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# CHANGES IN SEASON AND THE EFFECTS ON THE FISHER'S INCOME: A CASE STUDY OF GILI SULAT-GILI LAWANG, INDONESIA

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**ABSTRACT**

Fishing is a primary livelihood and a key contributor to the local economy in Gili Sulat-Gili Lawang, Indonesia. However, seasonal changes significantly affect a fishers' catch. This study aims to analyse the effects of seasonal variations on a fishermen's income. Primary data were collected through face-to-face interviews with 85 randomly selected respondents from four villages and analysed using the t-test. Results indicate that, although the same fishing gears were employed in both the west and east monsoons, average gross income was approximately 19% higher during the west monsoon. Of the eight types of fishing gear, only gill nets and cast nets showed significant differences, as they primarily targeted pelagic species that are more abundant during the rainy seasons due to an increase in surface chlorophyll-a concentrations. These results highlight the vulnerability of fishing livelihoods to income fluctuations and underscore the need for adaptive management. Strategies such as gear diversification, alternative livelihoods, and participatory governance are crucial in building resilience and ensuring the sustainability of small-scale fisheries.



## Introduction

Situated within the Coral Triangle, Indonesia is recognised as one of the global centres of marine biodiversity (Ceccarelli *et al*., 2022). Its coral reef ecosystems are home to approximately 70% of the world's coral species and 40% of reef fish species (Asaad *et al*., 2018). Reflecting this ecological richness, Indonesia produced 12.014 million metric tonnes of fishery products in 2022 (Ministry of Marine Affairs and Fisheries, 2022). However, fisheries production in Indonesia is highly influenced by seasonal variations, particularly the west monsoon (December to May) and the east monsoon (June to November) (Wiyono *et al*., 2024). The east monsoon signifies the dry season while the west monsoon brings the rainy season.

Seasonal differences create catch variability and income fluctuations among fishermen. Harvests are typically lower during the west monsoon season and higher in the east monsoon season, as the dry season brings calmer seas and milder winds that facilitate more fishing. Conversely, heavy rainfall and rougher seas throughout the rainy season often restricts fishing activities (Lukum *et al*., 2023). Moreover, Fitriani *et al*. (2021) stated that seasonal transitions cause shifting monsoon patterns and increasingly unpredictable marine conditions. In other words, unpredictable monsoons reduce fishing days, lowering income.

Recent studies have confirmed that seasonal dynamics contribute to income fluctuations among small-scale fishers. For example, a study by Ulva *et al*. (2020) in Teluk Pandan District reported higher earnings during the east monsoon compared to the west monsoon.

Similar findings were observed by Saleh *et al*. (2022), who found that fishers on Pasaran Island, Bandar Lampung City, also earned more during the dry season. By comparison, Metkono *et al*. (2022) documented the opposite trend in Nualunat Village, South Central Timor Regency, where income peaked during the west monsoon. These differences highlight the role of species availability, as cold-water species tend to dominate in the rainy season while warm-water species are more abundant in the dry season.

Beyond local seasonal cycles, large-scale climatic phenomena such as the El Niño–Southern Oscillation (ENSO) further influence fisheries productivity by altering sea surface temperatures, chlorophyll concentrations, and fish migration patterns across the Indo-Pacific. These dynamics not only exacerbate the risks faced by small-scale fisheries but also highlight their vulnerability to climate variability and change. Previous research highlights that strengthening resilience requires adaptive strategies, including gear diversification, alternative livelihoods, and community-based management (Allison & Ellis, 2001; Badjeck *et al*., 2010). Integrating these perspectives is crucial for understanding how seasonal and climatic variability interact to shape the socioeconomic well-being of fishing communities.

