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Analysis of socio demographic economic components in the livelihood vulnerability index of coastal communities due to tidal flooding in Bandar Lampung City

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ABSTRACT

Tidal flooding is a recurring hazard in coastal areas and poses a serious threat to the sustainability of community livelihoods, particularly in regions that are highly dependent on coastal-based economic activities. In Bandar Lampung City, frequent tidal flooding events have disrupted the social, demographic, and economic conditions of coastal households, increasing their overall livelihood vulnerability. This study aims to analyze the level of social demographic economic vulnerability of coastal communities using the Livelihood Vulnerability Index (LVI) approach. The assessment focuses on four coastal districts Bumi Waras, Panjang, Teluk Betung Timur, and Teluk Betung Selatan and applies a balanced weighted averaged method to ensure equal contribution of each indicator within the composite index. Standardization of sub-components is conducted to enable consistent aggregation and comparison across districts. The results reveal that all studied districts fall within the vulnerable to very vulnerable categories. Bumi Waras District shows the highest level of vulnerability, primarily driven by a high proportion of female-headed households and limited household expenditure capacity. Panjang District is also characterized by considerable vulnerability due to demographic pressures and reduced labor productivity associated with household age structure. Meanwhile, Teluk Betung Timur and Teluk Betung Selatan exhibit relatively lower vulnerability levels, although persistent dependency ratios and gender-related household characteristics continue to constrain resilience. These findings demonstrate that livelihood vulnerability in coastal urban areas is multidimensional and shaped by the interaction of demographic structure, gender roles, and economic capacity. The study highlights the importance of integrating social and economic dimensions into coastal development planning and disaster risk reduction efforts to enhance household resilience and support sustainable livelihoods in Bandar Lampung City.

Keywords: Bandar Lampung City; coastal livelihoods; economic vulnerability; gender dynamics; livelihood vulnerability; social demographic factors; tidal flooding

1. INTRODUCTION

Tidal flooding is one of the hydrometeorological disasters primarily caused by elevated wave conditions along coastlines (Wang et al., 2020). As a tangible manifestation of climate change, tidal flooding not only results in physical and environmental degradation (Aisyah et al., 2015) but also exerts direct impacts on the social, demographic, and economic conditions of coastal communities (Fajrin et al., 2021). In the coastal area of Bandar Lampung City, recurrent tidal flooding events have disrupted the sustainability of local livelihoods, particularly among households that depend heavily on coastal-based economic activities such as fisheries, port-related services, small-scale industries, trade, and tourism. This high level of dependence on coastal resources increases community exposure and sensitivity to environmental disturbances, thereby intensifying livelihood vulnerability (Saha et al., 2024). Repeated exposure to tidal flooding reduces the capacity of households to recover between events, gradually eroding their resilience and increasing long-term vulnerability, especially in communities with limited adaptive resources.

From a social and demographic perspective, the coastal zones of Bandar Lampung City are characterized by relatively high population density, the presence of vulnerable age groups, and households with diverse educational backgrounds. These characteristics significantly shape the adaptive capacity of communities in responding to tidal flooding hazards (Amriawan et al., 2024). High population density increases competition for limited resources and infrastructure, whereas the presence of children, the elderly, and other vulnerable groups heightens dependency within households. Households with lower educational attainment and limited access to information tend to have reduced capacity to understand risks, access external assistance, and develop effective adaptation strategies (Incoom et al., 2025). Consequently, preparedness and response actions are often reactive rather than preventive, further exacerbating vulnerability. Moreover, the demographic structure, marked by a high proportion of working-age individuals engaged in informal sectors, further intensifies vulnerability, as economic shocks become more severe when business activities and employment are disrupted during tidal flooding events (Danquah et al., 2024).

From an economic standpoint, tidal flooding has imposed substantial pressure on income stability and livelihood security within coastal communities (Risna et al., 2024). Key economic sectors, such as fisheries, processing industries, trade, and tourism, are highly dependent on the condition of coastal environments and infrastructure (Zhao et al., 2024). When tidal flooding inundates residential areas and business locations, productivity declines owing to damaged equipment, disrupted supply chains, and reduced working hours. At the same time, recovery costs increase as households are required to repair homes, replace assets, and restore business operations, while the risk of job loss escalates, particularly for informal workers (Fariz et al., 2025). For low-income households relying on a single source of income, these impacts further deepen economic vulnerability and prolong post-disaster recovery periods (Ullah et al., 2025), making it increasingly difficult to rebuild livelihoods sustainably.

