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Public Policy Analysis of Riverbank Management in Jember Regency: Integrating Fishbone Analysis and Administrative Operability

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A B S T R A C T

This study aims to identify the primary causes of riparian buffer zone violations and formulate viable policy options for managing river setbacks in Jember Regency through a public policy analysis approach. The research addresses the limited studies that integrate root-cause analysis with assessments of local administrative feasibility. Using a qualitative method based on secondary data, this study examines 30 journal articles from 2020 to 2025 obtained through a systematic literature review and 43 online news articles published from 2024 to 2026. Data were analyzed using NVivo 12 Plus through coding, matrix analysis, and word clouds. Root-cause analysis was conducted using a fishbone diagram, while policy alternatives were evaluated through an administrative operability framework. The findings show that riverbank encroachment in Jember is driven by systemic and multidimensional factors, including regulatory inconsistencies, weak law enforcement, land-use planning problems, infrastructure limitations, and hydrological pressures. The study contributes to public policy analysis by linking diagnosis of interacting governance failures with a structured assessment of administrative feasibility, thereby connecting problem diagnosis with policy design. The Single Spatial Data Policy (SSDP) is identified as a feasible preventive option, while Risk-Based Licensing Reform serves as a complementary strategy to strengthen compliance and reduce violations. Because the study relies exclusively on secondary data, the findings should be interpreted in light of limitations associated with documentary coverage, media reporting bias, and the absence of direct stakeholder perspectives.

INTRODUCTION

Jember Regency is one of the areas facing serious challenges in riverbank management. Several issues have been identified as violations occurring within the riverbank areas in this region. *First*, there is residential development in flood-prone areas (Nawawi, 2026). In practice, numerous developers construct housing projects within riparian zones and undertake soil excavation directly along riverbanks, a practice that may technically reduce the width of the river channel(Silvia & Gonsaga, 2026a). In fact, according to Ministry of Public Works and Public Housing Regulation No. 28/PRT/M/2015, the establishment of river buffer zones is intended to protect rivers from human activities that could disrupt and damage river water quality, the physical condition of riverbanks and riverbeds, and ensure the safety of river flow. (Amin et al., 2025; Endarwati, Widodo, et al., 2021; Pasaribu et al., 2022)(Adam et al., 2025)(Siregar et al., 2021)Riparian Buffer Zone; Fishbone Analysis; Single Spatial Data Policy; Administrative Operability; Environmental Governance.

(Mahrus, 2025a; Silvia & Gonsaga, 2026a)Riverbank management in Indonesia is increasingly revealing the complexity of issues that extend beyond environmental concerns to encompass spatial planning, regulatory compliance, and regional development dynamics (Amin et al., 2025; Endarwati, Widodo, et al., 2021; Pasaribu et al., 2022). Riverbanks, as protected areas, play a strategic role in maintaining ecosystem balance, preventing flooding and erosion, and preventing a decline in water quality (Adam et al., 2025). However, in practice, riverbank areas are often under pressure due to uncontrolled land use, inadequate oversight, and a lack of firmness in implementing established policies (Siregar et al., 2021). These conditions are better understood as an environmental governance problem in which policy implementation, institutional fragmentation, spatial planning, and stakeholder interests interact rather than as isolated instances of legal non-compliance.

Secondly, there are still many areas where operational river boundaries have not yet been established (Alwajdi & Spaltani, 2023). Meanwhile, the spatial planning policies set forth in Jember Regency Regulation No. 1 of 2015 provide only a general framework. This has sparked resistance from the local community, who question the legal basis for the establishment of property boundaries, the status of the Certificates of Ownership (SHM) and Building Permits (IMB) that have been issued, and the lack of a constitutional compensation mechanism.

This issue becomes even more fundamental when examined in light of regulatory obligations that the government itself has never fulfilled. Minister of Public Works and Public Housing Regulation No. 28/PRT/M/2015 explicitly requires local governments to establish operational river boundaries through local regulations or decisions by the head of the local government. However, to date, such a designation has never been made in Jember Regency. The absence of such operational regulations has fundamental legal implications: the state cannot require citizens to comply with boundaries that have never been established, implemented, or officially announced to the public. Furthermore, this lack of designation also indirectly creates a loophole for the issuance of building permits (IMB) and certificates in areas that should be protected, as the permitting authorities lack sufficiently clear legal instruments to serve as a basis for refusal. This situation underscores that the root of the problem lies not solely in the behavior of the public or developers, but rather in the state's failure to fulfill its own regulatory obligations before demanding compliance from other parties

