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Unequal Exposure: The Politics of Tidal Flood Risk Inequality on Java's Northern Coast

Ratna Istriyani
Sunan Kalijaga State Islamic University, Indonesia
ratna.istriyani@uin-suka.ac.id

Abstract

Indonesia's maritime potential significantly contributes to its economic growth, particularly in the coastal areas of the northern coast of Java, which serves as a major maritime trade route. This has led to increased industrial activity through the development of industrial infrastructure, property, and public facilities. As the backdrop, industrialization on the Northern Coast of Java has led to increased land subsidence, resulting in significant tidal floods that have become more severe over the past few years. This flooding has had a severe impact on the community, highlighting class-based risk inequality. Following Ulrich Beck's analytical framework, flooding on the northern coast of Java is a natural disaster caused by tides and the characteristics of alluvial soil, which places the habitats at risk. Moreover, the significance of tidal floods in recent years has been influenced by massive industrial activity, a manifestation of modernity, especially groundwater exploitation, which has accelerated land subsidence and become a daily concern for people living in the coastal areas of the northern coast of Java. The method used in this study is a literature review and secondary data analysis, incorporating data from previous research, articles, credible digital media sources, and relevant ministries. The research results indicate that tides are becoming increasingly intense, extending farther inland and affecting the ecological, economic, and social aspects of the community. Hence, the impacts of tidal floods are not evenly distributed, but rather accumulate among the directly affected communities, namely the lower classes, who bear the risks as government policy does not provide a solution.

Keywords: industry, inequality, marine, risk, tidal flood

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I. INTRODUCTION

Indonesia is a vast archipelagic country, with 67% of its territory consisting of waters spanning approximately 6.4 million square kilometers[1], connecting its numerous islands. This geographic position made Indonesia not only an archipelagic state but also a maritime nation. This designation underpins Indonesia's efforts to realize its vision as a global maritime axis, as articulated in Presidential Regulation Number 34 of 2022 concerning the Indonesian Ocean Policy Action Plan, which involves coordination among various ministries.[2] This vision is further supported by data indicating that 90% of global trade routes are maritime, with 40% of them passing through Indonesian waters.[3]

Indonesia's strategic geographic location, serving as an economic corridor, has driven the rapid growth of trade and industrial activities along its maritime routes. This is evidenced by the substantial number of ports functioning as maritime industrial hubs —1,407 ports and docks nationwide.[4] Among these, two of the busiest ports —Tanjung Priok in the north of Jakarta and Tanjung Perak in East Java—are located along the northern coast of Java.[5] These ports predominantly facilitate export-import trade, which in turn fuels intensified industrial activity in the Northern Coast of Java region, stretching from the North of Banten Province to East Java Province. Reports indicate that there are 70 industrial zones along the Northern Java coastline.[6] In addition, the development of supporting facilities for industry and the tourism industry has also grown rapidly, including the coastal reclamation project in Semarang, Central Java[7] and North Jakarta[8], along with the development of residential and real estate sectors.[9]

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[1] Sidako, "SIDAKO KKHL," SIDAK KSDAE, accessed June 8, 2025, https://sidako.kkp.go.id/sidako/index.

[2] JDIH Kemenko Bidang Kemaritiman dan Investasi, "Poros Maritim Dunia," 2022, https://jdih.maritim.go.id/en/poros-maritim-dunia.

[3] Kemenhub, "Empat Puluh Persen Jalur Perdagangan Dunia Melewati Indonesia Kementerian Perhubungan Republik Indonesia," 2018, https://dephub.go.id/post/read/empat-puluh-persen-jalur-perdagangan-dunia-melewati-indonesia.

[4] Kemenhub, "Data Jenis Dan Jumlah Pelabuhan Di Indonesia PORTAL SATU DATA | Kementerian Perhubungan," 2023, https://portaldata.kemenhub.go.id/content/dataset/10447.

[5] shasolo, "4 Pelabuhan Tersibuk Di Indonesia," *PT SHA SOLO*, September 28, 2022, https://shasolo.com/4-pelabuhan-tersibuk-di-indonesia/.

[6] Liputan6.com, "Degradasi Pantura Jawa Diperkirakan Ancam Keberadaan 70 Kawasan Industri," liputan6.com, January 10, 2024, https://www.liputan6.com/bisnis/read/5502219/degradasi-pantura-jawa-diperkirakan-ancam-keberadaan-70-kawasan-industri.

[7] Siti Munasikhah, "Dari Hutan Mangrove Menjadi Tambak: Krisis Ekologis Di Kawasan Sayung, Demak (1990-1999)," *Journal of Indonesian History* 10, no. 2 (2021): 2, https://doi.org/10.15294/jih.v10i2.52898.

[8] Annisa Widya Syafitri and Agus Rochani, "Analisis Penyebab Banjir Rob Di Kawasan Pesisir Studi Kasus: Jakarta Utara, Semarang Timur, Kabupaten Brebes, Pekalongan," *Jurnal Kajian Ruang* 1, no. 1 (2022): 1, https://doi.org/10.30659/jkr.v1i1.19975.

[9] Syafitri and Rochani, "Analisis Penyebab Banjir Rob Di Kawasan Pesisir Studi Kasus."

Industry, as a manifestation of both classical and late modernity[10], has significantly contributed to both ecological and environmental crises. The rapidly growing industry in coastal areas, apart from providing financial benefits to the macroeconomy, has a significant impact on the surrounding community. Sayung District in Demak Regency, Central Java, for instance, has experienced land use conversion of approximately 1,476.65 hectares between 2016 and 2022. Its transformation was marked by increased areas allocated for industrial and residential purposes, aggravated by the decline of vegetated wetlands, rice fields, and fishponds.[11] A similar trend was observed in Surabaya, East Java. Industrial and residential activities have led to extensive groundwater extraction, triggering land subsidence—identified as a primary cause of tidal flood.[12] The complexity of tidal flood disasters is further compounded by geomorphological research indicating that the northern coast of Java consists of fine-textured, soft, and highly subsidence-prone alluvial soil. Consequently, land subsidence and sea-level rise were inevitable, particularly in the absence of spatial planning that considers geomorphological factors.[13] These facts illustrate the heightened vulnerability of the Northern Java coastline. High levels of vulnerability have been documented in Tangerang, Bekasi, Brebes, Demak, Jepara, Pati, and Rembang.

