

A Comparative Study of Social-Ecological Characteristics of Land-based and Island-based Small-Scale Fisheries in Southeast Sulawesi Province

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ABSTRACT

Small-scale fisheries exhibit unique, diverse, and varied characteristics in each region. These distinctive traits render small-scale fisheries challenging to regulate centrally. This research aims to compare the characteristics of land-based and island-based small-scale fisheries in Southeast Sulawesi Province. Data were collected through structured interviews involving 445 respondents from two distinct areas: North Konawe, representing land-based fisheries, and Konawe Islands, representing island-based fisheries. Both qualitative (questionnaire data) and quantitative analyses were conducted using R software. Proportion data were tested using the R ggstatsplot package, while word cloud analysis utilized the R wordcloud package. The analysis of fishing ground distribution hotspots was performed using QGIS software version 3.30. The research findings demonstrate differences across various aspects, including education levels, boat sizes, fishing frequency, monthly income, and types of captured fish. Furthermore, the study highlights that island-based small-scale fisheries hold a higher income potential compared to their land-based counterparts. These differing characteristics serve as essential considerations in developing policies that support sustainable management of small-scale fisheries based on the needs of local communities.

Introduction

In global development, the fishery sector, particularly small-scale fisheries, plays a crucial role in meeting the animal protein needs of communities and supporting both global and national economies [1–3]. Over half of the global catch is estimated to come from small-scale fisheries, which provide employment to more than 90% of fishermen worldwide [4,5]. Indonesia is one of the countries that contributes significantly to global fishery production. In 2016, Indonesia's fish catch totalled 6.5 million tons [6]. This represents the potential for natural resources that must be managed well and sustainably. In Indonesia, most fishing activities are dominated by small-scale fisheries, with approximately 90% being small-scale capture fishermen [7]. Southeast Sulawesi Province has substantial fishery resource potential, with an estimated fish resource of 1,520,340 tons per year, of which 15.41% or 234,239 tons have been managed to date [8,9]. As such, fisheries have become a vital sector, especially small-scale fisheries, providing livelihoods for many fishermen.

Small-scale fisheries generally exhibit unique and specific characteristics such as their response to environmental conditions, fishermen's behaviours and attitudes, vessel and gear ownership, financial management capabilities, social structures of fishing communities, and prevailing institutions in the area [10]. Small-scale capture fisheries are highly dynamic activities that must be grouped based on shared

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characteristics [11]. However, their diverse characteristics make regulating small-scale capture fisheries challenging [12]. Due to its geographical location, Southeast Sulawesi comprises both land- and island-based areas. This geographical distinction gives rise to different characteristics in small-scale fisheries, namely land-based and island-based fisheries. This study was conducted in the districts of North Konawe and Konawe Island, Southeast Sulawesi Province, to compare the characteristics of land-based and island-based small-scale fisheries in the region. By examining the differences in characteristics between these two types of small-scale fisheries, valuable insights can be provided to policymakers and the management of small-scale fisheries in Southeast Sulawesi.

Small-scale fisheries have unique characteristics. These characteristics include fishermen's contribution to local fish needs, which is heavily influenced by fisheries' catch moratorium policies [13,14]. Age and residential location significantly impact fishermen household income. Educational aspects, seafaring experience, and family responsibilities do not affect fishermen household income [15]. There are two adaptation strategies employed by small-scale fisheries: catch strategy and seeking alternative income [16]. The characteristics of small-scale fisheries excel in human aspects but lag in institutional aspects.

The concepts and goals for managing small-scale fisheries, both at the central and regional levels, have not yet matured. Data collection among fishermen engaged in small-scale fisheries and collaboration among relevant institutions remain poorly organized and coordinated [17]. The social and economic factors influencing fishermen's income include trip numbers, production costs, production costs, and fish prices. Age, education level, family dependence, and fishermen's experiences do not have a significant impact [18]. This study focuses on the social and ecological characteristics of small-scale fisheries and compares the social and ecological characteristics of fishermen along coastal and island regions.

Materials and Methods

Study Area

The study comparing the characteristics of coastal fisheries in North Konawe Regency and island-based fisheries in Konawe Kepulauan, Southeast Sulawesi, was conducted from February to November 2022. The research locations can be seen in Figure 1.

