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Socio-Economic Vulnerability of Coastal Communities in Geospatial Aspects Toward Tanjung Carat Port Establishment (Case Study of Sungsang Village, Banyuasin II)

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ABSTRAK

Rencana pembangunan Pelabuhan Internasional di Tanjung Carat sebagai salah satu Proyek Strategis Nasional merupakan upaya pemerintah Provinsi Sumatera Selatan dalam meningkatkan pertumbuhan ekonomi masyarakat Desa Sungsang. Namun, pembangunan ini dapat berdampak negatif bagi sosial dan ekonomi masyarakat desa yang penghidupannya bergantung dengan hasil tangkapan laut, sebab akan terjadi konversi hutan mangrove dan berkurangnya wilayah tangkapan nelayan. Oleh sebab itu, kajian dan pemetaan kerentanan sosial ekonomi masyarakat Desa Sungsang penting dilakukan guna memitigasi dan mencegah terjadinya dampak yang merugikan masyarakat. Tujuan penelitian ini yaitu menganalisis tingkat kerentanan sosial-ekonomi masyarakat Desa Sungsang terhadap pembangunan pelabuhan di Tanjung Carat serta memberikan arahan kebijakan mitigasi terkait hasil analisis kerentanan sosial ekonomi masyarakat tersebut. Metode yang digunakan yaitu pembobotan dari setiap indikator sosial dan ekonomi yang dipilih dan selanjutnya diubah menjadi data raster menggunakan software ArcGIS. Selanjutnya, untuk menilai kerentanan digunakan metode Spatial Multi Criteria Evaluation (SMCE), sehingga dihasilkan peta kerentanan sosial dan ekonomi dan dilakukan analisis deskriptif untuk menguraikan arahan kebijakan mitigasi potensi dampak terhadap sektor sosial ekonomi. Hasil analisis total kerentanan sosial ekonomi Desa Sungsang termasuk ke dalam kategori sangat rentan karena mayoritas masyarakatnya berprofesi sebagai nelayan tradisional dengan tingkat pendidikan dan upah yang relatif rendah. Fakta ini akan mempengaruhi kondisi sosial dan ekonomi masyarakat seiring dengan perubahan ekosistem yang terjadi akibat pembangunan pelabuhan tersebut. Upaya awal untuk mengurangi kerentanan sosial ekonomi ini dapat dilakukan dengan merumuskan arahan kebijakan yang sesuai dengan peraturan yang berlaku dari berbagai aspek. Selain itu, dibutuhkan program nyata yang dapat membantu memulihkan perekonomian nelayan yang terdampak.

***Kata kunci*:** Kerentanan, Sosial-Ekonomi, Pembangunan, Pelabuhan

ABSTRACT

The establishment of an international port at Tanjung Carat is part of the National Strategic Projects initiated by the South Sumatra Provincial Government to boost local economic growth. However, the development of the port will involve converting a 60-hectare mangrove forest and imposing restrictions on fishing areas near the port. This will have a negative impact on the socio-economic conditions of the coastal communities in Sungsang Villages, as they heavily depend on marine catches. Therefore, it is essential to analyze and map the socio-economic vulnerabilities of the village community in order to minimize and prevent adverse impacts. This study aims to investigate the level of socio-economic vulnerability of the coastal community to the development of Tanjung Carat port and to provide policy directives as mitigation strategies. The research utilized the ArcGIS Software to weight selected social and economic indicators and convert them into raster data. The Spatial Multi-Criteria Evaluation (SMCE) method was applied to produce social, economic, and socio-economic vulnerability maps, and policy directives were formulated using descriptive analysis. The results revealed that the total socio-economic vulnerability in the four villages falls into the highly vulnerable category, mainly due to the predominant profession as traditional fishermen with relatively low income and education. Formulating policy directives based on applicable regulations in various aspects could be an initial effort to reduce socio-economic vulnerability. Furthermore, applicable programs are needed to help restore the economy of the impacted fishermen.

***Keywords*:** Vulnerability, Socio-Economic, International Port, Establishment

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1. INTRODUCTION

Sungsang is a rural area located near the East Coast of Sumatra, specifically in Banyuasin II Regency, South Sumatra Province. The community's settlement pattern extends along the flow of the Musi River Estuary and passes directly into the Bangka Strait (Wolters, 1979). The Sungsang community is considered a maritime society due to its geographical location, situated on the edge of the river and sea. This is closely related to a lifestyle system that heavily depends on water as an economic, social, and cultural asset, as well as a means of transportation (Tri & Putra, 2015).

Water transportation facilities are closely linked to infrastructure construction and development, which are basic requirements for economic growth in a region and play a key role in national economic transformation. Regional and national development goals are interconnected, aiming to foster economic growth and equity (Haidir, 2021). This is reflected in the National Strategic Projects (PSN) program, based on Presidential Regulation No. 3 of 2016, which focuses on both physical and non-physical development to promote economic growth through regional infrastructure development. There is an urgent need to establish a new port to support import and export activities in South Sumatra Province. As a result, the construction of the Tanjung Carat International Port in Banyuasin II Regency is included in the PSN list, as per the Appendix to Regulation of the Coordinating Minister for Economic Affairs No. 7 of 2021.