In contrast, very high levels of vulnerability were observed in Serang, Karawang, Subang, Indramayu, Cirebon, Tegal, Kendal, Semarang, and Gresik.[14] Areas with high vulnerability to high levels have the potential to experience tidal flooding with relatively high intensity. Semarang, for example, falls into the high-risk category. Tidal flooding occurs four to nine times a month.[15] By September 2024, flood levels reached 1 m, exceeding the normal threshold.[16]

The situation on the northern coast of Java presents a paradox. The persistent and worsening issues of land subsidence and tidal flood have severe implications for coastal settlements and local economies in the Northern Coast of Java. Nevertheless, on the one hand, Macro Industries continues unabated. This contradiction has raised critical inquiries: How does industrialization in the Northern Coast of Java contribute

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[10] George Ritzer, *Teori Sosial Postmodern (Terj. Muhammad Taufik)* (Kreasi Wacana, 2010).
[11] Aqilla Fadhila Haya, "Analisis Perubahan Penggunaan Lahan Pesisir Di Kecamatan Sayung Kabupaten Demak Periode 2016-2022" (Universitas Gadjah Mada, 2023).
[12] Ifrad Budi Tritama et al., "Identifikasi Kejadian Banjir Rob Wilayah Surabaya Tahun 2021-2022: Identification of Tidal Flood Events in Surabaya Area in 2021-2022," *Jurnal Hidropilar* 9, no. 1 (2023): 11–20, https://doi.org/10.37875/hidropilar.v9i1.274.
[13] Syafitri and Rochani, "Analisis Penyebab Banjir Rob Di Kawasan Pesisir Studi Kasus."
[14] Dian N. Handiani et al., "Coastal Vulnerability Assessment Along The North Java Coastlines-Indonesia," *Jurnal Segara* 18, no. 1 (2022): 1, https://doi.org/10.15578/segara.v18i1.10664.
[15] B A Hakim et al., "Assessing Environmental Physics: Tidal Flood Impact with Multidiscipline Approach (Case Study Coastal Cities Semarang Indonesia)," *Journal of Physics: Conference Series* 2377, no. 1 (2022): 012059, https://doi.org/10.1088/1742-6596/2377/1/012059.
[16] Luhur Moekti Prayogo et al., "Tidal Characteristics in the Northern Coast of Central Java (a Case Study in Semarang, Indonesia)," *Lempuk: Jurnal Ilmu Kelautan Dan Perikanan* 3, no. 2 (2024): 65–69, https://doi.org/10.35891/lempuk.v3i2.5643.

to the ongoing ecological and economic crises? Who bears the brunt of these intersecting environmental, social, and economic threats? This study focused on both questions. First, analyze the causative factors and impacts of tidal floods. Second, analyze the facts of risk distribution, highlighting the dichotomy of risk-based classes.

Based on this background, this study adopted Ulrich Beck's theoretical framework of the "Risk Society." Ulrich Beck posits that the advent of "new modernity" — a term he prefers over postmodernity — has given rise to a risk society.[17] Unlike classical modernity, which emerged during the early industrial era of the 19th century and sought to distribute welfare and equality, new modernity emphasizes the significant role of science and technology in generating both industrial development and systemic risk.[18]

In this context, risk is not only embedded in spatial and temporal dimensions but also in class, stratified, or pattern. Ulrich Beck made a distinction between classical modernity and new modernity, also referred to as recent modernity. Classical modernity conceived class in terms of hierarchical access to wealth, where increased wealth implied upward mobility. New modernity reveals that class now reflects one's ability to avoid or mitigate risk. According to the theory of risk society[19], the more affluent classes actively minimize their exposure to risks.

In contrast, lower socio-economic groups are often unable or find it difficult to avoid these risks, thereby bearing a disproportionate share of the risk burden. Thus, Ulrich Beck noted that new modernity is not solely about the pursuit of welfare, but also about the pursuit of risk security, wherein risk becomes increasingly concentrated at the lower end of the social hierarchy. Beck refers to as "risk positioning".[20]

This study employed a literature review method, involving the collection and meta-analysis of data from previous qualitative research sourced from academic journals and news outlets. It published videos addressing the causes and impacts of tidal floods.[21] To enrich the analysis, statistical data from secondary sources—such as governmental institutions, ministries, news media, and prior research publications—are incorporated.[22] The data is systematically organized and analyzed using Ulrich Beck's Risk Society theory.

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[17] Ritzer, *Teori Sosial Postmodern (Terj. Muhammad Taufik)*.
[18] Ritzer, *Teori Sosial Postmodern (Terj. Muhammad Taufik)*.
[19] Ulrich Beck, *Risk Society: Towards a New Modernity*, Theory, Culture & Society (Sage Publications, 1992).
[20] Beck, *Risk Society*.
[21] W. Lawrence Neuman, *Metodologi Penelitian Sosial: Pendekatan Kualitatif Dan Kuantitatif* (Indeks, 2013), 143–54.
[22] Neuman, *Metodologi Penelitian Sosial: Pendekatan Kualitatif Dan Kuantitatif*, 413.

II. COASTAL DISASTERS IN NORTHERN JAVA: MANIFESTATIONS OF ECOLOGICAL RISKS, ECONOMIC RISKS, AND SOCIAL RISKS

Tidal floods along the northern coast of Java represent a classical yet persistent issue, rendering it a compelling subject for scholarly investigation, particularly through the analytical framework of Ulrich Beck. According to Beck's perspective, disasters do not occur as purely natural events; instead, they are manifestations of rapidly evolving risks stemming from the advancement of science and technology — consequences of modernization itself.

More than merely identifying risks, Ulrich Beck offers a framework that explicates how modernization also distributes these risks unevenly across different societal positions, a concept he refers to as risk positions. These positions reveal that inequality in modern societies is not solely material but also includes the unequal distribution of risks borne by individuals and groups according to their social position (or social class).[23]

This paper, therefore, begins by analyzing the types of risks emerging from modernization processes along the Northern Coast of Java, with particular emphasis on the consequences of expanding industrialization. As is known, the North Coast of Java has been an area frequently affected by tidal flooding for at least the past ten years. Tidal flood is not only a natural disaster, but also a profound implication of excessive human activity, one of which is industrialization. Even a tidal flood itself brings other equally serious effects. Therefore, the author attempts to classify the risks resulting from industrialization, including inundation or tidal flood and other latent effects. These risks include three types: ecological risks, economic risks, and social risks. This paper further describes the mapping of risk liability based on class or position within Ulrich Beck's framework. In this statement, Ulrich Beck indicates the existence of inequality.

Tidal floods are among the most frequently occurring hydrometeorological disasters along the northern coast of Java. This phenomenon occurs when sea levels rise above the elevation of the land, resulting in inundation of coastal areas. Naturally, tidal floods are influenced by astronomical forces—namely, the gravitational pull exerted by the sun and the moon on the Earth, with the volume of seawater also playing a significant role. During a full moon, the gravitational pull of the moon increases tidal levels, causing seawater to rise. However, such natural phenomena typically persist for only 12 to 24 hours.[24]

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[23] Beck, *Risk Society*.

[24] Syafitri and Rochani, "Analisis Penyebab Banjir Rob Di Kawasan Pesisir Studi Kasus."

Beyond astronomical influences, geomorphological factors also contribute significantly to the occurrence of tidal floods. The Northern Java coastline is characterized by alluvial soils, fine-grained, and soft sediments[25], which naturally undergo a sediment compaction process that continues to the present.[26] This compaction contributes to land subsidence, wherein the ground surface lowers and becomes more susceptible to sea intrusion, especially during high tides, thereby intensifying the tidal flood phenomenon.[27] Furthermore, geomorphologically, the northern coast of Java functions as a downstream region receiving runoff from the upstream highlands. During episodes of intense rainfall, river discharge from upstream areas increases significantly. If the river capacity is insufficient to accommodate both the incoming upstream water and the intruding seawater, inland flooding becomes inevitable.[28]

These natural factors represent scientific facts that should be considered for anticipating and mitigating tidal flood impacts. However, the empirical condition reveals a worsening of the situation, with tidal floods becoming deeply embedded in the daily lives of coastal communities. While tidal floods should ideally occur only during specific periods and last no longer than 12–24 hours, in reality, they persist for several days in provinces, especially the Northern Coastline. For instance, in Semarang, Central Java, the frequency of tidal floods has reached 4 to 9 events per month.[29] Additionally, flood depths have increased significantly; in Northern Jakarta, the average height has risen from 0.4 meters to 1.98 meters. The increase in flood levels had a linear impact on the expansion of the affected area, from the initial two sub-districts of Penjaringan and Cilincing to four sub-districts: Penjaringan, Cilincing, Pademangan, and Tanjung Priok.[30] It is similar to Pekalongan District, Central Java, especially in 2020, reaching 1,730 Ha, from the previous (2019) area of 1,057 Ha.[31]

