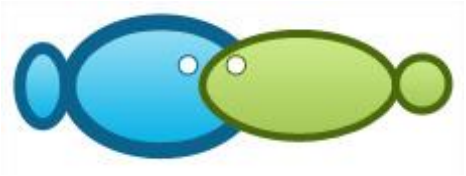

Artisanal fisher's occupational diversity in Karimunjawa Islands

Arin T. Putri, Dian Wijayanto, Dian A. N. N. Dewi, Faik Kurohman, Tita Elfitasari, Abdul H. A. Riza, Dita J. Kurnia

Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Semarang, Central Java, Indonesia. Corresponding author: D. A. N. N. Dewi, dianayunitanugraheni@lecturer.undip.ac.id

Abstract. Artisanal fishers in Karimunjawa Islands have major contribution to the food security and the local economy. Unfortunately, they are at high risk of economic vulnerability due to seasonal fluctuations, environmental changes, and restrictions on fishing access related to conservation area management. This research analyzed the employment patterns, income, and the role of livelihood diversification in order to achieve higher welfare of traditional fishers in Karimunjawa Islands. Primary data were collected through a survey of 98 fisher households. The research results show that fishers who rely on a single source of income (single-profession fishers) tend to have lower average income of IDR 2,475,000/month compared to fishers with multiple occupation who also work in seaweed cultivation, fishery product processing, and marine tourism services. Occupational diversification improves income stability and reduces economic risks due to seasonal uncertainty and conservation zoning restrictions. These findings emphasize the importance of integrating livelihood diversification strategies into the management of Karimunjawa National Park. An inclusive, community-based, and multi-professional conservation approach is needed in enhancing the sustainability of coastal ecosystems while improving the welfare of traditional fishers.
Key Words: conservation area, Karimunjawa Islands, livelihood diversification, traditional fishers, t-test.

Introduction. Traditional fishers in Karimunjawa Islands, Indonesia generally operate small boats with simple fishing gear such as handlines and traps to make living. However, their livelihoods and income are prone to changes in fish resources due to various factors (Wijayanto et al 2023), including weather factors, fishing seasons, and fish stock availability. Various structural constraints, such as limited market access, high operational costs, limited technology adoption, and limited access to capital from formal financial institutions also affect their welfare (Wibowo et al 2022; Hapsari et al 2023). Artisanal fishers face economic vulnerability since fishing is mostly their main occupation. Fishers who rely solely on capture fisheries tend to have more limited income sources than those engaged in additional economic sectors. However, not all fishers have equal access, capacity, or opportunities to diversify their livelihoods. Therefore, secondary occupations should be regarded as adaptive strategies that emerge in response to economic constraints, seasonal variability, conservation-related pressures, and the need to maintain household income sustainability.

The designation of Karimunjawa Island as a marine conservation are also impacts the dynamics of fishers's livelihoods. The limitation of fishing areas brings economic greater pressure and social vulnerability. Nevertheless, the designation will improve the sustainability of fish resources, increase fish populations and sizes, and increase fisheries productivity in the surrounding area in the long run (Horta e Costa et al 2013; Westlund et al 2017). Unfortunately, the conflicts over land use between the fisheries and tourism sectors have increased as Karimunjawa Islands are now a thriving marine tourism destination (Setiawan et al 2017). Ecological pressures, conservation policies, and changes in local economic structures simultaneously bring greater economic vulnerability, climate change, and fish stock fluctuations (Madrigal-Ballestero et al 2017; Hafsaridewi et al 2025).

In regards to this situation, occupational and business diversifications offer an effective approach toward enhancing fishers's economic resilience. Business diversification, both in the fisheries (fish processing, aquaculture) and non-fisheries sectors (including tourism), reduces the dependence on fishing, expands income sources, and alleviates pressure on marine resources. The success of business diversification is determined by the government policy support, market access, capital, and human resource capacity building (Brugère et al 2008; Roscher et al 2022). This research was specifically performed to identify traditional fishers' employment patterns, income, and business diversification potential in Karimunjawa Islands as a basis for formulating equitable fisheries management and conservation policies.