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This issue is compounded by the fact that river channels are geomorphologically dynamic. Processes such as lateral erosion, sediment deposition, meander migration, and avulsion can shift the position of riverbanks over time, meaning that the physical boundaries of riverbanks, which are assumed to be static in regulations, actually change naturally. This dynamic demonstrates that rivers cannot be understood as static lines, but rather as landscape systems that are constantly changing due to geomorphological and hydrological processes, changes in land cover, and anthropogenic pressures (Belenok et al., 2021; Ielpi & Lapôtre, 2020; Kreibich et al., 2022).

The historical dimension of riverbank land tenure must be recognized as a distinct structural factor that compounds the complexity of this issue. Most of the land currently classified as riverbank areas in Jember Regency has been held by local communities in good faith for generations, even long before modern riverbank regulations were enacted. Such tenure has been granted strong legal protection — The case law of the Supreme Court of the Republic of Indonesia has consistently protected rights holders who acquired land in good faith (Supreme Court Case No. 1261 K/Pdt/1984), while Article 32(2) of Government Regulation No. 24 of 1997 stipulates that a Certificate of Ownership (SHM) that has been issued for more than five years and was acquired in good faith can no longer be challenged or unilaterally annulled.

The fact that the communities whose land is within the buffer zone have not yet received compensation or land acquisition payments exacerbates this problem. The community's land rights are legally vested and cannot be lowered by administrative discretion alone in the absence of a constitutional land acquisition process as outlined in Law No. 2 of 2012. The public resistance that has emerged as a result is not merely a failure to comply with regulations, but a response that is legally justifiable. Sediment dynamics and changes in river morphology can also affect flow capacity, flood exposure, and safe limits for land use around rivers; therefore, the establishment of river buffer zones should ideally be based on up-to-date hydrological and geomorphological data, spatial imagery, and flood risk mapping, rather than solely on static administrative boundaries (Rentschler et al., 2022a; Tabari, 2020a; Tellman et al., 2021a).

This issue means that various riverbank management policies in Jember Regency are often faced with a dilemma between environmental, social, and economic interests. In fact, the narrowing of river channels due to the encroachment of buildings on riverbanks can be one of the main causes of flooding (Noviani et al., 202). Ultimately, this issue undermines the vital role of riparian zones in preserving the environment, particularly in preventing flooding, erosion, and water quality degradation (Adam et al., 2025).Previously, numerous studies on river boundaries have been conducted, ranging from legal analyses (Djibran & Susilowati, 2020; Noviani et al., 2025; Za et al., 2025) to policy studies (Firdaus et al., 2021; Jesica & Cristiana, 2023; Wahyuningsih et al., 2022). In addition, a literature review using VosViewer on Scopus-indexed publications with the keyword "riparian buffer zone" from 2020 to 2025 shows that research on riparian buffers is dominated by several main clusters, namely the relationship between riparian buffer zones and water quality, nitrogen, surface runoff, and land use.

Based on the analysis, there is a strong correlation with ecological aspects such as vegetation, biodiversity, and stream conditions. This indicates that most previous studies have

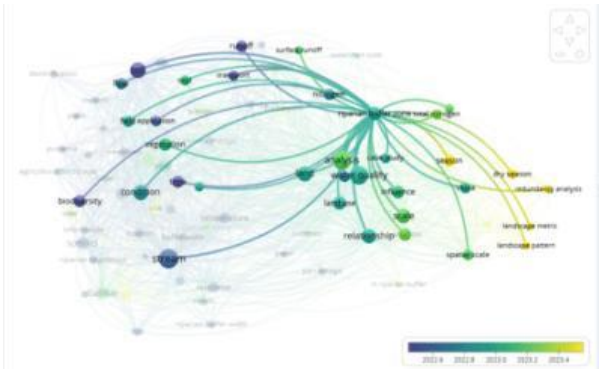

Figure 1. Bibliometric Visualization of Key Themes in Riparian Buffer Zone
Source: VOSviewer analysis of Scopus-indexed articles, 2020–2025)

focused on the ecological and hydrological functions of riparian buffers (Majumdar & Avishek, 2025a; Mwasenga & Mjemah, 2023a; Paarlberg, Sena, Huu, et al., 2025).By integrating public policy analysis with root-cause analysis in the context of riverbank management, this study presents a fresh research approach based on previous literature evaluations. The topic of riverbanks in Jember is dominated by narratives about flooding and rivers, according to a word cloud analysis of news coverage by Kompas Surabaya, Ngopibareng, and Tribun Jatim.