The activities of humans are known to have a negative impact on the environment. For example, previous studies have shown that sand mining activities lead to air pollution and a decline in river function, ultimately affecting the health and socio-economic activities of the community (H S D Kospa et al., 2021). Additionally, pollution in river water due to community and industrial dumping on riverbanks results in decreased water quality and disrupts the balance of the river ecosystem (Herda Sabriyah Dara Kospa & Rahmadi, 2019). The environmental permits issued by the central government are a concern for the construction of a port, as 60 out of the 200 hectares of land to be used are part of a protected mangrove forest area (urban.id, 2023). This will have an impact on the coastal communities of Sungsang Villages, which are located close to the new port development area and mainly rely on marine products for their livelihoods by processing them into various seafood specialties (Widayatsih et al., 2018) (Fauziyah et al., 2019).

The establishment of a port has had a significant impact on the livelihoods of coastal communities, particularly traditional fishermen (Haryanto et al., 2023) (Yamamoto, 2023). The fishing range in the area was limited by the security measures of international port officers, which disrupted the fishing activities of the community. Additionally, the conversion of mangrove ecosystems in the area has resulted in a loss of habitat for aquatic biota reproduction, leading to a 50% to 75% reduction in income from marine (R. B. A. Nugraha et al., 2019) (Akram et al., 2023) (Carugati et al., 2018) (Qiao et al., 2020). Furthermore, the conversion of mangroves has caused flooding and damage to ponds, negatively affecting the harvest of fish and crabs (Hafni, 2016; Febria, 2017; Anton et al., 2012).

The establishment of ports has a significant impact on the social and economic aspects of coastal communities (Dinia & Habibah, 2021). To minimize this impact, it is crucial to conduct a thorough assessment and mapping of the community's socio-economic vulnerability (A. L. Nugraha et al., 2022). Vulnerability refers to the condition influenced by social and economic factors or processes that can heighten a community's exposure to disasters. Specifically, vulnerability can be categorized into two types: social and economic vulnerability (BKNPB, 2007).

Analyzing the socio-economic vulnerability associated with the establishment of a port requires thorough examination. The results can be visually represented through mapping using a geographic information system (GIS). These maps can provide an overview of the distribution of potential hazards and historical events of vulnerability in an area (Beluru Jana & Hegde, 2016). Additionally, policymakers can use this information to assess the benefits and risks when making decisions, especially in formulating policies aimed at reducing losses from social and economic vulnerabilities in the future as a first step in a mitigation strategy (Biswas & Nautiyal, 2023); (Fuchs et al., 2012).

The research is unique because it focuses on the socio-economic vulnerability in Sungsang Village in relation to the establishment of Tanjung Carat Port, using Geographic Information System (GIS). The use of GIS allows for the display of information on all attributes of the distribution of socio-economic vulnerabilities in Sungsang Village. The maps created can provide important data for the local government to formulate policies aimed at reducing the number of vulnerable households. Therefore, socio-economic vulnerability assessment is crucial in addressing potential negative impacts faced by vulnerable or at-risk groups.

The objectives of this study are articulated as follows:

1) To conduct a comprehensive analysis of the socio-economic vulnerability of the Sungsang coastal community concerning the proposed construction of a new port in Tanjung Carat.
2) To offer well-informed recommendations for mitigation policies, drawing upon the insights gained from the analysis of the community's socio-economic vulnerability.

2. DATA AND METHODS

2.1. Study Area

Social and economic vulnerability mapping was conducted in Banyuasin II Regency, specifically in the coastal areas of Sungsang I, Sungsang II, Sungsang III, and Sungsang IV Villages as indicated in Figure 1. Banyuasin II Regency is a part of Banyuasin Regency in South Sumatra and comprises 10 villages. The capital of Banyuasin II Regency is Sungsang City.

2.2. Research Period and Stages

This study was carried out from March to December 2023. During January and February, desk studies and literature reviews were conducted to refine the research framework and identify key socio-economic indicators relevant to Sungsang Village. During March and April, desk studies and literature reviews were conducted to refine the research framework and identify key socio-economic indicators relevant to Sungsang Village. In May, preliminary field observations and meetings with local stakeholders (Sungsang Village heads) helped finalize data collection instruments. The primary data collection phase (household surveys, interviews, and geospatial mapping) took place from June to August. Finally, data cleaning, analysis, and interpretation occurred from September and October, culminating in the initial draft of findings. Finally, the results were discussed and compiled into progress reports in November, and the draft manuscript was completed in December.