Material and Method

Location and time of research. This research was conducted at Karimunjawa Islands, Jepara Regency, Indonesia (coordinates 5°40'–6°00' S; 110°05'–110°31' E) as shown in Figure 1, primarily on the two largest islands; Karimunjawa Island and Kemujan Island, from November 2025 to January 2026.

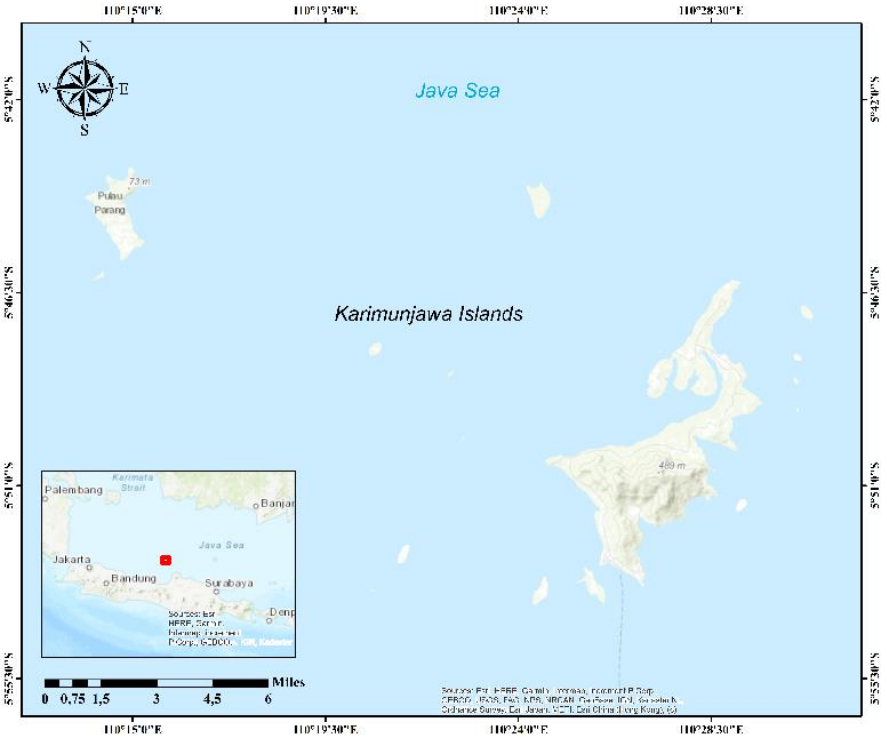

Figure 1. Research site

Data collection. A structured questionnaire was used to collect the data on the income, assets, business activities, diversification, and social status of 98 respondents, divided into two groups, namely single fisher and fisher with secondary occupations, which data were then used to examine their fishing activities and business diversification (Wijayanto et al 2023).

Data analysis. Quantitative data were analyzed descriptively, and a comparative analysis was conducted between individual fishers and the ones with diversified businesses in the form of a t-test at 95% confidence level. The hypothesis testing was conducted to examine differences in income between single-profession fishers and fishers with diversified livelihoods. The null hypothesis (H0) stated that there is no significant difference in average income between the two groups, while the alternative hypothesis (Ha) stated that a significant difference exists. An independent samples t-test was applied at a 95% confidence level ($\alpha = 0.05$).

Results. Karimunjawa Islands were designated as a conservation area in 1999 to protect the coastal ecosystems, including coral reefs, seagrass beds, and mangrove forests. These ecosystems are the habitats of various reef fish species and are the sources of living for small-scale fishers. Artisanal fishers provide local food and drive the household economy among the coastal community. However, their welfare is highly vulnerable to environmental changes, seasonal influences, and conservation area management policies (FAO 2024).

Respondent profile. All respondents in this research were traditional fishers, including both solo fishers and fishers who also run different businesses. Based on the data, variations in the use of fishing gear types, business patterns, and socioeconomic conditions are identified (Figure 2). The most common fishing gear used was hand line, while a small proportion used spears and scoop nets. This pattern reflects the general characteristics of small-scale fisheries in tropical small island regions with limited capital (Eriksson et al 2019).