Social, demographic, and economic vulnerabilities are further intensified by limited access to productive assets, savings, and social protection mechanisms. Coastal households lacking sufficient economic reserves face greater difficulty in meeting basic needs during recurrent disaster events, leading to increased reliance on coping strategies that may undermine long-term livelihood security (Doondori et al., 2023; Karnaji et al., 2024). Income instability, rising costs associated with housing and business repairs, and limited alternative employment opportunities collectively reinforce the cycle of livelihood vulnerability in the coastal areas of Bandar Lampung City. Therefore, focusing on the social, demographic, and economic components of the Livelihood Vulnerability Index is highly relevant for comprehensively understanding the extent to which tidal flooding affects the sustainability of coastal livelihoods. The findings of this study provide an essential foundation for disaster risk reduction policies, the strengthening of socioeconomic resilience, and the development of climate-adaptive coastal planning strategies in Bandar Lampung City.

2. METHODOLOGY

The Social Demographic Vulnerability Score, as a component of the Livelihood Vulnerability Index (LVI), is calculated using a balanced weighted average approach through a questionnaire survey administered to 156 respondents. Sullivan et al. (2002) explain that "*balanced weighted averaged means that each sub-component contributes equally to the overall index, even though each major component may consist of a different number of sub-components*." This methodological approach is intended to ensure proportional representation of all indicators within the composite index, regardless of differences in the number or type of sub-components included under each major dimension. By applying equal weighting, the approach minimizes potential bias that may arise from overrepresentation of certain indicators and enhances the comparability of vulnerability levels across different spatial units or population groups. Moreover, this framework allows the Social Demographic Vulnerability Score to capture a more comprehensive picture of underlying social and demographic conditions that shape household sensitivity and adaptive capacity within the LVI framework. The sub-components of Social-Demograpic are mention below (Hanh et al., 2009): (1) dependency rasio; (2) percentage of female head's household; (3) average age of female heads of household; and (4) average of monthly outcome.

Because the subcomponents are measured on different scales, standardization is required to convert them into a comparable index so that they can be aggregated consistently. A composite index approach is applied to transform the scale of each subcomponent, adopting the methodology derived from the life expectancy index. The calculation of each subcomponent follows the formulation proposed by Hahn et al. (2009), as follows:

$$\text{Index Sb} = \frac{\text{Sb} - \text{Smin}}{\text{Smax} - \text{Smin}}$$

Sb represents the value of a sub-component for area *b*, while *Smin* and *Smax* denote the minimum and maximum values of each sub-component, respectively, as determined from the data of the study area. Following the standardization process, the standardized subcomponents are averaged using the formula proposed by Hahn et al. (2009) to subsequently calculate the value of the corresponding major component.

$$\text{Mb} = \frac{\sum_1^n indexs_{b}i}{n}$$

Mb represents one of the socio demographic components in area *b*. Index $_b$i reflects the value of the *i*-th indexed sub-component. Based on Hahn et al. (2009), the interpretation of *Mb* shows the vulnerability level of the component of an area (see Table 1):

Table 1. LVI Component's Interpretation

Score	Category
0 – 0.2	Not Vulnerable
0.21 – 0.4	Vulnerable
0.41 – 0.5	Very Vulnerable

Source: Hanh et al., (2009)

3. RESULTS AND DISCUSSION

3.1. Social Demographic Economic Component of Bumi Waras District

The calculation of the social demographic economic component in the Bumi Waras district indicates an LVI index value of 0.445, placing the district in the very vulnerable category. This high level of vulnerability is primarily driven by the very high proportion of female-headed households, which reaches 0.725, and the low average monthly household expenditure, reflected by an index value of 0.446. These

indicators suggest that a large share of households faces economic limitations that reduce their capacity to cope with livelihood shocks. In contrast, the dependency ratio (0.389) and the average age of female household heads (0.221) are relatively lower, although their interaction with income constraints remains significant.