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[25] Syafitri and Rochani, "Analisis Penyebab Banjir Rob Di Kawasan Pesisir Studi Kasus."
[26] T Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java: A New Hazard?," *IOP Conference Series: Earth and Environmental Science* 925, no. 1 (2021): 012015, https://doi.org/10.1088/1755-1315/925/1/012015.
[27] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."
[28] Mila Karmilah Boby Rahman, "THE TIDAL FLOODING CAUSES IN THE NORTH COAST OF CENTRAL JAVA: A SYSTEMIC LITERATURE REVIEW," *Journal of Southwest Jiaotong University* 56, no. 6 (2021): 6, https://jsju.org/index.php/journal/article/view/1090.
[29] Hakim et al., "Assessing Environmental Physics."
[30] Indah Ferdiani Zuhriah et al., "Pemodelan Banjir Rob Wilayah Jakarta Utara Menggunakan Sistem Informasi Geografis," *Jambura Geoscience Review* 4, no. 2 (2022): 2, https://doi.org/10.34312/jgeosrev.v4i2.14196.
[31] Mohd Ibrahim et al., "Serious Flooding in Pekalongan City: What Are the Government Policies in Tackling This Problem?," paper presented at Proceedings of the 1st International Conference on Environmental Science, Development, and Management, ICESDM 2023, 2 November 2023, Banjarmasin, South Kalimantan, Indonesia, August 21, 2024, https://eudl.eu/doi/10.4108/eai.2-11-2023.2348205.

The increasing intensity and height of tidal floods are primarily driven by human-induced processes.[32] Human dominance over nature is indicative of modernity, where, through reason and scientific knowledge, humans have sought to engineer and control natural systems—primarily through industrial activities involving mass production and machinery.[33] This shift in rational thinking reflects an anthropocentric ethos geared toward the pursuit of economic objectives rooted in commodification.[34] This is particularly evident in the massive land-use changes along the northern coast of Java, where agricultural lands have been increasingly converted for industrial development.[35] Additionally, demographic pressures have driven a growing demand for space, visible in the rapid expansion of residential areas.[36] Such demographic pressure is closely aligned with industrial expansion, as the increase in industrial zones correlates directly with rising employment and housing needs.[37] Exacerbating the ecological decline are numerous urban development projects, including the construction of public infrastructure and land reclamation.[38]

Based on data, particularly in the North Coast region of Central Java, land conversion for residential and industrial use (urban development) has occurred significantly around several basin rivers. Land conversion has even occurred in several villages near rivers, which have the potential to become cities (urban sprawl). At least four basin rivers in the North Coast region have experienced significant land conversion, particularly between 2009 and 2018.[39]

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[32] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."
[33] Margaret M Poloma, *Sosiologi Kontemporer* (Rajagrafindo Persada, 2010).
[34] Akhyar Yusuf Lubis, *Postmodernisme: Teori Dan Metode* (Raja Grafindo Persada, 2016).
[35] Hakim et al., "Assessing Environmental Physics."
[36] Westi Utami et al., "The Impact of Tidal Flooding on Decreasing Land Values in the Areas of Tugu District, Semarang City," *Jurnal Ilmu Lingkungan* 19, no. 1 (2021): 10–20, https://doi.org/10.14710/jil.19.1.10-20.
[37] Wiwandari Handayani et al., "Urbanization and Increasing Flood Risk in the Northern Coast of Central Java—Indonesia: An Assessment towards Better Land Use Policy and Flood Management," *Land* 9, no. 10 (2020): 10, https://doi.org/10.3390/land9100343.
[38] Boby Rahman, "THE TIDAL FLOODING CAUSES IN THE NORTH COAST OF CENTRAL JAVA."
[39] Handayani et al., "Urbanization and Increasing Flood Risk in the Northern Coast of Central Java—Indonesia."

Table 1. Land Conversion along Basin Rivers in Central Java in 2009-2018

River Basin	Area (km2)		Change
	2009	2018	
	Built-Up	Built-Up	
Jratunseluna	1222.58	1581.26	29.34 %
Urban	89.19	211.93	137.62 %
Potentially Urban	330.88	467.69	41.35 %
Rural	802.51	901.64	12.35 %
Wiso-Gelis	70.72	89.81	26.99 %
Urban	2.38	2.62	10.08 %
Potentially Urban	31.42	36.93	17.54 %
Rural	36.92	50.26	36.13 %
Bodri-Kuto	117.17	244.56	108.72 %
Urban	12.34	17.4	41.00 %
Potentially Urban	41.51	88.39	112.94 %
Rural	63.32	138.77	119.16 %
Pemali-Comal	556.14	670.71	20.60 %
Urban	63.27	69.7	10.16 %
Potentially Urban	204.47	293.02	43.31 %
Rural	288.4	307.99	6.79 %

Source: Handayani et al., "Urbanization and Increasing Flood Risk in the Northern Coast of Central Java—Indonesia."

Based on the table above, significant land conversion has occurred along the Bodri-Kuto River, particularly along the riverbanks, in surrounding villages, and even in villages with potential for urban development (urban sprawl), with a percentage exceeding 100%. The river, which originates in Temanggung Regency, empties into Kendal Regency and the Northern Sea.

The conversion of productive land for industrial, residential, and public infrastructure purposes—alongside the accompanying environmental degradation—offers a concrete illustration of Ulrich Beck's argument that modernity inherently generates risk. The rapid economic growth driven by industrialization and infrastructure development is a manifestation of modernization, inevitably giving rise to a range of consequences or risks.[40] On the Northern Java coastline, at least three interrelated types of risks can be identified: ecological, economic, and social risks. These dimensions of risk are deeply interconnected with each other.

[40] Ritzer, *Teori Sosial Postmodern (Terj. Muhammad Taufik)*.

It is essential to note that the Northern Coast of Java is characterized by alluvial soil, which renders it fundamentally unsuitable for the construction of large-scale, permanent structures. The weight of the structural load placed upon such soil is directly related to the greater acceleration of land subsidence, in addition to the natural factors previously discussed.[41]

The increasing intensity of infrastructure and industrial development in the region also correlates directly with heightened water usage—particularly groundwater consumption. In practice, groundwater remains the primary source of water in the coastal Northern Coast of Java region, especially in cities such as Jakarta, Pekalongan, Semarang, and Demak, serving both domestic and industrial needs.[42] However, excessive groundwater extraction significantly exacerbates the risk of land subsidence. A notable case of land subsidence occurred in Semarang, Central Java, where the number of groundwater wells increased dramatically from 94 in 1974 to 1,050 by 2000. Correspondingly, annual groundwater consumption surged from 0.9 million m^3 to 38 million m^3. This increase contributed to a decline in the groundwater table by approximately 1.2 to 2.2 meters per year.[43] The combination of groundwater exploitation and declining water tables has led to accelerated land subsidence, with an average rate of 1 to 20 centimeters per year.[44]

This reality clearly illustrates how the logic of modernity in the Northern Coast of Java region has produced significant risks for local communities. Infrastructure development and industrial expansion—initiated with the intention of fulfilling human needs and achieving economic prosperity—have paradoxically generated substantial ecological consequences. The considerable land subsidence now occurring has triggered a recurring disaster for coastal populations, known as tidal flooding.