2.3. Field Data Collection

The study covered four villages in Sungsang: Sungsang I (1,783 households), Sungsang II (1,783 households), Sungsang III (974 households), and Sungsang IV (1,450 households), giving a total of 5,990 households. To determine a suitable sample size, Taro Yamane's formula (1967) was applied, using a margin of error (e) of about 12%. This calculation recommended approximately 65 households:

$$n = \frac{N}{1 + N\,(e^2)}$$

Where:

N = 5,990

e = 0.12

To ensure proportional representation, these 65 households were distributed among the four villages according to each village's share of the total population. This approach helps capture variations in socio-economic conditions while remaining logistically feasible (Israel, 1992).

Meanwhile, secondary data was obtained from various agencies such as the Central Bureau of Statistics (BPS) Banyuasin Regency for regional population and economic data and the Agency for Regional Development (Bappeda) of Banyuasin Regency for data and maps of the Spatial Plans (RTRW) of Banyuasin. Additionally, detailed population information was obtained from the Village Heads of Sungsang I, II, III, and IV. The research data is presented in Table 1, and administrative data from the villages and Banyuasin II Regency were also used.

2.4. Methods

This study employed a Spatial Multi-Criteria Evaluation (SMCE) approach utilizing ArcGIS (Malczewski, 2006). Each socio-economic variable, including income level, type of occupation, and education attainment, was assigned a weight based on its relative significance in determining community vulnerability. A thorough review of existing literature indicated that income and education are often pivotal factors influencing resilience to economic and environmental shocks (Biswas & Nautiyal, 2023). Additionally, consultations with local stakeholders, such as village leaders and community members, helped validate the indicators that most strongly affect daily livelihoods. Each indicator was assigned a weight reflecting its relative importance.

- **Economic Indicators**

a. Income levels
   This indicator is given the highest weight among economic factors due to its significant impact on a household's ability to adapt to disruptions, such as restricted fishing zones or diminished mangrove areas. Households with higher income levels typically possess more resources to invest in alternative livelihoods or other adaptation strategies.
b. Type of occupations
   This indicator reflects whether a household primarily engages in fishing, labor, or more stable employment, such as civil service. Occupations that rely heavily on marine catches, like small-scale fishing, are more susceptible to the effects of port development. While essential, this factor is weighted slightly lower than income because the type of occupation often influences adaptive capacity indirectly rather than being a sole determinant.
c. Job diversifications
   The capacity to hold multiple jobs or sources of income can reduce vulnerability by distributing financial risk. However, this factor receives the lowest weight among economic indicators, as the income level generally serves as a more direct measure of overall resilience. Although having multiple occupations can be advantageous, the overall income and primary job type tend to overshadow its impact.

- **Social indicators**

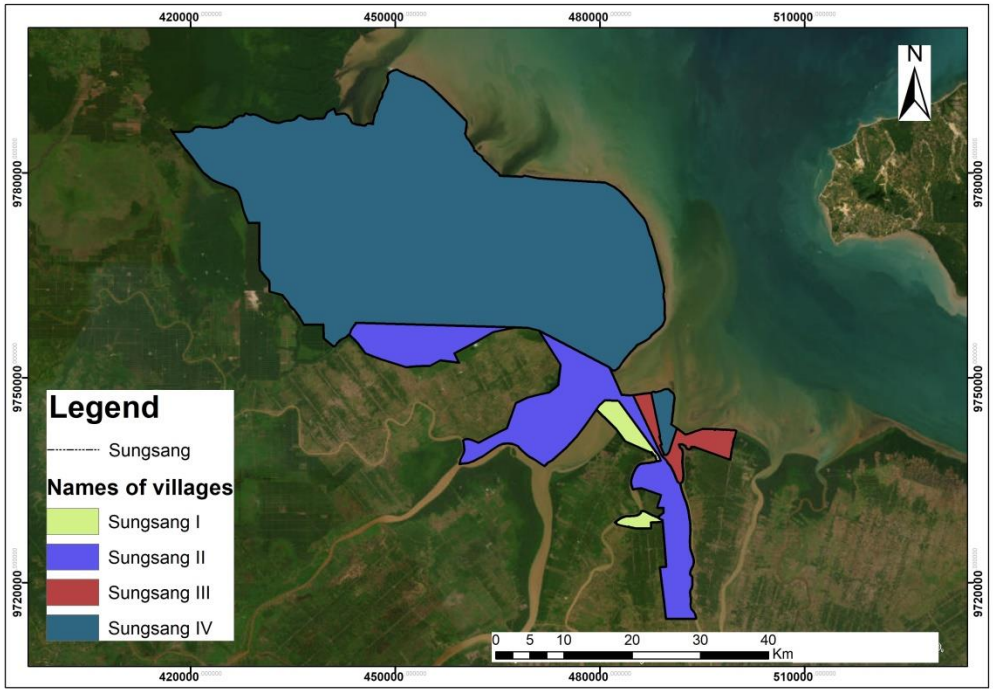
a. Education atteinment
   Education is widely recognized as a key factor in determining resilience (Josiana & Hizbaron, 2019). Higher education equips individuals with better decision-making skills, improved problem-solving

abilities, and increased employability. This enables them to navigate changes such as shifts in fishing grounds or economic disruptions related to ports. Therefore, education is given the highest weight among social indicators.

b. Residence Period
The length of residence in a specific area enhances local knowledge, social networks, and adaptive strategies. Individuals or families who have lived longer in the same location generally have stronger coping mechanisms for environmental and economic changes. Although its weight is slightly lower than that of education, it remains an important factor in vulnerability analysis.

c. Number of Family Members
Larger households may experience greater resource strain and require more financial stability. However, this variable has the lowest weight because, while family size is relevant, it is less crucial than education or residence period in predicting a household's capacity to adapt over time.