Low household expenditure reflects limited income and wage levels, which are closely associated with relatively low educational attainment in the area. This condition constrains access to better employment opportunities and reinforces dependence on low-paying and informal economic activities. The predominance of female-headed households further intensifies this situation, as income generation often relies on a single, limited source. This finding is consistent with Sharma (2023), who notes that female-headed households with low levels of education and wages tend to experience higher economic vulnerability, particularly households with dependent children.

Additionally, Suryanto (2021) explains that a high proportion of female household heads can lead to reliance on a single income source, thereby increasing household exposure to economic shocks. In Bumi Waras, the interaction between gendered household structures and limited household incomes may also reflect broader structural constraints, including restricted access to productive resources and economic opportunities. Previous research indicates that female-headed households frequently encounter institutional and socioeconomic barriers in accessing land, credit, and productive assets, which can reinforce cycles of vulnerability and limit livelihood resilience (Agarwal, 1997; FAO, 2011). These results highlight the need for targeted socioeconomic interventions, particularly those aimed at strengthening income security and economic opportunities for female-headed households.

3.2. Social Demographic Economic Component of Panjang District

The social demographic economic component in Panjang District recorded an LVI index value of 0.401, which is classified as vulnerable. This condition is influenced by a relatively high dependency ratio (0.385), indicating a considerable proportion of non-productive household members who depend on working-age individuals. In addition, the index value for the age of female household heads (0.405) reflects a vulnerable demographic structure that may constrain labor productivity. The proportion of female-headed households is also relatively high, with an index value of 0.428, placing it in the very vulnerable category.

The combination of demographic pressure and gendered household structure has direct implications for household economic stability. As household heads age, their physical capacity and labor flexibility may decline, particularly in the informal or labor-intensive sectors. This demographic condition can potentially influence labor productivity and income continuity, thereby increasing livelihood insecurity. Previous studies have shown that aging labor forces may experience declining physical work capacity, which can affect productivity and household economic stability, particularly in sectors that depend heavily on manual labor (Ilmarinen, 2001; Skirbekk, 2004). These findings show that increasing age is associated with declining work capacity, which can reduce individual productivity and negatively affect household economic conditions.

Furthermore, reliance on a limited number of income sources increases household sensitivity to economic disturbances, such as job loss or reduced working hours. When combined with high dependency levels, these factors constrain household capacity to build savings or invest in alternative livelihoods. As a result, the Panjang District remains vulnerable, despite not reaching the highest vulnerability category, emphasizing the importance of policies that support labor productivity, income diversification, and economic security for vulnerable households.

3.3. Social Demographic Economic Component of Teluk Betung Timur District

The LVI index value for the social demographic economic component in the Teluk Betung Timur district is 0.28, which falls within the vulnerable category, as it lies in the range of 0.21–0.40 proposed by Hahn et al. (2009). The dependency ratio index (0.38) indicates a moderate proportion of the non-productive population, suggesting a demographic structure that still places economic pressure on productive household members.

However, Teluk Betung Timur is characterized by relatively high average monthly household expenditure, amounting to IDR 1,809,523. This condition suggests that households in this district generally have stronger purchasing power and better access to economic resources than those in other districts. Higher expenditure levels may also reflect more diversified income sources or relatively stable employment opportunities.

Despite this relative economic advantage, the district remains categorized as vulnerable because of persistent demographic pressures. Moderate dependency levels can still limit households' ability to accumulate savings or invest in long-term livelihood improvements. These findings indicate that economic capacity alone does not fully offset vulnerability when social and demographic constraints persist. Therefore, improving social resilience alongside economic capacity is essential for reducing overall livelihood vulnerability in Teluk Betung Timur.

3.4. Social Demographic Economic Component of Teluk Betung Selatan District

The social demographic economic component in the Teluk Betung Selatan District is classified as vulnerable, reflecting the combined influence of moderate dependency levels and high gender-related vulnerability. The dependency ratio index of 0.3112, or approximately 31%, indicates a moderate proportion of non-productive household members. Although not extreme, this level still contributes to increased economic responsibility for working household members.

