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Analysis of the Livelihood Shift of Sea Cucumber Fishermen on Local Economic Mobility in Sitardas Village

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***Abstract*— Sitardas Village is located in Central Tapanuli Regency, a coastal area rich in marine resources, one of which is sea cucumbers (holothurians). Sea cucumbers have long been an ecologically and economically important commodity for the community, serving as the primary source of livelihood for fishermen. Sea cucumbers caught in Sitardas Village not only meet local market demand but also have significant potential in the global market, particularly in the export trade sector. Sea cucumber fishing is becoming increasingly common due to increasing demand. Given this potential, the urgency of this research is that it often faces various challenges. One such challenge is the decline in sea cucumber populations due to overexploitation. To address this issue, the aim of this research is to influence local economic mobility and how communities can adapt to these changes without compromising the sustainability of marine resources. Therefore, this analysis is crucial for providing strategic recommendations for managing natural resources sustainably while encouraging improved community welfare. This research is also expected to identify patterns of livelihood changes and their driving and inhibiting factors, so that interventions can be designed appropriately and support sea cucumber conservation efforts while strengthening the local economy in a sustainable manner.**

Keywords—Ecosystem Approach; Overexploitation; Resource Management; Traditional Knowledge.

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I. INTRODUCTION

Sitardas Village is located in Central Tapanuli Regency which is rich in marine resources [1], one of which is sea cucumbers (holothurians). This marine biota has long been an ecologically and economically important commodity for the community [2], both as a main source of livelihood for fishermen and as part of local traditions. Sea cucumber fishing is becoming more common due to the increasing demand. According to [3], excessive sea cucumber fishing by fishermen and the community will threaten the sustainability of the population of this biota, therefore, there is a need for control over sea cucumber fishing to maintain the sustainability of the sea cucumber population.

Over time, sea cucumber fishermen in Sitardas village have faced various challenges. One of these is the decline in sea cucumber populations due to overexploitation. This is caused by changes in marine environmental conditions and the effects of climate change. On the other hand, economic and social pressures are forcing most fishermen to seek alternative livelihoods, both in the fisheries and non-fisheries sectors. One example is that in the fisheries sector, it is known that increasing catches can lead to a decline in sea cucumber populations [4].

This shift in fishermen's livelihoods not only impacts the socio-economic dynamics of the village, but also brings significant changes in local economic mobility patterns. This economic mobility is seen in the form of shifts in community income, changes in welfare levels, and the emergence of economic inequality between groups of people who are able to adapt and those who are not. This is in accordance with what was stated by [5], each person has a different livelihood that can be seen based on the natural conditions of that person's existence.

This situation requires a deep understanding of the various factors driving the shift in livelihoods within the fishing community of Sitardas Village. This is done to evaluate the impact of these changes on local economic mobility and how the community can adapt without sacrificing the sustainability of the marine resources that are their primary source of livelihood. These changes affect not only the economic aspects but also the social structure and lifestyle of coastal communities, so a holistic understanding is needed so that interventions can bring long-term benefits. This study also aims to identify the main challenges faced by fishermen during the livelihood transition process and find appropriate innovative solutions, while also providing applicable strategic recommendations for sustainable natural resource management. These recommendations are expected to assist the village government and stakeholders in designing policies and empowerment programs that align with community needs and maintain the balance of the marine ecosystem, thereby sustainably improving the welfare of the community in Sitardas Village and ensuring the sustainability of marine resources for future generations.

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This research is also highly relevant and actively supports a number of Sustainable Development Goals (SDGs) initiated by the United Nations (UN). Specifically, this research contributes to the achievement of SDG 1: Poverty Eradication by improving the welfare of fishing communities; SDG 8: Decent Work and Economic Growth through strengthening sustainable livelihoods; SDG 12: Responsible Consumption and Production by promoting efficient and sustainable management of natural resources; SDG 14: Deep Water Ecosystems which includes the protection and sustainable use of marine resources; and SDG 17: Partnerships for the Goals, through collaboration between governments, communities, and other stakeholders in realizing inclusive and sustainable development. Therefore, this research not only provides local benefits, but also aligns with the global agenda for balanced and sustainable development.