Moreover, tidal floods have resulted in latent ecological degradation, particularly the deterioration of coastal ecosystems. One visible impact is the destruction of mangrove forest biodiversity, a process exacerbated by both the intensification of land-use change and the increasing frequency and severity of tidal floods.[45] Statistical data indicate a consistent decline in mangrove forest area in West Java, Central Java, and East Java, particularly after 2010. In fact, this is evident in the following chart.

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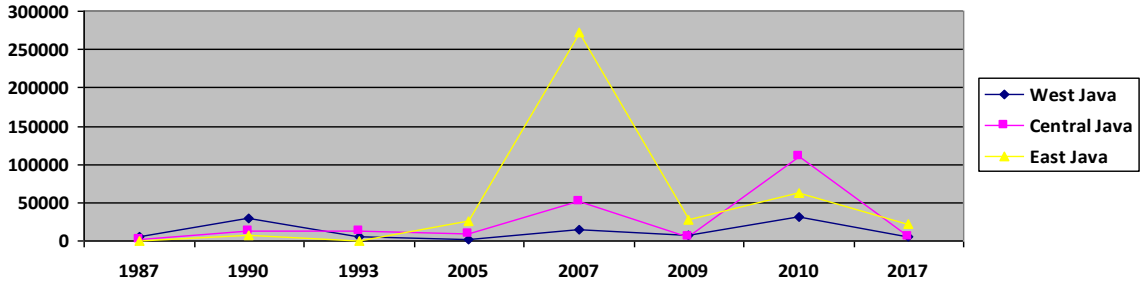
[41] Boby Rahman, "THE TIDAL FLOODING CAUSES IN THE NORTH COAST OF CENTRAL JAVA."
[42] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."
[43] H.Z. Abidin et al., "Land Subsidence in Coastal City of Semarang (Indonesia): Characteristics, Impacts and Causes," *Geomatics, Natural Hazards and Risk* 4, no. 3 (2013): 226–40, https://doi.org/10.1080/19475705.2012.692336.
[44] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."
[45] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."

Chart 1. Area of Mangrove in West Java, Central Java, and East Java in the period 1987-2017



Source: Aswin Rahadian et al., "A Historical Review of Data and Information of Indonesian Mangroves Area," Media Konservasi 24, no. 2 (2019): 163–78, https://doi.org/10.29244/medkon.24.2.163-178

Deforestation, or the significant reduction of mangrove forest areas, has contributed to an increase in the height and extent of tidal flood inundation. This is primarily due to the considerable loss of the mangroves' natural functions as wave barriers and ecosystem stabilizers. The situation is further exacerbated by widespread land-use conversion of mangrove areas into aquaculture industries[46] and land reclamation projects.[47] Of course, mangrove damage is a factor that increases the risk of tidal flooding in coastal areas. Coastal communities often face flooding regularly.

The impacts of tidal flood extend beyond physical inundation, as it also contributes to the deterioration of environmental quality, particularly in relation to the availability of clean water.[48] This decline is not only caused by pollution from organic and inorganic materials carried by tidal flood, but also by seawater intrusion. Seawater intrusion refers to the penetration of seawater into groundwater systems, altering their chemical composition and rendering the water unsuitable—or entirely unfit—for consumption.[49] Tidal flooding also impacts residents' sanitation. Due to the flooding, sanitation systems fail to function correctly. Consequently, bacteria carried by the tidal flooding can become a source of disease for the community.[50]

[46] Munasikhah, "Dari Hutan Mangrove Menjadi Tambak."
[47] Ayang Armelita Rosalia et al., "ANALISIS SEBARAN DAN PERUBAHAN EKOSISTEM MANGROVE DI WPP-NRI 712 INDONESIA," *Jurnal Kemaritiman: Indonesian Journal of Maritime* 3, no. 2 (2022): 2, https://doi.org/10.17509/ijom.v3i2.37976.
[48] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."
[49] Hakim et al., "Assessing Environmental Physics."
[50] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."

The clean water problem is evident in the northern region of Pekalongan, Central Java. According to 2020 research, the water quality of 22 villages (55.55%) out of a total of 36 villages in Ulujami District, Pekalongan Regency, was deemed unfit for consumption. This was due to three factors: high salt content, cloudy water, and odor. In fact, 15% of the water was declared completely unfit due to tidal flooding or permanent tidal inundation.[51] The percentage breakdown of each factor contributing to water unsuitability is illustrated in the diagram.

Table 2. Unsuitability of Drinking Water in Ulujami District, Pekalongan, Central Java

Number	Aspects of Water Unsuitability	Percentage
1.	Smelly water	11,11 %
2.	Salt Water	22,22 %
3.	Colored Water (Turbid)	55,55 %
4.	Water mixed with tidal	13,6 %

Source: Asyifa and Wibowo, "THE EFFECT OF TIDAL WATER ON WELL WATER QUALITY IN NORTHERN COAST ROAD."

Based on this data, the primary cause of water being unsuitable for consumption is its cloudy color. The findings categorize cloudiness into two categories: slightly cloudy and very cloudy. The second factor that contributes significantly is salt contaminating groundwater or filtered water (from the Local water company/PDAM). In other words, seawater intrusion has entered residential areas, mixing with groundwater or filtered water, rendering it unfit for consumption.

A tidal flood can be likened to the tip of an iceberg. It appears minor on the surface, yet it conceals a far more complex and extensive set of underlying issues upon closer examination. All this time, tidal flood has predominantly been approached from an ecological perspective, both in terms of its causes and its impacts. However, the ecological consequences themselves have become increasingly problematic due to their cascading effects on the economic sector. As Abidin et al.[52] note, damage to infrastructure and industrial zones caused by tidal flood has triggered a domino effect, resulting in significant economic losses. Based on the findings, economic risks are evident in the following points.

These economic losses are particularly evident in the degradation of economic assets and livelihoods in the Northern Coast of Java. Data indicate a marked decline in livelihood sources across various areas along the Northern coast of Java. Coastal abrasion, driven by seawater encroaching onto land, has led to the loss of agricultural

[51] Adwiyah Asyifa and Pebri Wibowo, "THE EFFECT OF TIDAL WATER ON WELL WATER QUALITY IN NORTHERN COAST ROAD," *International Journal of Engineering Technology and Natural Sciences* 2 (July 2020): 32–38, https://doi.org/10.46923/ijets.v2i1.74.
[52] Abidin et al., "Land Subsidence in Coastal City of Semarang (Indonesia)."

land. In Semarang, for instance, 235 hectares of agricultural land were submerged by seawater in 2022, resulting in a shift in land use primarily to aquaculture.[53]

The loss of agricultural areas has gradually transformed into fishponds. However, the high intensity of abrasion and inundation has also contributed to the decline of fishpond areas managed by local communities. This is quite paradoxical, considering that fishponds are also a contributing factor to the increasing intensity of abrasion and tidal flooding, particularly when their presence displaces mangrove areas. However, fishponds are a valuable economic industry for coastal communities along the north coast of Java, and their damage impacts their economic stability. Therefore, the destruction of fishpond areas is a problematic effect that needs to be addressed. Between 2001 and 2019, there was an increase in tidal flooding, covering 1,811 hectares and affecting fishpond areas in Bekasi, West Java.[54]