The resulting weights were then transformed into raster data using ArcGIS software. Three scenarios were examined in this research: social scenarios, economic scenarios, and socio-economic scenarios. The data processing using SMCE produced social vulnerability maps and economic vulnerability maps. A comprehensive assessment of social and economic vulnerability was conducted to generate a socio-economic vulnerability map. Descriptive analysis was then employed to elucidate the current conditions of the study area and the levels of vulnerability. The analysis of social vulnerability maps, economic vulnerability maps, and socio-economic vulnerability maps was undertaken to identify the factors influencing the nature of vulnerabilities in the research area.



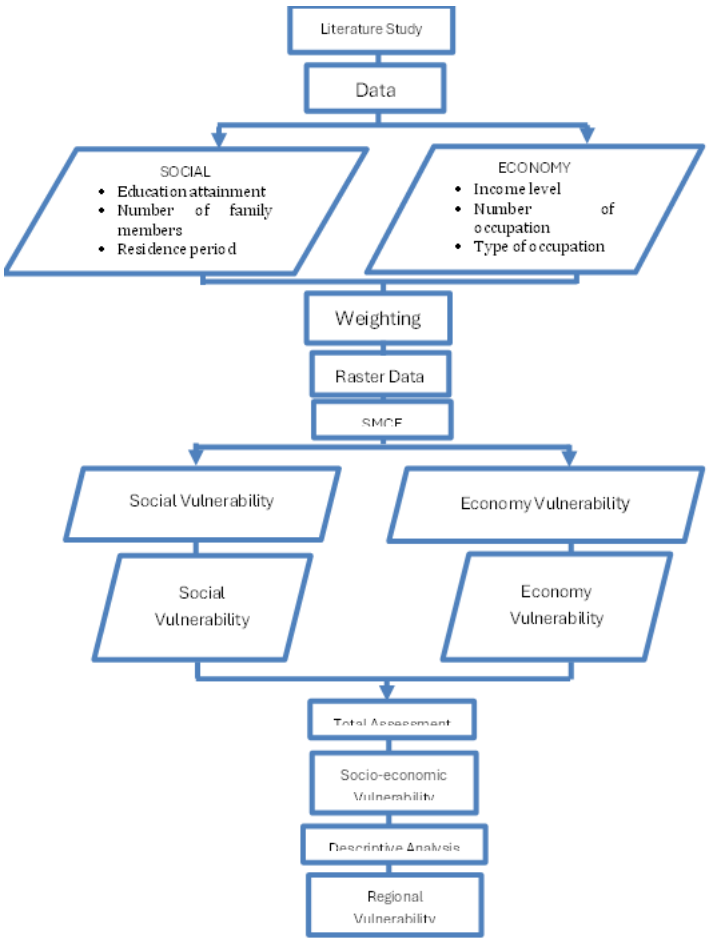
Source: Analysis, 2023

Figure 1. The Map of Study Area

Tabel 1. Research Variables and Indicators

No.	Type of Vulnerability	Indicators	Information
1	Economy	Type of occupation	The more dependent on sea, the more vulnerable
		Income Level	The higher the income level, the less vulnerable
		Number of occupation	The higher the number of job, the less vulnerable
2	Social	Education Level	The higher the level of education, the less vulnerable
		Number of family members	The higher the number of household members, the more vulnerable
		Length of stay	The longer the period of domicile, the less vulnerable

Source: Analysis, 2023



Source: Analysis, 2023

Figure 2. Research Model

Table 2. Economic Vulnerability Category

No	Economic Vulnerability Category	Weight	Economic Vulnerability Category		
			Score 1	Score 2	Score 3
1	Income level	3	> Rp 5,000,000	Rp 2,000,000 – 5,000,000	< Rp 2,000,000
2	Type of occupation	2	Civil Servant/Army/ police officer, etc.	Entrepreneur / Entrepreneur of marine catches	Fisherman/labour fisherman
3	Job diversification	1	>2	2	1

Source: Analysis, 2023

Table 3. Result of Economic Vulnerability

No	Economic Vulnerability Category	Number of Respondents in Each Village			
		Sungsang 1	Sungsang 2	Sungsang 3	Sungsang 4
1	Low	2 (3.08%)	3 (4.62%)	6 (9.23%)	5 (7.69%)
2	Moderate	28 (43.08%)	16 (24.62%)	31 (47.69%)	24 (36.92%)
3	High	35 (53.85%)	46 (70.77%)	28 (43.08%)	36 (55.38%)
Total		65 (100%)	65 (100%)	65 (100%)	65 (100%)

Source: Analysis, 2023

3. RESULT AND DISCUSSION

3.1. Economic Vulnerability Analysis

An analysis of the economic vulnerability related to the Tanjung Carat port development plan was based on three parameters: 1) Monthly income; 2) type of occupation; and 3) job diversification. The weighting method was determined based on the level of importance, and the scoring process was based on those most affected by marine resources (see Table 2).

