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Alternative Livelihoods of Traditional Fishermen as the Impact of Climate Change in Ambon City

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ABSTRACT

This study aimed to describe and analyze non-fishery alternative livelihoods and to calculate the income and expenditure of traditional fishermen in Ambon City. The research employed a descriptive qualitative method to explore the types of non-fishery alternative livelihoods, while a quantitative method was used to calculate their income and expenditure. Data were collected through questionnaires, in-depth interviews, and field observations. The findings showed that traditional fishermen's non-fishery livelihoods were primarily in agriculture (64.3%), fisheries-based entrepreneurship (21.4%), and daily labor (14.2%). Monthly income from non-fishery livelihoods amounted to IDR 2,080,000, while fishing income was IDR 3,875,800, resulting in a total monthly income of IDR 5,955,800, while their monthly expenditure was IDR 8,554,200. The conclusions drawn were: (1) non-fishery livelihoods are mainly in agriculture, which is not yet optimal in supporting fishermen's income, (2) the total income of fishermen is still low compared to their food and non-food expenditures, and (3) non-fishery livelihoods, mainly agriculture and fisheries-based entrepreneurship, need to be integrated more effectively through entrepreneurship to boost economic growth. It is suggested that the government and stakeholders should focus on developing business opportunities for fishery households to improve their income and welfare in Ambon City.

INTRODUCTION

Ambon Island is one of the islands in Maluku Province. Administratively, Ambon Island has two territories, consisting of the city of Ambon, and partially consisting of the Central Maluku Regency, with its capital city of Masohi located on Seram Island. Ambon Island is classified as a small island and is considered highly vulnerable to climate change due to various factors that contribute to the increase in greenhouse gases, such as methane, nitrous oxide, and carbon dioxide **(Kesaulya *et al.*, 2023a; Kesaulya & Rahman, 2023; Salamena *et al.*, 2023; Tubalawony *et al.*, 2024)**.

Ambon City has a tropical marine climate and a monsoon climate. Being surrounded by the sea, the island's climate is heavily influenced by the ocean, and this influence coincides with the monsoon seasons: the West or North monsoons and the East or Southeast monsoons. The transition between seasons is marked by a transitional period, which serves as a bridge between the two seasons. The West season typically lasts from December to March, followed by a transition period in April leading into the East season, which lasts from May to October. A second transitional period occurs in November, bridging back to the West season.

In Ambon City, traditional fishermen who catch flying fish (*Cypselurus* sp.) operate throughout the year. However, due to limited fishing facilities, their catches are often insufficient, typically only meeting household consumption needs. Many fishermen continue to live in poverty, facing various limitations, whether economic, social, political, or educational. Research on poverty has shown that traditional fishermen are among the poorest groups and make up the largest social demographic in Indonesia's fishing communities **(Stacey *et al.*, 2021; Sunartomo *et al.*, 2023)**. This condition is largely due to their high dependence on natural conditions. For example, unfavorable weather conditions can hinder the work of traditional fishermen. This issue is compounded by the low capacity, knowledge, and skills of traditional fishermen in Arungkeke Village, Arungkeke District, to engage in economically productive activities outside of fishing.

It is crucial to provide alternative livelihoods to improve fishermen's welfare without diverting them from their main occupation of fishing. Additionally, enhancing skills and expertise in the fisheries and seaweed sectors, including methods for cultivating and arranging their products for better competition, is necessary. Supportive policies from the Regional Government are needed to develop coastal areas in Arungkeke District. Cooperation from relevant institutions, including local social organizations, is also vital to assist in lifting fishing communities out of poverty.

In contrast, traditional fishermen in Ambon City face compounded challenges, with climate change forcing them to pursue alternative livelihoods to supplement their household income. Non-fishery alternative livelihoods for these fishermen generally fall into two categories: agriculture and non-agriculture sectors. Agriculture has long been a part of the cultural identity of coastal communities and small islands in Maluku, as people depend on both land and sea for subsistence. In the non-agricultural sector, alternative livelihoods stem from the development of infrastructure to support the social and economic needs of the community **(Chilombo & Horst, 2021; Pical *et al.*, 2024)**.

This study aimed to describe and analyze non-fishery alternative livelihoods and to examine the income and expenditure of traditional fishermen in Ambon City. The findings will serve as a valuable resource for the local government of Ambon City and policymakers in fisheries development, helping to improve the welfare of traditional fishing communities.

