



The impact of blood cockle (*Tegillarca granosa*) pond development on fishermen income in the Sinaboi District, Rokan Hilir Regency, Riau Province, Indonesia

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Abstract. This research was conducted in 2023 with the aim of determining the income of fishermen and the impact of blood cockle (*Tegillarca granosa*) pond development on their income in the Sinaboi District, Rokan Hilir Regency, Riau Province, Indonesia. The method used in this research was a survey method, and the selection of respondents was done through purposive sampling, considering that the respondents selected for this study were fishermen who were knowledgeable about the research issue and affected by blood cockle pond development. The total number of respondents involved in this research was 48 fishermen. Based on interviews with the fishermen, it was found that their income before the existence of blood cockle ponds was 20.16 USD per day, while after the existence of blood cockle ponds, it decreased to 10.08 USD per day. This indicates that the development of blood cockle ponds has had a negative impact on fishermen income. According to the results obtained, This shows that the development of blood cockle ponds has a negative impact on fishermen's income.

Key Words: cultivation business, income, potential.

Introduction. The Sinaboi District, which is a result of the division from the Bangko District, is located in the Rokan Hilir Regency, Riau Province, Indonesia. The division was carried out based on the Rokan Hilir Regency Regional Regulation No. 23 of 2002, which also divided the area into the Pasir Limau Kapas Sub-district, Pujud Sub-district, and Simpang Kanan Sub-district. Geographically, the Sinaboi District is situated in a lowland area of 362.55 km² or 3.78% from the area of Rokan Hilir Regency. The district consists of 83 neighbourhoods (RT) and 89 community units (RW). The boundaries of the Sinaboi District are as follows: the north is bordered by the Malacca Strait, the south and east are bordered by Dumai, and the west is bordered by Bangko (Rahmiati 2020). The majority of the population in the Sinaboi District works as fishermen who primarily catch blood cockles (*Tegillarca granosa*). Blood cockles have high economic value and are consumed by the community due to their taste and high fat and protein content. The demand for blood cockles has been increasing over time, both to meet local and external demands (Intan et al 2012). To cope with the increasing demand, the community in Sinaboi has started cultivating blood cockles in ponds. This cultivation practice is essential to ensure the sustainability of the supply and ensure an adequate quantity and quality of blood cockles for consumption purposes.

The development of blood cockle ponds conducted by the community in Sinaboi has a significant impact on fishermen income. Sutiknowati (2010) stated that blood cockle cultivation requires several production inputs, including seedlings, pond facilities, labor, and molluscicides. Hidayah et al (2022) added that besides these factors, there are other important factors that need to be considered in the process of blood cockle pond cultivation, such as the depth of stake nets and the distance of the ponds from the coastline. Ruga et al (2018) stated that fishing catch is greatly influenced by the depth of

the water, and Utojo et al (2009) revealed that the location selection for pond cultivation has a significant impact on production outcomes. Srimaryani et al (2020) explained that the land allocation system for blood cockle cultivation is considered as common property, which means that the land is collectively owned and can be used by anyone for blood cockle cultivation.

The development of blood cockle ponds can disrupt the livelihood of traditional fishermen by limiting their accessibility and fishing grounds, ultimately resulting in negative impacts on their income (Kusuma 2020). The presence of blood cockle ponds is a problem that affects the lives of fishermen along the coast. In recent years, the rapid development of blood cockle ponds has been observed, which can have significant impacts on the lives of traditional fishermen who rely on fishing in the surrounding waters for their livelihoods. The development of blood cockle ponds can disrupt the lives of fishermen in several aspects. One of them is the reduction of space and accessibility for fishing activities. As blood cockle ponds expand, the previously open fishing grounds become obstructed by these ponds. This makes it difficult for fishermen to find more effective fishing locations, leading to negative impacts on their income.

The development of blood cockle ponds has an impact on the decline in the availability of fish resources in the surrounding waters, resulting in competition between traditional fishermen and the ponds in search of diminishing fish resources. In-depth research on the impact of blood cockle pond development on fishermen income is crucial. Such research can clearly identify the impacts of blood cockle pond development on fishermen income and the sustainability of their livelihoods. The data and findings from this research can serve as a basis for making appropriate policies to maintain a balance between blood cockle pond development and the livelihoods of traditional fishermen. Possible solutions may include spatial planning regulations for the ponds, the development of sustainable cultivation methods, or the diversification of fishermen's livelihood sources. This research is expected to provide valuable insights for local governments, fisheries policy-makers, and the local community in formulating policies and strategic measures to maintain a balance between blood cockle pond development and the livelihoods of traditional fishermen.