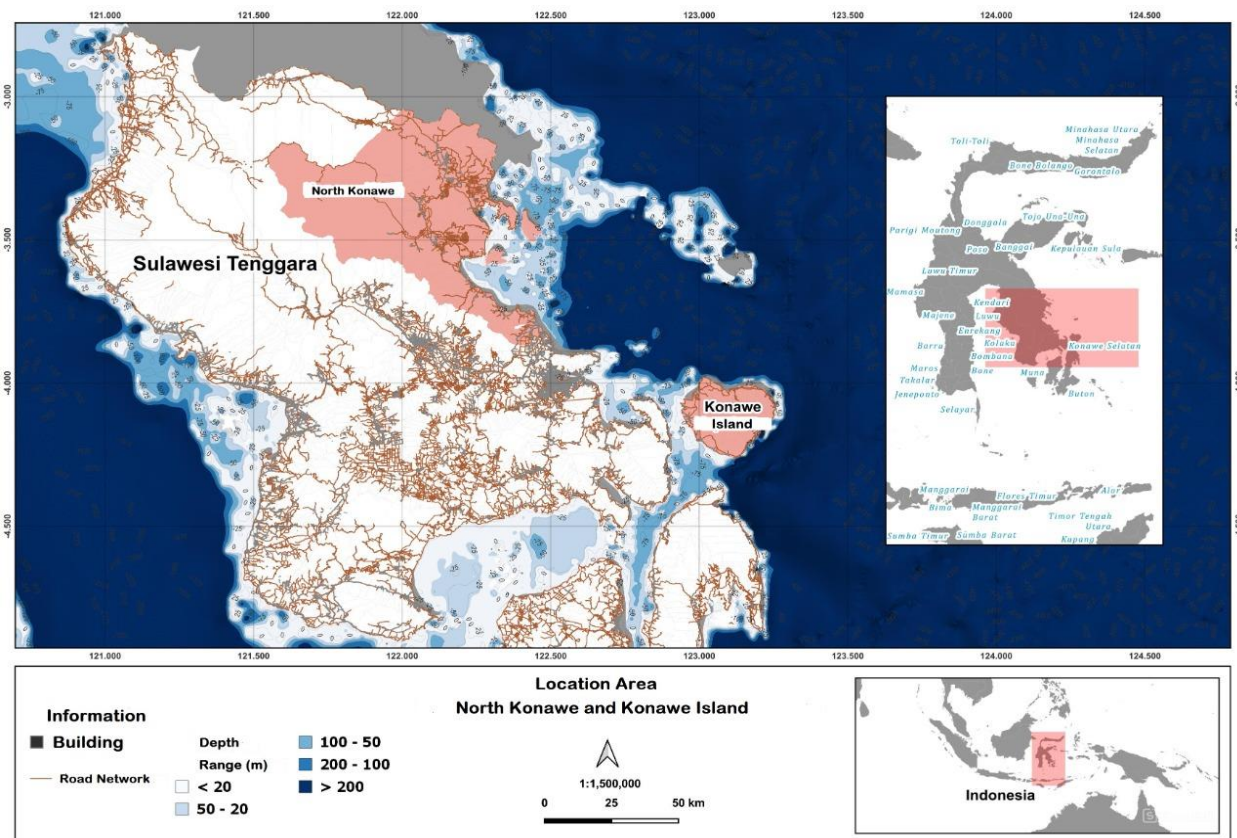


Figure 1. Research site.

Data Collection

The data collection method involved structured interviews using questionnaires, and the samples were selected through purposive sampling. The total number of respondents was 445 individuals, comprising small-scale fishermen distributed across 12 villages in North Konawe (220 respondents) and 44 villages in Konawe Islands (224 respondents).

Data Analysis

This research employed a qualitative method with a descriptive approach, focusing on inductive reasoning and scientific logic. Data were obtained through interviews, relevant documents, and field surveys on the condition of capture fisheries in Southeast Sulawesi Province. The research process utilized inductive logic for systematic and meticulous data interpretation [19]. All data analyses, whether qualitative (questionnaire data) or quantitative, were conducted using the R software [20]. Proportion tests were conducted using the R package ggstatsplot [21], while word cloud analysis employed the R package wordcloud [22]. The analysis of fishing ground hotspot distribution used the QGIS software version 3.30.

Results and Discussion

Characteristics of Fishermen Based on Age Range and Education Level

The profiles of fishermen varied based on age range and education level in both regions. This observation reveals the existence of groups of fishermen with diverse educational backgrounds, ranging from informal education to graduates of Elementary School (*SD/Sekolah Dasar*), Junior High School (*SMP/Sekolah Menengah Pertama*), Senior High School (*SMA/Sekolah Menengah Atas*), Diploma III, and bachelor's degrees (Figure 2).

