JSPB: Jurnal Studi Perikanan Berkelanjutan

E-ISSN: 3123-9269
Volume 1, Number 2 (2026), Page. 14-25
Available online at:
https://ojs.ucp.ac.id/index.php/JSPB

Linking Satellite-Derived Sea Surface Temperature and Chlorophyll-a to *Decapterus* Catch Variability in the Banda Sea, Indonesia

Anisa Aulia Sabilah[1*], Yasser Arafat[1], Muhammad Hery Riyadi Alauddin[2], Mohammad Roin Najih[1], Khairul Jamil[1], Muhammad Maskur[3], Nurhikmah[1]

[1]Department of Marine Engineering, Polytechnic of Marine and Fisheries Bone, Bone Regency, South Sulawesi Province, Indonesia
[2]Department of Fisheries Cultivation Engineering, Polytechnic of Marine and Fisheries Bone, Bone Regency, South Sulawesi Province, Indonesia
[3]Department of Fishing Engineering, Polytechnic of Marine and Fisheries Bone, Bone Regency, South Sulawesi Province, Indonesia
Email correspondence author's: anisa.auliasabilah.aas@gmail.com

ARTICLE INFO
Article History
Received: 08-04-2026
Accepted: 15-05-2026

Keywords:
Sea Surface Temperature, Chlorophyll-a, *Decapterus*, Banda Sea, Satellite Remote Sensing

ABSTRACT

Small pelagic fisheries are highly sensitive to oceanographic variability, particularly sea surface temperature (SST) and primary productivity. The Banda Sea, located in eastern Indonesia, represents one of the country's most productive yet understudied pelagic fishing grounds. This study examines the relationship between satellite-derived SST and chlorophyll-a concentration and the catch variability of *Decapterus* spp. in the Banda Sea. Monthly fisheries landing data from Banda Fishing Port in 2024 were integrated with Aqua MODIS Level 3–4 SST and chlorophyll-a products using spatial analysis and multiple linear regression. SST ranged from 25.3 to 33.6 °C, while chlorophyll-a concentrations varied between 0.04 and 13.78 mg.m^{-3}, exhibiting strong seasonal patterns. The highest *Decapterus* catch (740,374 kg) occurred during the first transition season, coinciding with moderate SST and elevated chlorophyll-a levels. Regression analysis revealed strong correlations between catch and SST (r = 0.778) and chlorophyll-a (r = 0.775), indicating a significant influence of oceanographic conditions on fish availability. This study provides one of the first quantitative assessments linking satellite-derived environmental variability to small pelagic fisheries in the Banda Sea. The findings highlight the potential application of satellite-based monitoring to support ecosystem-based and climate-adaptive fisheries management in tropical marine environments.

This is an open access article uses Open Journal Systems 3.5.0.0
Published by https://ojs.ucp.ac.id

OPEN ACCESS

https://doi.org/10.65943/jspb.2026.v1.i2.77

INTRODUCTION

The Banda Sea, located between Sulawesi and the Maluku Islands, is one of Indonesia's most productive pelagic fishing grounds. Small pelagic species, particularly Decapterus spp., are vital for food security and livelihoods. The fisheries sector also contributes significantly to coastal economic development and fisheries-based communities in Indonesia (Sawir et al., 2026). Their abundance is strongly influenced by oceanographic parameters such as SST and chlorophyll-a, which regulate primary productivity and fish distribution (Chassot et al., 2011;

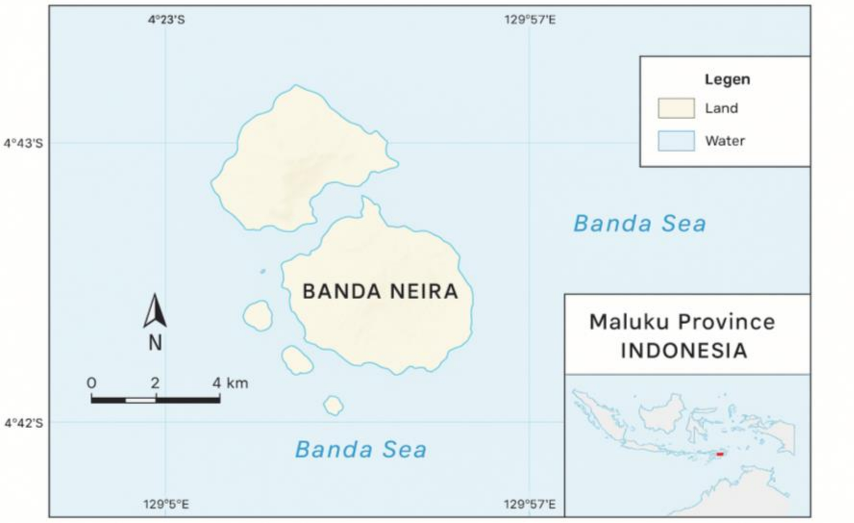
Gustantia et al., 2021). Oceanographic variability in tropical seas is largely driven by monsoonal winds, upwelling, and nutrient dynamics. SST influences fish physiology, migration, and spawning, while chlorophyll-a serves as a proxy for phytoplankton biomass, the foundation of marine food webs (Ben Salah et al., 2025). Understanding the interaction between these parameters is crucial for predicting fish abundance and supporting ecosystem-based fisheries management. Climate variability can disrupt marine ecosystem productivity and influence fish distribution patterns in Indonesian waters (Novi, Bimbi, et al., 2026).