The total earnings depend on the type of occupation, such as traditional fishermen and labor fishermen who derive their income from marine catches. The construction of Tanjung Carat Port will negatively impact their earnings as it will lead to a reduction in the number of marine catches. As a result, they will need to fish in areas farther away than before (Hardianti et al., 2021).

Based on the parameters of economic vulnerability and the results of the questionnaire from each village, the following data were obtained (see Table 3).

Based on spatial mapping analysis, Sungsang I, Sungsang II, and Sungsang IV Villages exhibited high

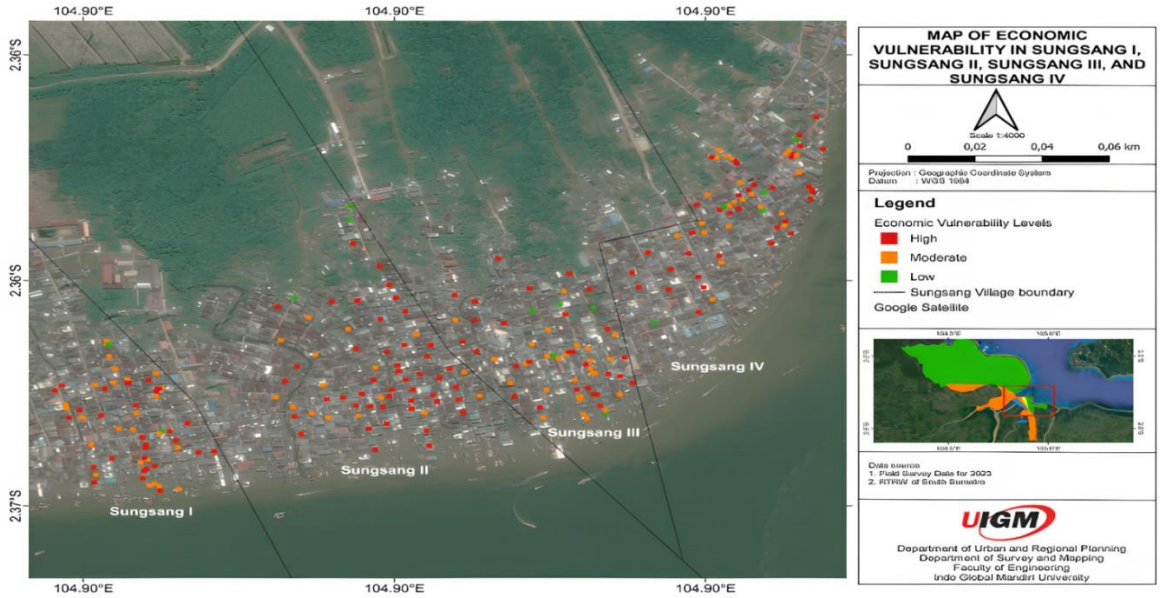
economic vulnerability. This was due to the dominance of fishermen in the community, resulting in inadequate incomes and limited job diversification. These findings suggest that the construction of the Tanjung Carat port would significantly impact on the economic well-being of the Sungsang coastal community, which heavily relies on marine catches for its livelihood (Hardianti et al., 2021).

In Sungsang III, most people are identified as having a moderate level of economic vulnerability. Many of them work as professional fishermen in the fishery on large ships, catching fish in areas far away, such as the Bangka Sea. Their income is relatively high, sometimes reaching up to twenty million rupiahs in a single fishing trip, but they have less job diversification. Here are the results of mapping the economic aspects of vulnerability in the four villages.

3.2. Social Vulnerability Analysis

The parameters utilized for the analysis of social vulnerability included education level, number of family members, and length of residence (see Table 4). Based on the parameters of social vulnerability and the results of the questionnaire from each village, the following data were obtained (see Table 5).

According to the spatial mapping analysis, it was found that all villages were considered to have moderate social vulnerability. This result was influenced by the average education level of the community, which typically ranged up to junior high school, with far fewer people having higher education. As for the length of residence, it was revealed that almost all respondents from the four villages had stayed for more than 10 years, with only a few in the 5 to 10 year category. Additionally, the number of family members in Sungsang I, Sungsang II, Sungsang III, and Sungsang IV was mostly between 4 to 6, indicating a moderate level of vulnerability. The social vulnerability map of the four villages can be seen in Figure 4.



