Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 29(5): 2035 – 2050 (2025)
www.ejabf.journals.ekb.eg

Characterization of Marine Primary Productivity as a Source of Fish Nutrition Using UFL+ (Underwater Fish Lamp Plus) Integrated with a Real-Time Sensor-Based System

Muhammad Nur[1*], Fajriah[2], Zulkifli[3], Kobajashi Togo Isamu[4], Muhammad Sainal Abidin[5]

[1]Agribusiness Study Program, Faculty of Agriculture, Universitas Muhammadiyah Kendari, Jati Raya, Jl. K.H. Ahmad Dahlan No. 10, Wowawanggu, Kadia District, Kendari City, Southeast Sulawesi 93127, Indonesia

[2]Department of Fisheries Resource Utilization, Faculty of Fisheries and Marine Sciences, Universitas Muhammadiyah Kendari, Jati Raya, Jl. K.H. Ahmad Dahlan No. 10, Wowawanggu, Kadia District, Kendari City, Southeast Sulawesi 93127, Indonesia

[3]Management Study Program, Faculty of Islamic Economics and Business, Universitas Muhammadiyah Kendari, Jati Raya, Jl. K.H. Ahmad Dahlan No. 10, Wowawanggu, Kadia District, Kendari City, Southeast Sulawesi 93127, Indonesia

[4]Department of Fisheries Product Technology, Faculty of Fisheries and Marine Sciences, Universitas Halu Oleo, 93232, Indonesia

[5]Electrical Medical Technology Study Program, Faculty of Science and Technology, Universitas Mandala Waluya, Southeast Sulawesi, 93561, Indonesia

[*]Corresponding Author: muhammad.nur@umkendari.ac.id

ARTICLE INFO

Article History:
Received: July 6, 2025
Accepted: Sep. 11, 2025
Online: Oct. 8, 2025

Keywords:
Marine primary productivity,
Chlorophyll-a,
Phytoplankton,
UFL+,
Light spectrum,
Real-time monitoring

ABSTRACT

Marine primary productivity underpins aquatic food webs and determines nutrient availability for fish populations. Light spectrum and depth significantly influence phytoplankton photosynthesis, yet their interactive effects in tropical marine environments remain insufficiently quantified. This study evaluated the effects of Underwater Fish Lamp Plus (UFL+) with green and orange light spectra on chlorophyll-a concentration, plankton community structure, and environmental parameters in Tondonggeu coastal waters, Kendari, Indonesia. Experiments were conducted at depths of 5, 10, and 15m. Chlorophyll-a was measured spectrophotometrically; plankton were identified microscopically, and ecological indices of diversity (H′) and evenness (E) were calculated. Real-time data on light intensity, temperature, salinity, dissolved oxygen, and turbidity were recorded by integrated sensors. Green UFL+ illumination significantly increased chlorophyll-a concentration (1.11mg m^{-3}), plankton abundance (1.47×10^4 cells L^{-1}), diversity (H′ = 1.81), and evenness (E = 0.83) compared with orange light (0.950 mg m^{-3}; 1.20×10^4 cells L^{-1}; H′ = 1.60; E = 0.78). Green light penetrated deeper (2,100 lux at 15m) than orange light (1,000 lux), with optimal productivity observed at 10m depth where temperature (27–29 °C), salinity (30–31 ppt), and dissolved oxygen (6.7–6.9 mg L^{-1}) remained stable. UFL+ with green light enhances marine primary productivity and plankton community stability through improved light penetration. The integration of UFL+ and real-time sensors offers a novel approach for monitoring ecosystem dynamics and supporting sustainable, ecosystem-based fisheries management.

INTRODUCTION

Marine primary productivity serves as a critical foundation for aquatic ecosystems, influencing food webs and biomass availability across multiple trophic levels, with phytoplankton being the primary producers in this dynamic. The interplay between light levels, water depth, and oceanographic conditions profoundly affects marine primary productivity, which in turn determines the availability of resources for plankton, fish, and higher predators **(Domingues & Barbosa, 2023)**. The reliance of phytoplankton on photosynthesis, a process intricately linked to these environmental factors, highlights the importance of understanding the variability in light and nutrient conditions that can drive fluctuations in ecosystem stability and overall productivity **(Isroni *et al.*, 2023; Masithah & Islamy, 2023)**.

Light penetration in aquatic systems is uneven, with specific wavelengths impacting photosynthetic efficiency differently **(Luimstra *et al.*, 2020)**. Studies illustrate that green light penetrates the water column more effectively than orange light, potentially enhancing photosynthesis in deeper waters where phytoplankton reside **(Ye *et al.*, 2021)**. Nonetheless, empirical data linking water depth, specific light wavelengths, and phytoplankton productivity is still scarce, especially in tropical marine contexts **(Luimstra *et al.*, 2020; Domingues & Barbosa, 2023)**.