Remote sensing technologies, especially Aqua MODIS satellite imagery, provide efficient and cost-effective tools for monitoring oceanographic conditions across large spatial scales (Lai & Zhou, 2025). While previous studies have examined SST and chlorophyll-a dynamics in Indonesian waters (Mandhalika et al., 2025; Muksin et al., 2025), limited research has quantified their direct relationship with Decapterus catch in the Banda Sea, despite its importance as part of Fisheries Management Area (WPP 714).

Despite extensive studies on sea surface temperature and chlorophyll-a dynamics in Indonesian waters, quantitative investigations linking these parameters directly to *Decapterus* catch variability in the Banda Sea remain limited. Most existing studies focus on western Indonesian waters or large pelagic species, leaving a critical knowledge gap for small pelagic fisheries in eastern Indonesia, particularly within Fisheries Management Area (WPP) 714. Addressing this gap is essential for improving fisheries forecasting and supporting sustainable management in one of Indonesia's most productive yet understudied marine regions. This study aims to analyze the seasonal distribution of SST and chlorophyll-a and evaluate their influence on *Decapterus* catch in Banda Neira waters. By integrating satellite-derived oceanographic data with fishery landing records, this research provides insights into the ecological drivers of pelagic fisheries and highlights the potential of remote sensing for sustainable fisheries management.

METHOD

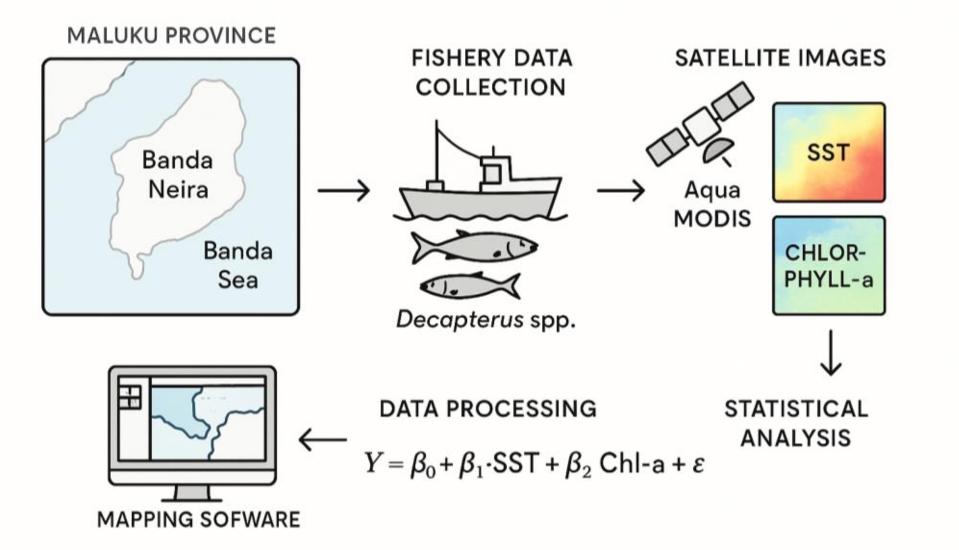
Study Area



Picture 1. Workflow of Research Method

The Banda Sea is part of Fisheries Management Area (WPP 714), encompassing Tolo Bay and surrounding waters (Picture 1). Banda Neira Islands are located in Maluku Province, characterized by monsoonal climate with four distinct seasons: west monsoon (December–February), transition season I (March–May), east monsoon (June–August), and transition season II (September–November). The Banda Sea is strongly influenced by the Indonesian

Throughflow (ITF) and seasonal upwelling, which play a crucial role in regulating nutrient availability and primary productivity in the region. These characteristics make the area suitable for examining interactions between environmental variability and pelagic fisheries dynamics.



Picture 2. Workflow of research method

Fishery Data Collection

Monthly landing data of *Decapterus* spp. were obtained from Banda Fishing Port. The data represent aggregated catches from small-scale and semi-industrial fishing vessels operating in the surrounding Banda Sea. Total landed weight (kg) was used as a proxy for relative fish abundance, a common approach in fisheries–environment studies when fishery-independent data are unavailable. *Decapterus* spp. were selected as the target species due to their ecological importance and economic value in the Banda Sea. As a small pelagic fish, *Decapterus* responds rapidly to changes in oceanographic conditions, making it an appropriate indicator species for examining environment–fishery relationships (Apriansyah et al., 2024; Yuniar et al., 2025).

Satellite-Derived Oceanographic Data

Satellite remote sensing data were used to characterize environmental conditions in the study area. Monthly sea surface temperature (SST) and chlorophyll-a concentration were obtained from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Aqua satellite.

SST data were used to represent thermal conditions that influence fish physiology, behavior, and habitat suitability, while chlorophyll-a concentration served as a proxy for phytoplankton biomass and primary productivity (Hazen et al., 2018). Both variables were spatially averaged over the fishing grounds to match the temporal resolution of the fishery data (Setiawati et al., 2023).

The use of Aqua MODIS Level 3–4 data allows for consistent, synoptic, and long-term observation of oceanographic variability, which is particularly valuable in data-limited tropical fisheries.

Data Processing

Satellite-derived SST and chlorophyll-a data were processed using SeaDAS software, followed by spatial analysis in ArcGIS. Monthly composite images were generated at a spatial resolution of 4 km. Mean SST and chlorophyll-a values were extracted from the fishing ground area surrounding Banda Neira using zonal statistics.