Against this backdrop, this study investigates how seasonal variation affects fishermen' income in Gili Sulat-Gili Lawang, Indonesia, where fishing remains a primary livelihood and income patterns may differ from other regions. In this area, relatively higher earnings can occur during the west monsoon due to its unique geographic setting. As noted by Tatas (2013), dense mangrove coverage shields the islands from strong wave impacts, keeping wave heights stable at about one metre throughout the year, with current speeds around 0.25 m/s. These conditions allow fishers to operate in the surrounding waters during both the west and east monsoons, ensuring continuous access to fishing grounds. Nevertheless, income levels still fluctuate between seasons, reflecting broader environmental and ecological variability. In light of these dynamics, the objective of this study is to analyse the impact of seasonal changes on the income of fishers in Gili Sulat-Gili Lawang, Indonesia.

## Materials and Methods

### *Area of Study*

This study was conducted in Gili Sulat-Gili Lawang, which is located in Sambelia, East Lombok, West Nusa Tenggara, in Indonesia. Gili Sulat is geographically located at 8°19'15.7"S, 116°43'04.6"E and Gili Lawang at 8°17'51.7"S, 116°41'54.2"E. The location map of Gili Sulat-Gili Lawang is shown in Figure 1.

### *Source of Data*

Data was collected through face-to-face interviews conducted by trained enumerators, who were local residents with an academic background specialising in fisheries. Their familiarity with the local language and fisheries-related issues facilitated effective communication with respondents and the accurate administration of the structured questionnaires. The interviews were carried out between June and September 2023.

As the interview sessions depended entirely on the fishermen's information provided by the respondents, in order to ensure that the information gathered was from both seasons, the information gathered was based on the information recorded the previous year (i.e., 2022 data). Although the reference period for income data was 2022 and the interviews were conducted in 2023, recall bias was mitigated using several strategies. Respondents were guided to recall their income based on significant events and seasonal patterns in fishery activities, which were well-remembered in the community.

To fulfil the sample size requirements i.e., the number of respondents required for the interview, the Slovin formula was used. The Slovin formula was chosen due to its practicality and suitability where the total population size is known but little is known about the population's

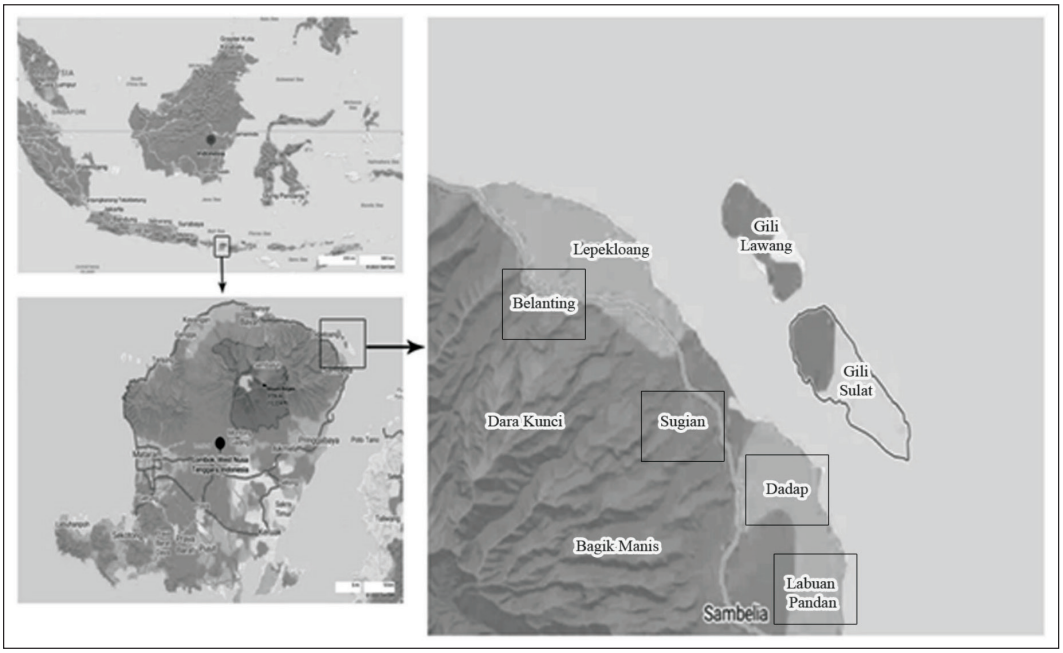


Figure 1: Study area (Gili Sulat-Gili Lawang, West Nusa Tenggara, Indonesia)

behaviour or variability, offering a starting point for sample size determination in the absence of detailed data.