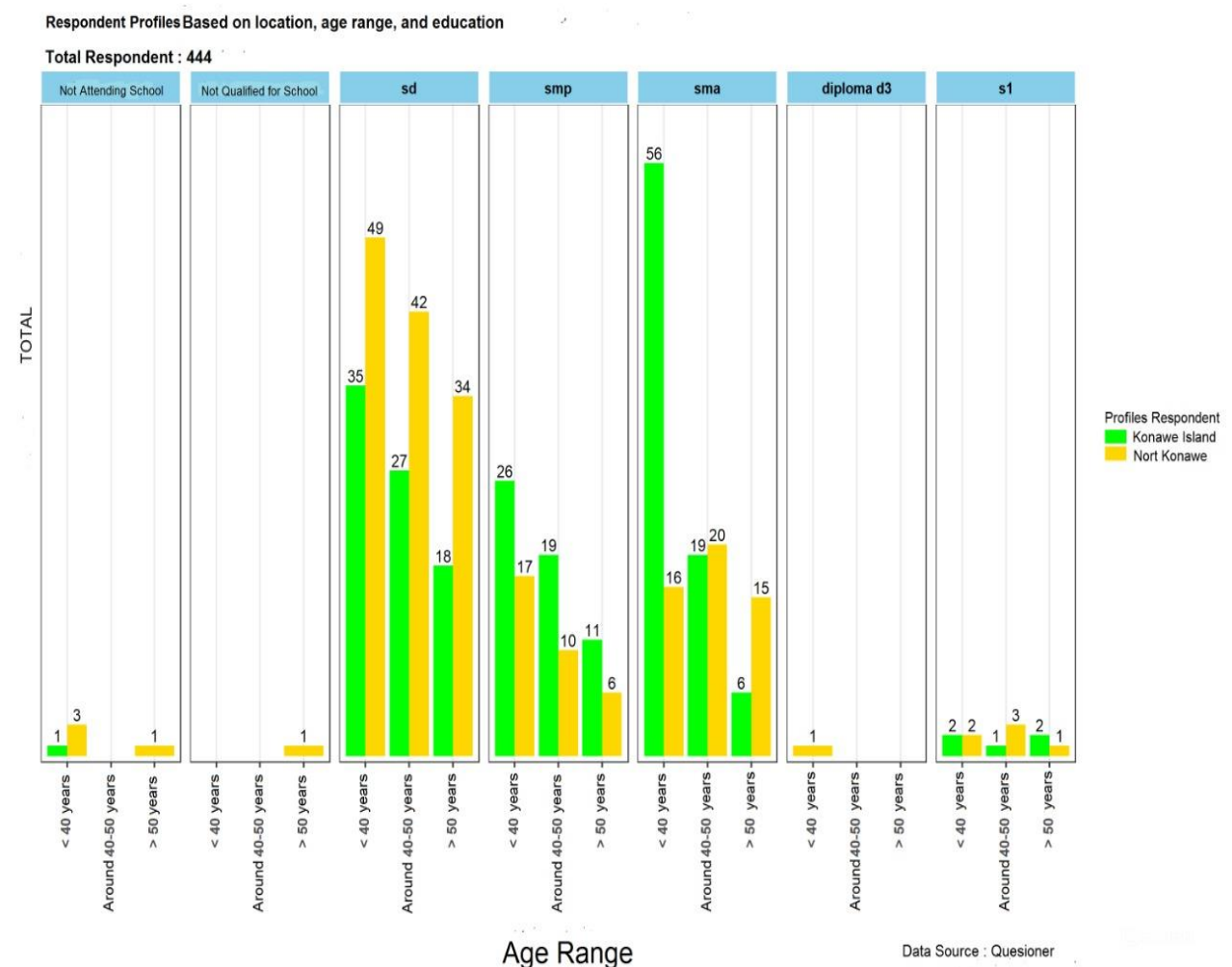


Figure 3. The respondents' profiles were based on location, age range, and education.

Further analysis indicates that in the North Konawe region, fishermen with an SD education level tend to fall within the age range of less than 40 to over 50 years. Meanwhile, groups of fishermen with SMP and SMA educational backgrounds are mostly found in the Konawe Islands region, while Diploma III graduates are only found in North Konawe. Nevertheless, fishermen with bachelor's degrees can be found in both regions. This overview of education levels indicates that fishermen in the Konawe Islands region tend to have higher education levels than those in the North Konawe region. However, many fishermen in both areas still possessed low levels of education, such as SD, SMP, and SMA. Overall, this data portrays that the education of fishermen in Indonesia is generally dominated by relatively low educational levels [23,24].

Fishing Ground

Fishing grounds refer to geographical areas where fishermen engage in fishing activities [25]. These areas constitute regions that provide fishery resources utilized by local fishermen. Based on the information depicted in the map presented in Figure 4, the fishing grounds in the two regions have relatively limited coverage and tend to be located around local or regional areas. The fishing grounds in both regions remained close to the coastline and required relatively short journeys. This characteristic aligns with the fishing patterns of small-scale fishermen [26].