A more critical factor influencing vulnerability in this district is the high proportion of female-headed households, with an index value of 0.405, which falls into the very vulnerable category. Households headed by women often face structural constraints related to employment opportunities, wage levels, and potential time allocation pressures between income-generating activities and domestic responsibilities. Gender studies consistently show that women tend to bear a disproportionate share of unpaid care and household labor, which can limit their participation in income-generating activities and reduce working hours in formal or higher-paying sectors (Chant, 2007; Doss, 2013). This finding shows that female-headed households tend to experience greater limitations in time and mobility, leading to shorter working hours or engagement in lower-paying jobs.

These conditions reduce household income stability and limit the capacity to build financial reserves, thereby increasing sensitivity to economic shocks. The combination of moderate dependency and high female-headed household prevalence reinforces social, demographic, and economic vulnerability in Teluk Betung Selatan. These results highlight the importance of gender-responsive policies that enhance women's access to stable employment, skills development, and social protection to strengthen household resilience.

3.5. Comparative Analysis of Social Demographic Economic Vulnerability Across Districts

Across the four districts, several shared drivers of social demographic economic vulnerability can be identified, although their intensity varies. One common factor is the presence of female-headed households, which appears as a significant vulnerability driver in Bumi Waras, Panjang, and Teluk Betung Selatan. In these districts, households led by women often rely on a limited number of income sources and face structural constraints, such as lower wage levels, restricted employment opportunities, and greater domestic responsibilities. In addition, the dependency ratio emerges as another cross-district factor affecting vulnerability. Although the magnitude differs, all districts show some level of demographic pressure, in which productive household members must support non-productive dependents. This condition reduces household capacity to accumulate savings, diversify income sources, or absorb economic shocks, thereby increasing livelihood vulnerability.

Despite these shared drivers, district-specific characteristics shape overall vulnerability patterns. In Bumi Waras, vulnerability is primarily driven by economic constraints, particularly low household expenditures and a high proportion of female-headed households, indicating limited income capacity and restricted access to stable livelihoods. In Panjang, vulnerability is more closely associated with demographic pressures, including a relatively high dependency ratio and the aging of female household heads, which may reduce labor productivity and income continuity. In contrast, Teluk Betung Timur

exhibits a relatively stronger economic capacity, reflected in higher household expenditure levels above the poverty line. However, vulnerability persists due to moderate demographic pressures, suggesting that economic resources alone do not fully offset structural social constraints.

Meanwhile, Teluk Betung Selatan demonstrates a vulnerability pattern strongly linked to gendered household structures, in which a high proportion of female-headed households amplifies livelihood insecurity despite moderate dependency levels. This indicates that gender-related constraints in labor participation and income generation remain critical drivers of vulnerability. Overall, the cross-district comparison shows that while gender structure and demographic dependency constitute shared underlying drivers, each district displays distinct combinations of economic capacity, demographic composition, and gender dynamics that shape its specific vulnerability profile. These findings suggest that policy responses should combine region-wide interventions addressing gender inequality and demographic pressures with district-specific strategies tailored to local socioeconomic conditions.

4. CONCLUSION

The assessment of the social demographic economic component of the Livelihood Vulnerability Index (LVI) across coastal districts in Bandar Lampung City demonstrates that livelihood vulnerability is shaped by the complex interaction of demographic structure, gendered household characteristics, and economic capacity. The findings reveal that all assessed districts fall within the vulnerable to very vulnerable categories, underscoring the persistent socioeconomic challenges faced by coastal communities. Bumi Waras emerges as the most vulnerable district, driven primarily by a high concentration of female-headed households and limited household expenditure capacity. Panjang District also exhibits substantial vulnerability due to demographic pressure and declining labor productivity associated with the age structure of household heads. Meanwhile, Teluk Betung Timur and Teluk Betung Selatan present relatively lower but still significant vulnerability levels, highlighting spatial variations in vulnerability drivers across the study area.