II. METHOD

A. Research Approach

The types of data used in this study are primary and secondary data obtained from the Sitardas Village government. Primary data includes the number of sea cucumber fishermen in Sitardas Village, economic data on fishermen in Central Tapanuli, and data on the coastal environmental conditions of sea cucumber fishermen. Secondary data includes data on the area of the Fish Management Area (DPI) in Sitardas Village, economic statistics of fishermen in Central Tapanuli, fisherman catch production, and satellite mapping to accurately identify the DPI location. The combination of these two types of data provides a strong foundation for comprehensive and valid analysis, so that the research results can provide a comprehensive picture of the socio-economic dynamics and environmental conditions that affect the livelihoods of sea cucumber fishermen in the region.

B. Place and Time

This research was conducted in Sitardas Village, Badiri District, Central Tapanuli Regency, from July 1 to 31, 2025. The research was conducted in four stages: data collection, questionnaire completion, data processing, and data analysis. Each stage was carried out carefully to ensure the accuracy and validity of the data obtained. Furthermore, this research involved the active participation of the local community to obtain a comprehensive picture of the socio-economic conditions and changes in livelihoods in the area. The results of the data analysis are expected to provide useful recommendations for the development of community empowerment programs and sustainable management of marine resources.

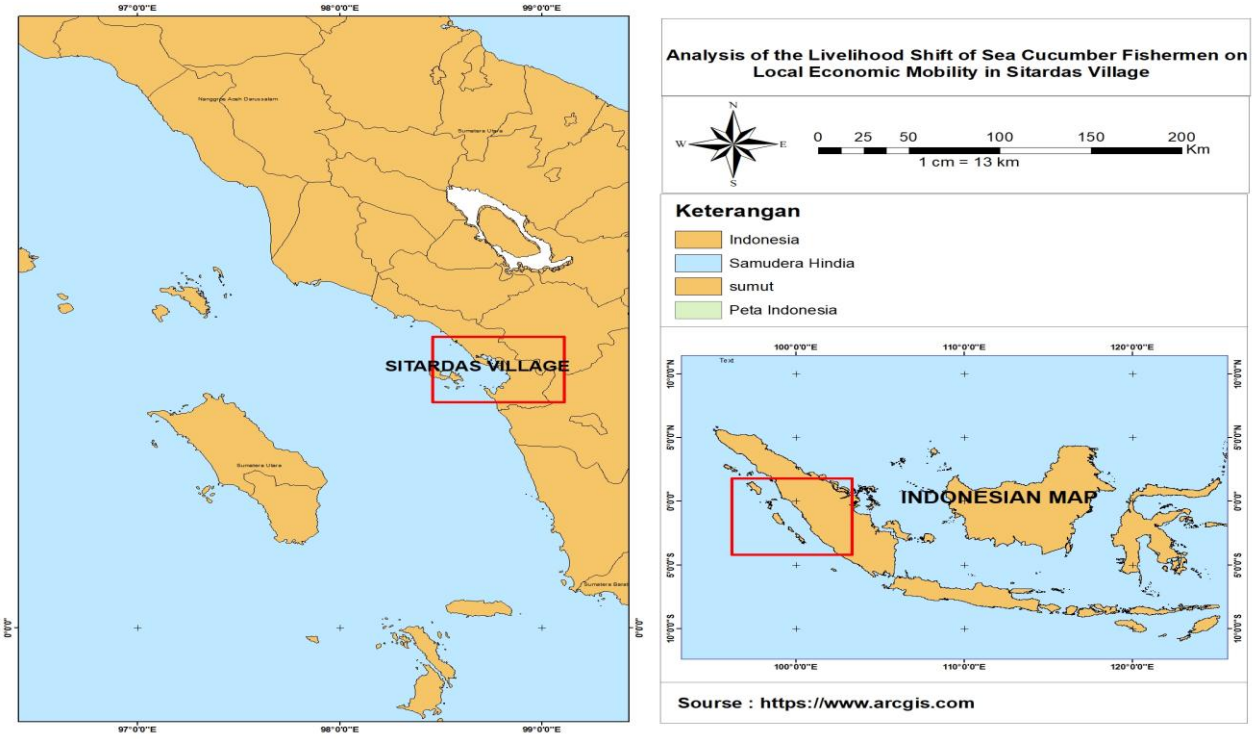

Figure. 1. Research Location

C. Selection of Respondents and Informants

Sample selection was based on the research objectives and did not deviate from the sample characteristics. The sample size was determined using the Slovin calculation with a 15% error rate. The equation used is as shown in equation 1. This method was chosen to ensure that the sample size is representative and able to accurately describe the population, so that the research results are reliable and valid. Furthermore, the sample selection process was carried out systematically to avoid bias and ensure representation of various subgroups within the study population [6].

$$N = \frac{N}{1+N\,(e2\,)}$$

Description:
n = Number of samples
N = Known population
e = Desired critical value (accuracy limit) of 15% with a confidence level of 85%.

$$n\,\frac{290}{1+290(0.15)2}$$

$$\frac{290}{5{,}05}$$

N=58

The population used in this study was 290 people, with a total of 58 fishermen selected as respondents. The number of respondents was determined using a purposive sampling formula as in equation 1, with a margin of error of 15%. This purposive sampling method was chosen to ensure that the respondents had characteristics and experience relevant to the research objectives, ensuring that the data obtained accurately reflected actual conditions in the field and was useful for further analysis.

D. Data Analysis