MATERIALS AND METHODS

Time and location

This study was conducted for 10 months starting from February until November 2018, in Kilang Village, Naku Village, and Hukurila Village in South Leitimur District in the city of Ambon (Fig. 1)

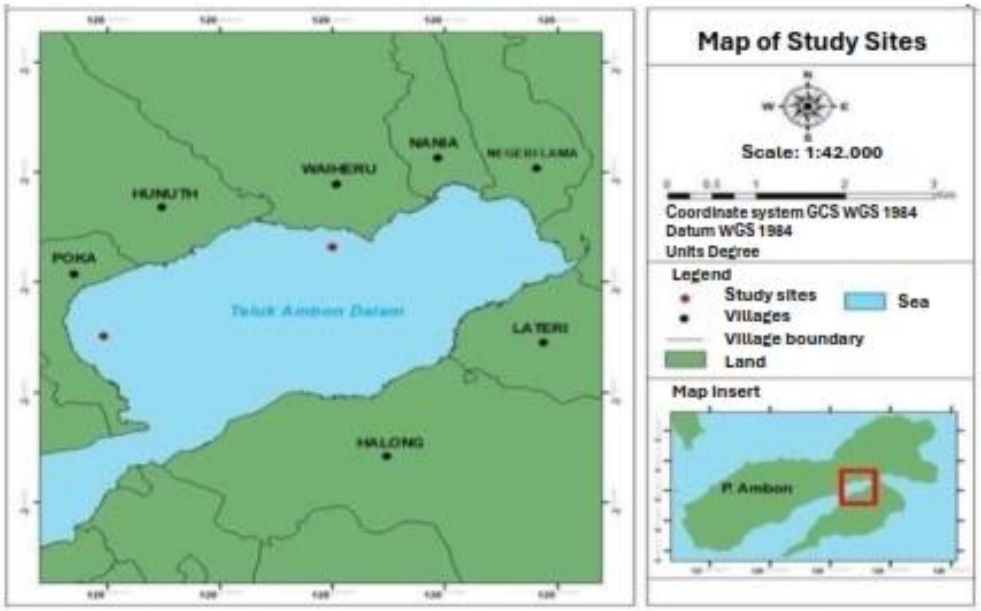

Fig. 1. Research location

The reason for choosing this location for this research is because the area has a high potential of flying fish (*Cypselurus* sp.) resources which leads to the local community's traditional utilization activities.

Data sampling

This study collected two types of data which were primary and secondary. Primary data included data on respondent characteristics, descriptions of fishing gear, alternative non-fishery livelihoods (agriculture and non-agriculture), and income and expenditure of traditional fishermen that catch flying fish. Primary data sources were obtained from the traditional fishermen community. They were collected through focus group discussion (FGD), in-depth interviews, observation, documentation, and daily reports in the field. In this research, focus group discussion (FGDs) were conducted with 10 participants. These participants were:

- **Full-time fishermen:** Those who depend solely on flying fish for their livelihood.

- **Part-time fishermen:** Those who supplement their income by catching flying fish.
- **Local community leaders:** Influential figures within the fishing villages.
- **Representatives of fishing households:** Family members involved in various aspects of fishing activities.

Participants were purposively selected to ensure representation of the traditional fishing community in the study area. The FGDs aimed to understand the social context of flying fish fishing, including the challenges faced by fishing communities and the roles of different members within these communities.

Moreover, the secondary data were population data, climate, and references related to this research. Secondary data sources were collected from BPS in Ambon City, the Maluku Provincial Agency for Meteorology, Climatology, and Geophysics, the State Government Offices of Refineries, the three villages of Kilang, Naku, and Hukurila, and the South Leitimur District Office. Secondary data collection techniques were acquired through literature study and literature review.

The samples used in this study were snowball sampling and random sampling **(Chan, 2020)**. The snowball sampling technique was used for traditional fishermen who utilized flying fish resources (Full fishermen), while random sampling was intended for traditional fishermen of all types of fish (Side fishermen). This study involved a total of 36 respondents, comprising:

- **Full fishermen:** 20 individuals who primarily rely on flying fish as their main source of livelihood.
- **Side fishermen:** 16 individuals who supplement their income by catching flying fish.