Statistical Analysis

Multiple linear regression analysis was employed to assess the relationship between SST, chlorophyll-a, and catch yields. The regression model was expressed as (Montgomery et al., 2021):

$$Y = \beta_0 + \beta_1 \cdot SST + \beta_2 \cdot Chl - a + \epsilon$$

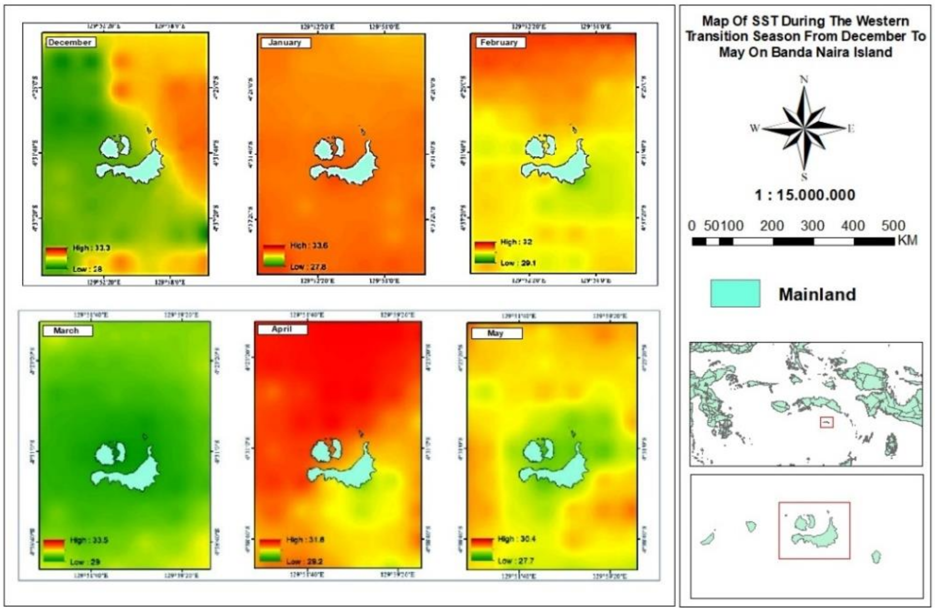
where Yrepresents monthly catch (kg), SST is sea surface temperature (°C), and Chl-a is chlorophyll-a concentration (mg.m^{-3}). Model assumptions, including normality and independence of residuals, were tested to ensure validity. Correlation coefficients (r) were used to evaluate the strength of relationships.

Prior to regression analysis, multicollinearity between SST and chlorophyll-a was evaluated using Variance Inflation Factor (VIF). Although linear regression was applied, potential non-linear ecological responses were considered in the interpretation of results.