Material and Method

Time and location. This research was conducted in 2023 in the Sinaboi District, Rokan Hilir Regency, Riau Province, Indonesia.

Research methodology. The methodology used in this research is the survey method. The survey method is an approach used to gather the required data and information through the use of questionnaires as data collection instruments. This method enables the collection of data from a number of respondents considered to represent a specific population in the research (Kriyantono & Rakhmat 2008). In this study, the survey method was employed to obtain in-depth information regarding the impact of blood cockle pond development on the income of fishermen in the Sinaboi District, Rokan Hilir Regency, Riau Province. The use of the survey method allows researchers to observe and critically investigate the issues present in the research location to obtain valid and accurate information (Creswell & Creswell 2009). The survey method provides advantages in collecting data efficiently and generating reliable information. In this research, the researcher developed a carefully designed questionnaire that covered various relevant aspects related to the impact of blood cockle pond development on fishermen income. The questionnaire was distributed to a number of respondents, including traditional fishermen in the Sinaboi District.

Determining respondents. The selection of respondents in this research used the purposive sampling method. Purposive sampling is a sampling technique based on specific criteria relevant to the research objectives (Kurniawan & Puspitaningtyas 2016). In the context of this study, the criteria used were fishermen who have knowledge about the issues related to blood cockle pond development and are affected by these pond

activities. 48 fishermen were selected as respondents in this study. This sample size was chosen to ensure an adequate variation and representation of fishermen affected by blood cockle pond development in the Sinaboi District. Respondents were carefully selected based on their knowledge and experience regarding the issues under investigation. By using the purposive sampling method, it was expected to obtain rich and in-depth information regarding the impact of blood cockle pond development on fishermen income. The findings of this research can provide a more comprehensive understanding of the influence of blood cockle ponds on fishermen livelihoods and enable the formulation of appropriate policies to address the existing issues.

Data analysis. The analysis used to measure the fishermen income in this research was descriptive analysis. According to Nazir (2013), descriptive analysis is used to describe the status of a group of people, objects, conditions, thought systems, or current events with the aim of presenting a systematic, factual, and accurate description of the researched facts. Meanwhile, the analysis used to determine the impact of blood cockle pond development on Sinaboi fishermen income utilizes the Ratio Income Multiplier method (Vanhove 2005). The Ratio Income Multiplier is a method that measures the direct impact felt from the business owners' expenditures on the local economy. The mathematical formula is expressed as follows:

$$\text{Ratio Income Multiplier, Type II} = (D+N+U) / D$$

Where: D - local income obtained directly; N - local income obtained indirectly; U - local income obtained through induced effects. The respective values (direct income, indirect income, and induced effect income) were obtained from the blood cockle cultivation businesses. The criteria for the results obtained are as follows: if the values are less than or equal to zero (≤ 0), then the location has not been able to provide economic impact; if the values are between zero and one ($0 < x < 1$), then the location has a low economic impact; if the values are greater than one (> 1), then the location of the blood cockle pond farming activity has a significant economic impact on fishermen.

Results and Discussion

Fishermen income. Based on the information obtained from fishermen in 2023, the daily income has been declining both during the fishing season and off-season. During the interviews, fishermen expressed their concerns that before the development of blood cockle ponds, their average daily income during the fishing season was 33.61 USD, and during the off-season, it was 20.16 USD. This situation aligns with the view of Johnson (2016), who notes that seasonal fluctuations and changes in weather patterns can also impact fishermen income. During unfavorable seasons, such as the off-season, fish catches decrease, and fishermen income can significantly decline.

The cultivation of blood cockles in ponds increases with the increasing knowledge gained by the community, resulting in a further decline in fishermen income. After the establishment of blood cockle ponds, fishermen income from their catches averaged 20.16 USD per day during the fishing season and 10.08 USD per day during the off-season. According to Srimaryani et al (2020), the cultivation of blood cockles in ponds also requires seedlings, which are priced between 13.44 and 20.16 USD per can with a weight of 17 kg. This condition will impact the income of fishermen who catch blood cockles, because the natural seedlings are used in the ponds of those who engage in cultivation and are sometimes sold to those in need of seedlings. This study found that the presence of ponds in traditional fishing areas reduced fish catches and had a negative impact on fishermen income.