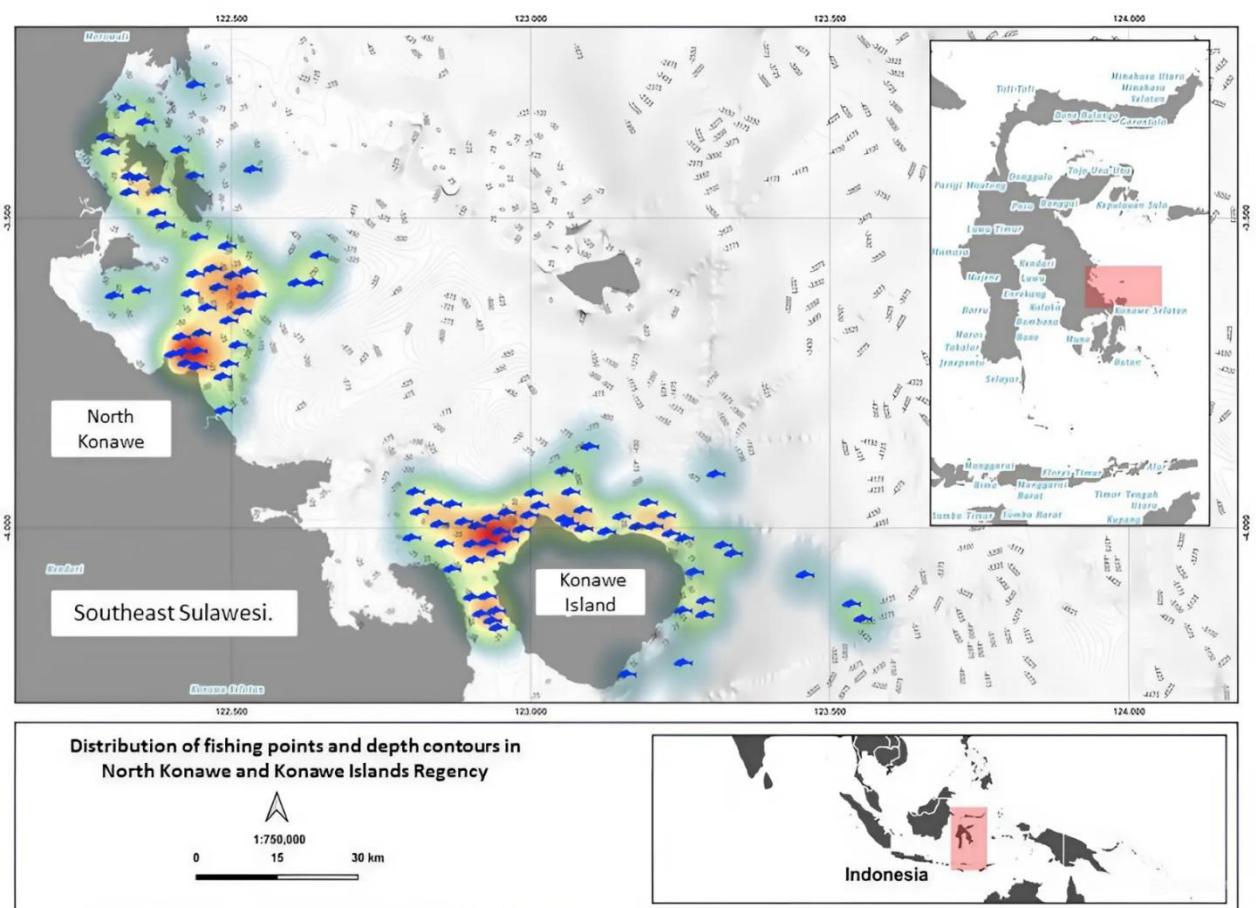


Figure 5. Fishing ground area.

Target Fish

The main catch results of the two fishing communities in the North Konawe and Konawe island regions exhibited differences (Figure 4). Commonly targeted fish species caught by fishermen in the North Konawe Regency include white fish (*kuwe*) (Carangidae), grouper (Serranidae), and snapper (Lutjanidae). The target fish species present in the Konawe Islands Regency are commonly caught, encompassing grouper (Serrnadiae), skipjack tuna (Scombridae), and catfish (Plotosidae). The fish species caught in the Konawe Islands region include grouper, skipjack tuna, ponyfish (Leiognathidae), mackerel (Scombridae), and spangled emperor (Lethrinidae) [27].



Figure 6. Target fish catch types in North Konawe (A) and the Konawe Islands (B).

Vessel Size and Crew Number

Vessel size and crew number indicate that fishermen in both regions primarily engage in small-scale fishing, with vessels predominantly sized at three Gross Tonnage (GT) and operated by one person. Vessel sizes ranging from 1 to 3 GT are prevalent in North Konawe, with varying crew numbers, whereas vessels sized between 4 and 10 GT, with varying crew numbers, are found in the Konawe Islands. Based on this, there is a distinction in vessel size, where smaller vessels of 1 to 3 GT are prevalent in North Konawe, while larger vessels of 4 to 10 GT are found in the Konawe Islands (Figure 5).