Data analysis

The data analysis method used to describe and analyze non-fishery alternative livelihoods was descriptive qualitative analysis referring to the concept of Miles and Huberman **(Mezmir, 2020)**. This was achieved by creating an interactive model concept that explains three interrelated data analyses sub-processes called data reduction, data presentation, and conclusion. Data reduction is a process of selecting, focusing on simplifying, abstracting, and transforming raw data that emerge from written records in the field. Presentation of data is the preparation of the information that allows concluding and taking action. In practice, the presentation of this data can be in the form of narrative text or matrices, graphs, networks, and charts. Meanwhile, concluding takes the form of recording the regularity of existing patterns, explanations, possible configurations, causal paths, and proportions.

The data analysis method used to analyze the amount of income and expenditure of traditional fishermen in Ambon City was as follows:

a) Business income analysis

Analysis of farming business income holds an important role related to the objectives achieved by each farming business, as well as those with an interest in farming with various considerations and motives (**Brown *et al.*, 2021**). This analysis aims to determine the input and output components involved and the amount of net income obtained from the business activities carried out. The concept of operating income analysis is calculated based on the difference between total revenue (TR / Total Revenue) and total cost (TC / Total Cost). The revenue of full-time and part-time fishermen was measured based on the catch of flying fish and other economic activities. Analysis was conducted to compare the contribution of flying fish catches to the total household income of both full-time and part-time fishermen.

According to **Elinur *et al.* (2022)**, the calculation of business income is formulated as follows: $\pi = TR - TC$

Information:

π = Net income
TR = Total revenue
TC = Total cost

The criteria used are:

TR > TC = Business income makes a profit
TR = TC = Non-profit, non-loss / break-even
TR < TC = Business income with loss

b) R / C analysis

The analysis aims to determine how effectively each rupiah spent contributes to generating revenue. To assess the feasibility of the flying fish fishing business, the Return on Cost (R/C) analysis method was used. Theoretically, an R/C ratio of 1 indicates a break-even point, where neither profit nor loss occurs. However, due to costs associated with farming that are sometimes overlooked, this criterion can be adjusted based on the researcher's judgment **(Łuczka & Kalinowski, 2020)**. The analysis was conducted using a partial budget analysis, with the R/C ratio serving as the key indicator. The R/C ratio represents the relationship between revenues and costs **(Li *et al.*, 2019)** as follows:

R/C = TR/TC

The criteria used are:
R / C > 1: Profitable business activities
R / C = 1: Business activity at break-even
R / C < 1: Business activities are detrimental

c) Total income analysis

The calculation of the main net income value of traditional flying fish fishermen uses the equation:

$$\pi_{main} = TR_{main} - TC_{main}$$

The calculation of the value of alternative livelihood income for fishermen uses the equation:

$$\sum \pi_i = \sum TR_i - \sum TC_i$$

Information:

i = alternative livelihoods (MPA), MPA_1, MPA_2, MPA_3…….MPA_n

$$\pi_{main} = \pi_{main} + \sum \pi_i$$

RESULTS AND DISCUSSION

1. Profile of traditional fishermen in Ambon City

Traditional fishermen are categorized into two types, namely full fishermen and side fishermen. Full fishermen are fishing-oriented toward the target flying fish species (*Cypselurus* sp.), and their catch is not market-oriented but aimed toward household consumption. On the other hand, side fishermen target species that are economically important fish such as skipjack, tuna, and yellowfin tuna, while fly fishing is only an alternative where the catch is sold to the market following the main catch.

Based on the type of traditional fishermen, the focus of research here is on full fishermen. The average time spent working for fishermen ranges from 5 to 7 hours per day with the scale of the business being classified as traditional. On average, flying fish fishers in Maluku can go fishing approximately 15–25 days per month during the fishing season. However, during the off-season, this activity may decrease significantly. Flying fishing vessels used were smaller than 5 GT, made of wood, and not motorized. The fishing location was around village waters one to two miles from the coast with the workforce limited to one to two people with family ties. The type of fishing gear used was drift gillnets **(Richardson *et al.*, 2019)**. Drift gillnets are rectangular nets that have the same mesh size on the entire net. The width of the net used was shorter than its length, and a float was placed on the top sheet of netting. The size of the net used was 1.5 pcs, and this net was placed in the opposite direction to the current.