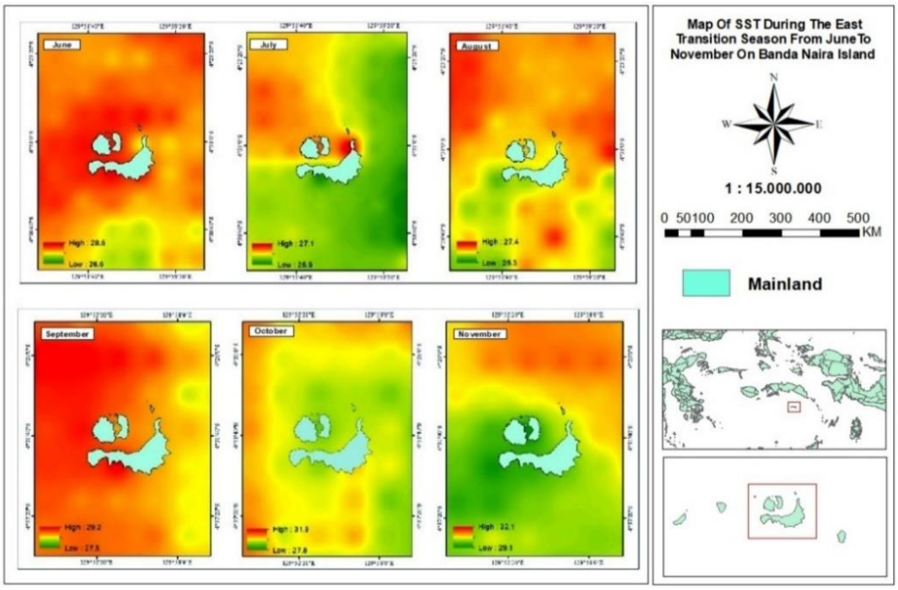
RESULT AND DISCUSSION

Results

Seasonal Variability of Sea Surface Temperature



Picture 3. Map of SST from December to May in Banda Sea



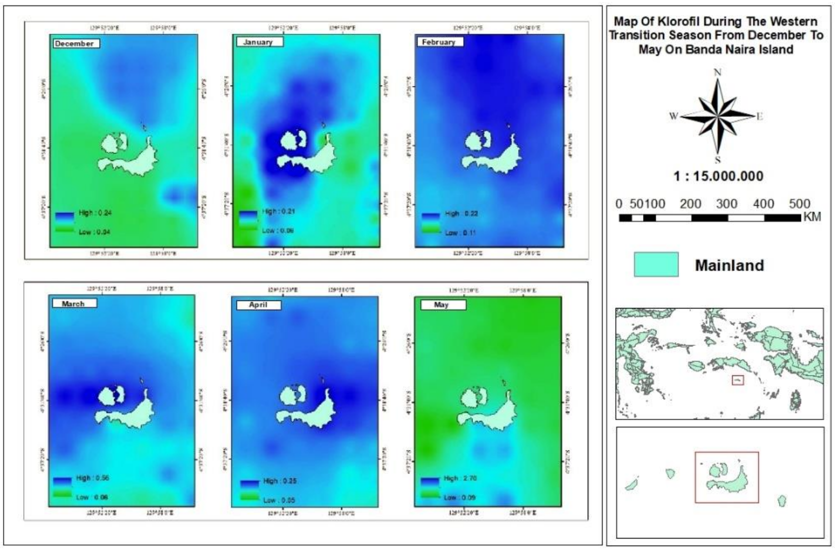
Picture 4. Map of SST from June-November in Banda Sea

Sea surface temperature (SST) in the Banda Sea during 2024 exhibited clear seasonal variability, ranging from 25.3 to 33.6 °C (Picture 3 and 4). The highest SST values were recorded during the west monsoon season (December–February), with a peak of 33.6 °C observed in January. This period is characterized by weak wind stress and increased solar radiation, leading to enhanced surface heating and strong vertical stratification of the water column.

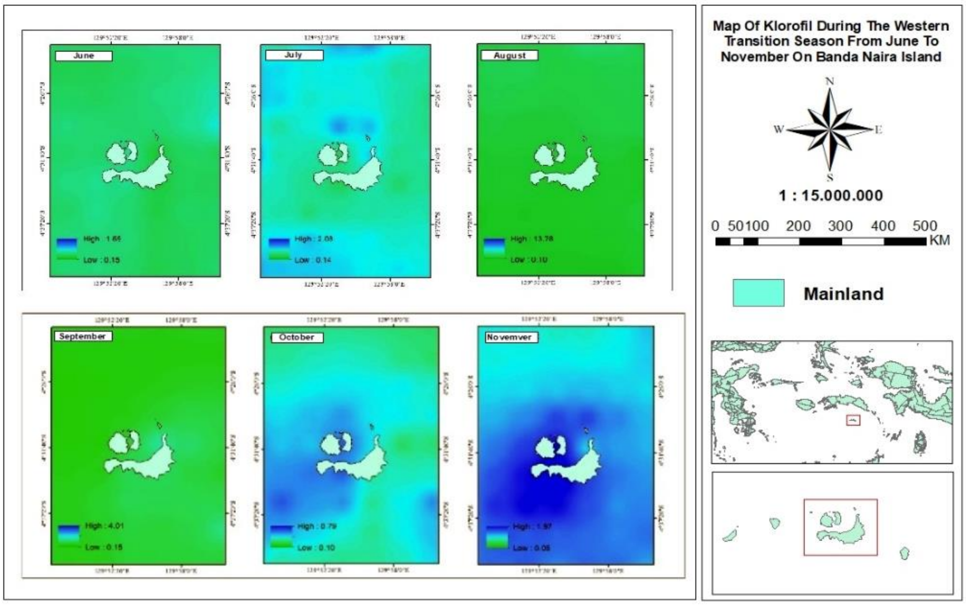
In contrast, the lowest SST values occurred during the east monsoon season (June–August), reaching a minimum of 25.3 °C in August. The marked cooling during this period reflects intensified southeasterly winds that enhance vertical mixing and promote upwelling of cooler subsurface waters. Such SST reductions are commonly associated with increased nutrient supply to surface waters in the Banda Sea and surrounding eastern Indonesian seas (Sprintall et al., 2019; Gordon et al., 2022).

Spatially, lower SST values were more pronounced in offshore and southern Banda Sea waters during the east monsoon, indicating the influence of regional-scale oceanographic processes, including the Indonesian Throughflow and wind-driven circulation.

Seasonal Variation of Chlorophyll-a Concentration



Picture 5. Map of Chl-a from December to May in Banda Sea



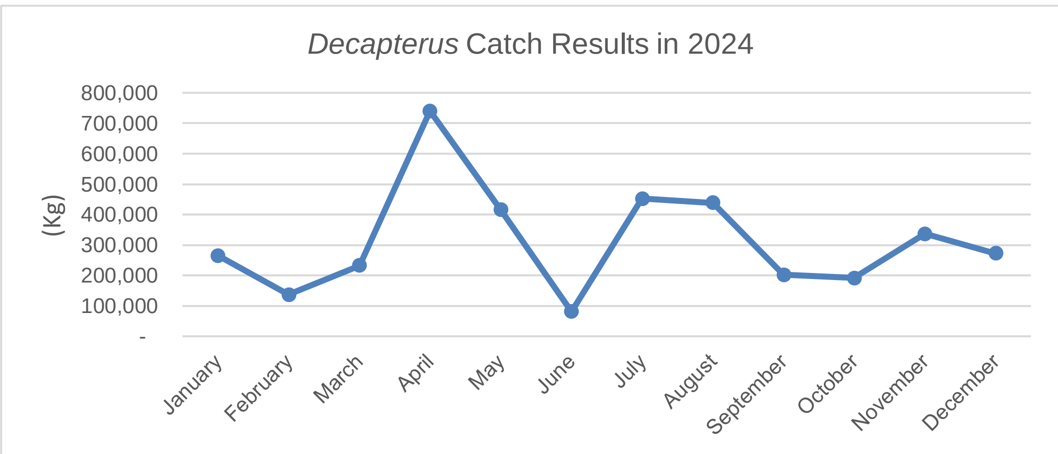
Picture 6. Map of Chl-a from June-November in Banda Sea

Chlorophyll-a concentrations showed substantial temporal variability, ranging from 0.04 to 13.78 mg.m-3 throughout the study period (Picture 5 and 6). Low chlorophyll-a values (<0.2 mg.m-3) dominated during the west monsoon, reflecting oligotrophic conditions associated with strong stratification and limited nutrient input to surface waters.