Damage to salt ponds is also a result of tidal flood, as occurred in Cirebon, West Java, one of the largest salt pond centers in Java. Tidal flood in 2016 and 2018 caused a total of 170.3 billion (Rupiah) in damage during the pre-production period. During the harvest period, losses were estimated at 1.38 trillion (Rupiah).[55] In 2022, 500 hectares of salt ponds in Cirebon were also inundated by tidal flooding, resulting in crop failure. In the same year, similar losses occurred in Pekalongan, where the salt harvest failed on 600 hectares of a total land area of 700.96 hectares. This was followed by other areas in Central Java, such as Brebes, Tegal, and Pati.[56]

Equally complex is the issue of tidal flooding, which has damaging impacts and also results in the loss of potential economic gains. As is known, the North Coast is a center of the expedition economy and a macro-industrial area, particularly in Jakarta and Central Java. Therefore, the tidal flooding, initially triggered by industrialization, ultimately impacts industrial activity itself. The disruption of industrial activity and distribution has resulted in significant material losses. Tidal flooding along the Jakarta coast threatens 70 industrial areas, with potential losses of 2.1 trillion rupiah per year.[57] A similar situation also occurs in the Pantai Utara/Northern Coast region of Central Java, with annual economic losses reaching 2.5 trillion rupiah.[58]

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[53] Anninditya Arddin Fadillah and S. Si Danardono, "Analisis Fenomena Banjir Rob Dan Kaitanya Dengan Perubahan Penggunaan Lahan Di Kawasan Pesisir Kota Semarang Tahun 2016 Dan 2022" (s1, Universitas Muhammadiyah Surakarta, 2024), https://doi.org/10/Lampiran.pdf.

[54] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."

[55] Anang Widhi Nirwansyah and Boris Braun, "Tidal Flood Risk on Salt Farming: Evaluation of Post Events in the Northern Part of Java Using a Parametric Approach," *Geosciences* 11, no. 10 (2021): 420, https://doi.org/10.3390/geosciences11100420.

[56] Hakim et al., "Assessing Environmental Physics."

[57] Tempo, "Banjir Rob Di Pesisir Utara, Airlangga: Kerugian Ekonomi Bisa Sampai Rp 10 Triliun per Tahun," *Tempo.Co*, January 10, 2024, https://www.tempo.co/ekonomi/banjir-rob-di-pesisir-utara-airlangga-kerugian-ekonomi-bisa-sampai-rp-10-triliun-per-tahun-99447.

[58] Kompas Cyber Kompas, "Kerugian akibat Banjir Rob di Pantura Capai Rp 2,5 Triliun dan Pelibatan AI untuk Memimalisasi Dampak," KOMPAS.com, October 2, 2024, https://regional.kompas.com/read/2024/10/02/183818278/kerugian-akibat-banjir-rob-di-pantura-capai-rp-25-triliun-dan-pelibatan-ai.

As explained in the previous presentation, the increasingly widespread tidal flooding has resulted in a decline in environmental quality. This has also had a domino effect on people's health and quality of life. Therefore, areas inundated by seawater, already plagued by a series of existing environmental problems, are considered less livable, or even uninhabitable. This is compounded by the difficulty of accessing public services due to tidal flooding. This has also contributed to the decline in land prices in flood-affected areas, as well as in nearby areas.

This is similar to what happened in Semarang City, Central Java, which is the region with the highest rates of land subsidence and tidal flooding in Indonesia.[59] In addition to infrastructure and accessibility, land prices are primarily influenced by flood risk. Therefore, in the area traversed by the North Coast National Road and its surroundings, land prices have consistently increased, especially between 2014 and 2019, averaging Rp 700,000 per square meter, or approximately $55. This is due to easy accessibility, proximity to industrial areas, adequate infrastructure, and the absence of disaster risks (tidal flooding). However, the area experiencing consistent price increases decreased from 2018 to 2019. This means that only a small number of areas experienced an average price increase of Rp 700,000 per square meter, namely areas directly along the Northern Coast National Road. A rather sad reality occurs in the northernmost areas bordering the coast. Land prices consistently declined between 2014 and 2019, averaging Rp 200,000 to Rp 300,000 per square meter, or approximately $15- $ 20. Furthermore, the expansion of flooded areas has had a linear impact on the area experiencing declining land prices.[60]

Tidal flood has caused widespread damage to various forms of public infrastructure, significantly disrupting the social functioning of affected communities. One of the most acute crises is the inundation of residential areas along with the destruction of local livelihoods. Many villages located directly along the northern coast of Java face the imminent threat of being submerged by tidal floods. The most extreme case is found in Sayung Subdistrict, Demak Regency, Central Java, where three northernmost villages—Timbulsloko[61], Bedono, and Sriwulan[62]—experienced severe inundation after 2010, resulting in the partial or near-total submergence of their territories. This resulted in large-scale displacement, with most residents being forced to migrate elsewhere. Massive migration also occurred in Tambakrejo Village, Tanjung Mas, Semarang, Central Java. As many as 70% (30 families) of residents from one neighborhood association (RT) chose to relocate to a safe location.

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[59] Delfi Ana Harahap, "Deretan 3 Kota Besar Rawan Banjir Rob | Tempo.Co," Mei 2022, https://www.tempo.co/lingkungan/deretan-3-kota-besar-rawan-banjir-rob-348255.

[60] Utami et al., "The Impact of Tidal Flooding on Decreasing Land Values in the Areas of Tugu District, Semarang City."

[61] "Tenggelam Di Timbulsloko," *Indonesiaku*, directed by Trans 7 Trans 7, Trans 7, April 7, 2025, https://www.youtube.com/watch?v=7Iq2CjzTK2c.

[62] Refleksi DAAI TV Refleksi DAAI TV, "Bedono, Desa Yang Hilang Ditelan Laut Dan Kisah Mak Jah Yang Tetap Bertahan Di Rumahnya Sendirian - YouTube," January 6, 2025, https://www.youtube.com/watch?v=XXlafKw0WSc.

Meanwhile, in another neighborhood association (RT), they agreed to relocate because their homes were affected by the East flood Canal project, part of an effort to mitigate tidal flooding.[63] Mass migration indicates a new problem: depopulation in certain areas. If left unaddressed, the emergence of ghost villages and ghost towns will continue.

In addition to facing the reality of massive migration (depopulation), residents affected by the tidal flood who still choose to remain must adapt to environmental and physical damage. Not only are assets damaged, but communities also experience inadequate public facilities. This undoubtedly hampers public services. Education is among the most affected sectors. School buildings have gradually deteriorated due to prolonged inundation, significantly undermining the quality of teaching and learning processes. An ironic example is found in SDN Sriwulan 3, Demak, Central Java, where half of the school structure is submerged, reducing the availability of classroom space. In instances of severe flooding, educational activities are relocated to students' homes, relying on independent study methods.[64]

Tidal flood also causes affected areas to become increasingly isolated, as access routes to the villages are frequently obstructed. It affected mobility, requiring significantly longer time.[65] In response, residents not only engage in routine road rehabilitation efforts but also develop alternative transportation methods. One such innovation involves the creation of improvised boats made from plastic drums, enabling movement during periods of inundation.[66]

A less visible but equally serious consequence of increasingly frequent and severe tidal floods is their impact on the psychological well-being of affected populations. The rise in flood intensity brings with it a range of latent risks that extend beyond physical damage. The destruction of homes, deteriorating environmental conditions, and loss of livelihoods contribute to both declining health and household income. Simultaneously, residents must bear the financial burden of annual home repairs. These compounding stressors have been found to affect mental health negatively, resulting in elevated levels of anxiety, stress, and depression among impacted communities.[67]

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[63] Haryani Saptaningtyas et al., "Tidal Flood and Slow Onset Mobility in the Urban Community on The Northeast Coast of Central Java, Indonesia," *BIO Web of Conferences* 155 (2025): 06004, https://doi.org/10.1051/bioconf/202515506004.

