

# Factors affecting fishermen's income on Karimunjawa Island

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**Abstract.** Karimunjawa Islands is one of the marine conservation areas in Indonesia with high aquatic biodiversity. Most of the local community work as fishermen, thereby their participation in the environment conservation is needed. Regarding this matter, it is necessary to examine the factors that influence the income of fishermen in Karimunjawa Island to improve the welfare of fishermen which will support the success of the conservation program. Path analysis was performed to examine the relationship between variables affecting fishermen's income. Surveys were conducted to 244 fishermen on Karimunjawa Island. The results showed that education, boat size, investment capital, fuel consumption, and fishing trip time positively affected fishermen's income. Fishermen in the productive age group were likely to earn higher income than those in nonproductive age group.

**Key Words:** age, education, fishermen income, path analysis, production input.

**Introduction.** The Karimunjawa Islands is a marine conservation area with high biodiversity in terms of fish types, coral reefs, mangroves and seagrass beds. In Karimunjawa Islands, some rare and protected species of forest plants, land animals and birds were also found (BTNKJ 2019; Wijayanto et al 2022). The success of a conservation effort requires the support of the local community, otherwise conservation goals would be hard to achieve (Rakotonarivo et al 2017; Ramadhan et al 2022; Wijayanto et al 2022). Therefore, the support of local community is one of the key factors for the success of conservation in the Karimunjawa Islands. Local community has been living there for generations, even before the area was designated as a conservation area. Without an adequate source of livelihood, the community might carry out activities that are destructive to the environment against the marine conservation program (Zamroni 2018; Wijayanto et al 2021; Wibowo et al 2022).

Fishermen are the main profession in the Karimunjawa Islands. Conservation stakeholders in Karimunjawa need to understand the characteristics of fishermen as the information would be beneficial in determining the strategies to engage the local community into conservation programs (Awabdi et al 2018; Zhong et al 2019; Sapoetra et al 2019; Wijayanto et al 2022). Therefore, the socio-economic aspects that affect fishermen's income need to be investigated.

## Material and Method

**Research location.** The research was conducted on Karimunjawa Island which is the largest island of the Karimunjawa Islands (Figure 1). Karimunjawa Island is the center of the economy and center of government activities. The population of this island is also the largest among other Islands (Wibowo et al 2022; Wijayanto et al 2022).