The data obtained in this study used qualitative and quantitative analysis. Qualitative analysis was obtained from the data collection process through direct interviews with 58 sea cucumber fishermen. The interview process was conducted using a questionnaire method with a Likert Scale (1-5). Quantitative analysis was obtained using SmartPLS3 software with the SEM (Structural Equation Modeling) model. This dual approach allows for a deeper and more comprehensive understanding of the phenomenon studied, as well as increasing the validity of the results. In addition, qualitative data was also analyzed thematically to capture important patterns and insights that support the quantitative findings, resulting in more holistic and applicable conclusions in the context of empowering sea cucumber fishermen [7].

III. Results and Discussion

A. Reasons for the Change in Livelihoods of Sea Cucumber Fishermen

The shift in livelihoods among sea cucumber fishermen is a phenomenon that occurs when fishermen shift from their primary occupation as fishers to another occupation as sea cucumber catchers. Based on field results, this shift reflects the adaptation of fishing communities to the dynamics of resources and constantly changing market conditions. This shift can be temporary, when fishermen catch sea cucumbers during a specific season, or it can also be permanent, when fishermen catch sea cucumbers without regard to the season but catch them continuously. Both of these shifts aim to improve family welfare and support the economic resilience of fishermen who previously depended on fishing.

These changes are influenced by several factors, including declining fish catches due to overfishing, marine habitat degradation, and changing climate conditions that result in declining fisheries catches [8]. Furthermore, these changes are also influenced by social factors such as demographic pressures, the influence of fisheries policies, and access to technology. Based on these factors, fishermen are seeking more promising and sustainable income alternatives, such as sea cucumber fishing, which is considered to have high economic value and stable market demand.

B. Dynamics of Fishermen's Livelihood Shift

The dynamics of livelihood transitions among fishermen in Sitardas Village were obtained based on questionnaire results divided into three main aspects: reasons for livelihood changes (A), economic mobility (M), and the main challenges faced by the fishing community (T). Each aspect is broken down into five specific indicators that reflect the driving factors, economic dynamics, and main obstacles in the fishing process, as shown in Table 1. This grouping of indicators is designed to provide a comprehensive picture of the various dimensions of change experienced by fishermen, as well as to facilitate analysis of the relationships between variables in the context of social and economic transmission. The data is expected to provide a strong basis for formulating appropriate strategies to overcome challenges and maximize opportunities in sustainable marine resource management. [9].