Respondent Profiles Based on Location, Number of Crew Members, and Ship's Gross Tonnage
Total Respondent : 444

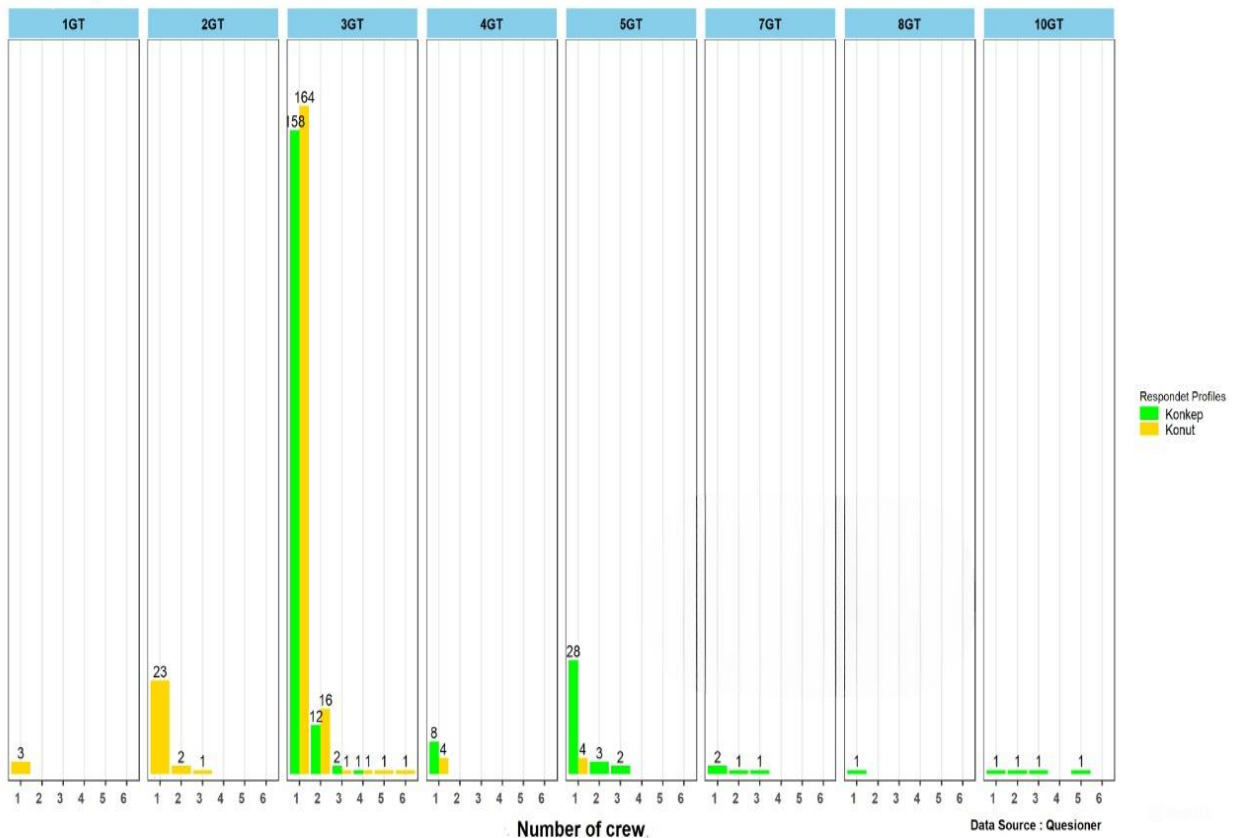


Figure 5. Respondents' profile based on location, number of crew members, and vessel gross tonnage.

Number of Fishing Trips

The number of fishing trips in both regions varied significantly, with one fishing trip occurring every 25 days being predominantly carried out by fishermen in the Konawe Islands region; however, fishermen in North Konawe have relatively longer and more frequent fishing journeys compared to those in the Konawe Islands (Figure 6). The variation in the number of fishing trips in these two regions indicates diverse patterns, where the occurrence of one fishing trip within a 25-day period is prevalent among fishermen in the Konawe Islands. Nonetheless, fishermen in North Konawe undertake longer and more frequent fishing journeys than those in the Konawe Islands.