Figure 2. Word Cloud Berita Sempadan Jember
Source: Word Cloud Analysis by Nvivo 12 Plus, 2024-2026)

This reflects a media framing that tends to be reactionary rather than preventive. The coverage also focused on specific affected locations and highlighted the government's role as the primary actor in the response, while aspects of regulation, oversight, and law enforcement were discussed only minimally. Although there are indications that human activities such as settlement and development contribute to the problem, the discussion has not addressed the structural root causes, so the media tends to focus more on the impacts than on prevention and sustainable management.

These findings underscore the novelty of both studies, namely the local context of Jember Regency—which has never been comprehensively examined in terms of riverbank management—where the absence of operationally defined riverbanks in many areas, coupled with increasing pressure from housing development in flood-prone zones, creates a unique policy gap that has not yet been documented academically. From a public policy perspective, the case of Jember Regency is representative of what is known as a wicked problem (Dunn,

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2003) namely policy issues that have no single correct solution, involve many stakeholders with conflicting interests, and where any attempt at a resolution has the potential to create new problems.

The literature therefore suggests a clear conceptual gap. Existing studies provide substantial evidence on the ecological and hydrological functions of riparian buffers and, to a lesser extent, on legal and institutional implementation. However, fewer studies explain how fragmented institutional arrangements, regulatory ambiguity, weak implementation capacity, and environmental pressures interact to generate persistent riverbank encroachment at the local level. The bibliometric and word-cloud analyses used in this study are not treated as findings in themselves; rather, they are used to identify the dominant ecological and flood-related themes and the relative underrepresentation of integrated governance analysis. This gap provides the rationale for combining NVivo-based thematic coding and Fishbone Analysis to diagnose interacting causes, followed by Administrative Operability to connect those causes with implementable policy alternatives.

These findings underscore the novelty of the study in the local context of Jember Regency, where riverbank management has not been comprehensively examined through an integrated public policy lens. The contribution is not that Fishbone Analysis or Administrative Operability is a new method in itself, but that their sequential use creates an analytical bridge between diagnosing interacting governance failures and examining the administrative conditions under which policy alternatives can be implemented. In this sense, the study extends public policy analysis by treating riverbank encroachment as a policy implementation and institutional coordination problem embedded within a socio-ecological system, rather than solely as an environmental or legal problem.

1. What are the causes of riverbank encroachment in Jember Regency, as viewed through the lens of the gap between the regulatory framework for riverbank protection and policy implementation practices at the local level?
2. What policy alternatives can be implemented for riverbank management in Jember Regency based on an administrative operability approach??

Therefore, this study aims to fill that gap through a context-based analysis that can serve as the basis for policy recommendations, while contributing not only to the advancement of scientific knowledge but also to environmental governance practices at the district level. More specifically, the study demonstrates how a root-cause diagnosis can be translated into a structured policy feasibility assessment, offering an analytical framework that can be adapted to other districts facing comparable riverbank governance problems.

METHOD

This study employs a qualitative approach using secondary data to gain an in-depth understanding of flood issues and riverbank management, particularly in the context of public policy and the dynamics of land use (Creswell & Creswell, 2018; Yin, 2018). The data used in this study were drawn from two main sources. First, scientific data in the form of 30 journal articles obtained through a systematic literature review (SLR) and selected based on their relevance to the study's topic, specifically regarding riparian buffer zones and riverbanks, published between 2020 and 2025. Second, data in the form of online news articles reflecting the actual conditions on the ground, consisting of 14 articles from the Surabaya edition of Kompas, 19 articles from Tribun Jatim, and 10 articles from Ngopibareng.id, collected from 2024 to 2026. The use of this news data aims to strengthen contextual analysis regarding flood issues and riverbank encroachment in Jember Regency.