The innovation of Underwater Fish Lamp Plus (UFL+) technology, originally developed for attracting fish, has furthered research capabilities by integrating real-time oceanographic sensors to monitor multiple environmental variables critical to assessing marine productivity **(Baumgartner *et al.*, 2020; Fajriah & Isamu, 2025; Fajriah *et al.*, 2025a, c)**. This system facilitates the exploration of how different light spectra affect chlorophyll-a concentrations and phytoplankton dynamics under varying conditions. Initial studies suggest that integrating this technology provides an avenue for quantifying primary productivity and understanding phytoplankton response to light conditions, which remains a relatively underexplored area of marine research **(Booge *et al.*, 2018; Masithah & Islamy, 2023)**.

Despite the advancements in technological tools like the UFL+, there is still a substantial gap in the understanding of how these environmental variables interact with phytoplankton community structure and productivity **(Ye *et al.*, 2021)**. This lag in knowledge presents an opportunity for future studies. The proposed research objectives, which aim to assess chlorophyll-a concentrations under varied light and depth conditions, analyze phytoplankton community structures, and apply ecological indices, are critical for advancing our understanding of marine ecosystems and supporting sustainable fisheries management **(Baumgartner *et al.*, 2020; Domingues & Barbosa, 2023)**.

The interaction of light quality, water depth, and other oceanographic conditions creates a complex network influencing marine primary productivity. Technological advancements in monitoring these interactions not only foster deeper ecological insights but also pave the way for informed fisheries management strategies that consider the nuanced behaviors of marine ecosystems. The present study aimed to: (1) quantify chlorophyll-a concentrations under green and orange UFL+ lighting, (2) analyze phytoplankton composition and abundance, (3) calculate ecological indices of diversity (H′) and evenness (E), and (4) evaluate the influence of depth (5, 10, and 15m) and oceanographic conditions on primary productivity. By integrating UFL+ with real-time environmental monitoring, this research provides novel insights into marine primary productivity and its implications for fish nutrition and sustainable fisheries management.

MATERIALS AND METHODS

Study area and sampling design

The study was conducted in the coastal waters of Tondonggeu, Kendari City, which is adjacent to the waters of South Konawe Regency, Southeast Sulawesi, Indonesia. The area is characterized by relatively good water transparency, making it suitable for light penetration studies. Sampling was carried out at three depths (5, 10, and 15m) under two light treatments using the Underwater Fish Lamp Plus (UFL+): green and orange. Each treatment was replicated to ensure data reliability.

Chlorophyll-a analysis

Water samples were collected from each depth using a Van Dorn water sampler and preserved with 90% Lugol’s solution. Chlorophyll-a was extracted following standard spectrophotometric methods, and concentrations were expressed in milligrams per cubic meter (mg/m^3). Absorbance values were measured using a calibrated UV-Vis spectrophotometer.

Plankton identification and abundance

Plankton samples were obtained by filtering seawater through a 25µm plankton net. Samples were preserved with Lugol’s solution and analyzed under a compound microscope. Identification was based on established taxonomic references **(Masithah & Islamy, 2023)**. Abundance was quantified in cells per liter (cell/L) using a Sedgewick-Rafter counting chamber.

Ecological indices

The Shannon–Wiener diversity index (H′) and Pielou’s evenness index (E) were calculated to assess plankton community structure and stability **(Islamy *et al.*, 2024)**.

These indices provided insights into species richness and distribution patterns under different light treatments.

Oceanographic sensor measurements

The UFL+ device was equipped with an integrated real-time oceanographic sensor system. Parameters measured included light intensity (lux), water temperature (°C), salinity (ppt), dissolved oxygen (mg/L), and turbidity/clarity (NTU) Data were continuously recorded during the experimental period to capture environmental variability **(Islamy *et al.*, 2024)**.

Statistical analysis

Data were analyzed using descriptive and inferential statistics. Analysis of variance (ANOVA) was employed to test differences in chlorophyll-a concentration, plankton abundance, and ecological indices between treatments (light spectrum and depth). Post-hoc Tukey tests were applied where significant differences were detected. Statistical significance was set at $P< 0.05$.

RESULTS

Chlorophyll-a concentration

Chlorophyll-a concentration varied significantly between treatments. The green UFL+ light produced higher concentrations (1.11mg/ m^3) compared to the orange light (0.950mg/ m^3), indicating enhanced phytoplankton photosynthetic activity under green illumination (Fig. 1 & Table 1).

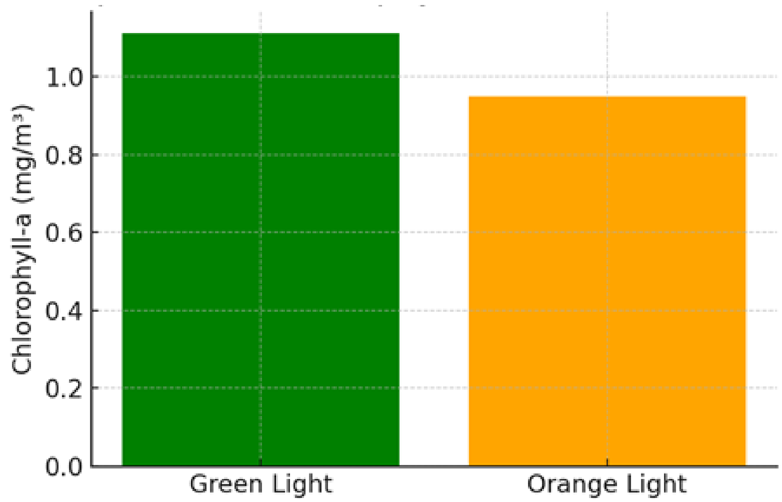

Fig. 1. Comparison of chlorophyll-a concentrations under green and orange UFL+ light treatments

