The influence of the number of fishing fleets on the growth of fishery production in an effort to determine shipyard clusters using linear regression

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Abstract. Shipyards are not only an essential part of the shipping industry but also function as a crucial element for carrying out various tasks in the process of building and repairing ships. The shipyard's involvement in this process makes it the most important element supporting the progress of the maritime industry as a whole. Therefore, this research was designed with the main aim of investigating and analyzing the relationship between the number of ships or fleets and production growth in the fisheries sector. The data used in this research consists of statistical data on capture fisheries covering the period from 2020 to 2022. This data was then analyzed using a simple linear regression analysis method to identify and understand the dynamics of the relationship between the number of vessels and the growth of fisheries production. Through the use of this approach, the research aims to explore the extent of the influence of the number of vessels on the growth of fisheries production in the context of the years studied. However, the results of the analysis show that there is no significant influence between the number of vessels and the growth of fisheries production. Nevertheless, these findings provide an important contribution to a further understanding of factors that may influence fisheries production dynamics. The implications of this research can provide valuable insights for shipping and fishing industry stakeholders in their efforts to optimize their strategies and policies to support sustainable growth in this sector.

1 Introduction

Modern shipyards are entities involved in various activities such as shipbuilding, ship repair, ship modification, and other similar maritime work [1]. Taking into account these activities, shipyards can be categorized into several types, including new building yards, special repair yards, and combined new building and repair yards [2], [3]. Despite their crucial role in the maritime industry, shipyards in Aceh still encounter significant challenges related to human resources, land, facilities, and production capacity.

Several issues have arisen, encompassing a shortage of skilled labor, imperfect organizational structure, and incomplete facilities [4]. Moreover, there is a lack of updated technology [5], irregular working time patterns, and the absence of set annual production
targets [6]. Additionally, some shipyards are situated in less strategic land locations [7], [8], [9]. The modern shipbuilding industry demands adequate facilities due to its high production complexity, particularly as it generates a substantial number of large ships annually [10].

Meanwhile, shipyards in Aceh still adhere to traditional practices. These traditional shipyards are considered community shipyards that employ traditional construction methods, utilizing traditional tools, and relying on wood as the primary material [11], [12]. Shipbuilding is regarded as a part of the traditional heritage in Indonesia, where handmade wooden boats are constructed using techniques passed down through generations [13], [14].

Given the substantial disparities between modern and traditional shipyards, the challenges in Aceh necessitate adaptation and renewal to ensure the shipbuilding industry can effectively compete in an era marked by increasingly complex and modern ship production. Efforts to cluster shipyards are a crucial aspect that must be undertaken to optimize various facets of the industry. Clustering not only shortens processing time in building new ships and repairing old ones but also has a positive impact on reducing ship queues and enhancing efficiency in ship construction and repair processes [15]. Concurrently, establishing a comfortable and organized work environment remains a top priority. An organized workplace facilitates the implementation of comprehensive maintenance activities on the facilities and infrastructure systems within the shipyard. This not only enhances the comfort of the workforce but also minimizes operational costs and improves the efficiency of managing the diverse facilities available at the shipyard.

However, to achieve a more efficient level of clustering, comprehensive data concerning the number of vessel fleets and fishery production results is essential. This information serves as the foundation for clustering management and forms the basis for mapping the relationship between fleet size and fisheries production. Therefore, regression analysis was conducted to gain a more profound understanding of the dynamics of the relationship between these variables. Through regression analysis, it is hoped that significant patterns and trends can be identified between the number of vessel fleets and fisheries production results. The outcomes of this analysis can provide a deeper understanding, offer strategic insights, and serve as a basis for more effective decision-making in managing shipyard clustering. This way, shipyard clustering efforts can become more efficient, positively impacting the shipping industry as a whole, and contributing positively to economic growth in the region.

The purpose of simple regression analysis is to elucidate how one variable can quantitatively influence other variables. In the realm of regression analysis, variables that serve as instigators or catalysts for change are referred to as independent variables. Conversely, variables that undergo changes in response to the independent variable are labeled related variables or dependent variables. When the regression equation encompasses one independent variable and one related variable, it is termed a simple regression equation. In such instances, the analysis centers on the direct relationship between these two variables. For instance, to ascertain the degree to which changes in temperature (independent variable) can impact plant growth (related variable), simple regression analysis can be employed.

However, in scenarios where there are multiple independent variables that could influence related variables, a multiple regression equation becomes necessary. Multiple regression equations enable the consideration of the combined effects of two or more independent variables on related variables. For example, if the aim is to comprehend how not only temperature but also air humidity and sunlight intensity collectively influence plant growth, multiple regression analysis is the appropriate tool.