[64] Refleksi DAAI TV, "Bedono, Desa Yang Hilang Ditelan Laut Dan Kisah Mak Jah Yang Tetap Bertahan Di Rumahnya Sendirian - YouTube."

[65] Akhmad Asrofi et al., "The Impact of Tidal Floods on Poor Households in the Sayung Coast, Demak Regency, Indonesia," *Indonesian Journal of Geography* 56, no. 3 (2024): 3, https://doi.org/10.22146/ijg.94063.

[66] Refleksi DAAI TV, "Bedono, Desa Yang Hilang Ditelan Laut Dan Kisah Mak Jah Yang Tetap Bertahan Di Rumahnya Sendirian - YouTube."

[67] Asrofi et al., "The Impact of Tidal Floods on Poor Households in the Sayung Coast, Demak Regency, Indonesia."

III. CLASS-BASED RISK INEQUALITY: A STRATEGIC APPROACH FOR COASTAL SOCIETY

Tidal flooding, exacerbated by intensive and widespread industrialization along the northern coast of Java, has had far-reaching consequences for local communities. However, when approached through Ulrich Beck's theory of risk society, the task of analyzing risk extends beyond merely identifying its forms. In Ulrich Beck's framework, damage and disaster are not simply natural outcomes; rather, they are universalized through industrial activity.[68] As explained in the previous exposition, industrialization expanded significantly in the northern coastal areas of Java, aligning with the distribution centers of maritime trade. When damage is universalized by industry, Ulrich Beck argues, it becomes a social, political, economic, and cultural contradiction. [69] These contradictions are particularly evident in the unequal distribution of accumulated risks, which disproportionately affect certain groups or social positions. Unlike wealth, which tends to accumulate upward among the affluent, risk accumulates downward, increasingly burdening lower-income or marginalized populations. These are the individuals and communities most directly exposed to hazards and who occupy the least secure positions within society. Their vulnerability is compounded by limited income, lack of political power, and insufficient education, leaving them with few options or guarantees other than to endure and manage the risks as best they can.[70]

In addition to the ecological impacts previously discussed, lower-income and directly affected communities face a set of latent and deeply challenging dilemmas. In fact, tidal floods represent a silent disaster—emerging gradually and often without immediate notice, yet intensifying over time—forcing communities to remain constantly vigilant and develop adaptive responses to the ongoing degradation of their environment. As such, this study seeks to explore how grassroots, bottom-tier communities actively engage in survival strategies amidst the recurring threat of tidal flood. These adaptive efforts primarily fall into two categories: protecting remaining assets and seeking alternative livelihoods or sources of income to sustain their livelihoods.

Inadequate or seemingly impartial responses to the problem of tidal floods have left marginalized communities living in prolonged uncertainty and hardship.[71] Those directly exposed to the risks of modernity and the impacts of tidal floods were compelled to take the initiative in finding solutions to sustain their livelihoods. One of the most fundamental concerns in this context is the issue of residence. There are generally two patterns of preference adopted by individuals in the most vulnerable risk

[68] Beck, *Risk Society*.
[69] Beck, *Risk Society*.
[70] Beck, *Risk Society*.
[71] Hakim et al., "Assessing Environmental Physics."

positions: 1) self-initiated relocation and 2) continued residence in inundated areas through ongoing environmental adaptation.

The first preference is undertaken by communities for whom continued life in their flood-affected villages is no longer viable. Those with limited assets pursue voluntary relocation by moving to safer areas and renting housing. Meanwhile, those with greater financial resources are comparatively fortunate, as they purchase land or property in less hazardous zones.

The second preference is adopted by individuals who lack the financial capacity to relocate, making continued residence and the protection of existing assets—primarily their homes—the only feasible option.[72] This group represents the most vulnerable "risk position," as they are forced to endure the increasingly severe fluctuations of tidal flood. Consequently, they must engage in continuous disaster adaptation strategies while also independently protecting their homes through self-financed efforts.

These asset-protection efforts typically involve elevating the floor of the house using any available materials, such as stacked debris, sand, soil, or cement. This form of adaptation must be repeated approximately every five years, with elevation heights ranging from 0.5 to 2 meters.[73] Meanwhile, raising the floor of a house incurs costs of around $20 million to $30 million.[74] Of course, this is not a cheap cost for coastal communities whose livelihoods are damaged by tidal flooding.

Survival strategies are not only individual, but also collective. Collective efforts are primarily concerned with rehabilitating public infrastructure in communities where residents remain despite the risk. Such efforts include removing debris carried in by tidal flood, repairing drainage systems and levees, and periodically raising road surfaces.[75] These maintenance and rehabilitation initiatives—both for private dwellings and public facilities—inevitably impose additional economic burdens on already disadvantaged communities, compounding their basic subsistence needs. In times of limited economic conditions, people often seek rehabilitation funds by applying for loans, seeking assistance from family and other institutions.[76]

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[72] Refleksi DAAI TV, "Bedono, Desa Yang Hilang Ditelan Laut Dan Kisah Mak Jah Yang Tetap Bertahan Di Rumahnya Sendirian - YouTube."
[73] I Rudiarto et al., "The Effectiveness of Strategy Adaptations on Tidal Flood in The Coastal Areas of Sayung, Demak, Central Java, Indonesia," *IOP Conference Series: Earth and Environmental Science* 448, no. 1 (2020): 012090, https://doi.org/10.1088/1755-1315/448/1/012090.
[74] Saptaningtyas et al., "Tidal Flood and Slow Onset Mobility in the Urban Community on The Northeast Coast of Central Java, Indonesia."
[75] Hakim et al., "Assessing Environmental Physics."
[76] Saptaningtyas et al., "Tidal Flood and Slow Onset Mobility in the Urban Community on The Northeast Coast of Central Java, Indonesia."

Additionally, the distribution of external aid often fails to keep pace with the increasing frequency and severity of tidal floods. In many cases, assistance has not yet been extended to cover rehabilitation or relocation support for those most directly affected.[77] As a result, residents are left to live with persistent and unrelenting risk, sometimes for a lifetime. While their efforts may temporarily extend the usability of their homes, they do not resolve the underlying problem—merely postponing an eventual outcome in which these settlements are destined to be entirely submerged.

As previously discussed, tidal flood not only submerges residential areas but also inundate the primary sources of livelihood for coastal communities along the Northern Coast of Java, most of whom rely heavily on the agrarian and maritime sectors—particularly fishing, aquaculture, and salt farming. The loss of these livelihoods inevitably forced communities to seek alternative forms of employment or income generation.