Seen from the demographic structure, the respondents varied in age, with an average age of approximately 43.9 years. This age structure indicates a predominance of experienced fishers while also indicating a lack of interest among the younger generation in continuing their parents' profession. In developing countries, income absorption and increased alternative employment opportunities in non-fishing sectors influence the regeneration process of fishers (Béné et al 2009). Most of them are elementary school graduates (low education). In general, respondents' homes were considered habitable, with permanent walls, roof tile with ceiling, and ceramic tiles. The community mostly consists of Javanese descendants, followed by Bugis, Mandar, Buton, and groups. The fresh water is supplied by from *Perusahaan Daerah Air Minum* (PDAM, fresh water supplier company) and private wells. The diversity of fishers's socioeconomic conditions is influenced by social factors, livelihoods, institutions, and resource conditions (Allison & Ellis 2001; Putri et al 2024).

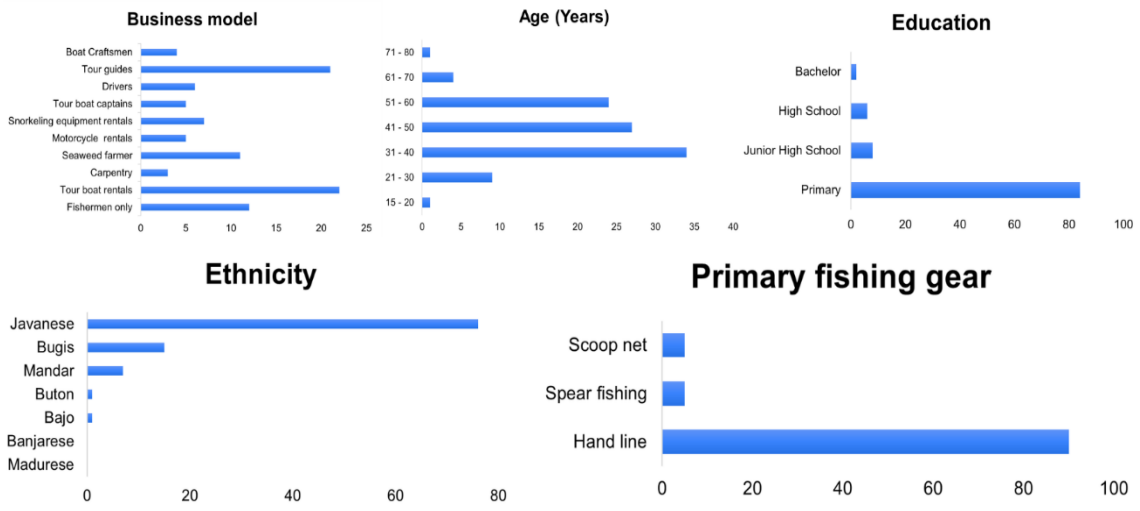

Figure 2. Respondent characteristics.

Fishers's income. Table 1 presents that traditional fishers who run other businesses show better well-being and more stable incomes than solo fishers. Fishers who do secondary professions as seaweed farmers or marine tourism guides tended to have higher average incomes and lower economic risks from seasonal changes. Most of the respondents own side businesses. The results of this research support the view stating that livelihood diversification is an effective adaptive strategy for increasing the economic resilience of fishing households in conservation areas and vulnerable coastal areas (Allison & Ellis 2001; Brugère et al 2008; Roscher et al 2022). In the context of Karimunjawa, business

diversification also reduces the pressure on fisheries resources, which supports the goals of the conservation (Wibowo et al 2022).

Table 1

Fishers's income levels based on business diversification

Occupations	*Number of respondents*	*Income (IDR month^{-1})*			*Average side income*	
		Min	*Max*	*Average*	*%*	*IDR*
Single profession as a fisher	12	1,000,000	4,000,000	2,475,000	0	0
Multiprofessional fishers, with side jobs:						
- seaweed farmers	11	2,000,000	4,500,000	3,009,091	40	1,154,545
- tour guides	21	1,600,000	4,000,000	2,790,476	32	900,000
- tour boat rentals	22	1,500,000	4,000,000	2,886,364	31	881,818
- carpenter	3	1,500,000	3,500,000	2,666,667	27	666,667
- motorcycle rental	5	2,000,000	2,500,000	2,500,000	36	800,000
- snorkeling equipment rental	7	2,000,000	3,500,000	2,714,286	30	857,000
- tour boat captain	5	3,000,000	3,000,000	3,000,000	21	620,000
- driver	8	1,700,000	3,500,000	2,725,000	31	875,000
- boat craftsmen	4	3,000,000	3,500,000	3,125,000	44	1,375,000