Moreover, the formula has been used across various fields, including market research, social sciences, and quality control to estimate sample sizes that balance accuracy and practicality (Mukti, 2025). At the end of the calculation, 85 people were selected as respondents and divided proportionately across each village (i.e., 15 respondents from Dadap, 5 from Belanting, 22 from Sugian, and 43 from Labuan Pandan). Although the sample size was relatively small, it meets the minimum requirements for statistical validity. Respondents were randomly selected based on the criterion that they had at least one year of fishing experience. To ensure the accuracy of the information collected, only the vessel heads or captains were interviewed.

### *Data Analysis*

Data was analysed using a t-test and performed using an IBM SPSS Statistics 26. The t-test was used to determine whether there were statistically significant differences in the average income of fishermen across different seasons, based on the type of fishing gear used. This test was chosen because it is suitable for small sample sizes and relies on the sample mean and variance, rather than requiring data from the entire population.

Prior to the t-test analysis, an estimation of the fishermen's income was conducted. This study measured income using gross income, which was calculated by multiplying the total income from a single fishing trip by the number of trips made in one month. Since the focus of this study is to assess income specifically from fishing activities, only revenue generated through fishing was considered in the gross income calculation. In other words, gross income refers to the total earnings from fishing activities, without any deductions for expenses or taxes.

Gross income was used as the primary income measure because detailed and reliable data on fishing costs were not consistently available across respondents. Many fishermen do not maintain formal records of expenses and

some operational costs are shared among crew members or covered in-kind, making accurate estimation of net income challenging.

Furthermore, the study's main objective was to assess the overall revenue-generating capacity of fishing activities rather than profitability. While net income would provide a more precise measure of economic return, the absence of accurate cost data could lead to misleading results. This limitation is acknowledged and the exclusion of net income analysis is noted as a potential area for future research when more reliable cost data can be collected.

## Results and Discussion

### *Demographic of Fishermen*

Table 1 presents the demographic characteristics of the respondents. Majority of fishermen were between 30 and 39 years old (40%) and had less than nine years of fishing experience (32%). In terms of education, the majority completed primary school (54%), followed by secondary school (41%). Only a small portion had had tertiary education or had no formal education, each accounting for 2% of the total number of respondents.

Table 1: Demographics of fishermen in Gili Sulat-Gili Lawang, Indonesia

| The Characteristics of the Respondent | | Frequency | Percentage |
|---|---|---|---|
| Age | 20-29 | 14 | 16% |
| | 30-39 | 34 | 40% |
| | 40-49 | 17 | 20% |
| | 50-59 | 11 | 13% |
| | ≥ 60 | 9 | 11% |
| Experience | 0-9 | 27 | 32% |
| | 10-19 | 19 | 22% |
| | 20-29 | 21 | 25% |
| | 30-39 | 11 | 13% |
| | 40-49 | 5 | 6% |
| | ≥ 50 | 2 | 2% |
| Education | No formal education | 2 | 2% |
| | Primary school | 46 | 54% |
| | Lower-secondary education | 22 | 26% |
| | Upper-secondary education | 13 | 15% |
| | Tertiary education | 2 | 2% |
| Marital status | Married | 80 | 94% |
| | Single | 3 | 4% |
| | Divorced | 2 | 2% |
| Family member | Small family (up to 3) | 34 | 40% |
| | Medium family (4-6) | 49 | 58% |
| | Large family (7 and above) | 2 | 2% |

n = 85

Of the 85 respondents, 94% were married, 4% were single, and 2% were divorced. Household sizes also varied, with 58% have medium-sized families, 40% have small families, and 2% have large families.