Table 1. Summary of laboratory measurements under green and orange UFL+ light treatments

Parameter	Green Light (UFL+)	Orange Light (UFL+)
Chlorophyll-a (mg/m^3)	1.11	0.950
Plankton abundance (cell/L)	1.47×10^4	1.20×10^4
Diversity index (H′)	1.81	1.60
Evenness index (E)	0.82	0.78

Plankton abundance and community structure

Plankton abundance was greater under green light (1.47×10^4 cell/L) compared to orange light (1.20×10^4 cell/L). Diversity (H′) and evenness (E) indices were also higher under green light (H′ = 1.81; E = 0.83) relative to orange light (H′ = 1.60; E = 0.78), suggesting a more balanced community structure (Figs. 2, 3 & Table 1).

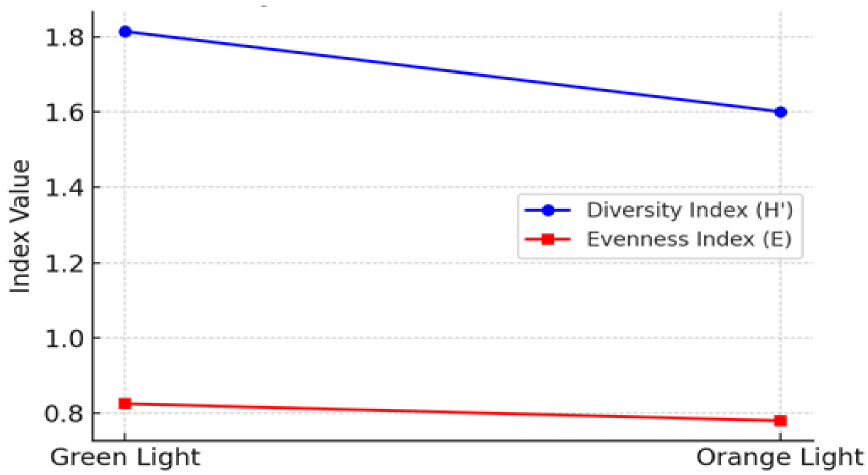

Fig. 2. Plankton abundance (cell/L) observed under green and orange UFL+ light treatments

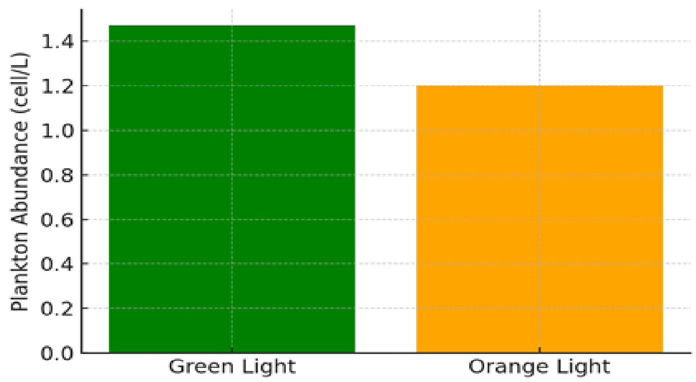

Fig. 3. Diversity (H′) and evenness (E) indices of plankton communities under green and orange UFL+ light treatments

Depth variation in light intensity

Light penetration differed markedly between treatments. Green light penetrated deeper, maintaining 2,100 lux at 15m, compared to only 1,000 lux for orange light at the same depth **(Islamy *et al.*, 2025)**. The 10m depth emerged as the optimum photosynthetic zone, with the highest chlorophyll-a concentrations and phytoplankton abundance (Table 2 & Fig. 4).

Table 2. Light intensity (lux) of green and orange UFL+ at different depths

Depth (m)	Green Light (lux)	Orange Light (lux)
5	6,500	5,400
10	4,600	3,200
15	2,100	1,000