Fishers with a single profession have lower average incomes than those engaged in additional economic activities. Secondary occupations, such as seaweed farming, marine tourism services, and tourism equipment rental, contribute substantially to household income. These activities provide alternative income sources during periods of reduced fishing activity caused by seasonal changes and unfavorable weather conditions. However, some tourism-related occupations remain directly affected by sea conditions, resulting in income fluctuations. Overall, the relatively high proportion of secondary income in several categories indicates that livelihood diversification enhances income stability and reduces dependence on seasonal capture fisheries.

Table 2 presents the results of the independent samples t-test comparing income between single-profession and diversified fishers. The results indicate that fishers with secondary occupations tend to have higher average incomes (IDR 2,837,210±617,785) compared to single-profession fishers (IDR 2,475,000±883,305). However, the difference was not statistically significant at the 95% confidence level ($t = -1.798$; $p = 0.075 > 0.05$). The test results showed that the significance value exceeded 0.05, indicating that the null hypothesis (H0) could not be rejected. This suggests that livelihood diversification does not necessarily lead to a substantial increase in income levels. Nevertheless, the higher average income observed among diversified fishers reflects the contribution of additional activities in complementing fishing income. Secondary occupations provide alternative revenue sources during periods of low catch or unfavorable weather conditions, highlighting their role in enhancing income stability rather than merely increasing total income. This is further supported by the lower standard deviation among diversified fishers, indicating more consistent earnings compared to single-profession fishers, who experience greater income variability.

Table 2

Results of statistical test on fishers income differences

Fisher category	*N*	*Mean income (IDR month^{-1})*	*Std. deviation*
Single fishers	12	2,475,000	883,305
Diversified fishers	86	2,837,210	617,785

$t = -1.798$; $p = 0.075$

Discussion. Occupational diversification contributes to improving income stability and economic resilience among traditional fishers in Karimunjawa Islands. Fishers with diversified livelihoods show higher average incomes (IDR 2,837,210) compared to single-profession fishers (IDR 2,475,000); however, the difference is not statistically significant. This indicates that diversification does not necessarily lead to a substantial increase in total income, but rather functions as a risk management strategy that helps reduce income fluctuations caused by seasonal variability, environmental uncertainty, and limited fishing access. Fishing remains the primary occupation for most respondents, while supplementary activities provide an important buffer during low fishing seasons. The peak fishing season typically occurs from September to December, whereas tourism-related activities peak in May and December, as well as after the Eid al-Fitr holiday. Side employment such as seaweed farming is more common on Kemujan Island, while tourism-related work is more prevalent on Karimunjawa Island. These findings highlight the importance of integrating livelihood diversification into conservation and fisheries management strategies to enhance household economic stability.

The findings of this research propose suggestions to the management of Karimunjawa National Park in balancing ecosystem conservation goals with the sustainability of local community livelihoods. Business diversification serves as an adaptive strategy to mitigate economic risks resulting from seasonal uncertainty, environmental change, and limited fishing space. Conservation area management that focuses solely on resource protection without considering socio-economic dimensions may provoke community resistance that leads to lower conservation effectiveness (Westlund et al 2017).

The welfare of traditional fishers is influenced by multiple dimensions; economic conditions (income and assets), access to resources, human capabilities (education and health), market access, infrastructure, social capital (social networks and cooperatives), and adaptive capacity to external shocks. Income from catches and ownership of production capital, such as boats and fishing gear, also determine the ability of fishing households to meet basic needs and make long-term investments (Stacey et al 2021). Mastering skills outside the fishing sector equips fishers with skills for alternative businesses, especially during low fishing season (Suadi et al 2021). Access to broader markets and business diversification opportunities, including aquaculture (fish and seaweed) and tourism also potentially improve the income stability and welfare of fishers in the long term (Aceves-Bueno et al 2023).