TABLE 1.
FISHERMAN INTERVIEW RESULTS

No	*Reasons to Increase Livelihood* (A)				
	A1	A2	A3	A4	A5
1	0	0	0	0	0
2	1	15	0	0	3
3	38	35	22	0	20
4	19	8	36	35	35
5	0	0	0	23	0
Total	**58**	**58**	**58**	**58**	**58**

(a) Results of analysis of reasons for increasing livelihoods

No	*Economic Mobility* (M)				
	M1	M2	M3	M4	M5
1	0	0	0	0	0
2	3	4	4	0	1
3	38	36	34	0	37
4	17	18	20	35	17
5	0	0	0	23	3
Total	**58**	**58**	**58**	**58**	**58**

(a) Results of the analysis of economic mobility

No	*Main Challenge* (T)				
	T1	T2	T3	T4	T5
1	0	0	0	0	0
2	3	0	0	0	0
3	23	35	0	7	0
4	32	23	58	23	58
5	0	0	0	28	0
Total	**58**	**58**	**58**	**58**	**58**

(c) Results of the analysis of the main challenges

Table 1 presents various key pieces of information related to the preservation of fishermen's livelihoods in Sitardas village. The data collected aims to provide a comprehensive picture of changes in the social and economic conditions of the fishing community over time, including aspects of respect, social networks, and the role and position of fishermen within their community. Understanding these indicators provides valuable insights into the dynamics of social life and the stability of livelihoods in the area.

In addition to social aspects, the data obtained also revealed environmental conditions that significantly impact the sustainability of fishermen's livelihoods. Critical variables such as local climate change impacting temperature and rainfall patterns, the fluctuating availability of fishery resources due to exploitation pressure, and the intensity of human activities that increase marine habitat degradation are important elements that are analyzed in depth. This approach confirms the complex and interconnected relationship between socio-economic factors and environmental conditions, which together determine the stability and sustainability of fishermen's livelihoods while maintaining the function of the marine ecosystem in the coastal area of Sitardas Village. Thus, this holistic analysis is key to formulating a resource management strategy oriented towards long-term sustainability.

The information presented in this table is expected to serve as a strong empirical foundation for formulating comprehensive sustainable development policies and strategies. By emphasizing strengthening social networks and increasing solidarity and mutual respect among community members, it is hoped that synergy will be created that can optimize the welfare of fishermen in a sustainable manner. This effort also supports marine environmental conservation through responsible resource management practices. This integrative approach, combining social, economic, and ecological dimensions, is a key ecosystem for ensuring the long-term survival and well-being of coastal communities, while maintaining the continuity of the marine ecosystem that supports the livelihoods of fishermen.

The analysis results show that the majority of respondents chose options 3 and 4 as the primary reasons for improving fishermen's livelihoods. This choice underscores the importance of improving economic well-being in the lives of fishermen as a strategic step in supporting the survival and well-being of their families. Improving livelihoods is not merely an economic aspect, but also reflects fishermen's efforts to address the various environmental and social challenges they face daily.

Furthermore, the economic mobility analysis revealed a tendency for respondents to choose answers 3 and 4, indicating that changing jobs or diversifying income sources has a positive impact on fishermen's social status. After changing jobs, fishermen tend to experience an increase in social status and an overall improvement in their quality of life. This finding indicates that economic mobility plays a significant role in improving welfare and providing new opportunities for fishermen to escape the cycle of poverty. Changing professions provides a way for them to improve their living conditions and expand their social networks [10].