### *A Fisher's Income*

First, the data in was tested for normality. According to Sukono *et al*. (2021), the purpose of a normality test is to determine whether the data distribution follows or approximates a normal distribution. This study employed the Kolmogorov-Smirnov test to assess normality. The test was conducted using the total income of the fishermen, categorised by fishing gear type and season. Results showed a significance value of 0.074, indicating that the data was indeed normally distributed. As stated by Pratama and Permatasari (2021), a significance level above 0.05 meets the assumption of normality, allowing the analysis to proceed to subsequent tests. The results of the normality test are presented in Table 2.

Table 3 presents the average gross income of the fishermen in Gili Sulat-Gili Lawang by season. During the west monsoon, income ranged between Indonesian Rupiah (IDR) 7,333,333 and IDR 64,659,375 per month, compared with between IDR 6,166,667 and IDR 53,125,000 over the east monsoon period. Overall, higher earnings were recorded in the west monsoon for most gear types, except handlines and trolling lines. Notably, cast nets generated the highest returns in the west monsoon but the lowest in the east monsoon.

In terms of fishing gear performance by season, cast nets produced the highest income during the west monsoon, followed by longlines, gill nets, spear guns, handlines, trolling lines, trammel nets, fishing rods, and scoop nets. Meanwhile, during the east monsoon, trolling lines produced the highest income, followed by longlines, trammel nets, gill nets, handlines, spear guns, cast nets, fishing rods, and scoop nets.

Moreover, a t-test was used to examine income differences between the west and east monsoons. The results revealed significant variation for gill nets ($p = 0.004$) and cast nets ($p = 0.040$), both below the 0.05 threshold.

Table 2: Normality test Kolmogorov-Smirnov test

| | Kolmogorov-Smirnov Test | | | |
|---|---|---|---|---|
| | **Statistic** | **Df.** | **Sig.** | **Decision** |
| Income | 0.050 | 294 | 0.074 | Normal distributed |

Table 3: Average gross income per month by fishing gear type and season in Gili Sulat-Gili Lawang, Indonesia

| **Type of Fishing Gear** | **Average of Gross Income (IDR)** | | |
|---|---|---|---|
| | **West Monsoon** | **East Monsoon** | **Sig.** |
| Handline | 23,336,711 | 23,817,763 | 0.934 |
| Gill net | 48,159,643 | 25,480,603 | 0.004 |
| Fishing rod | 9,663,000 | 8,987,500 | 0.940 |
| Spear gun | 28,421,429 | 13,424,107 | 0.386 |
| Longline | 51,174,784 | 46,481,012 | 0.780 |
| Scoop nets | 7,333,333 | 6,166,667 | 0.751 |
| Cast nets | 64,659,375 | 12,047,167 | 0.040 |
| Trolling line | 17,595,000 | 53,125,000 | 0.183 |

These findings indicate that fishermen who used these gears earned significantly higher income during the west monsoon compared to the east monsoon.

In this case, the fishermen's income in Gili Sulat-Gili Lawang was comparable to findings by Fitri *et al*. (2022), who reported an average gross income of approximately IDR 42,997,135 per month in Tangkolak Sukakerta, Indonesia. The variations in income between regions may be attributed to the differing adaptations of fish species to seasonal environmental changes. According to Dida *et al*. (2016), the west monsoon, which occurs from October to March is characterised by higher rainfall intensity.

Several studies have shown that the abundance of certain marine biota increases during the rainy season. For instance, Ridho *et al*. (2019) observed peak species density in the waters of Lebak Jungkal in February, coinciding with the rainy season. Many fish also spawn during this time, supported by near-neutral seawater pH in coral reef areas, which enhances overall stock availability.

Interestingly, Samdani *et al*. (2021) noted that heavy rainfall, strong winds, and high waves during the rainy season often discourage fishing activity, leading to reduced earnings. Conversely, Saparwadi *et al*. (2015) reported that despite fewer fishing trips in the low season, fish prices during the west monsoon were considerably higher than in the normal season. In this study, the greatest revenue was recorded for cast nets in the west monsoon while the lowest occurred in the east monsoon. This pattern likely reflects the operation of cast and gill nets, which primarily targets pelagic species concentrated near the surface of the water (Morales, 2021; Rochmat *et al*., 2023).