Gender-related household structure was identified as a critical determinant of livelihood vulnerability across all districts. The consistently high proportion of female-headed households contributes significantly to elevated vulnerability scores, particularly in Bumi Waras, Panjang, and Teluk Betung Selatan. These households often face compounded constraints, including limited access to stable employment, lower wage levels, and reduced opportunities for income diversification. Such conditions restrict households' capacity to build savings, invest in productive assets, or recover quickly from economic disturbances. Consequently, gendered vulnerability emerges not only as a social issue, but also as a structural economic challenge that requires targeted policy attention.

Economic capacity, as reflected by average household expenditures, further differentiates vulnerability levels among districts. Teluk Betung Timur demonstrates relatively stronger economic conditions, with household expenditures exceeding the regional poverty line. However, the persistence of moderate dependency levels indicates that improved income alone does not eliminate vulnerability when demographic pressures remain. In contrast, low household expenditures in Bumi Waras reflect constrained income opportunities and limited financial resilience, which significantly increases sensitivity to livelihood shocks. These findings emphasize that economic indicators must be evaluated alongside demographic and social dimensions to fully capture livelihood vulnerability.

Overall, the results highlight the multidimensional nature of livelihood vulnerability in coastal urban settings. Dependency ratios, household head characteristics, and income stability interact to reinforce vulnerability and slow recovery processes following socioeconomic or environmental disturbances. These insights underline the importance of integrated interventions that combine gender-responsive economic empowerment, social protection mechanisms, and livelihood diversification strategies. Incorporating these dimensions into coastal development planning and disaster risk reduction frameworks is essential for strengthening household resilience and ensuring sustainable livelihoods in the coastal districts of Bandar Lampung City.

Ethical Approval

Not Applicable

Informed Consent Statement

Not Applicable

Authors' Contributions

RMP was primarily responsible for conceptualizing the research framework, formulating the research objectives, and designing the methodological approach, including the application of the Livelihood Vulnerability Index. RMP also led the data analysis and interpretation of results, particularly in relation to social, demographic, and economic vulnerability across the study area. TG contributed to data collection, data processing, and the standardization of indicators, as well as supporting the analysis of district-level vulnerability patterns. Meanwhile, MH assisted in drafting sections of the methodology and results. ARI played a key role in reviewing and refining the manuscript, strengthening the discussion and conclusions, and ensuring the overall coherence and clarity of the paper. All authors contributed to the interpretation of findings, provided critical feedback throughout the writing process, and approved the final version of the manuscript.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Data Availability Statement

The data presented in this study are available on request from the corresponding author due to privacy reasons.

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REFERENCES

Agarwal, B. (1997). Bargaining and gender relations: Within and beyond the household. *Feminist Economics, 3*(1), 1–51. https://doi.org/10.1080/135457097338799

Aisyah, S., Rindarjono, M. G., & Muryani, C. (2015). Analisis perubahan permukiman kumuh akibat abrasi dan inundasi di pesisir Kecamatan Sayung Kabupaten Demak tahun 2003–2013. *Jurnal GeoEco*, *1*(1), 83–100. https://jurnal.uns.ac.id/GeoEco/article/view/8900

Chant, S. (2007). *Gender, generation and poverty: Exploring the feminisation of poverty in Africa, Asia and Latin America*. Edward Elgar Publishing.

Danquah, M., Ouattara, B., Ohemeng, W., & Barimah, A. (2024). Urbanization, climate change, and labour productivity in Accra, Ghana. *Cities*, *169*, 106584. https://doi.org/10.1016/j.cities.2025.106584

Doondori, A. K., Budiana, I., & Paschalia, Y. P. M. (2023). Descriptive study: Characteristics of coastal communities regarding disaster preparedness. *Jurnal EduHealth*, *14*(4), 648–655. https://ejournal.seaninstitute.or.id/index.php/healt/article/view/3582

Doss, C. (2013). Intrahousehold bargaining and resource allocation in developing countries. *The World Bank Research Observer, 28*(1), 52–78. https://doi.org/10.1093/wbro/lkt001

Fajrin, A. R. M., Hayati, A., & Faqih, M. (2021). The spatial characteristics of tidal flood vulnerability and adaptation strategy in Tambak Lorok kampung settlement. *IPTEK Journal of Proceedings Series*, *6*, 363–371. http://dx.doi.org/10.12962%2Fj23546026.y2020i6.11124