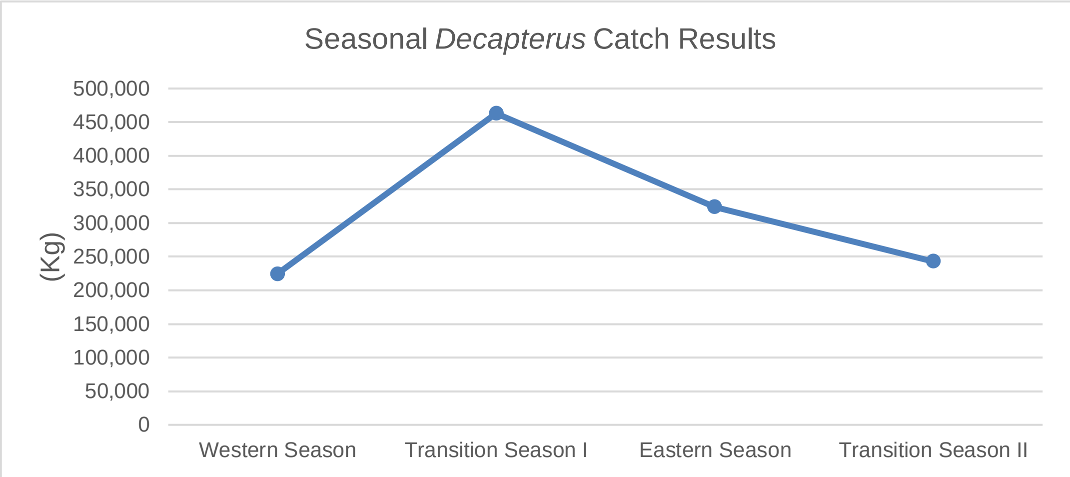
In contrast, elevated chlorophyll-a concentrations were observed during the east monsoon and transition season I, particularly in July and September. These peaks coincide with periods of intensified upwelling and vertical mixing, which transport nutrient-rich subsurface waters into the euphotic zone, stimulating phytoplankton growth. Chlorophyll-a concentrations exceeding 1 mg.m-3 indicate highly productive conditions, which are relatively rare in tropical open-ocean environments but characteristic of upwelling-influenced regions such as the Banda Sea (Ware et al., 2016; Chen et al., 2021).

The spatial distribution of chlorophyll-a revealed higher concentrations near productive fishing grounds surrounding Banda Neira, suggesting that localized oceanographic processes enhance primary productivity in these areas.

Variability of *Decapterus* Catch



Picture 7. Graph of Decapterus Cath Results in 2024



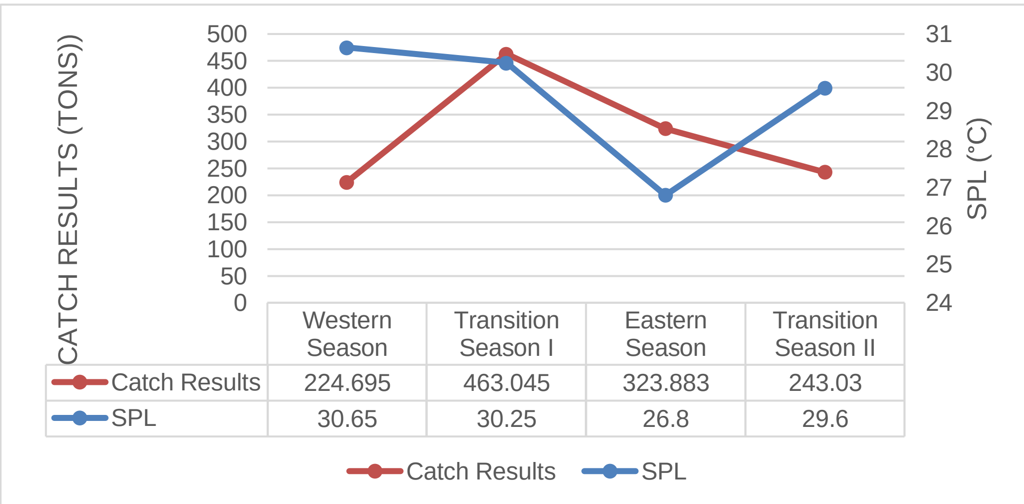
Picture 8. Graph of Seasonal *Decapterus* Catch Results

Total annual landings of *Decapterus* spp. at Banda Fishing Port reached 3,763,961 kg in 2024, indicating the continued importance of small pelagic fisheries in the region (Picture 7). Monthly catch data exhibited pronounced variability, with the highest catch recorded in April (740,374 kg) during transition season I, while the lowest catch occurred in June (80,865 kg) during the early east monsoon.