The magnitude of fishermen catch greatly influences their livelihood, including meeting their daily needs (Amika et al 2022). According to Srimaryani et al (2020), community ponds are placed into three categories: small, medium, and large. The income of communities with small-scale blood cockle ponds amounts to 52854.71 USD per day. Furthermore, the income of communities with medium-scale ponds reaches

74284.066 USD per day, while the income of communities with large-scale ponds reaches 88531.89 USD per day. In this context, research by Amika et al (2022) demonstrates that the magnitude of fishermen catch has an impact on their income. Similarly, the study by Srimaryani et al (2020) presents income data for communities with blood cockle ponds in various strata.

Ratio Income Multiplier, Type II. The economic impact of blood cockle cultivation ponds can be seen in Table 1.

Table 1

Economic impact of blood cockle ponds on fishermen per year

No	Impact	Amount (USD)
Economic impact of small-scale blood cockle cultivation		
1	a. Direct economic impact (D)	52854.71
	b. Indirect economic impact (N)	134.43
	c. Local income obtained through induced effects (U)	181.48
	Total (Year)	5317.06
	Impact	1.01
Economic impact of medium-scale blood cockle cultivation		
2	a. Direct economic impact (D)	74284.07
	b. Indirect economic impact (N)	134.43
	c. Long-term economic impact (U)	181.48
	Total (Year)	74599.97
	Impact	1.00
Economic impact of large-scale blood cockle cultivation		
3	a. Direct economic impact (D)	88531.89
	b. Indirect economic impact (N)	134.43
	c. Local income obtained through induced effects (U)	181.48
	Total (year)	88847.80
	Impact	1.00

The economic impact of blood cockle cultivation in the small-scale category has a value of 1.01, while the medium-scale and large-scale categories have a value of 1.00. This indicates that all categories of blood cockle cultivation have significant economic impacts on fishermen.

The direct economic impact. With the development of blood cockle ponds, cultivators can obtain significant income according to the category of the pond they own. The findings presented by Srimaryani et al (2020) offer valuable insights into the economic implications of blood cockle cultivation. The income figures reported for different categories of ponds indicate the varying levels of profitability and economic potential within the industry. The higher incomes observed in the medium and large categories suggest that larger-scale operations can yield more substantial financial returns compared to smaller-scale operations.

The income generated by blood cockle cultivators has important implications for the local economy. It contributes to the overall economic activity within the region, fostering employment opportunities, income circulation, and economic growth. The income earned by cultivators can be spent on various goods and services, stimulating local businesses and supporting the livelihoods of other community members. Moreover, the income received by cultivators can have a positive impact on the welfare of the community. Higher incomes enable cultivators to improve their standard of living, access better healthcare and education services, and invest in their future. As a result, the income generated from blood cockle cultivation can contribute to poverty alleviation and enhance the overall well-being of individuals and families involved in the industry.

It is important to note that, while the income data presented in the study provides valuable insights, it is essential to consider other factors that may influence the economic impact of blood cockle cultivation. These factors may include production costs, market dynamics, government policies, and environmental sustainability. Additionally, further

research and analysis are necessary to assess the long-term sustainability and resilience of the blood cockle cultivation sector in supporting economic development and community welfare.

Indirect economic impacts. The development of blood cockle ponds can create employment opportunities in the processing and distribution sectors, which in turn can have indirect economic impacts through increased income and wage payments to workers. Mulyadi (2003) stated that labor is the most dominant factor of production in productive activities. This finding is consistent with those of Sutrisno et al (2017) which concluded that labor significantly affects production outcomes. Hidayah et al (2022) explained that one of the factors influencing blood cockle pond cultivation in Panipahan village is labor. The wages earned by workers in blood cockle cultivation activities amounts to 134.43 USD per month. Srimaryani et al (2020) determined that the labor used by blood cockle pond owners in carrying out the business can be categorized into: 1) permanent labor consisting of 2 individuals per pond unit, with wages ranging from 134.43 to 168.03 USD per person per month; permanent labor is essential for maintaining the ponds due to the risk of theft; 2) during harvesting, the labor force ranges from 8 to 10 individuals per pond unit, with wages of 0.067 USD per kg paid to the workers. In this business activity, the indirect economic impact is derived from the wages of permanent workers provided by the pond owners on a monthly basis, as it is not dependent on production and is already tied to the pond owners in maintaining the ponds to prevent theft. On the other hand, the wages of non-permanent workers depend on production, which cannot guarantee the level of success. Onibala et al (2017) explain that permanent workers tend to have more job security compared to non-permanent workers.