For those who have undertaken voluntary relocation to safer areas, securing new employment is a primary concern. However, this transition is far from straightforward, as it requires adapting existing skills to the economic opportunities available in their new environments. Conversely, those who remain in their original, flood-prone settlements must adapt to the shifting ecological landscape—where land has effectively transformed into sea—by changing their occupations. This occupational shift includes transitions from traditional agrarian farming to aquaculture and coastal resource cultivation, such as shellfish or mangrove farming, as observed in communities still residing in Bedono, Sayung Subdistrict, Demak District, Central Java.[78] Another notable adaptation is the emergence of so-called "nelayan darat" (land-based fishermen), as seen in the village of Timbulsloko.[79] This term refers to former farmers who have turned to fishing in areas of previously arable land that are now permanently submerged by tidal flood. Fishing in these areas is conducted not in open seas but in the shallow waters covering former agricultural fields. As a result, the boats used are typically makeshift and small in size—often constructed from improvised materials such as 120-liter plastic jerry cans or drums, which are cut in half to create flotation devices.[80]

The aforementioned reality serves as a critical reflection. The issues of land subsidence, tidal flood, and the complex latent impacts they generate have remained unresolved and, in many cases, inadequately anticipated for years. Although the government has attempted to mitigate the overexploitation of groundwater through policies such as taxation, in practice, groundwater usage continues to increase. This situation is further exacerbated by insufficient monitoring and enforcement related to

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[77] Refleksi DAAI TV, "Bedono, Desa Yang Hilang Ditelan Laut Dan Kisah Mak Jah Yang Tetap Bertahan Di Rumahnya Sendirian - YouTube."
[78] Refleksi DAAI TV, "Bedono, Desa Yang Hilang Ditelan Laut Dan Kisah Mak Jah Yang Tetap Bertahan Di Rumahnya Sendirian - YouTube."
[79] "Tenggelam Di Timbulsloko."
[80] "Tenggelam Di Timbulsloko."

groundwater extraction violations, thereby compounding the associated risks.[81] Ultimately, affected communities are compelled to independently and informally navigate the challenges posed by tidal flood. This is particularly problematic given that such issues are regional in nature and thus require comprehensive, systemic interventions across both top-down and grassroots levels, rather than fragmented or partial approaches.

This reality underscores a broader socio-political contradiction. Once again, disparities in wealth and power appear to reverse the logic of risk distribution. Possessing economic capital and political influence affords individuals the privilege of either shielding themselves from risks or minimizing exposure. For instance, those with surplus assets are more likely to relocate to safer areas, while those unaffected often continue to enjoy their secure zones without disruption. In contrast, directly impacted communities lacking assets and power are left with no option but to coexist with perpetual disaster risk—whether by adapting their livelihoods or modifying their living spaces.[82] Thus, it may be argued that coastal communities along the Northern Coast of Java (Northern Coast of Java) that continue to endure tidal flood embody the characteristics of a "risk society".[83]

IV. POLITICAL CONTRADICTIONS IN THE RISK ENQUALITY

Referring to the previous sub-discussion, industrialization is a trigger and plays a significant role in the significance of tidal flooding in the Notern Coast of Java. Therefore, industry is considered a driving force behind the universal damage to the surrounding community. This is certainly a worthy argument. Ulrich Beck even emphasized the need to examine social, political, economic, and cultural contradictions.[84] In this regard, the author sees indications of a bureaucratic oversight function in controlling industrial growth in the Northern Coast of Java. As previously explained, there are 70 industrial areas along the North Coast[85], which then have a domino effect on the development and expansion of settlements[86] and other public facilities[87]. Yet, geomorphologically, it is known that the Northern Coast of Java is an area with alluvial soil that continues to experience consistent sedimentation to this

[81] Boby Rahman, "THE TIDAL FLOODING CAUSES IN THE NORTH COAST OF CENTRAL JAVA."
[82] Beck, *Risk Society*.
[83] Ritzer, *Teori Sosial Postmodern (Terj. Muhammad Taufik)*.
[84] Beck, *Risk Society*.
[85] Liputan6.com, "Degradasi Pantura Jawa Diperkirakan Ancam Keberadaan 70 Kawasan Industri," liputan6.com, January 10, 2024, https://www.liputan6.com/bisnis/read/5502219/degradasi-pantura-jawa-diperkirakan-ancam-keberadaan-70-kawasan-industri.
[86] Utami et al., "The Impact of Tidal Flooding on Decreasing Land Values in the Areas of Tugu District, Semarang City."
[87] Boby Rahman, "THE TIDAL FLOODING CAUSES IN THE NORTH COAST OF CENTRAL JAVA."

day.[88] Therefore, the load of buildings on top significantly influences the formation of depressions and inundation of seawater onto the land.[89] Based on this, beyond the significant economic potential, ecological threats and other latent effects of land exploitation also pose serious risks that must be considered.

In a structural approach, modernization through industrial development and expansion is heavily influenced by political policy. In this context, the government plays a role in monitoring and ensuring environmental impact analysis and the potential risks that arise when an area is developed as an industrial zone. Japan, an industrialized nation, faces geological and geomorphological conditions similar to Indonesia's, namely as an archipelagic and maritime nation. Therefore, they face the dilemma of coastal disasters (tidal floods and tsunamis) and the potential of coastal economies, similar to Indonesia's. This risk even increased after World War II (after 1950), when Japan began developing its coastal economy by converting coastal areas for salt farming. This was compounded by reclamation efforts for industrial and urban development, such as in Tokyo, Nagoya, and Osaka.[90]

At the top-down level, the government created and implemented mitigation policies as a preventative measure, namely by allocating infrastructure development budgets to minimize the impact of tidal wave damage from 1961 to the highest budget allocation in 1995 (0.06% of the national gross domestic product). Even the budget allocation was distributed to the regional level starting in 1950 through a regional subsidy system. In addition, legally in 1956 the Japanese government specifically issued the Coastal Law that established the implementation mechanism for coastal protection projects. In this case, there is a division of duties between the central and regional governments. The central government is responsible for implementing macro-scale mitigation projects that cannot be undertaken by local governments, and covers two-thirds of the total required budget. Meanwhile, local governments, led by the Governor, are tactically responsible for coastal management and cover one-third of the required infrastructure and management budget.[91] In 1999, the Coastal Law was revised to align the principles of ecological protection with safe and comfortable economic utilization (such as tourism, sports, and fisheries). In other words, mitigation policies in this case do not only involve building canal infrastructure to prevent erosion or inundation, but also include ecologically sound preventive measures that also open up space for economic and industrial growth.[92] At the grassroots level, communities are consciously working to minimize the impact of damage that threatens not only the environment but

[88] Syafitri and Rochani, "Analisis Penyebab Banjir Rob Di Kawasan Pesisir Studi Kasus."
[89] Solihuddin et al., "Coastal Inundation and Land Subsidence in North Coast of West Java."
[90] Mikio Ishiwatari, "Resilient Coastal Management In Japan To Reduce Risk & Adapt," *CWR*, January 23, 2024, https://cwrrr.org/opinions/resilient-coastal-management-in-japan-to-reduce-risk-adapt/.
[91] Ishiwatari, "Resilient Coastal Management In Japan To Reduce Risk & Adapt."
[92] Ishiwatari, "Resilient Coastal Management In Japan To Reduce Risk & Adapt."

also living assets. This effort is carried out by planting trees along the coast to stem tidal flooding or storm surges that are about to enter the mainland.[93]

This contradiction actually refers to the Indonesian context, where economic interests appear to be inversely proportional to ecological interests. In other words, the development of industrialization actually disrupts ecological sustainability—a basic human need. Indonesia actually has a series of regulations related to industrial development that still consider the impact on the environment, especially Undang-undang Number 32 of 2009 concerning Environmental Protection and Management.[94] One of these regulations regulates the business licensing mechanism (particularly for industry) by involving an environmental impact analysis, particularly in coastal areas. Recently, the substance of regulations regarding environmental protection has been updated with the emergence of new regulations through Undang-Undang Number 11 of 2020 concerning Cipta Kerja (Economic and Empoyment Law),[95] which was then amended through Peraturan Pemerintah Pengganti Undang-Undang Number 2 of 2022, [96] and refined through the amendment of Peraturan Pemerintah Pengganti Undang-Undang Number 2 of 2022 to Undang-Undang 2 of 2022 (UU No. 6 of 2023). This law addresses spatial utilization and the categorization of business permits based on risk. This law also specifically addresses the utilization of coastal areas and the anticipation of coastal disasters caused by human activities (in this case, industry).

