications of the Department of Fisheries, the internet, and related gray literature. The marine production contributed only about 12.53% of total production in 2023–24. A decreasing trend was found from 2021-22 to 2023-24. The increasing total production of prawns and shrimp in the coastal area was recorded from 0.0082 ± 0.03 to 0.3154 ± 0.04 million metric tons between 1983–84 and 2023–24. The regression trend was logarithmic, and the equation was $y = 0.1258 \ln(x) + 0.0005$, where R^2 is 0.9395. Between 2015–16 and 2023–24, the total production of mud crab in the coastal area was noted between 0.0132 ± 0.04 and 0.01078 ± 0.05 million metric tons, respectively. The crab production decreased between 2022-23 and 2023-24. The regression trend was polynomial, and the equation was $y = -0.0002x^2 + 0.0041x - 0.0069$, where R^2 is 0.7667.

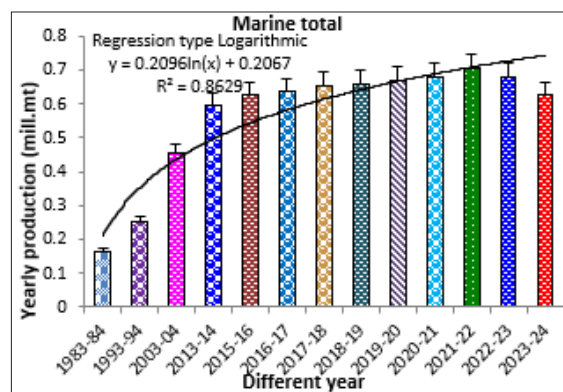


Figure: A decreasing trend of total marine production between 1983-84 and 2023-24.

The potential traditional cultures of sea bass (*Lates calcarifer*) areas are Satkhira-Khulna-Bagerhat and Patuakhali-Barisal-Barguna. The fish farmer collected sea bass fry from the river and prawns and shrimp gher. No other aquaculture of fish species is not developed still now. Fishery resources are facing challenges due to natural and anthropogenic causes, including overexploitation of prawns, crabs, sea bass, and dolphins. An eco-friendly catch should be practiced until hatchery was not established. Developing biological management technology for coastal aquaculture reduces resource declination and enhances production.

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Integrating Human Rights into the Legal Developments on Oceans and Seas: A Promise to be Fulfilled

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Abstract

In theory, international human rights law recognises a framework of rights and freedoms for individuals that applies constantly, regardless of whether on land at sea. Therefore, at first glance, there appear to be no substantial controversies at the intersection between international human rights law and the international law of the sea that would give rise to complex scientific debate. However, difficulties in connecting human rights and the marine environment persist relating to at least two aspects. Firstly, there are the particular challenges of applying international human rights norms to marine related issues such as ensuring the rights of vulnerable groups at sea. Secondly, international human rights law is closely linked to developments impacting maritime ecosystems. Rising sea and ocean levels, increased plastic pollution and the challenges of managing climate change have direct and proportional impacts on marine and human environment. Additionally, the significant effects of technological developments in ICT, robotics and artificial intelligence on the balance between human activity in the marine environment and human rights must also be considered. Therefore, it is necessary to understand the importance of addressing these issues at the level of the three relevant international organizations: the United Nations, the Council of Europe and the European Union.

The scientific objective of this paper is to explore the role of the seas and oceans and to place it in the context of the study of the right to a healthy environment as a third generation right, referencing the recent initiatives of international organisations in the field of human rights.

Keywords: Human Rights, Seas and Oceans, Healthy Environment, International Organizations, Multilateralism

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A Single VAM Project can be Like Removing 2 Million Cars Off the Roads - at USD 7 per tCO₂e

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Abstract

The atmospheric content of GHG (GreenHouse Gases) is only around 0.04%. Without them, the Earth would have been a frozen planet. Due to the tiny portion of GHG, the anthropogenic emissions since the second half of the 1800's have been causing Global Warming and Climate Change. To the scientific community, this is since a long-time crystal clear. Yet, effective measures still remain to be implemented.

According to the statistics of the IEA (International Energy Agency), global energy production increased from 1990 to 2021 by around 65%. Despite global concern and commitments (such as the Paris Agreement of 2016), the portion of fossil-based energy remained through the increase at 80% and the portion of coal-based energy remained around 30%.

When a coal seam is excavated, methane gas is released. Methane in air is explosive in concentrations between 5% and 15%. For safety reasons, ventilation air is forced through the mine to dilute the methane to typically below or much below 1%. Safety is obtained, but at the cost of a massive methane emission to atmosphere. A single, large shaft can annually emit 50 thousand tons or more. Financial drivers in form of a value (gain a revenue or avoid a penalty) to reduce the emissions are required to trigger project implementation.

This presentation ventures into the necessity to address major reductions of methane emissions to the atmosphere in parallel with emission reductions of CO₂, in order to have a better chance to cope with climate change in time, and how VAM Mitigation can play an important role as a large impact at a comparatively low cost. It outlines why VAM Mitigation as a climate action is a particularly Low Hanging Fruit.