Meanwhile, the analysis of the main challenges faced by sea cucumber fishermen shows that the majority of respondents chose numbers 3 and 4, indicating that sea cucumber fishermen are not yet part of an organized group or community. This situation has resulted in limited opportunities for them to receive adequate training, education, and understanding regarding sustainable sea cucumber management. Consequently, the future sustainability of sea cucumber commodities is vulnerable and requires more serious attention from various parties, including the government and related institutions, to provide structured assistance and empowerment so that sea cucumber potential can be utilized optimally and sustainably.

C. Livelihood Transition Factors

The PLS-SEM analysis in this study involved three latent constructs: Reasons for Livelihood Change (A1–A5), Challenges (T1–T5), and Economic Mobility (M1–M5). Evaluation of the measurement model showed that all constructs met the reliability and convergent validity criteria, with Composite Reliability (CR) values above 0.70 and Average Variance Extracted (AVE) values

above 0.50. These findings align with guidelines that emphasize the importance of these requirements to ensure indicators truly reflect the construct. Furthermore, discriminant analysis also confirmed that each construct has an adequate level of differentiation. Figure 1 shows the results of the factor analysis of livelihood shifts on economic mobility, which demonstrates a significant relationship between the constructs and strengthens the research hypothesis. These results provide a comprehensive picture of the social and economic dynamics occurring in the studied community.

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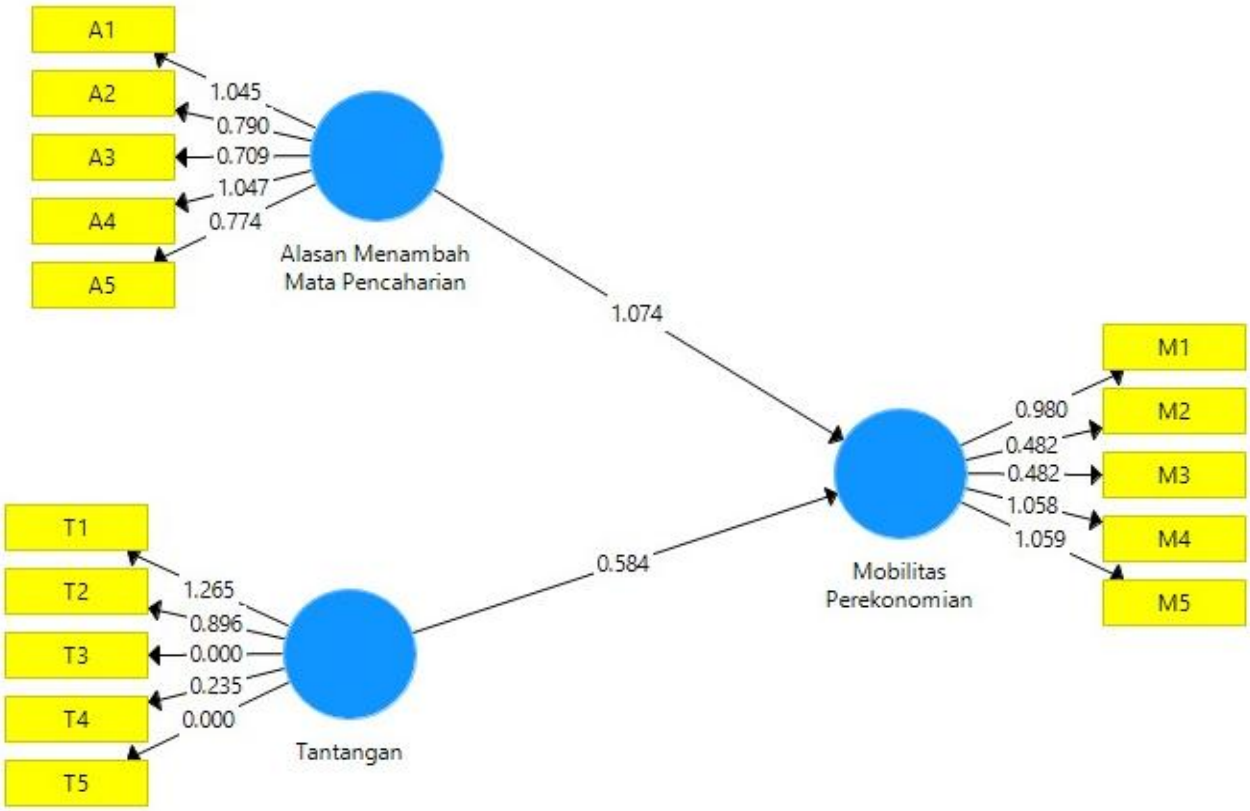