**Research time.** Surveys, interviews and observations were conducted from July to August 2022.

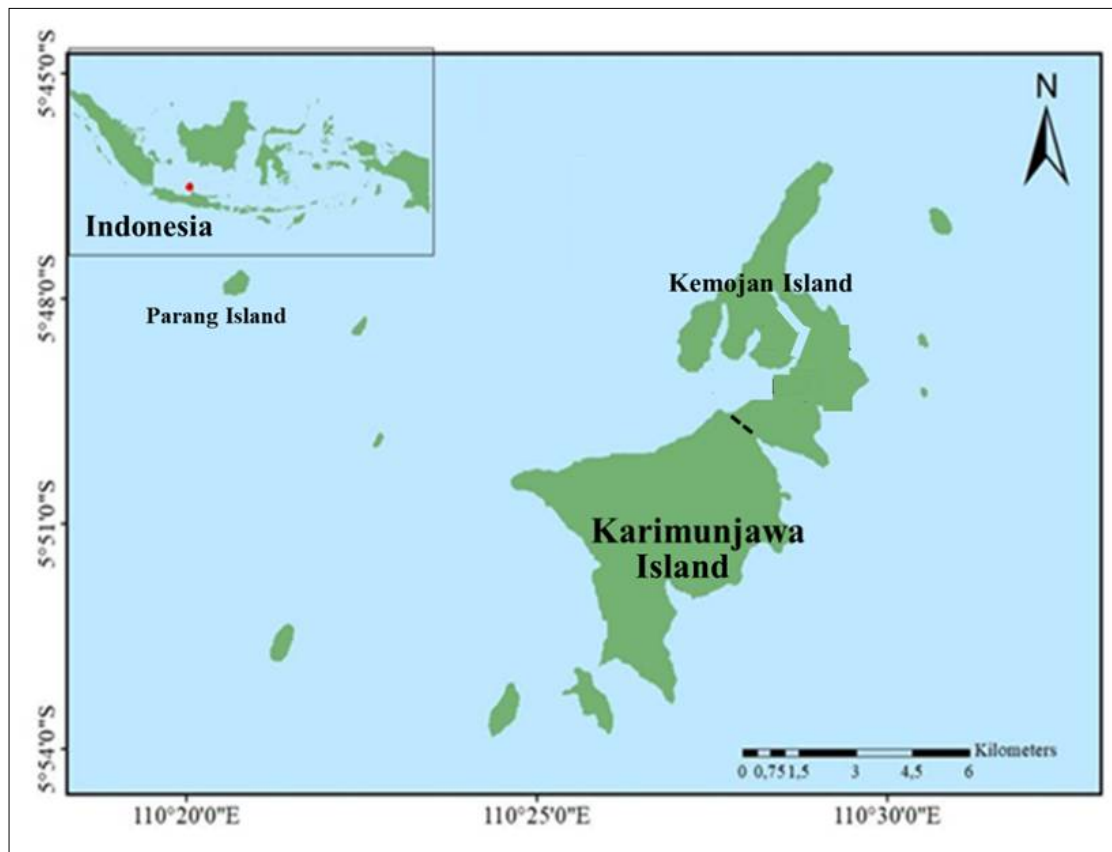


Figure 1. Karimunjawa Island (research location).

**Data collection.** Data collection was carried out using a questionnaire. The survey was conducted by interviewing the fishermen one by one. There were 244 respondents who agreed to participate in this study.

**Data analysis.** Data were analyzed in path analysis. Perception modeling with quantitative analysis has been employed by several researchers, including Sapetra et al (2019), Zhong et al (2019), and Wijayanto et al (2022). In this study fishermen's income (I) as the dependent variable (expressed in IDR per month) is influenced by several variables including: education (E), age (A), investment capital in IDR (C), boat length in meters (B), fishing trip time in hours per trip (T), and fuel consumption in liters per trip (F). Capital, boat size, fuel consumption and fishing trip time are input factors in capture fisheries production. The age variable was examined using the age group approach, where productive age ranges from 20-55 years (score 2), and those over 55 years were given score 1. The education variable used the length of study: 0 years if the respondent did not finish elementary school, 6 years if the respondent graduated from elementary school, 9 years if the respondent graduated from junior high school, 12 years if the respondent graduated from high school. Investment capital (C) also affects boat size (B), fuel (F) and fishing trip time (T). The model proposed in this study is presented in Figure 2.

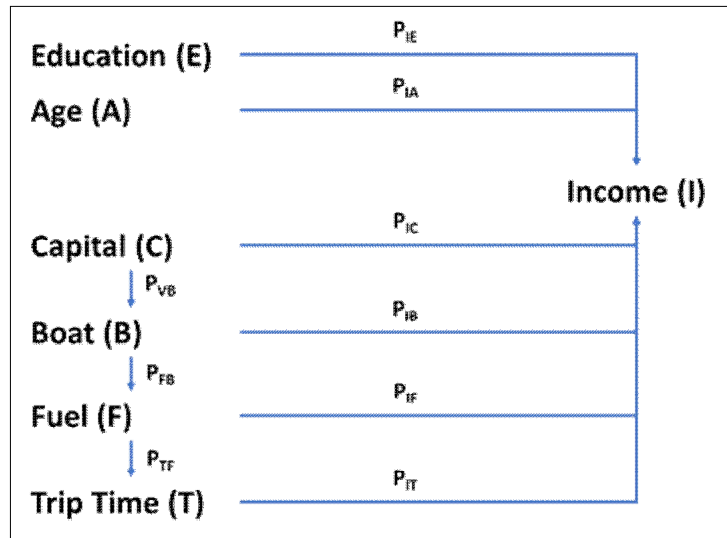


Figure 2. Research model.

**Results.** Karimunjawa Island is the largest island in the Karimunjawa Islands. Karimunjawa Island is the center of government and the center of the economy of the community, including the center of tourism activities. There are 4 villages in the Karimunjawa Islands: Karimunjawa Village, Kemojan Village, Parang Village and Nyamuk Village. The fishing profession is the main profession for the community. The capture fisheries business in the Karimunjawa Islands is dominated by artisanal fisheries caught in one day fishing using hand line fishing gear as the main fishing gear (BTNJK 2019; Wibowo et al 2022; Wijayanto et al 2022).