(Hai-Jew, 2020)(American Society for Quality, 2023)(Patton et al., 2015)This study employs a qualitative approach using secondary data to gain an in-depth understanding of flood issues and riverbank management, particularly in the context of public policy and the dynamics of land use (Creswell & Creswell, 2018; Yin, 2018). The data used in this study were drawn from two main sources. First, scientific data in the form of 30 journal articles obtained through a systematic literature review (SLR), selected for their relevance to riparian buffer zones, riverbank management, flood governance, and policy implementation, and published between 2020 and 2025. The literature search was conducted using Scopus-indexed publications and the keyword combination centered on "riparian buffer zone", followed by title/abstract screening, removal of duplicates, and relevance screening against the study objectives. Articles were retained when they substantively addressed ecological, spatial, governance, legal, or policy dimensions of riparian management. Second, contextual data consisted of 43 online news articles—14 from the Surabaya edition of Kompas, 19 from Tribun Jatim, and 10 from Ngopibareng.id—collected from 2024 to 2026. These sources were selected because they provided contemporaneous reporting on riverbank development, flooding, government responses, and local disputes in Jember Regency. News reports were treated as contextual documentary evidence rather than as equivalent to peer-reviewed scientific evidence, and their claims were compared across outlets and, where possible, against regulatory or institutional information.

Data collection and analysis were conducted using NVivo 12 Plus software. The scientific literature and news documents were imported separately and coded through a combination of deductive and inductive strategies. Initial nodes were derived from the research questions and relevant public policy concepts—regulation and permitting, institutional coordination, enforcement, spatial planning, infrastructure, hydrology, and stakeholder factors—while additional nodes were developed when recurrent issues emerged from the documents. Matrix coding and word-cloud functions were then used to examine the frequency and co-occurrence of themes. Analytical consistency was maintained through iterative review of coded passages and comparison of related documents. The coded themes were subsequently synthesized into five major causal categories for the Fishbone (Ishikawa) analysis. The Fishbone stage did not treat the categories as independent variables; instead, it was used to map the causal links among institutional, regulatory, spatial, infrastructural, and hydrological conditions. The outputs of the Fishbone analysis then informed the formulation of policy alternatives. These alternatives were evaluated using Administrative Operability across four dimensions: (1) technical and administrative feasibility, (2) human-resource and institutional capacity, (3) clarity of legal authority, and (4) political and social acceptability. Each alternative was assessed qualitatively against the same criteria using evidence from the literature, regulatory framework, and contextual data. The sequence was therefore: data collection → documentary screening → NVivo coding and thematic synthesis → Fishbone diagnosis → formulation of policy alternatives → Administrative Operability assessment → policy recommendation. Because the study relies exclusively on secondary data, it is subject to

limitations arising from incomplete documentary coverage, publication and media-selection bias, and the absence of direct stakeholder perspectives.

RESULTS AND DISCUSSION

The analysis first identifies the empirical pattern of riverbank encroachment and then uses the regulatory framework to interpret why the pattern persists. This ordering is important because the regulations are treated as explanatory context rather than as the principal finding. Across the documentary corpus, the evidence points to a recurring implementation gap in which spatial rules, land administration, permitting, enforcement, and flood-risk management are not consistently integrated.

Riparian buffer zones are ecological and hydrological protection zones that play a critical role in maintaining slope stability, filtering sediment, and providing flood storage space when river flow increases(Haidar & Rozak, 2024; Paarlberg, Sena, Huu, et al., 2025). Recognition of this strategic role is reflected in the national regulatory framework, where the procedures for drafting and issuing substantive approvals for Regional Spatial Plans are governed by Ministerial Regulation of the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency No. 11 of 2021. The regulatory framework for riverbank protection in Indonesia is actually quite comprehensive. Government Regulation No. 38 of 2011 on rivers establishes minimum buffer zones ranging from 10 m to 100 m, depending on the width of the river and the type of area (Firdaus et al., 2021). However, although this regulatory framework is in place, not all regions implement it consistently. One example that illustrates the gap between regulations and on-the-ground practices regarding river buffer zone regulations can be found in Jember Regency, East Java.

These violations are evident in the proliferation of housing developments that encroach on river boundaries. Based on various information gathered from news platforms, 54 housing developments are located near riverbanks, 13 of which are situated directly on the riverbanks, and at least two housing projects (Villa Indah and Devanka Land) were built less than 2 meters from the river's edge—far below the minimum standard set by regulations (Nawawi, 2026; Silvia & Gonsaga, 2026a). This issue is not confined to a single location but is widespread across various subdistricts in Jember Regency, as shown in the following map.