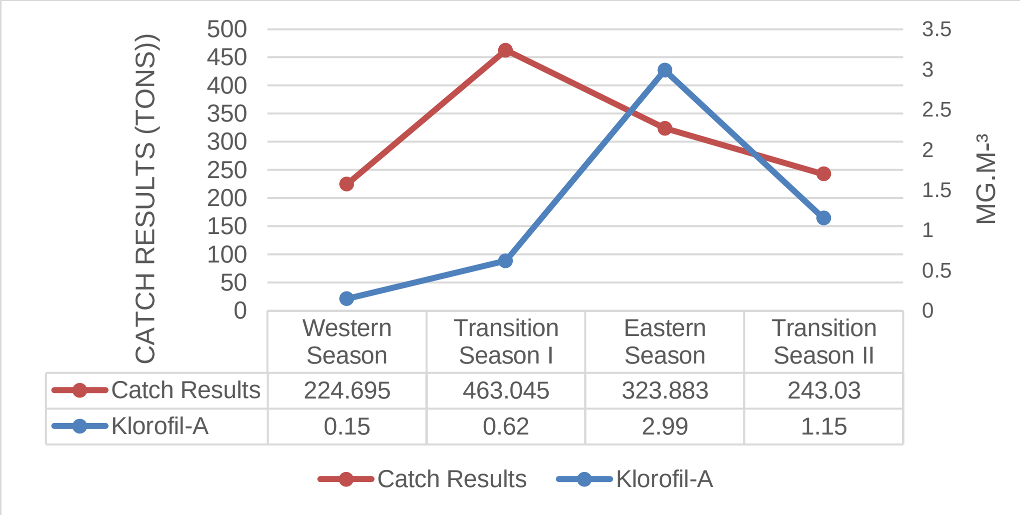
Seasonal aggregation of catch data showed that transition season I contributed the highest cumulative catch compared to other seasons, followed by the east monsoon and transition season II (Picture 8). The west monsoon consistently yielded the lowest catches. This pattern suggests that optimal fishing conditions for *Decapterus* occur during periods when oceanographic conditions balance enhanced productivity with suitable thermal habitat.

The observed mismatch between peak chlorophyll-a concentration and maximum catch indicates a potential time lag between primary production and fish availability, reflecting trophic transfer processes from phytoplankton to zooplankton and subsequently to pelagic fish populations.

Relationship Between SST, Chlorophyll-a, and Catch



Picture 9. Graph of relationship between SST dan Catch



Picture 10. Graph of relationship between Chl-a dan Catch

Multiple linear regression analysis revealed strong positive correlations between *Decapterus* catch and SST (r = 0.778) as well as chlorophyll-a concentration (r = 0.775) (Picture 9 and 10). The ANOVA test confirmed that both environmental variables significantly influenced catch variability ($p < 0.05$).

The strength of these relationships indicates that *Decapterus* distribution and availability are closely linked to seasonal oceanographic dynamics. Moderate SST conditions combined with elevated chlorophyll-a concentrations appear to provide favorable habitat conditions, enhancing feeding efficiency and fish aggregation. Although the regression model assumes linear relationships, the observed patterns suggest more complex ecological responses, potentially involving threshold effects and temporal lags.

Discussion

Oceanographic Control of Primary Productivity

The seasonal variability of chlorophyll-a concentration observed in this study reflects the strong influence of monsoon-driven oceanographic processes in the Banda Sea. Elevated chlorophyll-a levels during the east monsoon and transition season I indicate enhanced primary productivity associated with intensified wind forcing, vertical mixing, and upwelling processes that transport nutrient-rich subsurface waters into the euphotic zone (Sprintall et al., 2019; Gordon et al., 2022).

Recent studies in eastern Indonesian waters have shown that monsoon-induced upwelling and current variability play a dominant role in regulating phytoplankton biomass and productivity, particularly in semi-enclosed seas such as the Banda Sea (Pratama et al., 2025; Apriliani et al., 2024). These productivity pulses are especially important in tropical marine ecosystems, where background nutrient levels are typically low and biological production is highly episodic.

Consequently, the Banda Sea functions as a seasonally productive system, characterized by short periods of elevated biological activity capable of sustaining both small and large pelagic fish populations. Such seasonally driven productivity regimes are increasingly recognized as key features of tropical fisheries systems influenced by monsoon variability (Yuniar et al., 2024).

Bottom-Up Control of *Decapterus* Fisheries

The strong association between chlorophyll-a concentration and *Decapterus* catch supports the concept of bottom-up ecological control in pelagic ecosystems, whereby increased primary productivity enhances food availability at higher trophic levels (Ware et al., 2016; Chen et al., 2021). Elevated phytoplankton biomass promotes zooplankton production, which constitutes the primary food source for small pelagic fishes such as *Decapterus* spp., ultimately leading to increased fish biomass and catchability.

The highest catches recorded during transition season I, rather than during periods of peak chlorophyll-a concentration, suggest the presence of a trophic time lag between phytoplankton production and fish aggregation. This delay reflects the time required for energy transfer through the pelagic food web, from primary producers to zooplankton and subsequently to planktivorous fish (Chen et al., 2021; Yuniar et al., 2024).

Such time-lagged responses have been widely documented in recent fisheries–environment studies and highlight the importance of considering temporal offsets when using satellite-derived chlorophyll-a as an indicator for fisheries prediction and management (Syahdan et al., 2023; Putri et al., 2022).