According to Wirasatriya *et al*. (2021) and Prasetya *et al*. (2023), during the rainy season, surface chlorophyll-a concentrations increase, enhancing primary productivity and subsequently attracting pelagic fish to the surface of the water. This condition leads to higher catch rates for fishermen using cast nets and gill nets. Furthermore, Sarwati *et al*. (2025) report that potential fishing grounds for small pelagic species are more extensive during the west monsoon compared to the east monsoon.

Meanwhile, during the east monsoon, trolling lines yield the highest earnings, as target species such as tuna and marlin are more abundant and have greater market value. Purwasih *et al*. (2016) note that skipjack tuna, small tuna, large tuna, marlin, and albacore are commonly caught with this gear. Mas'ud *et al*. (2018) also found that trolling line fishermen in Mallusetasi District, Barru Regency achieved higher returns than those using other gear.

Likewise, Siburian *et al*. (2019) reported that the seasonal index for tuna caught with trolling lines is consistently higher in the east monsoon than in the west. Moreover, this result is consistent with a study of Joquiño *et al*. (2021) in Davao Gulf, Philippines, which found catches and fishermen revenues increased during the rainy season when pelagic fish stocks were more accessible. In contrast, Mwakaribu *et al*. (2022) reported that fishermen in Bangladesh faced income declines during flood season due to restricted fishing grounds and heightened safety risks.

Despite the higher income during the rainy season, fishermen remain highly vulnerable in socio-economic terms. As a result of seasonal income fluctuations, many fishermen are compelled to borrow money during lean periods. Consequently, additional earnings gained during the rainy season, when catches are higher, are often prioritised for repaying debts previously incurred. Similar patterns are seen in Ghana, where fishermen face recurring debt cycles and unstable livelihoods despite abundant catches (Ankrah *et al*., 2024). Consequently, higher seasonal revenues do not necessarily improve household food security, as much of the income is absorbed by loan repayments, operational expenses, and immediate needs. This condition highlights that although the rainy season can bring higher earnings, fishermen remain vulnerable to poverty traps without effective financial management, livelihood diversification, or policy support such as low-

interest credit and community-based savings schemes. Hence, fishing season dynamics should be viewed not only through ecological variability but also within the broader framework of socio-economic resilience in small-scale fishing communities.

From a poverty alleviation perspective, addressing livelihood instability is equally important. Off-season alternatives such as small-scale aquaculture, community-based ecotourism, or value-added fish processing could stabilise household income and reduce reliance on capture fisheries. Access to microfinance and community savings groups may further strengthen resilience against seasonal income shocks. Finally, the study underscores the role of adaptive co-management, where fishermen actively participate in local decision-making. Collaborative platforms involving fishing communities, local governments, and other stakeholders can foster accountability and ensure that seasonal fisheries management remains both socially inclusive and ecologically sustainable.

## Conclusions

Based on a socioeconomic study of fishermen in Gili Sulat-Gili Lawang, East Lombok, Indonesia, the overall gross income of fishermen was found to be higher during the west monsoon than in the east monsoon. The average income by fishing gear ranged between IDR 7,333,333 and IDR 64,659,375 a month in the west monsoon and between IDR 6,166,667 and IDR 53,125,000 in the east monsoon. Significant differences were observed for gill nets and cast nets, with p-values of 0.004 and 0.040, respectively ($p < 0.05$).

These findings emphasise the need for adaptive fisheries management strategies that align fishing activities with periods of peak biological productivity. Such synchronisation can increase economic returns while supporting the long-term sustainability of fish stocks. In line with Indonesia's Blue Economy Roadmap, the results highlight the importance of gear diversification and capacity-building programmes that help fishermen adjust to varying monsoon conditions.

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## Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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