The fishing operation took place from 05.00 to 12.00 WIT and did not depend on the tidal conditions. The position of the netting was to the right of the ship, with the spread of the net in the shape of a "U" or "S". Flying fish fishing techniques are always the same, following the experiences passed down through generations by paying attention to signs and natural symptoms around the waters **(Najamuddin *et al.*, 2020)**. This is traditional knowledge of flying fish fishing communities so that they can survive despite the current climate change phenomenon affecting the fishing activities of coastal communities and small islands in Maluku. One of the traditional forms of knowledge is local wisdom in the principles of conservation, management, and exploitation of natural, economic, and social resources. This is evident from the behavior that has such high respect for the natural environment, which is an inseparable part of life **(Deville *et al.*, 2021)**. Local knowledge of the community has proved very useful in predicting weather that is conducive or unconducive to fishing operations. For instance, by looking at the curvature of the sky in the direction of the line of sight or the black skyline, it is clear whether the weather will be unconducive to fishing operations. In addition, local knowledge has been utilized to estimate the number of fish by seeing the presence of birds that fly circling over the water surface, indicating that the area has a lot of fish. Moreover, taking notice of the moon's condition has likewise proved beneficial. If the moon is seen to be dark, it typically means many fish are present in the water. The local wisdom of the flying fish fishing community is the social capital that the community has in adapting to climate change. Full-time fishermen who focus on flying fish typically work 5-7 hours per day. Based on field experience, traditional fishermen tend to go to sea 15-20 days per month, depending on weather conditions, waves, and the fishing season. If fishermen go to sea an average of 15-20 days per month, then in one year (12 months), they go to sea approximately 180-240 days per year. Each trip is typically calculated based on the number of days at sea, as traditional fishermen usually return on the same day. Therefore, the number of trips will be the same as the estimated number of days at sea, which is approximately 15-20 trips per month or 180-240 trips per year.

The results showed that traditional fishermen aged ≥ 50 years had the status of the head of the family and were the backbone of the family economy. Based on interviews and field observations, the average traditional fisherman in the study area has 20 to 30 years of fishing experience. Fishermen who focus on flying fish have generally been working as fishermen since a young age. Many of them have more than 25 years of experience, as their skills and knowledge have been passed down through generations in their families. Fishermen who catch economic fish such as tuna and mackerel, in addition to flying fish, typically have more varied experience, ranging from 15 to 25 years, depending on when they started working in the sector. This long experience reflects the strong fishing tradition in the local community, where fishing skills and knowledge, including the use of fishing gear and understanding natural signs, are passed down from

generation to generation. This experience is also an important social capital for fishermen in facing challenges such as climate change and declining catches.

According to the observations of the fishing community, the current condition of the waters shows that marine products are increasingly difficult to obtain. This condition requires the role of other family members to support the fishermen's household economy so that it does not only depend on the head of the family. The fishermen's children offered their help in making and preparing the nets to allow their parents to save money and catch more fish. The fishermen's wives also play a role as fish sellers, ready-made food vendors, and market snack sellers. Additionally, the fishermen take on temporary roles as crew members on ships where they may use non-traditional large-scale fishing gear to catch fish such as the purse seine and pole and line.

Traditional fishermen in the face of climate change have alternative livelihoods. Alternative livelihoods are a new concept developed in order to reduce or eliminate pressure on natural resources as well as to increase community income **(Ahmadzai *et al.*, 2021; Lopulalan & Rahman, 2024)**. Alternative livelihoods are also defined as a substitute business that has the potential to be developed in increasing fisheries' household income.

2. Non-fishing alternative livelihoods

The results showed that the alternative livelihoods of traditional fishermen in Ambon City, especially Kilang Village, Naku Village and Hukurila Village in South Leitimur District, were mostly in the agricultural sector while others in the non-agricultural sector included entrepreneurs and daily laborers (Fig. 2)

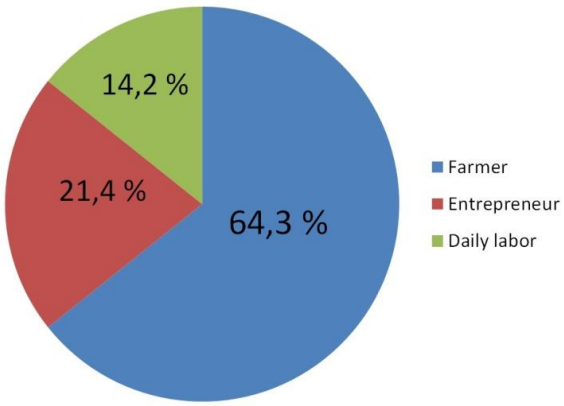

Fig. 2. Alternative livelihoods for traditional fishermen in Ambon City

Ambon Island is included in the category of small islands where the area of Ambon Island is 377km^2 **(Nurhaeny *et al.*, 2021)**. This is following Law Number 27 of 2007 concerning the management of coastal areas and small islands **(Kurdi, 2020)** that small islands have an area smaller than or equal to 2000km^2 along with the unity of the ecosystem. The characteristics of coastal communities and small islands are that they are