Simple regression analysis provides an estimate of the extent to which the related variable can alter due to a change in one independent variable. This information proves
invaluable in making predictions and comprehending the intricacies of relationships between variables. Through the application of this technique, a more profound exploration of the impact of independent variables on related variables is facilitated, thereby establishing a robust foundation for decision-making that is well-informed [16]

2 Research methods

Simple linear regression analysis involves establishing a linear relationship or model between the independent variable (x) and the dependent variable (y). In this study, the independent variables, referred to as influencing variables, include the growth of fisheries production and the number of fishing fleets. The dependent variable is the district/city name in Aceh. This analysis aims to ascertain the direction of the relationship between the independent variable and the dependent variable in the event of an increase or decrease in the independent variable. The formula utilized in simple linear regression analysis is as follows:

\[ Y = \alpha + \beta x \]

Where:
Y = Dependent variable
X = Independent variable
α = Constant
β = Regression coefficient

The coefficient of determination (R^2) in simple linear regression analysis is used to assess how well the regression line fits the data. The range of the coefficient of determination (R^2) is 0 to 1. The ability to explain the dependent variable is severely constrained the smaller the coefficient value. Conversely, a number around 1 indicates that the fluctuations in the dependent variable can be explained by the independent variable.

3. Results and Discussion

Based on capture fisheries statistical data from 2020 to 2022, it is evident that the number of fleets owned by each district/city in Aceh Province exhibits significant fluctuations, as illustrated in Figure 1. These fluctuations reflect variations occurring over time, signifying intricate dynamics within the fishing industry across these regions. It is crucial to emphasize that these fluctuations extend beyond fleet size and are also evident in the results of fishery production. Figure 2 outlines the trends of increases and decreases in the value of fisheries production in each district/city throughout this period. These changes indicate factors that could impact the performance of the fisheries sector, including climate change, resource management policies, or economic variability.

A comprehensive understanding of these fluctuations allows for a more profound analysis to identify the underlying factors causing these changes. For instance, whether an increase in production correlates with successful management interventions or specific external factors, and conversely, whether a decline in production is linked to a particular issue requiring special attention.

A profound comprehension of fluctuations in both the number of fleets and fisheries production in each district/city forms a robust foundation for making more precise and strategic decisions in fisheries resource management. Thus, a more detailed and holistic analysis can aid in formulating policies and strategic measures to foster sustainable growth within the fisheries sector in Aceh Province.
Based on this data, a linear regression analysis was conducted to assess the relationship between variable x (number of vessels) and variable y (amount of fisheries production). The analysis yielded a multiple R value of 0.416, indicating a moderate correlation between the two variables. The coefficient of determination, with a value of 0.098 or 10%, suggests that variable x (number of vessels) can account for approximately 10% of the variation in variable y (amount of fisheries production), while the majority of other variations are influenced by factors not encompassed in the model.

However, for a more comprehensive understanding, it is imperative to proceed with analysis of variance (ANOVA) calculations as the subsequent step. The outcomes of this analysis are presented in Table 1, where ANOVA provides insights into the significance of the relationship between the number of vessels and total fishery production. Thus, delving
into regression analysis and ANOVA allows for a thorough comprehension of the impact and significance of variable x on variable y, creating opportunities for enhanced interpretation and a deeper understanding of the factors influencing fisheries production.

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Based on the table above, it is evident that the significance value of F is greater than 0.05, indicating the absence of influence between variable x (number of vessels) and variable y (amount of fisheries production). This finding affirms that, in the context of this case, the number of vessels does not exert a significant impact on fisheries production. Despite the initial regression analysis suggesting a moderate correlation between the two variables, a significance F value surpassing the significance threshold indicates that this relationship cannot be considered statistically significant.

\[ Y = 4448881 + 3292.5x \]

Consequently, the resulting regression equation assumes significance in providing a detailed depiction. While this equation holds true under the condition x=0, possibly reflecting a scenario with no ships involved, a noteworthy increase in the y value of 3292.5 occurs when x=1. This seemingly simple equation offers insight into how fishery production may fluctuate with an increasing number of vessels.

In this context, the regression analysis and F significance results offer profound insights into the relationship between variables x and y, while the regression equation further elucidates the changes in fisheries production that may accompany variations in the number of vessels. This comprehensive interpretation establishes a robust foundation for meticulous and strategic decision-making regarding fisheries resource management.

4 Conclusion

The study aimed to examine the correlation between one or more independent variables and the dependent variable. The association among these variables was assessed using simple linear regression analysis. The findings indicate that there is no substantial impact observed between the quantity of fleets and the increase in fisheries production. The implications of this research can provide valuable insights for shipping and fishing industry stakeholders in their efforts to optimize their strategies and policies to support sustainable growth in this sector.

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