Source: Analysis, 2023

Figure 3. Economic Vulnerability Map

Table 4. Social Vulnerability Category

No	Social Vulnerability Category	Weight	Social Vulnerability Category		
			Score 1	Score 2	Score 3
1	Education attainment	3	High school/Higher education	Junior high school	No education /Elementary School
2	Residence period	2	>10	5-10	<5
3	Number of family members	1	>6	4-6	1-3

Source: Analysis, 2023

Table 5. Result of Social Vulnerability

No	Social Vulnerability Category	Number of Respondents in Each Village			
		Sungsang 1	Sungsang 2	Sungsang 3	Sungsang 4
1	Low	8 (12.31%)	17 (26.15%)	10 (15.38%)	13 (20%)
2	Moderate	54 (83.08%)	32 (49.23%)	51 (78.46%)	52 (80%)
3	High	3 (4.62%)	16 (24.62%)	4 (6.15%)	0 (0%)
	Total	65 (100%)	65 (100%)	65 (100%)	65 (100%)

Source: Analysis, 2023

The level of education one attains influences their job opportunities, ability to learn, and decision-making skills (Josiana & Hizbaron, 2019). Additionally, the length of time a person has lived in a certain area affects their ability to adapt to the community. The longer people live in an area, the more adaptable they become to changes. Moreover, a high number of family members affects the ability to provide for the family on a daily basis, resulting in a higher level of social vulnerability.

3.3. Socio-economic Vulnerability Analysis

The level of socio-economic vulnerability in the four villages was determined by analyzing both social and economic factors. The socio-economic vulnerability map is shown in Figure 5. In Sungsang I, 31 households were found to have a high level of vulnerability, while 30 households had a moderate level, and only 4 households were identified as the least vulnerable. In Sungsang II, 37 households were highly vulnerable, 21 had a moderate level of vulnerability, and 7 had a low level. Sungsang III and IV had similar findings, with 26 and 29 households respectively identified as most vulnerable, and 25 and 26 households at a moderate level of vulnerability.

The total socio-economic vulnerability analysis of Sungsang I, II, III, and Sungsang IV Villages in relation to the establishment plan of Tanjung Carat Port showed a high level of vulnerability. This is primarily due to factors such as the predominant occupation of traditional fishermen with low monthly incomes and low education levels in the area, making the community highly susceptible to ecosystem changes resulting from the establishment of Tanjung Carat Harbor near their fishing grounds (Salik et al., 2015) As a result, policy directives are necessary to enhance the adaptive capacity of these vulnerable coastal communities to cope with potential ecosystem changes (Huang et al., 2012).

3.4. Policy Directives

The Banyuasin Regency Spatial Plan (RTRW) for 2012–2032 identifies Sungsang fishing village as a culturally significant area with considerable potential for economic development. This village is uniquely positioned at the confluence of the Musi River and Bangka Strait and is home to a diverse population, including Malay, Bugis, and Javanese communities. This cultural diversity underpins unique traditions related to fishing, farming, and local customs, such as "lebak lebung," an auction-based system for securing fishing grounds.