**Respondents' characteristics.** The profiles of the respondents in this study are shown in Figure 3. Respondents were multi-ethnic groups with Javanese dominating, where Indonesian and Javanese languages are the lingua franca of the community. Most of the respondents had low education level. Some fishermen used several fishing gears in catching fish (multi-gears).

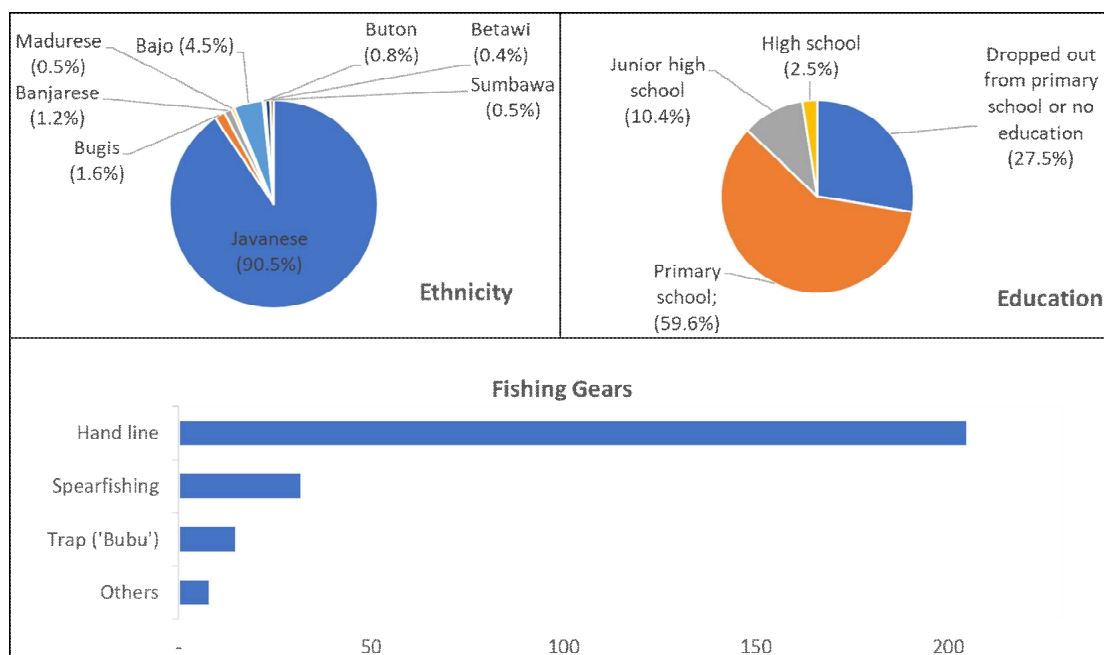


Figure 3. Respondents' characteristics.

The well-developing tourism in Karimunjawa Islands has increased the welfare of the local community. Some fishermen work another side job, where they rent their boats for

tourists. Some of them also assist the tourists as tour guides, and many of them also rent their properties for tourist accommodation. Tourism activities in the Karimunjawa Islands have also increased the demand for fish and the fish price. Despite their low education background, some fishermen there sent their children to attend university education.

**The determinants of fishermen's income.** Fishermen's income is influenced by many factors, including the condition of fish resources, fishing skill, fishing equipment, capital and season (Figure 4). In this study, fish resources and seasons were not examined since the fishermen in Karimunjawa Island fish in the same fishing area. The average income of fishermen from Karimunjawa Island is IDR 2,840,000 (Table 1). This amount is greater than the Jepara Regency minimum wage of Rp. 2,108,403 (Decree of Governor of Central Java No. 561/39). Unfortunately, 16% of the respondents earn below the regional minimum wage.