Despite the development of a series of policies based on the coastal economy (blue economy), which emphasizes both coastal well-being and environmental sustainability, their implementation has yet to demonstrate any significant changes that could mitigate the threat of tidal flooding, particularly on the Northern Coast of Java. This indicates political contradictions and has opened the floodgates to risks from unmanaged industrialization that adheres to existing regulations. These indications are particularly visible in the regulations and their implementation regarding spatial planning for industry and the handling of tidal flooding disasters that have occurred in the North Coast of Java.

For a case, Semarang is a city with the highest tidal flooding intensity. Many strategies have been made to localize tidal flood, through Regional Regulation Number 5 of 2025. This policy specifically regulates the 2011-2031 Spatial Planning Plan, particularly regarding the construction of embankments and restrictions on industrial area development.[97] Furthermore, curative efforts to address tidal flooding through the

[93] Ishiwatari, "Resilient Coastal Management In Japan To Reduce Risk & Adapt."
[94] Database Peraturan Perundang-Undangan Indonesia, "UU No. 32 Tahun 2009 Tentang Perlindungan Dan Pengelolaan Lingkungan Hidup," PERATURAN.GO.ID, 2009, https://peraturan.go.id/id/uu-no-32-tahun-2009.
[95] Database Peraturan Perundang-Undangan Indonesia, "UU No. 11 Tahun 2020 Tentang Cipta Kerja," PERATURAN.GO.ID, 2020, https://peraturan.go.id/id/uu-no-11-tahun-2020.
[96] Database Peraturan Perundang-Undangan Indonesia, "PERPPU No. 2 Tahun 2022 Tentang Cipta Kerja," PERATURAN.GO.ID, https://peraturan.go.id/id/perppu-no-2-tahun-2022.
[97] Reno Sakti Wijayanto et al., "Evaluasi Kebijakan Penanganan Rob Di Semarang Utara Tahun 2022-2023," *Journal of Politic and Government Studies* 13, no. 4 (2024): 343–63.

Regional Disaster Management Agency (Badan Penanggulanan Bencana Daerah) have been consistently implemented, but the implementation results have not been optimal, especially in emergency situations, as tidal flooding can occur at any time.[98]

However, despite efforts to address the impact of land subsidence, which causes tidal flood, the counterproductive effect is evident in the continued growth of large-scale industries, particularly along the Northern Coast of Central Java. Evaluations have shown that the dominance of these industries and warehouses is actually causing land subsidence. Of the 38 industries spread across Java's Northern Coast, the region experiencing the most significant decline due to industrial activity is in Batang Regency and Demak.[99]

Overlapping tidal flood management with industrial interests has prolonged the problem. This has led to the centralization of tidal flood management through the Great Giant Sea Wall megaproject, outlined in the National Medium-Term Development Plan, based on Presidential Regulation No. 12 of 2025. The construction Great Giant Sea Wall will begin from the northern coast of Banten Province to East Java, covering approximately 946 km.[100] However, this mega-project is not without risks, because the northern coast of Java has unstable geological characteristics, so it requires not only gray technology but also green technology and blue technology to ensure ecosystem balance. In addition, integrative coastal management is needed, which not only pays attention to risk mapping but also the function of the area and the involvement and consolidation of all stakeholders. If not carried out with this commitment, what will actually occur is the risk of massive environmental damage which will then directly impact the economic and social lives of the surrounding coastal communities.[101]

V. CONCLUSION

The tidal flooding along Java's Northern Coast reveals a fundamental pattern of unequal exposure, where vulnerability to environmental hazards maps directly onto existing social hierarchies. While industrial developments—such as manufacturing zones, real estate projects, and public infrastructure—generate economic benefits for elite actors and contribute to regional growth narratives, the environmental costs are externalized onto coastal communities, which lack the necessary political and economic capital to resist. These findings contrast with the claim that disasters in coastal areas are caused

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[98] Wijayanto et al., "Evaluasi Kebijakan Penanganan Rob Di Semarang Utara Tahun 2022-2023."

[99] Syachril W Mispaki et al., "Utilization of SAR Data to Evaluate Industrial Locations on the North Coast of Central Java," *IOP Conference Series: Earth and Environmental Science* 1418, no. 1 (2024): 012053, https://doi.org/10.1088/1755-1315/1418/1/012053.

[100] Tempo.co, "Bagaimana Kelanjutan Proyek Giant Sea Wall Setelah Masuk Daftar PSN? | tempo.co," Tempo, March 12, 2025, https://www.tempo.co/ekonomi/bagaimana-kelanjutan-proyek-giant-sea-wall-setelah-masuk-daftar-psn--1218639.

[101] ipb.ac.id, "Tanggapi Giant Sea Wall, Guru Besar IPB University: Antara Harapan Perlindungan Pesisir dan Tantangan Ekologis," *IPB University*, July 14, 2025, https://www.ipb.ac.id/news/index/2025/07/tanggapi-giant-sea-wall-guru-besar-ipb-university-antara-harapan-perlindungan-pesisir-dan-tantangan-ekologis/.

by environmental shifts. Instead, there is a connection that intertwines and locates human activities, mostly through the overexploitation of natural resources resulting from industrialization, which is an essential reality.

As a result, grassroots populations face the immediate, embodied consequences of rising tides: submerged homes, contaminated water sources, destroyed livelihoods, and forced displacement. This asymmetry in who benefits from development and who bears its environmental costs exemplifies how risk inequality is not an accidental by product but a structural feature of coastal development patterns that privilege capital accumulation over environmental justice. The politics underlying this risk inequality operate through multiple mechanisms of exclusion and marginalization. Lower socio-economic communities shoulder not only the environmental degradation itself but also the entire financial and social burden of adaptation: self-funded relocation without compensation, continuous home rehabilitation from personal savings, and occupational displacement that forces families into economic precarity.

Meanwhile, the industrial actors and government agencies whose decisions precipitated these conditions remain insulated from accountability. This distribution of risk and responsibility reflects deeper power asymmetries where coastal development policies prioritize economic growth and elite interests while rendering grassroots communities invisible in planning processes. The absence of adequate state protection, compensation mechanisms, or participatory governance structures reveals how political marginalization translates directly into heightened physical vulnerability. Addressing this crisis demands urgent government intervention that recognizes tidal flood risk as fundamentally a political problem, requiring structural solutions, not merely a technical challenge that can be addressed through engineering fixes. Without such interventions, the gap between those who profit from coastal development and those who suffer its consequences will continue to widen, transforming tidal flooding from a natural hazard into an ongoing regime of state-sanctioned environmental injustice. The government's failure to act is not merely administrative neglect, but a deliberate political choice that perpetuates structural inequality.

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