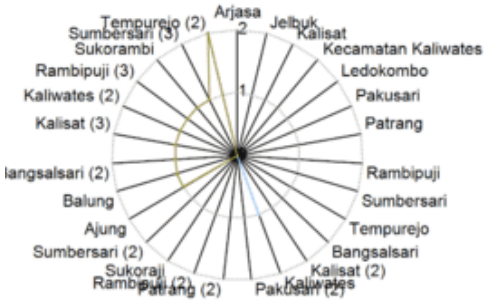

Figure 4. Matriks Coding Kecamatan Terdampak
Source: Processed by matriks coding Nvivo 12 Plus

From a regulatory perspective, these field findings indicate alleged violations of several legal instruments governing river buffers in Jember Regency. Government Regulation No. 38 of 2011 on Rivers establishes a minimum riverbank buffer zone of 10–100 meters and prohibits the construction of buildings in that area; however, in practice, buildings were found standing only about 2 meters from the river. This regulation should not be understood in isolation. Minister of Public Works and Public Housing Regulation No. 28 of 2015 further regulates riparian zoning based on river width and restricts the issuance of building permits within these protected zones. However, in practice, technical recommendations are often misconstrued as comprehensive authorization to construct buildings, thereby creating ambiguity in the implementation of riparian setback regulations.

Furthermore, from a spatial planning perspective, Law No. 26 of 2007 on Spatial Planning stipulates that riverbank are protected areas that must be reflected in the Regional Spatial Plan (RTRW); however, the 2015 Jember RTRW is considered insufficiently effective in preventing violations. In addition, Law No. 17 of 2019 on Water Resources prohibits activities that disrupt the function of rivers and riverbanks, but the practice of filling in riverbanks for the purpose of land certification continues to occur, thereby violating these provisions (jtvjember, 2026). Overall, this situation indicates a discrepancy between regulations and their implementation regarding riverbank regulations in Jember Regency.

A synthesis of the regulatory framework and empirical conditions indicates that the riverbank crisis in Jember Regency is not merely a technical failure, but rather a discrepancy between legal norms (das Sollen) and on-the-ground realities (das Sein). Although regulations have established strict setback limits, settlements are still found in high-risk zones—even less than 2 meters from the river—which reflects weak oversight and potential administrative irregularities in the permitting process. The impacts are not only material in nature but also contribute to ecological vulnerability and recurring floods. Therefore, a policy restructuring is needed that emphasizes law enforcement, development control, and the strengthening of the implementation of the Regional Spatial Plan (RTRW) to restore the function of riverbanks as protected areas.

Fishbone Analysis: Root Causes of River Bank Encroachment in Jember Regency

(Kusuma et al., 2024)The root causes of river boundary violations in Jember Regency are multidimensional and can be categorized into five interrelated main causes. An analysis using a fishbone diagram identified that each category has its own sub-factors that collectively contribute to the ultimate outcome of recurring floods, resulting in infrastructure, social, and economic damage. Importantly, the five categories should not be read as separate causes operating independently. The evidence indicates a reinforcing chain: regulatory ambiguity weakens preventive controls; fragmented authority makes monitoring and enforcement less consistent; spatial planning and watershed changes increase exposure; inadequate infrastructure reduces the capacity to absorb or convey floodwater; and hydrological pressures activate these accumulated vulnerabilities. The following figure is the result of an analysis of the factors contributing to riverbank encroachment in Jember Regency, illustrated using a fishbone diagram.

Causes of Regulatory Implementation Failures

Failure to interpret regulations correctly is the primary and most fundamental factor behind riverbank encroachments in Jember Regency. The Jember Regency government itself acknowledges the existence of systemic anomalies, whereby

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riverbanks can be designated as residential areas and simultaneously issued with land titles (Nawawi, 2025b, 2025c). This anomaly can be partly attributed to the fact that not all rivers and their riparian buffer zones have been formally integrated into spatial planning documents. In some cases, these areas have not yet been officially designated by the competent authorities, resulting in the absence of strong preventive mechanisms to restrict their utilization from the outset. The analysis identified three critical sub-factors. *First*, ambiguity regarding technical recommendations and full building permits, whereby technical recommendation letters issued by the relevant agency are misinterpreted or intentionally claimed by developers to be full building permits (IMB) (Silvia & Gonsaga, 2026a).