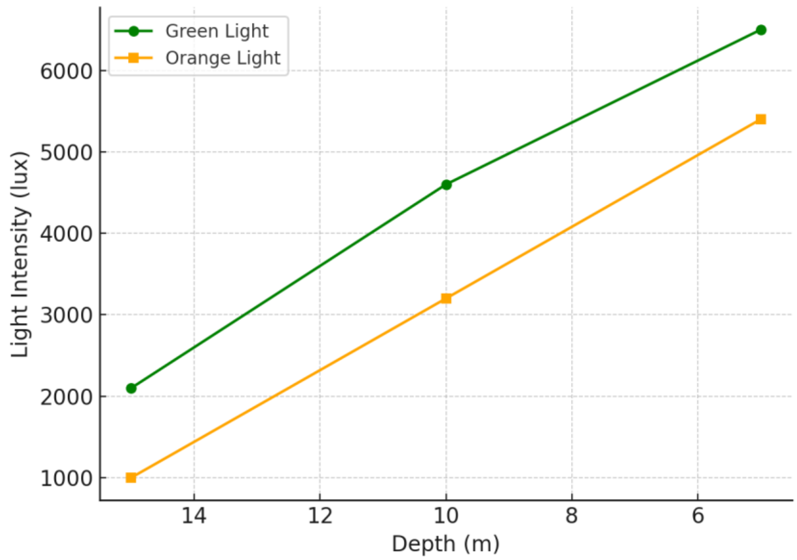

Fig. 4. Light intensity profiles of green and orange UFL+ at different depths in the study area

Oceanographic parameters

Real-time sensor data showed stable environmental conditions across treatments. Temperature ranged from 27- 29°C, turbidity from 48–49 NTU, salinity from 30– 31ppt, and dissolved oxygen from 6.7– 6.9mg/ L. These parameters supported favorable conditions for phytoplankton growth.

DISCUSSION

The results of this study demonstrate that light spectrum significantly influences marine primary productivity, with green UFL+ light producing higher chlorophyll-a concentrations, plankton abundance, and more balanced community structures compared to orange light. This finding aligns with the principle that different wavelengths of light penetrate the water column at varying depths, with green light known to penetrate more effectively than orange or red wavelengths. Enhanced penetration allows phytoplankton to photosynthesize efficiently even at greater depths, which explains the higher productivity observed under green illumination.

Depth also played a key role in shaping productivity patterns. The 10 m layer was identified as the optimal photosynthetic zone, characterized by high chlorophyll-a concentrations and phytoplankton abundance. At this depth, light intensity was sufficient for photosynthesis, while temperature and oxygen remained stable. These findings are consistent with studies in other tropical marine ecosystems, which report that moderate depths often represent the most favorable zone for phytoplankton growth due to balanced light and nutrient availability **(Fajriah & Isamu, 2025; Fajriah *et al*, 2025b)**.

The diversity (H′) and evenness (E) indices were higher under green light, indicating that this spectrum created conditions favorable for a wide range of phytoplankton species **(Masithah & Islamy, 2023)**. A stable and diverse phytoplankton community is essential for maintaining food web resilience and supporting higher trophic levels. In contrast, orange light supported lower diversity, likely due to its limited penetration, which favored dominance by fewer species. Similar patterns have been reported in light-manipulation experiments, where restricted spectral availability reduced species richness and increased community imbalance **(Fajriah & Isamu, 2025)**.

Real-time oceanographic sensor data further emphasized the interaction between environmental stability and productivity. Temperature, salinity, dissolved oxygen, and turbidity remained within ranges suitable for phytoplankton growth, suggesting that light availability was the primary factor driving the observed differences. The integration of UFL+ with sensor technology thus represents an important advancement for ecological monitoring, enabling researchers to simultaneously manipulate and record environmental variables with high precision **(Fajriah & Isamu, 2025; Fajriah *et al.*, 2025a, b)** .

From an applied perspective, these findings have important implications for ecosystem-based fisheries management. Primary productivity directly determines the availability of food for zooplankton and fish larvae, which in turn sustains populations of pelagic fish species with high economic value. By improving our understanding of how artificial light spectra affect phytoplankton dynamics, UFL+ technology could be used not only for fish attraction but also for ecological monitoring and optimization of marine resource use **(Isamu *et al.*, 2024, 2025)**.

Nevertheless, this study has limitations. The experimental design focused on short-term measurements of chlorophyll-a and plankton communities; longer-term monitoring would be required to assess seasonal or interannual variability. Additionally, future research should examine how light spectrum interacts with nutrient dynamics, as nutrient limitation often co-determines phytoplankton productivity in coastal ecosystems.

In addition to the ecological implications of light spectrum on primary productivity, the present findings resonate with broader studies on aquatic ecosystems in Indonesia. For instance, published study highlighted the importance of nutrient composition, particularly amino acids and fatty acids, in determining the nutritional value of fish species from peatland waters, underscoring how primary productivity directly contributes to fish quality **(Islamy & Senas, 2025)**. Environmental stressors such as microplastic contamination and associated genotoxic effects in freshwater or marine snails **(Islamy & Hasan, 2020; Isroni *et al.*, 2023)** and in fish populations **(Islamy *et al.*, 2025a, c)** further illustrate the vulnerability of aquatic organisms to changes in water quality, reinforcing the significance of continuous monitoring systems such as UFL+. Likewise, ecosystem disruptions caused by invasive species, including *Xiphophorus helleri* and *Amphilophus citrinellus* recently recorded in Indonesian waters **(Islamy *et al.*, 2025e, f)**, highlight the need for comprehensive ecological assessments where primary productivity serves as an early indicator of ecosystem balance. Parallel to these ecological concerns, research on agricultural weeds as natural bioactive compounds from aquatic plants and animals **(Islamy, 2019; Islamy *et al.*, 2024c, 2025d)** and sustainable feed sources **(Islamy *et al.*, 2024b; Mulyadi *et al.*, 2025)** emphasizes the intertwined role of primary producers in supporting both aquaculture and conservation goals. Furthermore, studies on eutrophication processes, such as water hyacinth blooms in major Indonesian rivers **(Islamy *et al.*, 2024a)**, demonstrate how excessive productivity can destabilize ecosystems, contrasting with the controlled enhancement of productivity achieved in this study through UFL+ technology. Collectively, these perspectives position UFL+ as not only an innovative fish-attracting device but also as a promising tool for integrating ecological monitoring, fisheries management, and aquatic conservation.