Figure. 4. PLS-SEM Structural Model of Livelihood Transition Factors on Economic Mobility

Figure 1 details the contribution of the indicators to the first construct, Reasons for Livelihood Improvement, showing variation. Indicator A4 has the highest loading value (1.047), making it the strongest representation, while A3 has the lowest loading value (0.709). This suggests that while all indicators are valid, certain reasons are more dominant in motivating individuals to improve their livelihoods. Furthermore, these differences in loading values provide important insights into understanding the priority of factors influencing livelihood change decisions, thus providing a basis for designing more targeted interventions and policies. Further analysis is also needed to identify causal relationships and the impact of each indicator on the final research outcomes.

Regarding the challenge construct, there are significant differences in contributions between indicators. The highest loading value is found in T1 (1.265), which describes marine environmental change as a major obstacle, while T3 and T5 have values of 0.000, indicating no significant contribution. This finding aligns with similar research showing that environmental factors are often the primary determinant of the sustainability of fishermen's livelihoods. This condition emphasizes the importance of paying attention to environmental aspects in the planning and implementation of fishermen's empowerment programs, while also providing the basis for developing effective adaptation strategies to address these challenges. Furthermore, these results also indicate the need for more in-depth studies of non-environmental factors that may play a role in the dynamics of livelihood changes in these communities.[12].

Furthermore, the Economic Mobility construct shows that the M5 indicator has the highest loading (1.059), indicating that income growth is the strongest indicator of economic mobility. Conversely, M2 and M3 have the lowest values (0.482). This indicates that although economic mobility can be viewed from various aspects, income growth remains the most significant indicator. This finding illustrates that increasing income directly impacts the economic well-being of individuals and families, making it a primary focus in efforts to improve quality of life. However, the low values for the M2 and M3 indicators indicate the need for more attention to other aspects such as access to resources or employment opportunities, which also contribute to economic mobility overall.

The relationships between constructs in the structural model display a pattern consistent with the indicator results. The path from Reasons for Increasing Livelihood to Economic Mobility has a coefficient of 1.074, higher than the path from Challenges to Economic Mobility (0.584). This finding confirms that motivation for increasing livelihood has a more dominant influence on economic mobility than the obstacles faced. The significance of the coefficients was then tested using a bootstrapping procedure, as shown in Table 2.

TABLE 2.
STRUCTURAL MODEL EVALUATION RESULTS

Hipotesis	Sampel Mean	STDEV	t-value	p-value
Alasan → Mobilitas	0,211	0,905	1,077	0,282
Tantangan → Mobilitas	-0,003	0,092	0,604	0,546

Table 2 shows the results of the structural model evaluation using PLS-SEM analysis. The path coefficient (β) for the relationship between Reasons for shifting livelihoods of sea cucumber fishermen and Mobility is 0.211 with a t-value of 1.077 and a p-value of 0.282, indicating a positive trend although not yet significant at the 5% confidence level. In contrast, the relationship between Main challenges Reasons for shifting livelihoods of sea cucumber fishermen and Mobility has a path coefficient (β) of -0.003 with a t-value of 0.604 and a p-value of 0.546, indicating a relatively weak influence. This condition confirms that the dynamics of fishermen's economic mobility are not fully influenced by these two constructs, so it is necessary to explore other factors that may be more determining.