Fariz, R., Rizky, T., Holeng, V., Damayanti, M., & Heriyanti, A. (2025). Mapping household physical vulnerability to tidal floods through indicator-based scoring analysis. *Spatial Review for Sustainable Development, 2*(2), 111–128. https://doi.org/10.61511/srsd.v2i2.2025.1657

Food and Agriculture Organization. (2011). *The state of food and agriculture 2010–2011: Women in agriculture—Closing the gender gap for development*. FAO. https://openknowledge.fao.org/handle/20.500.14283/i2050e

Hahn, M. B., Riederer, A. M., & Foster, S. O. (2009). The livelihood vulnerability index: A pragmatic approach to assessing risks from climate variability and change—A case study in Mozambique. *Global Environmental Change*, *19*(1), 74–88. https://doi.org/10.1016/j.gloenvcha.2008.11.002

Ilmarinen, J. (2001). Aging workers. *Occupational and Environmental Medicine, 58*(8), 546–552. https://doi.org/10.1136/oem.58.8.546

Incoom, A. M., Adjei, K., Odai, S., Siabi, E., Donkor, P., & Frimpong, K. (2025). Adaptation strategies by smallholder farmers to climate change and variability: The case of the savannah zone of Ghana. *Sustainable Futures*, *9*, 100543. https://doi.org/10.1016/j.sftr.2025.100543

Karnaji, K., Susanti, E., Ariadi, S., & Saud, M. (2024). Social impacts and post-disaster management in disaster-prone areas of East Java, Indonesia. *Jàmbá: Journal of Disaster Risk Studies*, *16*(1), Article a1747. https://doi.org/10.4102/jamba.v16i1.1747

Risna, A., Esariti, L., & Rahdriawan, M. (2024). Tingkat aset penghidupan rumah tangga terdampak banjir rob di Bandengan, Pekalongan. *Jurnal Pengembangan Kota*, *12*(1), 96–108. https://doi.org/10.14710/jpk.12.1.96-108

Saha, M., Biswas, A. K. M., & Faisal, M. (2024). Livelihood vulnerability of coastal communities in the context of climate change: An index-based assessment. *World Development Sustainability*, *4*, Article 100152. https://doi.org/10.1016/j.wds.2024.100152

Sharma, M. (2023). Poverty and gender: Determinants of female- and male-headed households with children in poverty in the USA, 2019. *Sustainability*, *15*(9), 7602. https://doi.org/10.3390/su15097602

Skirbekk, V. (2004). Age and individual productivity: A literature survey. In G. Feichtinger (Ed.), *Vienna yearbook of population research* (pp. 133–153). Austrian Academy of Sciences Press. https://doi.org/10.1553/populationyearbook2004s133

Sullivan, C., Meigh, J. R., & Fediw, T. S. (2002). *Derivation and testing of the Water Poverty Index: Phase 1 final report*. Department for International Development. https://nora.nerc.ac.uk/id/eprint/503246/

Suryanto, R., Guritno, D. C., Saputro, N., & Marniyati, S. (2021). Do social-economy vulnerability index and poverty index have correlation? Study in Bengawan Solo watershed. *International Journal of Business and Society*, *22*(2), 985–1003. https://doi.org/10.33736/ijbs.3777.2021

Ullah, W., Dong, H., Shah, A. A., Xu, C., & Alotaibi, B. A. (2025). Unveiling the multidimensional vulnerabilities of flood-affected communities in Khyber Pakhtunkhwa, Pakistan. *Water*, *17*(2), 198. https://doi.org/10.3390/w17020198

Wang, X., Xu, L., Cui, S.-H., & Wang, C.-H. (2020). Reflections on coastal inundation, climate change impact, and adaptation in the built environment: Progresses and constraints. *Advances in Climate Change Research*, *11*. https://doi.org/10.1016/j.accre.2020.11.010

Zhao, Y., Han, Z., Zhang, C., Wang, Y., Zhong, J., & Gao, M. (2024). Coastal cultural ecosystem services: A bridge between the natural ecosystem and social ecosystem for sustainable development. *Land*, *13*(9), 1352. https://doi.org/10.3390/land13091352