CONCLUSION

This study confirmed that adopting Underwater Fish Lamp Plus (UFL+) technology in boat lift net fisheries enhances both catch performance and economic returns when compared with conventional lighting systems. The integration of operational data into the SIDIA digital agribusiness platform enabled a structured and efficient feasibility analysis, producing positive indicators such as an NPV of IDR 8.54 million, IRR of 11.14%, Net B/C of 1.28, and a Payback Period of 4.93 years. However, sensitivity analysis revealed that the investment's viability is highly vulnerable to fluctuations in fish prices and fuel costs, underscoring the need for supportive interventions.

Beyond these baseline results, the study highlights the broader implication that combining technological innovation (UFL+) with digital financial analytics (SIDIA) can serve as a replicable model for improving decision-making and investment planning in small-scale fisheries across Indonesia and other coastal regions globally. Such integration not only strengthens fisher livelihoods but also contributes to the achievement of Sustainable Development Goals, particularly SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), and SDG 14 (Life Below Water). Future research should expand this model by incorporating real-time data streams and assessing ecological as well as socio-economic outcomes, ensuring that the framework can be adapted to diverse fisheries contexts and contribute to long-term sustainability within the blue economy.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to the Directorate of Research and Community Service (DPPM), Directorate General of Research and Development, Ministry of Higher Education, Science, and Technology of the Republic of Indonesia, for funding this research through the Fundamental Research Scheme Grant for Fiscal Year 2025. The authors also extend their appreciation to Universitas

Muhammadiyah Kendari for institutional support and facilitation throughout the study. Special thanks are conveyed to the local fishing communities in Tondonggeu, Kendari City, and South Konawe Regency for their active participation and valuable insights during the field trials. The authors further acknowledge the collaborative efforts of the SIDIA development team and the UFL+ engineering group, whose technical expertise and contributions significantly enhanced the quality and outcomes of this research.

REFERENCES

Adnan, N.; Bashir, A. and Harunurrasyid, H. (2021). The economies of scale and efficiency of small-scale capture fisheries in kurau village, central bangka district. Marine Fisheries Journal of Marine Fisheries Technology and Management, 11(2): 121-133. https://doi.org/10.29244/jmf.v11i2.32463

Aguión, A.; Basurto, X.; Funge-Smith, S.; Gorelli, G.; Iversen, E.; Mancha-Cisneros, M. and Gutiérrez, N. (2025). Illuminating pathways for marine food systems transformation by small-scale producers. One Ocean Science Congress, 3–6: OOS2025-312,. https://doi.org/10.5194/oos2025-312

Amarullah, T. and Gazali, M. (2019). Strategi peningkatan produktivitas perikanan skala kecil berkelanjutan di kabupaten aceh barat provinsi aceh. Jurnal Perikanan Tropis, 6(1): 1. https://doi.org/10.35308/jpt.v6i1.1086

Baumgartner, M.F.; Bonnell, J.; Corkeron, P.J.; Van Parijs, S.M.; Hotchkin, C.F.; Hodges, B.A.; Thornton, J.B.; Mensi, B. and Bruner, S. (2020). Slocum Gliders Provide Accurate Near Real-Time Estimates of Baleen Whale Presence From Human-Reviewed Passive Acoustic Detection Information. Front. Mar. Sci., https://doi.org/10.3389/fmars.2020.00100

Booge, D.; Schlundt, C.; Bracher, A.; Endres, S.; Zäncker, B. and Marandino, C. (2018). Marine Isoprene Production and Consumption in the Mixed Layer of the Surface Ocean – A field Study Over Two Oceanic Regions. Biogeosciences, https://doi.org/10.5194/bg-15-649-2018

Brown, C.; Hamilton, R.; Vuto, S.; Atu, W.; Masu, R.; Ramofafia, C. and Waldie, P. (2024). Contributions of small-scale and longline fishing to sea turtle mortality in the solomon islands. Conservation Letters, 17(6). https://doi.org/10.1111/conl.13056

Chuenpagdee, R. and Jentoft, S. (2019). Small-scale fisheries: Too important to fail. 349-353. https://doi.org/10.1163/9789004380271_059

Domingues, R.B. and Barbosa, A.B. (2023). Evaluating Underwater Light Availability for Phytoplankton: Mean Light Intensity in the Mixed Layer Versus Attenuation Coefficient. Water, https://doi.org/10.3390/w15162966

Fajriah, F. and Isamu, K.T. (2025). Enhancing aquatic primary productivity using the Underwater Fish Lamp Plus (UFL+): a novel approach to marine resource optimization. Egypt. J. Aquat. Biol. Fish., 29(2): 2667–2676. https://doi.org/10.21608/ejabf.2025.424449

Fajriah, F.; Kobajashi, T.I.; Muhammad, N. and Mustafa, A. (2025a). Optimizing fishing time with Underwater Fish Lamp Plus (UFLPlus) technology: a strategy to enhance productivity and sustainability of boat lift net fisheries. BIO Web of Conferences., 156: 03039. Published by EDP Sciences.