The tourism sector development opens other employment opportunities, such as offering guiding services, accommodation, culinary, and other services (Kurniawan et al 2021). The number of hotels, guesthouses and restaurants in Karimunjawa Island has increased, followed by the development of culinary sector, handicraft business, and infrastructure (Fafurida et al 2020). The tourism sector in Karimunjawa has been promoted through social media. Unfortunately, the mastery of international language in Karimunjawa is still inadequate due to the absence of formal training. Local residents develop their international language skills informally in order to be able to communicate with international tourists (Mufidah & Hadianti 2025). Therefore, the development of education sector (both formal and informal) is necessary. Quality education is also expected to support the poverty eradication (Putro et al 2016).

Improving fishers's ability to utilize advanced information technology is also necessary. Technology improves fishers's access to information on fish prices, weather forecasts, and market opportunities (Putri et al 2024). It is also regarded necessary to strengthen the community participation in conservation area management. Community participation supports governance effectiveness, including the effectiveness of the conservation management (Cinner et al 2009; Eriksson et al 2019). Therefore, conservation policies in Karimunjawa need to integrate realistic and local alternative livelihood strategies. Fishers who lose, or experience reduced access to fishing grounds require concrete support in the form of skills training, access to capital, and business mentoring. Numerous studies indicate that livelihood diversification initiatives facilitated by conservation area management institutions can enhance fishers' compliance with regulations while simultaneously reducing pressure on fishery resources (Brugère et al 2008; Roscher et al 2022). Some fishers apply technical adaptations by operating more

than one type of fishing gear, including passive gears such as fish traps. These gears are deployed in sufficient numbers, allowing fishers to continue harvesting catches even when they are unable to go to sea for several days due to unfavorable weather conditions. This finding indicates that adaptation to seasonal uncertainty occurs not only through livelihood diversification, but also through diversification of fishing strategies and technologies.

Strengthening co-management approaches and community participation is key to the success of conservation policies. Fishers's involvement in zoning planning, community-based monitoring, and policy evaluation have stronger sense of ownership of the conservation area (Horta e Costa et al 2013). Strengthening local institutions such as fishers's groups and cooperatives bridges the conservation interests and community economic needs. Overall, Karimunjawa conservation area managers need to adopt a multidimensional welfare perspective, since the conservation success is measured not only by ecological indicators, but also by its impact on social welfare, livelihood availability, and equity for stakeholders (Allison & Ellis 2001; Béné et al 2009).

Conclusions. Artisanal fishers in Karimunjawa Islands who only do fishing as their only occupation tend to have lower average income of IDR 2,475,000 compared to fishers who implement livelihood diversification with an average income of IDR 2,837,210, although the difference is not statistically significant. Business and occupational diversification increase income stability and reduce vulnerability to seasonality, environmental changes, and reduced fishing space due to conservation policies. Several recommendations were proposed in this research, including: (1) integrating livelihood diversification into the management of Karimunjawa National Park; (2) strengthening the capacity of fishers through training, access to capital, and institutional support; and (3) implementing a collaborative management approach that places community welfare as an integral part of conservation success. These measures are expected to support coastal ecosystems and improve the welfare of artisanal fishers in Karimunjawa Islands.

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Conflict of interest. The authors declare that there is no conflict of interest.

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Authors:
Arin Tazkia Putri, Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: arinntazz22@gmail.com; arintazkiaputri@students.undip.ac.id
Dian Wijayanto, Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: dianwijayanto@gmail.com; dianwijayanto@lecturer.undip.ac.id
Dian Ayunita Nugraheni Nurma Dewi, Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: dianayunitanugraheni@lecturer.undip.ac.id
Faik Kurohman, Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: faikkurohman@gmail.com; faikkurohman@lecturer.undip.ac.id
Tita Elfitasari Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: titaelfitasari@lecturer.undip.ac.id
Abdul H. A. Riza, Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: aliriza@students.undip.ac.id; haritsriza95@gmail.com
Dita Juni Kurnia, Faculty of Fisheries and Marine Science, Universitas Diponegoro, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: ditajuni2002@gmail.com

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