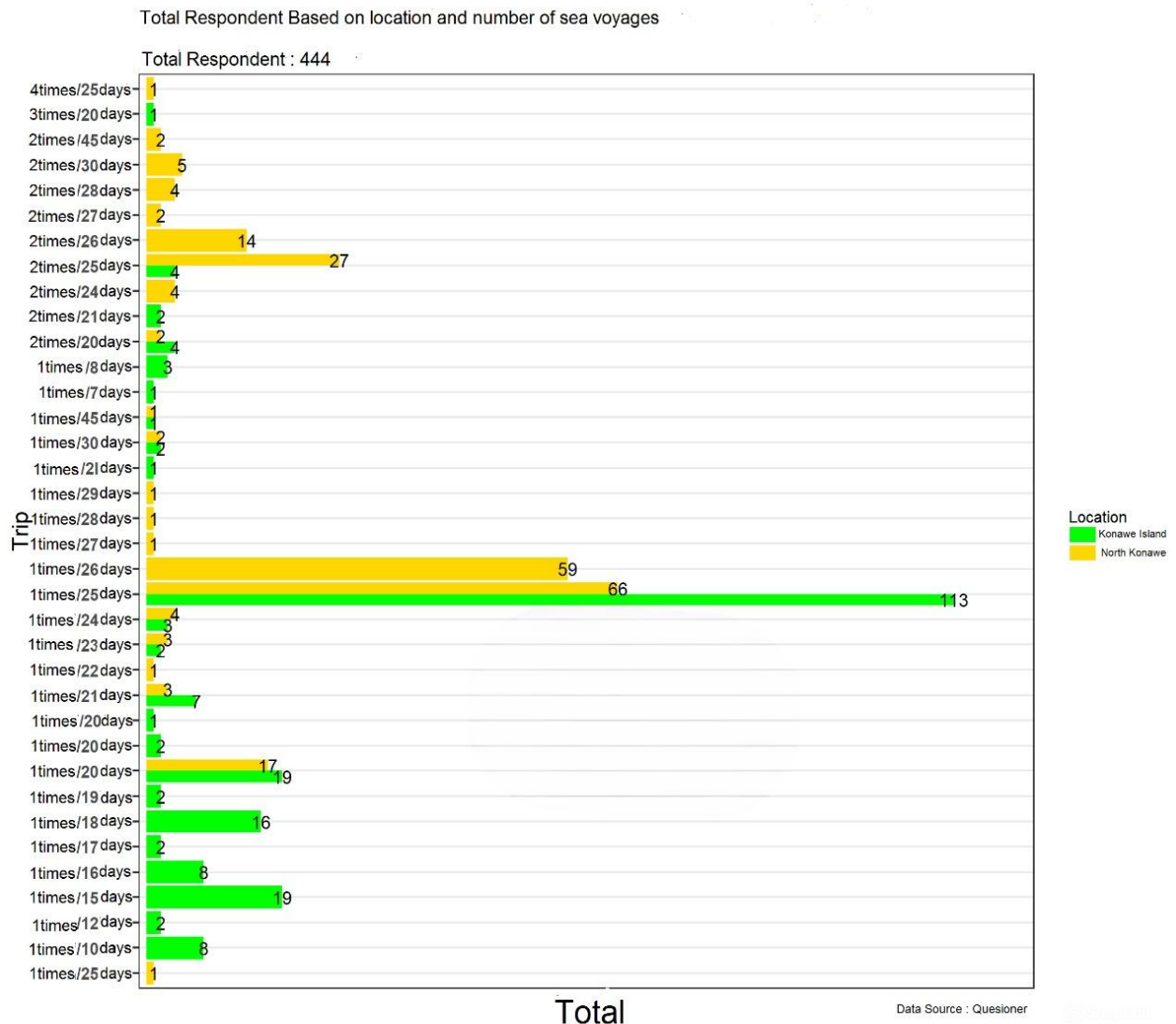


Figure 6. Respondents' profile based on location and number of fishing trips.

Monthly Income Based on Vessel Size

The monthly income levels of fishermen in the two regions (Figure 7) reveal varying income ranges. Fishermen in the North Konawe region predominantly earn incomes ranging from 2 to 3 million and 3 to 4 million rupiah on vessels sized 1 to 5 GT. On the other hand, fishermen in the Konawe Islands exhibit a different pattern, with income dominated within the range of 800 thousand to 1 million rupiah on vessels sized 4.5 and 10, and income 1 to 2 million rupiah on vessels sized 3, 4, 5, and 7 GT, as well as income exceeding 4 million rupiah on vessels sized 3.5, 7, 8, and 10 GT. This scenario depicts significant income disparities between the two regions, with fishermen in Konawe Islands generating notably higher incomes than those in North Konawe.