Fajriah; Isamu, K.T.; Abidin, M.S. and Saputra, H.N. (2025b). Innovation of the Underwater Fish Lamp (UFL+) in oceanographic monitoring through sensor calibration and evaluation of marine environmental dynamics. Egyptian Journal of Aquatic Biology and Fisheries, 29(2): 2559–2574. https://doi.org/10.21608/ejabf.2025.424441

Fajriah, F.; Isamu, K.T.; Nur, M. and Mustafa, A. (2025c). Optimizing fishing time with Underwater Fish Lamp Plus (UFLPlus) technology: A strategy to enhance productivity and sustainability of boat lift net fisheries. BIO Web Conf., 156: 3039. https://doi.org/10.1051/bioconf/202515603039

Fajriah; Isamu, K.T.; Nur, M.; Zulkifli. and Abidin, M.S. (2025d). Feasibility analysis of boat lift net fisheries assisted by UFL+ technology using the SIDIA Digital Agribusiness System. Egypt. J. Aquat. Biol. Fish., 29(5): 743–757. https://doi.org/10.21608/ejabf.2025.421656.6535

Harper, S.; Adshade, M.; Lam, V.; Pauly, D. and Sumaila, U. (2020). Valuing invisible catches: estimating the global contribution by women to small-scale marine capture fisheries production. Plos One, 15(3): e0228912. https://doi.org/10.1371/journal.pone.0228912

Huynh, P.; Ngoan, L.; Sen, L. and Thắng, T. (2021). Adaptive livelihood strategies among small-scale fishing households to climate change-related stressors in central coast vietnam. International Journal of Climate Change Strategies and Management, 13(4/5): 492-510. https://doi.org/10.1108/ijccsm-04-2020-0034

Hwang, J. (2022). Who becomes a fisherman? a two-stage sample selection analysis on small-scale fishery choice and income in korea. Sustainability, 14(4): 2167. https://doi.org/10.3390/su14042167

Innocenti, E.; Idda, C.; Prunetti, D. and Gonsolin, P. (2022). Agent-based modelling of a small-scale fishery in corsica. Proceedings of the 10th International Workshop on Simulation for Energy, Sustainable Development & Environment (SESDE 2022), 005. https://doi.org/10.46354/i3m.2022.sesde.005

Isamu, K.T.; E. Suprayitno; Yahya, A. Chamidah, Aulanni'am, M. F. Nur, R. F. Fataty, Fajriah, Ansharullah, and A. D. Ananto. (2025). ACE inhibition potential of Pokea clam (Batissa violacea Var. celebensis): An in silico approach toward hypertension treatment. Egyptian Journal of Aquatic Biology and Fisheries., 29(4): 453–469. https://doi.org/10.21608/ejabf.2025.440926

Isamu, K.T.; Fajriah, F. and Ansharullah, A. (2024). Characterization of Bioactive Peptides Derived from the Pokea Clam (Batissa violacea celebensis) Protein Hydrolysate. Egyptian Journal of Aquatic Biology and Fisheries., 28(5): 1141–1150. https://doi.org/10.21608/ejabf.2024.382139

Islamy, R.A. (2019). Antibacterial Activity of Cuttlefish Sepia sp. (Cephalopoda,) Ink Extract Against *Aeromonas hydrophila*. Maj. Obat Tradis., 24(3): 184. https://doi.org/10.22146/mot.45315

Islamy, R.A. and Hasan, V. (2020). Checklist of mangrove snails (Mollusca: Gastropoda) in South Coast of Pamekasan, Madura Island, East Java, Indonesia. Biodiversitas, 21(7). https://doi.org/10.13057/biodiv/d210733

Islamy, R.A. and Senas, P. (2025). Amino acid and fatty acid composition of wild climbing perch (*Anabas testudineus*) from Peatland drainage waters in central Kalimantan, Indonesia. Egypt. J. Aquat. Biol. Fish., 29(5): 779–791. https://ejabf.journals.ekb.eg/article_453682.html

Islamy, R.A.; Hasan, V.; Kilawati, Y.; Maimunah, Y.; Mamat, N.B. and Kamarudin, A.S. (2024a). Water Hyacinth (*Pontederia crassipes*) bloom in Bengawan Solo River, Indonesia: An Aquatic physicochemical and biology perspective. Int. J. Conserv. Sci., 15(4): 1885–1898.