traditional communities that depend on the use of natural resources on land and in the sea. This shows that there is complete unity between the two uses of these resources. The current phenomenon of climate change where increased rainfall and high wind speeds have an impact on waves and currents in the sea means the frequency of traditional fishing carried out by traditional fishermen has decreased. Capitalizing on the local wisdom of coastal communities and small islands, traditional fishermen can adapt to alternative livelihoods in agriculture, namely by carrying out activities such as farming, gardening, and raising livestock in their hamlets; customary areas designated for indigenous peoples in agricultural activities.

Traditional community hamlets on Ambon Island often cultivate food crops such as cassava, sweet potato, and corn. Agriculture, particularly food crops, is widely practiced in Kilang Village, Naku Village, and Hukurila Village, with cassava being the dominant crop. In the plantation sector, two types of commodities are grown: vegetables and fruits. The vegetable commodities in these villages include cucumbers (with an average production of 12.20 tons/ha), tomatoes (13.56 tons/ha), and peas (7.93 tons/ha). The main fruit crops include bananas (40 tons/ha), pineapples (15 tons/ha), and durian (12.50 tons/ha). In the livestock sector, pigs were the dominant commodity in 2015, with a population of 778 heads.

Alternative livelihoods for traditional fishermen in Ambon City, particularly in villages like Kilang, Naku, and Hukurila, are largely due to their access to agricultural land and traditional knowledge passed down through generations. Several factors contribute to this:

1. **Access to agricultural land**: Many fishermen own or have access to agricultural land in their villages, where they engage in farming, gardening, and livestock rearing. This land availability allows them to pursue agricultural activities as an alternative when fishing conditions are unfavorable, such as during adverse weather events like heavy rain or strong winds.
2. **Diversification as a coping strategy**: Diversification of livelihoods is a common strategy used by traditional communities to cope with environmental changes. Access to agricultural land provides opportunities for fishermen to reduce their dependence on fishing alone, ensuring economic stability for their households even when fish catches decline.
3. **Integration of land and sea resources**: Traditional coastal communities have long integrated land and sea resource use, adapting to challenges by using local wisdom to manage both sectors. For example, they know when to switch between fishing and farming activities based on weather patterns or fishing conditions.
4. **Impact of climate change**: The increasing difficulty in obtaining marine resources due to climate change has compelled communities to seek additional sources of income. Agricultural activities have thus become a vital alternative to support families and to ensure food security.

5. **Non-agricultural alternatives**: Some fishermen also engage in non-agricultural livelihoods such as entrepreneurship or daily labor to supplement their income. These alternatives are often facilitated by social networks or market opportunities within the community.

Therefore, while access to agricultural land is a primary factor, the combination of local knowledge, economic needs, and diversification strategies enables traditional fishermen to pursue alternative livelihoods.

These findings indicate that the living systems and patterns of coastal and small island communities are subsistence-based. People in these communities not only rely on small-scale, traditional fishing but also engage in alternative livelihoods to meet household needs. The use of natural resources from both narrow land areas and the wide sea is deeply integrated into the community's traditional knowledge, allowing these practices to persist despite the challenges posed by climate change. Non-fishery alternative livelihoods, dominated by agriculture and entrepreneurship, need to be properly integrated to stimulate economic growth.

The integration of these sectors can drive economic growth through entrepreneurship **(Surya *et al.*, 2021)**. In developing countries, the impact of entrepreneurship on economic growth varies, and various strategies are being considered to optimize entrepreneurial activities. Therefore, optimizing entrepreneurship in fisheries, agriculture, and community-based businesses requires proper integration. A key strategy is the reorganization of businesses and institutions into business clusters, which can lead to independent market functions and the formation of international networks. This integration process should be considered and developed to accelerate and enhance the quality of economic growth in these communities.