Overall, the research results show that economic motivation remains a more influential internal factor than external challenges in driving fishermen's economic mobility. Policy implications focused on economic empowerment, such as expanding access to capital, diversifying businesses, and improving skills, have the potential to have a more significant impact. This recommendation aligns with recent guidance emphasizing the importance of strengthening local economic capacity as a long-term adaptation strategy [13].

D. Impact on Local Economic Mobility

The shift in occupations experienced by sea cucumber fishermen in Sitardas village has had a significant impact on social and economic conditions. This shift arises from various factors, including limited fishing capacity due to population decline and environmental constraints such as marine habitat destruction. Furthermore, difficult market access is a major obstacle, preventing fishermen from always selling their catch at a reasonable price, leading to unstable incomes. Opportunities for more stable employment and a more secure income are available. On the other hand, other sectors also encourage fishermen to change occupations in an effort to maintain family well-being.

This transition has significant social impacts on fishing communities, where changes in livelihoods not only alter lifestyle patterns but also reshape traditionally established social structures. Fishermen who change professions are faced with the urgent need to adapt to new work mechanisms and master additional skills they previously lacked, so this adaptation process includes complex dimensions of learning and social transformation. Furthermore, the dynamics of sea cucumber fishing activities are strongly influenced by two main factors related to social mobility: upward social mobility, which opens up opportunities for improved welfare and social status, and downward social mobility, which marks the risk of declining economic and social conditions, both of which play a role in determining the sustainability of fishermen's lives amidst dynamic environmental and economic changes [14].

Upward social mobility is where fishermen strive to escape dependence on uncertain fishing conditions. This process demonstrates strong hope and motivation for social and economic change, which contributes to the transformation and development of fishing communities. The success of this vertical social mobility is highly dependent on infrastructure support, government policies, and access to adequate capital and technology. Downward social mobility, on the other hand, occurs as a result of various internal and external factors. Internal factors include limited business capital, repeated losses in fishing activities, and a lack of adequate skills or education. Meanwhile, external factors include difficult market conditions, increasing competition, and declining catches.

This situation has caused fishermen to experience a decline in their social and economic status. To address this situation, empowering fishermen through capital utilization and strengthening is a crucial solution. With better access to capital, skills training, and technical and institutional support, lower-class fishermen, especially laborers, can increase their production capacity. This empowerment not only allows them to survive economic pressures but also opens up opportunities for upward

social mobility, thereby sustainably improving their standard of living and family well-being [15].

IV. CONCLUSION

The government plays a crucial role in educating sea cucumber fishermen in Sitardas Village about the negative impacts of overfishing on the environment. Comprehensive and ongoing education is essential to help fishermen understand how uncontrolled resource exploitation can damage marine ecosystems and threaten the sustainability of fisheries resources. Based on this understanding, fishermen will be more aware of implementing environmentally friendly and sustainable fishing methods to maintain the sustainability of the surrounding marine habitat.

In addition to providing a deeper understanding of marine resource conservation, the government also has a strategic responsibility to encourage the implementation of holistic empowerment programs oriented towards improving the economic well-being of fishermen. Through relevant and adaptive skills training facilities, providing access to accurate and up-to-date information, and strengthening access to inclusive business capital, fishermen are given the opportunity to develop various sustainable and innovative alternative sources of income. This comprehensive approach will not only contribute to significant income increases but also act as a crucial catalyst in efforts to overcome the structural poverty that has historically shackled fishing communities, thus paving the way for achieving more inclusive and sustainable economic prosperity in the long term.

With this support, sea cucumber fishermen in Sitardas Village have the opportunity to significantly advance their social class. Government involvement in providing guidance and capital strengthening will strengthen their capacity to manage resources responsibly while increasing the competitiveness of marine products in the market. Collaboration between the government and the fishing community is key to achieving harmonious economic, social, and environmental sustainability in the region.

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