Islamy, R.A.; Hasan, V. and Mamat, N.B. (2024b). Checklist of Non-Native aquatic plants in up, middle and downstream of Brantas River, East Java, Indonesia. Egypt. J. Aquat. Biol. Fish., 28(4): 415–435. https://doi.org/10.21608/ejabf.2024.368384

Islamy, R.A.; Hasan, V.; Mamat, N.B.; Kilawati, Y. and Maimunah, Y. (2024c). Immunostimulant evaluation of neem leaves againts Non-Specific immune of tilapia infected by *A. hydrophila*. Iraqi J. Agric. Sci., 55(3): 1194–1208. https://doi.org/10.36103/dywdqs57

Islamy, R.A.; Hasan, V.; Kamarudin, A.S.; Mamat, N.B.; Valen, F.S. and Mutmainnah, N. (2025a). Assessment of microplastic accumulation, genotoxicity, and gill histopathological alterations in wild herbivorous fishes from the Brantas River, Malang, Indonesia. Inz. Ekol., 26(11): 1-16. https://doi.org/10.12911/22998993/205979

Islamy, R.A.; Hasan, V.; Poong, S.-W.; Kilawati, Y.; Basir, A.P. and Kamarudin, A.S. (2025b). Nutritional value and biological activity of *K. alvarezii* grown in integrated multi-trophic aquaculture. Iraqi J. Agric. Sci., 56(1): 617–626. https://doi.org/10.36103/6kp06e71

Islamy, R.A.; Kilawati, Y.; Hasan, V.; Valen, F.S.; Mamat, N.; Kamarudin, A.S. and Maimunah, Y. (2025c). Determination of microplastic compounds in some species of freshwater snails in Brantas River, East Java, Indonesia. Baghdad Sci. J., 22(8): 2629–2637. https://doi.org/10.21123/2411-7986.5026

Islamy, R.A.; Mutmainnah, N.; Putri, R.T.; Valen, F.S.; Kamarudin, A.S. and Hasan, V. (2025d). Cochineal powder as an Eco-Friendly carotenoid supplement to enhance coloration in Betta splendens. J. Ecol. Eng., 26(10): 116–125. https://doi.org/10.12911/22998993/205686

Islamy, R.A.; Valen, F.S.; Alfian, R.A.; Hasan, V.; Valen, F.S.; Alfian, R.A. and Hasan, V. (2025e). First record of *Xiphophorus helleri* (Heckel, 1848) (Cyprinodontiformes: Poeciliidae) from the Bangka Island, Indonesia. Ejabf.Journals.Ekb.Eg, 29(2): 1055–1065. https://doi.org/10.21608/ejabf.2025.418393

Islamy, R.A.; Valen, F.S.; Ramahdanu, D. and Hasan, V. (2025f). Presence of Midas cichlid (*Amphilophus citrinellus* Günther, 1864) (Actinopterygii : Cichlidae) on Bangka Island, Indonesia: an invasive non-native species. Egypt. J. Aquat. Biol. Fish., 29(2): 1045–1054. https://doi.org/10.21608/ejabf.2025.418392

Isroni, W.; Sari, P.D.W.; Sari, L.A.; Daniel, K.; South, J.; Islamy, R.A.; Wirabuana, P.Y.A.P. and Hasan, V. (2023). Checklist of mangrove snails (Gastropoda: Mollusca) on the coast of Lamongan District, East Java, Indonesia. Biodiversitas, 24(3). https://doi.org/10.13057/biodiv/d240341

Kurniawan, F. and Aini, Y. (2022). Mapping of changes in the utilization of marine resources in the small-scale fisheries subsector in Indonesia (2008-2017). Jurnal Perikanan Universitas Gadjah Mada, 24(1): 21. https://doi.org/10.22146/jfs.68659

Kushardanto, H.; Jakub, R.; Suherfian, W.; Subarno, T.; Ansyori, A.I.; Sara, L.; Alimina, N.; Fajriah, N.; Kardini, L.O.; De, L.R.E.; Yuliani, A.; Medianti, E.; Pradana, I.; Setiawan, H.; Muhammad, Y.; Djafar, L.F.; Box, S.; Cox, C. and Campbell, S.J. (2022). Household finances and trust are key determinants of benefits from small-scale fisheries co-management. Marine Policy, 145: 105284. https://doi.org/10.1016/j.marpol.2022.105284

Lindkvist, E.; Wijermans, N.; Daw, T.; González-Mon, B.; Girón-Nava, A.; Johnson, A.F; Van, P.I.; Basurto, X. and Schlüter, M. (2020). Navigating Complexities: Agent-Based modeling to support research, governance, and management in Small-Scale fisheries. Frontiers in Marine Science, 6. https://doi.org/10.3389/fmars.2019.00733

Luimstra, V.M.; H. Verspagen, J.M.; Xu, T.; Schuurmans, J.M. and Huisman, J. (2020). Changes in Water Color Shift Competition Between Phytoplankton Species With Contrasting Light-harvesting Strategies. Ecology. https://doi.org/10.1002/ecy.2951