3. Income and eexpenditure, revenue/cost, and total income of traditional fishermen

The price of flying fish varies depending on factors such as freshness, processing methods (e.g., dried or salted), and market location. Fresh flying fish typically sells for IDR 30,000 – 75,000 per kilogram. Processed products, like dried fish, can command higher prices, typically ranging from IDR 75,000 – 120,000 per kilogram. The price of flying fish eggs can range from IDR 750,000 to 1,500,000 per kilogram, depending on the quality and demand in international markets.

On average, traditional fishermen earn IDR 12,430,000 from fishing flying fish, while income from alternative livelihoods (non-fisheries) is IDR 2,080,000. This brings their total monthly income to IDR 14,510,000.

In terms of household expenditures, traditional flying fish fishermen typically spend an average of IDR 1,103,200 on food needs, and IDR 7,441,000 on non-food needs, totaling IDR 8,554,200 in monthly expenditure. The detailed breakdown of these figures can be seen in Table (1).

Table 1. Income and expenditure of traditional fishermen (per month)

Income sources	Revenue (IDR)	Expenditure	Expenses (IDR)
Fisheries	IDR 12,430,000	on food needs	IDR 1,103,200
Non-fisheries	IDR 2,080,000	non-food needs	IDR 7,441,000
Total household income	IDR 14,510,000	Total household expenses	IDR 8,554,200

The analysis indicates that the monthly income of traditional flying fish fishermen is IDR 3,875,800. Based on the business success criteria, the flying fish fishing operation is profitable, as the total revenue (TR) exceeds the total cost (TC). Specifically, TR amounts to IDR 14,510,000, while TC is IDR 8,554,200, demonstrating that the business generates a positive return for traditional fishermen. The income derived from fishing flying fish, amounting to IDR 12,430,000, along with additional income from alternative livelihoods, brings the total income to IDR 14,510,000, reflecting their monthly income.

This conclusion is supported by detailed household expenditures: IDR 1,103,200 for food and IDR 7,441,000 for non-food needs, which are typical of a one-month period. Thus, income and expenses are considered within the same monthly period. Revenue refers to the gross income of IDR 12,430,000 from fishing activities, while net income (after costs) is IDR 3,875,800, encompassing all household expenses, including those not directly related to the fishing business.

Moreover, the R/C ratio of 1.696 confirms the profitability of the flying fish (*Cypselurus* sp.) fishing business. According to the R/C analysis criteria, a business is deemed profitable when the R/C ratio exceeds 1, indicating that the fishing activity is economically viable and provides sustainable benefits to fishermen.

The total income analysis incorporates both earnings from the flying fish business and income from alternative livelihoods in other sectors. Traditional fishermen's total monthly income is IDR 5,955,800, a crucial amount in supporting their economic resilience, particularly in adapting to the effects of climate change. The combination of income from fisheries and alternative livelihoods demonstrates the efficacy of these strategies in maintaining economic stability.

The income of fishing households in Ambon, which includes IDR 12,430,000 from fisheries and IDR 2,080,000 from alternative livelihoods, significantly exceeds the Regional Minimum Wage (UMR) of IDR 3,250,000 per month, reaching more than four times the UMR. However, despite their relatively high income, household expenditures are also considerable, totaling IDR 8,554,200, covering both food and non-food needs. The diversification of income sources—combining both fisheries and non-fishery sectors like agriculture—enhances the resilience of fishing households to climate change and economic crises. Still, their dependence on natural resources, particularly fisheries, makes them vulnerable to fluctuations in weather and fish catches.

CONCLUSION

In conclusion, the alternative livelihoods of traditional fishermen, particularly within the agricultural sector, have not yet provided substantial support to their overall business income. Despite the efforts made, the total income generated by these fishermen remains inadequate to cover their food and non-food expenditures, highlighting a critical need for economic improvement. While agriculture and small-scale entrepreneurship are the predominant non-fishery alternatives, these activities must be more effectively integrated, particularly through entrepreneurial initiatives, to create greater economic opportunities and foster growth in fishing communities.

To address these challenges, government intervention is essential in optimizing the potential of the flying fish fishing business. Targeted support, including training and non-formal education programs, is necessary to equip fishermen with the skills and knowledge required to diversify their livelihoods and to increase productivity. Strengthening entrepreneurial capacity and enhancing non-fishery sectors could make a significant contribution to the improvement of the welfare and economic resilience of fishing communities, ultimately leading to greater long-term sustainability.

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