Table 1

The data analysis

<i>Variables</i>	<i>Values</i>
<i>Average income of respondents</i>	<i>IDR per month</i>
Min	1,000,000
Average	2,840,000
Max	6,000,000
<i>Respondent capital</i>	<i>IDR</i>
Min	0*
Average	74,091,168
Max	237,150,000
<i>Boat length</i>	<i>m</i>
Min	0*
Average	9
Max	17
<i>Fuel consumption</i>	<i>L per trip</i>
Min	4
Average	24
Max	490
<i>Fishing trip time</i>	<i>Hours per trip</i>
Min	1
Average	14
Max	288
<i>Variables affecting income</i>	<i>Slope</i>
<i>Education (E)</i>	
Direct effect of education ( $P_{IE}$ )	15,609
<i>Age group (A)</i>	
Direct effect of age group ( $P_{IA}$ )	299,037
<i>Capital (C)</i>	
Direct effect of capital ( $P_{IC}$ )	0.00307
Indirect effect of capital ( $P_{VC}, P_{DV}, P_{TD}, P_{IT}$ )	0.00001
Total effect of capital ( $P_{IC} + P_{VC}, P_{DV}, P_{TD}, P_{IT}$ )	0.00308
<i>Boat size (B)</i>	
Direct effect of boat size ( $P_{IB}$ )	48,854
Indirect effect of boat size ( $P_{FB}, P_{TF}, P_{IT}$ )	281
Total effect of boat size ( $P_{IV} + P_{FB}, P_{TF}, P_{IT}$ )	49,135
<i>Fuel (F)</i>	
Direct effect of fuel ( $P_{IF}$ )	3,052
Indirect effect of fuel ( $P_{TF}, P_{IT}$ )	179
Total effect of fuel ( $P_{IF} + P_{TF}, P_{IT}$ )	3,231
<i>Trip (T)</i>	
Direct effect of trip ( $P_{IT}$ )	2,335

Note: \* respondent does not own a boat and he works as a crew member.

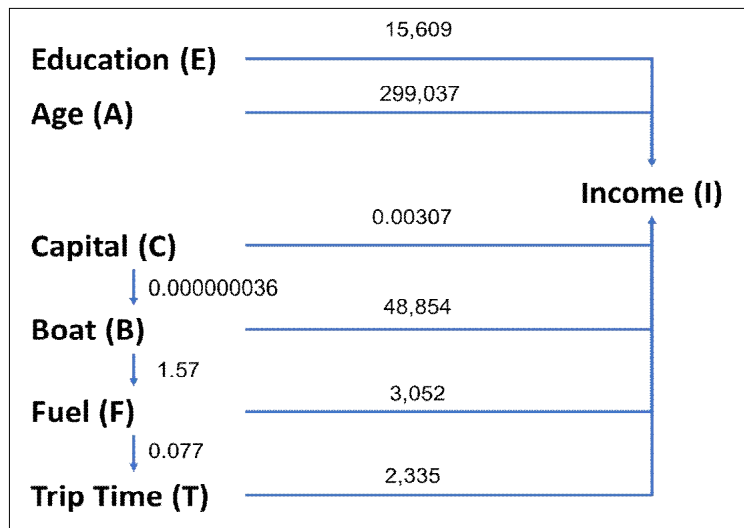


Figure 4. The result of research model.

The results of the data analysis show that education, boat size, investment capital, fuel consumption and fishing trip time positively affect fishermen's income. Therefore, education, empowerment and capital strengthening programs need to be carried out by the government and non-government parties in order to improve the welfare of fishermen on Karimunjawa Islands. Age also affects fishermen income, where older fishermen have lower productivity. In addition, capital, boat size, fuel consumption and fishing trip time also share positive correlation. The direct and indirect effects of variables that affect fishermen's income are presented in Table 1.

**Discussion.** In Indonesia, fishing is the main livelihood of the local community around marine protected areas (MPAs). Most fishermen use traditional fishing gear and there are fishing gears that can damage the aquatic environment. Effective environmental management and the integration of socio-ecological diversity are important aspects that determine the success of marine conservation (Estradivari et al 2022). Studies by Edinger et al (1998) showed that pollution from land (among others waste, sedimentation, and industrial pollution) reduces the marine biodiversity by 30 to 60%. The use of bombs to catch fish and anchor also damages coral reefs. According to Barbier (2015), the world's coastal areas (including the Karimunjawa Islands) are most vulnerable to climate change, where coastal areas are often the residential areas of poor community.

Education, boat size, investment capital, use of fuel for fishing and trip time have positive effects on fishermen's income. Education creates positive mind set related to problem solving, including for fishermen, seaweed farmers and other professions (Purwanto et al 2020; Wijayanto et al 2022). The challenges of conservation stakeholders in the Karimunjawa Islands are increasingly complex as they need to accommodate different interests of various parties. Therefore, the mindset of fishermen as the main profession in the Karimunjawa Islands needs to be improved to increase fishermen's welfare and support conservation.