Masithah, E.D. and Islamy, R.A. (2023). Checklist of freshwater periphytic diatoms in the midstream of Brantas River, East Java, Indonesia. Biodiversitas, 24(6). https://doi.org/10.13057/biodiv/d240621

Menon, A.; Sowman, M. and Bavinck, M. (2018). Rethinking capitalist transformation of fisheries in south africa and india. Ecology and Society, 23(4). https://doi.org/10.5751/es-10461-230427

Mulyadi, F.; Putri, R.T.; Purnama, S.M.; Supriyadi, S.; Czech, M.; Kamarudin, A.S.; Valen, F.S.; Hasan, V. and Islamy, R.A. (2025). Harnessing agricultural weeds as sustainable feed alternatives for herbivorous aquatic species. Egypt. J. Aquat. Biol. Fish., 29(3): 1509–1542. https://doi.org/10.21608/ejabf.2025.430132

Pita, P.; Bolognini, L. and Villasante, S. (2023). Editorial: coastal fisheries: emerging initiatives toward the sustainability objectives. Frontiers in Marine Science, 10. https://doi.org/10.3389/fmars.2023.1268711

Putra, A.; Mansyur, K.; Sulistiawati, D. and Nurdin, M. (2021). Suistainability of small scale capture fisheries in Banggai Laut Waters, indonesia. Journal of Marine Research, 10(4): 515-526. https://doi.org/10.14710/jmr.v10i4.31666

Salmi, P.; Setälä, J. and Saarni, K. (2024). Rediscovery of small-scale fisheries in the era of crises. Maritime Studies, 23(2). https://doi.org/10.1007/s40152-024-00360-6

Setyaningrum, E.; Harahab, N.; Wiadnya, D. and Sambah, A. (2024). Analysis of the vulnerability of small-scale capture fisheries in Pangpang Bay, Banyuwangi

Regency, Indonesia. Iop Conference Series Earth and Environmental Science, 1328(1): 012007. https://doi.org/10.1088/1755-1315/1328/1/012007

Setyaningrum, E.W.; Sambah, A.B. and Wiadnya, D.G.R. (2025). Sustainability of Small-Scale Capture fisheries based on coastal vulnerability in Pangpang Bay, Banyuwangi Regency, Indonesia. Jurnal Ilmiah Perikanan Dan Kelautan, 17(2): 421–437. https://doi.org/10.20473/jipk.v17i2.57946

Shen, S.C.; Kuo, C.Y. and Fang, M. (2013). Design and Analysis of an Underwater White LED Fish-Attracting Lamp and its Light Propagation. International Journal of Advanced Robotic Systems, 10(3). https://doi.org/10.5772/56126

Simmance, F.A.; Nico, G.; Funge-Smith, S.; Basurto, X.; Franz, N.; Teoh, S.J.; Byrd, K.A.; Kolding, J.; Ahern, M.; Cohen, P.J.; Nankwenya, B.; Gondwe, E.; Virdin, J.; Chimatiro, S.; Nagoli, J.; Kaunda, E.; Thilsted, S.H. and Mills, D.J. (2022). Proximity to small-scale inland and coastal fisheries is associated with improved income and food security. Communications Earth & Environment, 3(1). https://doi.org/10.1038/s43247-022-00496-5

Teh, L. and Pauly, D. (2018). Who brings in the fish? the relative contribution of small-scale and industrial fisheries to food security in southeast asia. Frontiers in Marine Science, 5. https://doi.org/10.3389/fmars.2018.00044

Tetelepta, J.; Natan, Y.; Pattikawa, J.; Uneputty, P.; Telussa, R. and Tawaulu, B. (2023). The small-scale tuna fisheries at Yaholu Village, central Maluku Regency, indonesia. Iop Conference Series Earth and Environmental Science, 1207(1): 012001. https://doi.org/10.1088/1755-1315/1207/1/012001

Tilley, A.; Lopes, J.D.R. and Wilkinson, S.P. (2020). PeskAAS: A near-real-time, open-source monitoring and analytics system for small-scale fisheries. bioRxiv (Cold Spring Harbor Laboratory). https://doi.org/10.1101/2020.06.03.131656

Villasante, S.; Tubío, A.; Gianelli, I.; Pita, P. and García-Allut, A. (2021). Ever changing times: sustainability transformations of galician small-scale fisheries. Frontiers in Marine Science, 8. https://doi.org/10.3389/fmars.2021.712819

Wiff, R.; Flores, A.; Peralta, L.; Estévez, R.; Gacitúa, S. and Gelcich, S. (2024). Monitoring data poor small-scale estuarine fisheries: a proposal from the striped mullet (*Mugil cephalus*) fishery in the rapel river, chile. Latin American Journal of Aquatic Research, 52(3): 473-485. https://doi.org/10.3856/vol52-issue3-fulltext-3145

Ye, Y.; Sunda, W.G.; Hong, H. and Shi, D. (2021). Effect of Increased CO2 on iron-light-CO2 Co-limitation of Growth in a Marine Diatom. Limnol. Oceanogr., https://doi.org/10.1002/lno.11984