Influence of Sea Surface Temperature on Habitat Suitability

Sea surface temperature plays a critical role in regulating fish physiology, behavior, and spatial distribution. In this study, extremely high SST values during the west monsoon were associated with lower *Decapterus* catches, suggesting that thermal conditions may exceed the optimal habitat range for the species. Elevated SST can induce physiological stress, increase metabolic demands, and alter vertical and horizontal habitat use, ultimately reducing fish aggregation and catchability (Pörtner et al., 2017; Tanaka et al., 2019).

High SST conditions are also associated with increased water-column stratification, which suppresses nutrient mixing and limits primary productivity, thereby indirectly reducing prey availability for pelagic fish (Free et al., 2019; Gordon et al., 2022). Conversely, moderate SST values observed during transition season I appear to provide favorable thermal conditions that support feeding efficiency and schooling behavior.

Similar relationships between intermediate SST ranges and enhanced pelagic fish catch have been reported in recent studies across tropical and subtropical fisheries, emphasizing the importance of thermal habitat suitability in determining fishing success (Syahdan et al., 2023; Pratama et al., 2025).

Implications of Climate Variability and Change

The sensitivity of *Decapterus* catch to SST and chlorophyll-a variability underscores the vulnerability of small pelagic fisheries to climate-driven oceanographic change. Recent assessments indicate that ongoing ocean warming and increasing variability in monsoon systems may alter productivity regimes in tropical seas, potentially shifting the timing, location, and magnitude of pelagic fish availability (Free et al., 2019; IPCC, 2023).

In the Banda Sea, projected increases in SST and changes in wind patterns could weaken seasonal upwelling and disrupt established productivity cycles, posing challenges for fisheries that depend on predictable environmental conditions (Sprintall et al., 2019; Gordon et al., 2022). Understanding environment–fish relationships at seasonal scales is therefore critical for anticipating climate impacts and developing adaptive management strategies.

Satellite-based monitoring offers a valuable and cost-effective approach for tracking climate-related environmental change and supporting dynamic fisheries management in data-limited tropical regions (Hobday et al., 2016; Chen et al., 2021).

Relevance for Fisheries Oceanography and Management

The integration of satellite-derived SST and chlorophyll-a data with fisheries landing records demonstrates the practical value of remote sensing for fisheries oceanography. By identifying periods of favorable environmental conditions, such approaches can support fishing-ground forecasting, optimize fishing effort, and reduce fuel consumption, thereby minimizing environmental and economic costs (Hobday et al., 2016; Kittinger et al., 2017).

Furthermore, the findings reinforce the importance of incorporating environmental indicators into fisheries management frameworks, particularly for small pelagic fisheries that respond rapidly to oceanographic variability. The application of satellite-based indicators aligns with ecosystem-based fisheries management principles and enhances the resilience of fisheries systems under increasing climate variability and change (Free et al., 2019; Yuniar et al., 2024).

CONCLUSION

Seasonal variations in SST and chlorophyll-a significantly influenced *Decapterus* catch in the Banda Sea. The first transition season yielded the highest catch, coinciding with elevated chlorophyll-a concentrations, while the west monsoon season recorded the lowest catch. Regression analysis confirmed strong relationships between oceanographic parameters and catch abundance, underscoring the importance of phytoplankton productivity in sustaining pelagic fisheries.

This study demonstrates the utility of satellite-derived data for identifying potential fishing grounds, offering a cost-effective approach to improve fishing efficiency and support sustainable fisheries management in Indonesia's tropical waters. The application of satellite-derived SST and chlorophyll-a offers a practical tool for developing early warning systems for fisheries productivity and supports ecosystem-based and climate-adaptive fisheries management in tropical marine ecosystems.

REFERENCES

Apriansyah, A., Atmadipoera, A. S., Nugroho, D., & Noviyanti, R. (2024). Shelf oceanography and small pelagic fishes in the Java Sea. E3S Web of Conferences, 483, 01010. https://doi.org/10.1051/e3sconf/202448301010

Apriliani, I. M., Sambah, A. B., Wiadnyana, N. N., & Hidayat, R. (2024). Seasonal variability of chlorophyll-a and its relationship with monsoon-driven upwelling in eastern Indonesian waters. Regional Studies in Marine Science, 68, 103263. https://doi.org/10.1016/j.rsma.2024.103263

Ben Salah, A., El Amrani, M., Zellou, B., Seaid, M., & El Mocayd, N. (2025). Copula-based modeling of sea surface temperature and chlorophyll-a distributions. Mathematical Geosciences. https://doi.org/10.1007/s11004-025-10201-9

Cahyanti, V., Heltria, S., & Depison, D. (2025). Spatio-temporal variability of sea surface temperature, salinity, and chlorophyll-a on large pelagic fish catch in West Sumatra waters. International Journal of Progressive Sciences and Technologies, 54(1), 1-12.