According to Ramadhan et al (2022), local communities and businessmen are likely to object to marine spatial planning that is pro-conservation. Similar objection also occurs in Karimunjawa Conservation Area. Arrangements for ship traffic lanes need to adjust to the migration routes of protected biota. Overlapping ship traffic lanes and migration routes have negative impacts on marine biota, which in turn also affects the livelihoods of local communities (Halliday et al 2022). Kennedy et al (2020) found that destructive fishing practices cause damages to coral reefs. Gaps in stakeholders' perspective regarding this matter can lead to conflict between the parties involved.

Some factors are threatening the environment, including the use of fishing gear (including trawls), water pollution, damage to aquatic ecosystems (including mangroves

and coral reefs) and climate change (Malakar et al 2018). As stated by Rakotonarivo et al (2017), local communities need to be exposed to the benefits of conservation to support conservation programs. Therefore coaching, empowerment and training of fishermen need to be carried out in order to encourage the fishermen to perform environmentally friendly fishing practices and support conservation programs.

In addition to fishing, fishermen on Karimunjawa Island are also providers of tourism services including tour boat rental services, tour guides, and providers of lodging and culinary services for tourists. During the social restriction due to Covid-19 pandemic, the community in Karimunjawa Islands earned lower income. To cope with this condition, they kept doing their jobs to meet their daily needs. Yuen et al (2023) believed that the marine ecotourism business was significantly impacted during the Covid-19 pandemic, where several marine conservation sites also serve as marine ecotourism from which the local community makes living. In order to fund the conservation programs, non-public funding can be an alternative financing option for MPAs that reduces the cost (Pascal et al 2021). Economic support from stakeholders (government and non-government sectors) is a critical factor that minimizes the destructive fishing practices in order to protect the biodiversity in the Karimunjawa MPA (Campbell et al 2013).

Tourism practices that damage the aquatic environment threaten the synergy between tourism and marine conservation Yuen et al (2023) found Virtual Reality Technology an alternative method (VRTME) of marine tourism that does not damage protected biota. VRTME allows tourists to be able to visit the site virtually. However, the VRTME application is still not fully accepted by the market as some people were reluctant to use VRTME.

Boat size, investment capital, fuel consumption and fishing trip time measure the capability of fishing businesses. Part of the water area in the Karimunjawa Islands is allowed for traditional fishing areas (BTNKJ 2019). Fishing gear with large fishing power such as trawls and purse seines are prohibited from being used in the Karimunjawa waters. Fishermen's institutions need to be optimized in developing the marketing of fish catches which will improve the fishermen's welfare.

Traditional fisheries management and marine conservation need to be synergized to support the conservation program. Suuronen et al (2010) argued, if fishermen are involved in conservation management, their compliance with the established conservation regulations will be higher. The involvement of fishermen in conservation efforts is very necessary. In a study, Eriksson et al (2019) showed that local communities in several conservation areas have experienced an economic improvement from conservation programs. Okumu & Muchapondwa (2020) also found that conservation program increased the welfare of local communities. Local ecological knowledge of local communities also plays a great role in the development and monitoring of conservation programs. Local communities can be empowered as local conservation agents (Awabdi et al 2018).

The conservation, fisheries and tourism in the Karimunjawa Islands should be balance. Conservation should be performed while taking into consideration the community welfare. Tourism effectively reduces poverty in some traditional communities. Tourism positively affects the economic growth, employment and national income. Marine tourism is a type of tourism that is growing rapidly. Consequently, both positive and negative ecotourism is tourism that emphasizes the appeal of environmental preservation with a focus on the protection of the nature. The government has vital role in ecotourism as the government provides public facilities, carries out supervision and formulates tourism development plans (Chen et al 2021). Weak law enforcement and the behavior of local people who still consume protected biota create a conflict of interest. Therefore, a combination of bottom-up and top-down collaborative governance is needed (Barrios-Garrido et al 2019). MPAs program can improve the quality of life of local communities. In addition, the long-term sustainability of MPAs depends on the support and compliance of human (Afonso et al 2019).

**Conclusions.** The results showed that education, boat size, investment capital, fuel consumption and trip time positively affected the level of fishermen's income. The

productive age groups were likely to earn higher income than the nonproductive age group. The combination of environmentally friendly fishing activities, ecotourism and conservation should be made balance in order to support the marine conservation program which eventually increases the community welfare.

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

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