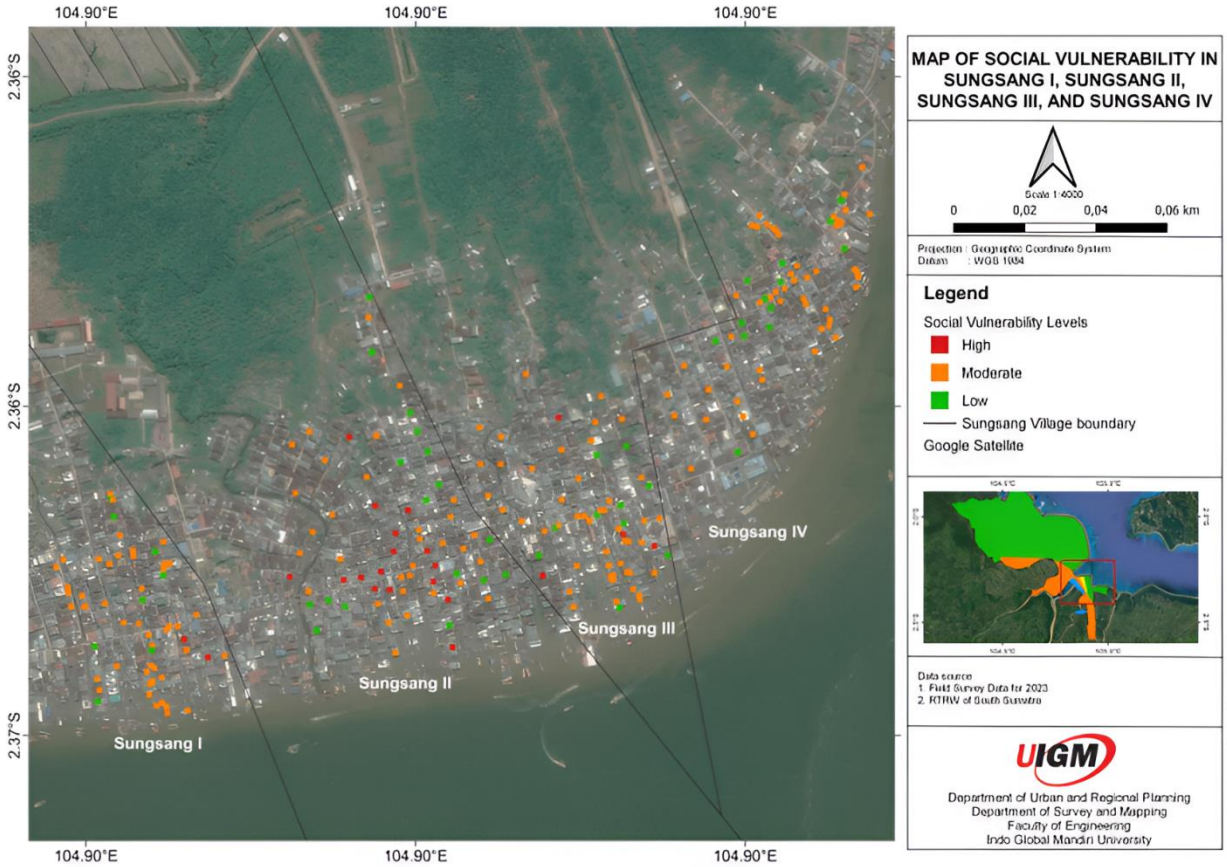


Figure 4. Social Vulnerability Map

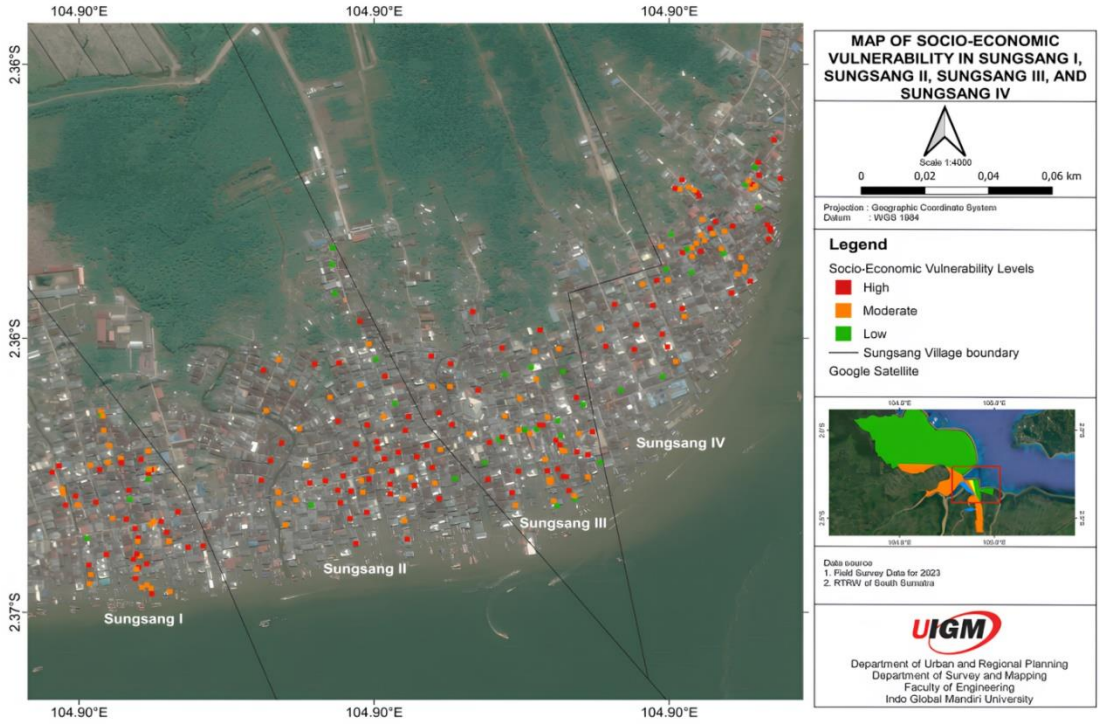


Figure 5. Socio-economic Vulnerability Map

In future planning, the district government aims to revitalize and rehabilitate the Sungsang village area, focusing on enhancing its cultural aspects to attract tourism. The plan includes refining technical strategies for building and environmental management to improve residential facilities, expand waterway transportation networks, and promote the development of home-based industries centered on fisheries. The plan emphasizes Sungsang's tourism potential, noting that its distinctive river and coastal ecosystems can be leveraged to increase visitor interest and enhance the local economy.

In addition to its cultural importance, the Spatial Plan designates Sungsang as a Regional Activity Center (PKWp) due to its proximity to existing and proposed transportation corridors. This advantageous location enables quick access to regional and national shipping routes, making it suitable for logistics, trade, and provincial-level industrial growth. These factors meet the criteria for PKWp status, which includes serving as a secondary node for export-import activities, providing broader transport connectivity, and functioning as a hub for industrial and service sectors. For Sungsang, the continued development of tourism, trade, and fisheries aligns with these objectives, ensuring that the village maintains its cultural identity while also playing a vital economic and infrastructural role in the region.