Chen, I. C., Hsieh, C. H., & Lee, M. A. (2021). Bottom-up control of small pelagic fish production under climate-driven oceanographic variability. Fisheries Oceanography, 30(4), 412-426. https://doi.org/10.1111/fog.12532

Free, C. M., Thorson, J. T., Pinsky, M. L., et al. (2019). Impacts of historical warming on marine fisheries production. Science, 363(6430), 979-983.

https://doi.org/10.1126/science.aau1758

Gordon, A. L., Napitu, A., Pujiana, K., & Agustiadi, T. (2022). Seasonal and interannual variability of upwelling in the Banda Sea. Journal of Geophysical Research: Oceans, 127(4), e2021JC017950. https://doi.org/10.1029/2021JC017950

Gustantia, N., Osawa, T., Dharma, I. G. B. S., & Adnyana, W. S. (2021). Relationship between chlorophyll-a and sea surface temperature with Sardinella lemuru catch in Bali Strait. Ecotrophic: Journal of Environmental Science, 15(1), 12-22. https://doi.org/10.24843/EJES.2021.v15.i01.p02

Hazen, E. L., et al. (2018). Marine top predators as climate and ecosystem sentinels. Frontiers in Ecology and the Environment, 16(10), 565-574. https://doi.org/10.1002/fee.1937

Hobday, A. J., Cochrane, K. L., Downey-Breedt, N., et al. (2016). Climate impacts and adaptation responses in marine fisheries. ICES Journal of Marine Science, 73(9), 2299-2314. https://doi.org/10.1093/icesjms/fsw171

IPCC. (2023). Climate Change 2023: Synthesis Report. Intergovernmental Panel on Climate Change.

Kittinger, J. N., Teh, L. C. L., Allison, E. H., et al. (2017). Committing to socially responsible seafood. Science, 356(6341), 912-914. https://doi.org/10.1126/science.aam9969

Lai, Q., & Zhou, W. (2025). Multiscale variation analysis of sea surface temperature in the fishing grounds of pelagic fisheries. Frontiers in Marine Science, 12, 1567030. https://doi.org/10.3389/fmars.2025.1567030

Mandhalika, V., Semedi, B., Sambah, A. B., & Leksono, A. S. (2025). Influence of sea surface temperature and chlorophyll-a on the abundance of dolphinfish (Coryphaena hippurus) in southern Java waters. Journal of Fisheries and Marine Research, 9(1), 45-56. https://doi.org/10.21776/ub.jfmr.2025.009.01.4

Montgomery, D. C., Peck, E. A., & Vining, G. G. (2021). Introduction to Linear Regression Analysis (6th ed.). Wiley. https://doi.org/10.1002/9781119578727

Muksin, D., Rumagia, F., Syukur, K., et al. (2025). Effect of sea surface temperature and chlorophyll-a on yellowfin tuna catch in North Maluku waters. Jurnal Kelautan Tropis, 28(3), 293-307. https://doi.org/10.14710/jkt.v28i3.29397

Novi, Bimbi, Wijaya, F. H., & Risal, A. W. (2026). Review Journal: Sustainable Fishery Supply Chain in Indonesia. *Jurnal Studi Perikanan Berkelanjutan*, *1*(2), 1–7. https://doi.org/10.65943/jspb.2026.v1.i2.55

Pratama, M. A., Sari, R. P., & Ningsih, N. S. (2025). Monsoon-driven variability of productivity and fisheries in the Banda Sea. Fisheries Oceanography, 34(1), 45-60.

Putri, A. R., Sambah, A. B., & Hidayati, N. (2022). Time-lag response of small pelagic fish catch to chlorophyll-a variability in Indonesian waters. Marine Policy, 138, 104988. https://doi.org/10.1016/j.marpol.2022.104988

Sawir, M., Sani, A. N. M., & Bahda, M. A. (2026). Marketing Analysis of Barracuda Fish Pempek (Case Study of DapurMakassar) in Makassar City. *Jurnal Studi Perikanan Berkelanjutan*, *1*(2), 8–13. https://doi.org/10.65943/jspb.2026.v1.i2.55

Setiawati, M. D., et al. (2023). Integration of satellite-derived oceanographic parameters and fishery statistics for pelagic fisheries assessment in Indonesian waters.

Regional Studies in Marine Science, 65, 103081. https://doi.org/10.1016/j.rsma.2023.103081

Sprintall, J., Gordon, A. L., Koch-Larrouy, A., et al. (2019). The Indonesian seas and their role in the coupled ocean-climate system. Nature Geoscience, 12, 567-576. https://doi.org/10.1038/s41561-019-0399-x

Syahdan, M., Sari, N. R., & Fitriani, D. (2023). Environmental drivers of small pelagic fisheries in eastern Indonesian waters. Ocean & Coastal Management, 231, 106369. https://doi.org/10.1016/j.ocecoaman.2023.106369

Ware, D. M., & Thomson, R. E. (2016). Bottom-up ecosystem trophic dynamics determine fish production. Journal of Marine Systems, 161, 31-41. https://doi.org/10.1016/j.jmarsys.2016.03.002

Yuniar, A. T., Wisha, U. J., & Nugroho, D. (2024). Seasonal productivity and small pelagic fish response in monsoon-dominated Indonesian seas. Regional Studies in Marine Science, 65, 103140. https://doi.org/10.1016/j.rsma.2023.103140

Yuniar, A., Zainuddin, M., Safruddin, Mustapha, M. A., Hidayat, R., Srioktoviana, S. K., & Mirham, D. (2025). Estimation Potential Fishing Zones of Decapterus ruselli Using Oceanography-Based Remote Sensing Data in the Bone Gulf, Indonesia. Egyptian Journal of Aquatic Biology and Fisheries, 29(3), 2971-2982. https://doi.org/10.21608/ejabf.2025.434405