In the context of blood cockle aquaculture development, the local income obtained through induced effects (U) can be observed through the expenditures of the population derived from their income, wages, or profits. Iskandar (2017) stated that income has a positive influence on household expenditure patterns, as increasing income will lead to an increase in household expenditure.

According to findings from interviews conducted with 48 fishermen, their average daily expenditures amount to 181.48 USD. In the context of household expenditures, Firdaus et al (2013) propose a categorization into two groups: expenditures for food and expenditures for non-food items. The authors suggest that households, at a certain income level, allocate their income to fulfill their needs and expenses. Thus, the quantity of food required by an individual may reach a saturation point. On the other hand, non-food needs, which include factors like food quality, are not constrained in the same manner. Therefore, while the amount of income allocated to food expenses can provide insights into the household's well-being, it should be considered alongside other non-food expenditures. By analyzing the proportion of income spent on food, researchers can gain an understanding of the household's level of well-being. Higher spending on food may indicate that the household is capable of meeting its basic nutritional requirements, and potentially have additional resources to allocate towards better quality food. Conversely, lower spending on food might suggest a limited ability to afford sufficient quantities or quality of food, thereby reflecting a lower level of well-being. It is important to note that the specific amount of income allocated to food expenditures may vary depending on cultural factors, dietary preferences, regional cost of living, and other contextual aspects. Additionally, the researchers' choice to focus on fishermen may introduce some limitations to the generalizability of the findings, as the expenditure patterns of this specific occupation may differ from those of other household types. To gain a comprehensive understanding of a household's well-being, it is crucial to consider not only the amount of income spent on food but also the overall expenditure patterns, including non-food items such as housing, education, healthcare, transportation, and recreation. These factors contribute to a holistic assessment of the household's financial stability and quality of life. The expenditure patterns of households, particularly the proportion of income allocated to food expenses, can serve as an indicator of their well-being. While the quantity of food needed by individuals may reach a saturation point,

non-food needs, including food quality, are not as constrained. Analyzing the allocation of income to food expenditures provides insights into a household's ability to meet their basic nutritional requirements and potentially afford higher quality food. However, it is important to consider other expenditure categories and contextual factors to form a comprehensive understanding of a household's overall well-being.

Food items consumed by fishermen in their daily lives, according to BPS (Central Bureau of Statistics), can be categorized into 14 groups: cereals, tubers, meat, eggs and dairy products, vegetables, legumes, fruits, oils and fats, beverages, spices, processed food and beverages, as well as tobacco and betel leaves. On the other hand, non-food items consist of housing and household facilities, various goods and services, clothing, footwear and headwear, taxes and insurance, as well as ceremonial and festive needs (Firdaus et al 2013). Purwantini & Mewa (2008) explain that the higher the share of food expenditure, the less prosperous the household is considered. Conversely, a smaller share of food expenditure indicates a more prosperous household. Both food and non-food expenditures have an impact on the economy of fishermen households, which is referred to as the long-term economic impact. According to Belinda (2013), the long-term economic impact is related to changes in economic activities resulting from household expenditures.

Conclusions. Fishermen income decreased after the development of blood cockle cultivation within a period of one year. Prior to the establishment of blood cockle cultivation ponds, fishermen average daily income was 33.61 USD during the peak season. After the development of blood cockle cultivation ponds, fishermen average daily income decreased to 20.16 USD during the peak season. Blood cockle cultivation ponds development significantly affected fishermen income, as seen from the values of the Ratio Income Multiplier, Type II. The Ratio Income Multiplier, Type II value for small-scale blood cockle cultivation is 1.01, while for medium-scale and large-scale blood cockle cultivation ponds it was 1.00.

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

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