Results indicate high socio-economic vulnerability in Sungsang due to low income, minimal job diversification, and dependence on traditional fishing. To address these issues, two strategic approaches—reductive and persuasive—are suggested, drawing on empirical studies of similar coastal contexts (Cadiz et al., 2024; Syarif et al., 2024).

3.4.1. Reductive Strategies

a. Education and Skills Enhancement

Households primarily engaged in low-paying fishing jobs (Section 3.1) face heightened vulnerability. Providing alternative vocational training (e.g., boat engine repair, fish processing techniques) could reduce their economic risk and increase household resilience (Stacey et al., 2021 Workshops facilitated by local NGOs or government programs can help fishermen develop marketable skills. This aligns with findings from other coastal regions where improved education correlates with reduced vulnerability (Yatimah et al, 2022).

b. Environmental Conservation and Resource Management

Mangrove degradation in port areas adversely affects fish stocks, thus decreasing fishermen's income (Akram et al., 2023). Conservation efforts—such as replanting mangroves—protect breeding grounds and stabilize coastlines (Carugati et al., 2018).

Local agencies and communities can collaborate on reforestation projects near Tanjung Carat. This mirrors success stories where ecosystem restoration led to improved fish catches and less shoreline erosion (Debrot et al., 2022).

c. Infrastructure Upgrades

Restricted access to cold storage or efficient transport links raises costs and reduces profits (Torrel et al., 2020). Improved infrastructure can

shorten supply chains, minimize post-harvest losses, and create more stable markets.

Construct centralized fishing docks, cold storage, and better roads, allowing fishers quick, secure access to broader markets (Sa'adah et al., 2024). Such measures directly reduce income vulnerability by cutting logistics costs.

3.4.2. Persuasive Strategies

a. *Community Engagement and Participatory Decision-Making*

Previous sections highlighted the community's reluctance toward external interventions (Sections 3.2 and 3.3). Engaging them in every phase of planning fosters trust and increases policy uptake (Brown and Hay-Edie, 2013).

Organize regular focus group discussions and "town-hall" style meetings where fishermen, local leaders, and project developers co-identify challenges and solutions (Gammage et al., 2017). This inclusive approach ensures policies reflect actual local needs, thus reducing socio-economic vulnerability.

b. *Advocacy and Inclusive Policy Formulation*

Government regulations (Banyuasin Regency Spatial Plan 2012–2032) recognize Sungsang as a strategic area, but fishermen's concerns can be sidelined without formal channels for input. Structured advocacy helps integrate community perspectives into regulatory frameworks.

Create advisory councils or committees that include representatives from the fishing community, local government, and non-governmental organizations. Regular meetings can align development plans (e.g., port expansions) with fisherfolk interests, echoing best practices found in other coastal provinces (Watts et al., 2021).

3.4.3. Joint Business Groups: Savings and Loan Cooperatives

High financial vulnerability arises from inconsistent earnings, especially when fishing zones shrink or relocate (Sections 3.1, 3.3). Savings and loan cooperatives can pool members' resources, offer low-interest credit, and foster collective bargaining power (Mozumder et al., 2018). It is proved that cooperatives in coastal communities have successfully reduced poverty and income instability by organizing group savings, facilitating microloans, and providing revolving funds (G. & Chidinma, 2017; Pasda et al., 2019).

Several steps should be conducted in implementing this effort as follows:

Capital Formation: Initially, small membership fees or grants from local government can seed cooperative funds. Members can then access loans for fishing equipment, boat repairs, or small-scale enterprises, thus improving livelihood security (Solomon, 2022; Taniu et al., 2024).

Governance and Training: Cooperative bylaws need clarity on repayment schedules, interest rates, and member responsibilities. Periodic training on financial literacy and bookkeeping ensures transparency and accountability (Wahyuni, 2020).

Linkages to Markets: Cooperatives can collectively market fish catches or processed products, increasing negotiating power and reducing transaction costs (Purcell et al., 2017)

4. CONCLUSION

The analysis of total socio-economic vulnerability in Sungsang I, II, III, and IV Villages indicates high vulnerability due to the predominant occupation as traditional fishermen, limited income sources, and low education levels. Therefore, any changes in the ecosystem resulting from the Tanjung Carat Port Development, which will involve converting 60 hectares of mangroves in the area, are likely to significantly impact the socio-economic conditions of the community. To address this, policy directives are necessary to reduce vulnerability and enhance the socio-economic resilience of the community. Furthermore, the local government should develop and implement specific programs to help the affected local communities recover their economy. This might include providing financial assistance for the purchase of sailing equipment to support traditional fishermen in catching marine products, as well as offering entrepreneurial training and support.

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