Comparison of monthly income level

Total Respondent :444

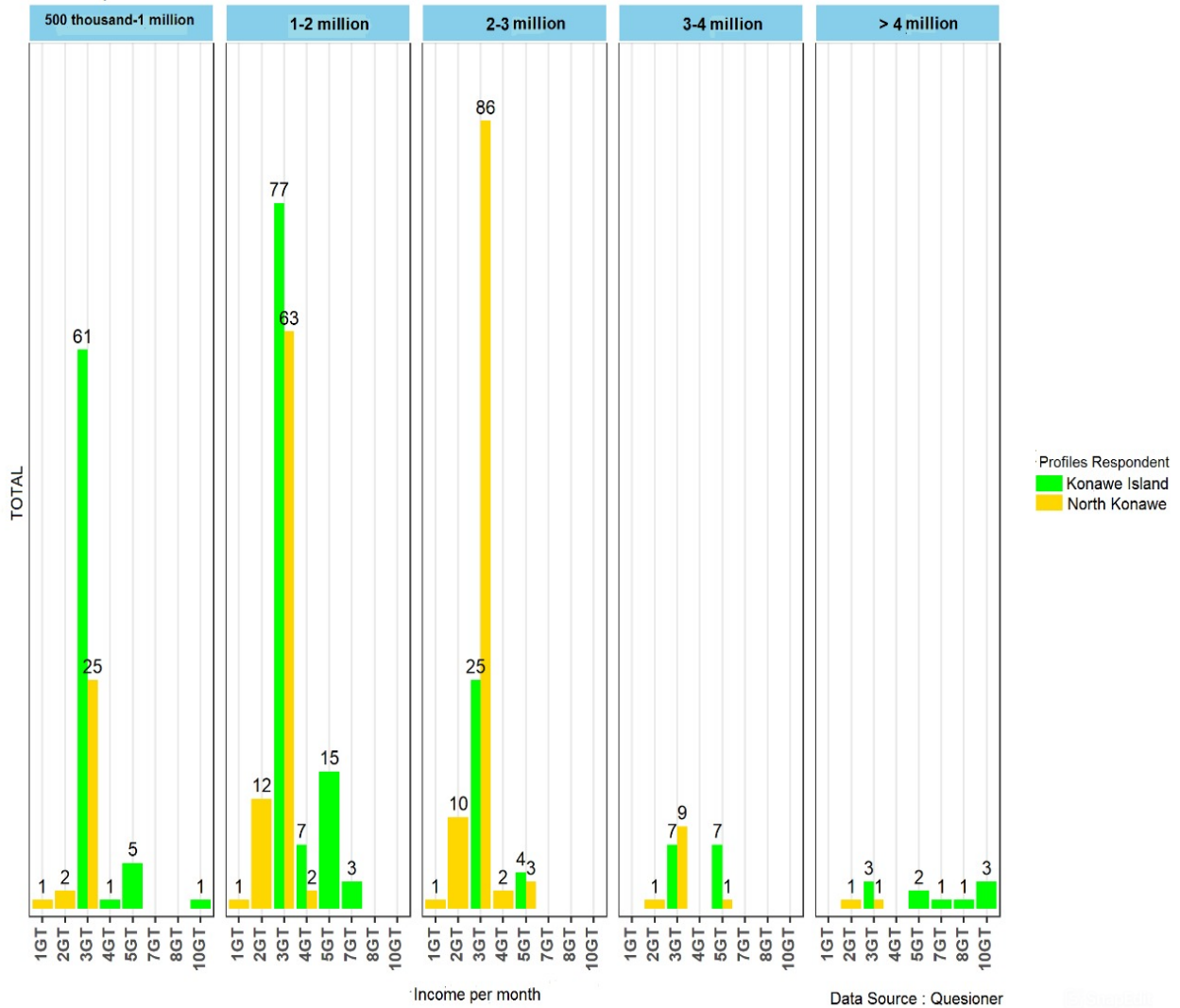


Figure 7. Comparison of monthly income levels.

Proportion Test of Income Ranges

The proportion test reveals that there are differences in income ranges in the two regions (Figure 8), where the Konawe Islands region has higher average income ranges of 500 thousand to 1 million, 1 to 2 million, 3 to 4 million rupiah, and > 4 million rupiah. Based on the income range values, it is apparent that there is an income difference between the North Konawe and Konawe Islands, where the income level in the Konawe Islands is greater than that in North Konawe. This indicates that based on the differences in the characteristics of fishermen in the two regions, several factors indicate this distinction. First, the education level of fishermen is a factor [28]; in the Konawe Islands region, fishermen have a better education level than those in North Konawe. Furthermore, vessel size significantly influenced catch rates. The vessels used by fishermen in the Konawe Islands are larger than those used by fishermen in North Konawe. A positive relationship exists between the type of vessel fishermen use and fish production [29]. In other words, the larger the vessel owned by fishermen, the higher the likelihood of catching fish [30,31].

Regarding the number of fishing trips, fishermen in the North Konawe region have more frequent and longer fishing trips than fishermen in the Konawe Islands. However, this condition does not necessarily translate into a higher income for fishermen in North Konawe. This is because fishermen tend to search for new and farther fishing areas as fish catch decreases in the region. Additionally, uncertainties in catching

fish and high fishing costs make fishermen more susceptible to losses [32]. Target fish species differed between the two regions. The Konawe Islands target grouper, skipjack tuna, and catfish as their main catches, where skipjack tuna and grouper are economically important. Fishermen in North Konawe target white fish (*kuwe*), groupers, and snappers as their main catch.

$$\chi^2_{\text{Pearson}}(4) = 66.23, p = 1.42\text{e-}13, \hat{V}_{\text{Cramer}} = 0.37, \text{CI}_{95\%} [0.28, 1.00], n_{\text{obs}} = 444$$

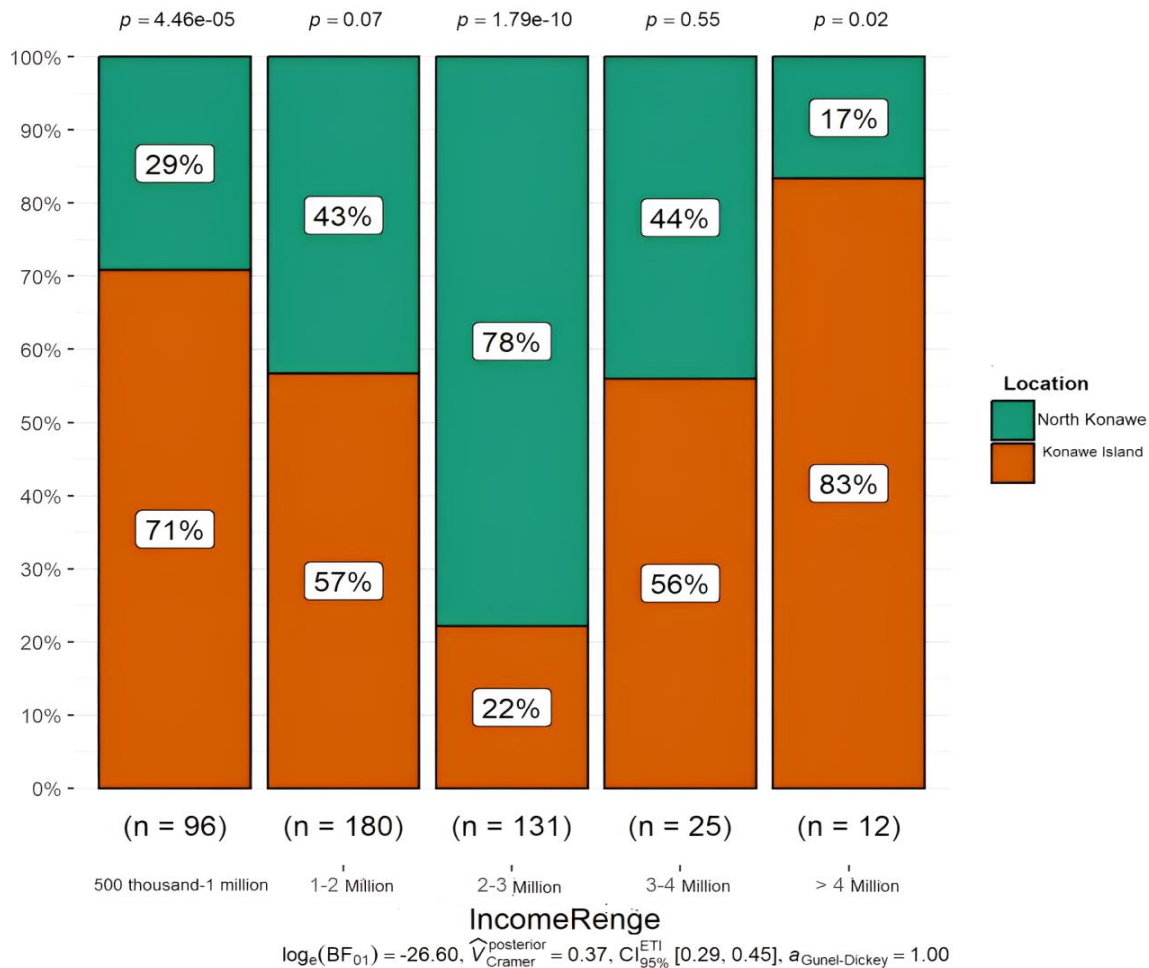


Figure 8. Proportion of income ranges.

Conclusion

A comparative study of fisheries characteristics in Southeast Sulawesi revealed distinctions in fishermen's educational levels, boat sizes, fishing trip frequencies, and incomes. Based on educational level, fishermen in North Konawe exhibit a range from incomplete primary education to bachelor's degrees. Meanwhile, most fishermen in the Konawe Islands have completed their high school education. Boat sizes in North Konawe range from one to five GT with one to three crew members, while boat sizes in the Konawe Islands range from 3 to 10 GT with one to five crew members. Fishing trips in North Konawe occur two to four times every 20 to 30 days, whereas, in the Konawe Islands, they occur only once every 20 to 25 days. Fishermen's incomes on the Konawe Islands are generally higher on average. Based on income levels, fishermen's incomes in the Konawe Islands were generally higher on average than those in North Konawe.

Author Contributions

MAR: Conceptualization, Methodology, Software, Investigation, Writing - Review & Editing; **LKA:** Writing - Review & Editing, Supervision; **DGB:** Writing - Review & Editing; **HAS:** Writing - Review & Editing; **AZ:** Writing - Review & Editing.

Conflicts of interest

There are no conflicts to declare.

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