In fact, under Indonesia's agrarian legal system, land title certificates—particularly Certificates of Ownership (SHM)—are legal instruments that prove a person's or legal entity's lawful possession of a parcel of land. Article 19(2)(c) of Law No. 5 of 1960 on the Basic Provisions of Agrarian Law (UUPA) states that land registration aims to provide a document of title that serves as strong evidence. The probative value of a certificate is reinforced by Article 32(2) of Government Regulation No. 24 of 1997 on Land Registration, which provides that a party who feels aggrieved by the issuance of a certificate may no longer file an objection if five (5) years have elapsed since the issuance and the certificate holder acquired the land in good faith. This legal fiction of acquisitive title provides stability and certainty to the national land tenure system. If a Certificate of Ownership (SHM) has been in effect for more than two decades—as is the case for some residents in the riverbank areas of Jember—then that right has undergone legal purification and cannot be unilaterally revoked without a valid legal process.

The land administration system and the spatial planning permitting system have distinct spheres of authority, and it is this separation that often serves as the structural root cause of gaps in riverbank oversight. Government Regulation No. 16 of 2004 on Land Management distinguishes three distinct concepts that are often conflated in practice: land tenure, land use, and land utilization. Land tenure refers to the legal relationship between an individual or legal entity and the land, as regulated by the Basic Agrarian Law (UUPA)—this is the domain of land administration, evidenced by the issuance of land title certificates. The use and utilization of the land must comply with the Regional Spatial Plan, and this is entirely the responsibility of the local government through the mechanisms of building permits (IMB) and spatial planning permits. Thus, land title certificates—including SHM certificates—merely prove ownership; they do not constitute a permit for use or exploitation.

Government Regulation No. 16 of 2004 also stipulates that the adoption of a Regional Spatial Plan does not affect the legal status of existing land rights—meaning that a change in land-use designation does not automatically nullify rights that have been legally established. If a structure is subsequently found to be located within a buffer zone based on a Certificate of Ownership (SHM) and a Building Permit (IMB) officially issued by a government agency, then the failure to verify the compatibility of the location with the zone's designated use is the responsibility of the land-use permitting system, not the land administration system.

Second, the lack of formal coordination mechanisms across sectors creates a vacuum of responsibility that hinders cooperation, as there is no clear framework for how spatial planning should be integrated with disaster management or climate change adaptation (Clegg et al., 2023). This situation is reflected in the fundamental difference between the verification conducted during the certificate issuance process—which pertains to proving control and ownership of the land—and the verification of land-use compliance, which falls under the purview of the spatial planning permitting system. The two operate under different legal frameworks; therefore, the issuance of a certificate for a parcel of land does not in itself mean that the use and development of that land have been approved in terms of land-use planning and the area's designated function. On the other hand, the National Land Agency (BPN) lacks the institutional authority to adjudicate violations of land-use boundaries, resulting in a gap in cross-sectoral oversight (Rusdi & Rosidi, 2025).Fragmented inter-agency coordination, differences in problem framing, and a tendency to operate in sectoral silos are structural barriers that have been consistently identified in studies of disaster governance in Indonesia (Dwirahmadi et al., 2023).

Third, the disregard for the approved site plan and the alteration of the building layout, resulting in a violation of property lines. The lack of ongoing on-site monitoring mechanisms following the issuance of the permit is at the root of this problem (Rusdi & Rosidi, 2025). Thus, the failure to implement regulations not only reflects weak coordination and synchronization among agencies, but also creates structural loopholes that various parties exploit opportunistically. This situation ultimately reinforces systematic and recurring violations and increases the potential for jurisdictional conflicts across sectors.

Supervision and Law Enforcement

The lack of firm oversight and law enforcement is a factor that systematically perpetuates impunity for river boundary violations and exacerbates the degradation of protected areas in Jember Regency. The successful implementation of spatial planning regulations is fundamentally determined by three factors: adequate monitoring capacity, deterministic sanction mechanisms, and effective interagency coordination (Innes, 1996). *First*, weak capacity for identification and follow-up oversight. The Jember Regency Government's Infrastructure and Spatial Planning Task Force has identified 104 residential areas that may be violating riverbank regulations—a primary cause of flooding—13 of which have entered the in-depth identification phase as suspected violations (Mahrus, 2025b). Nevertheless, these findings have not yet led to decisive enforcement actions. A joint inspection by Commission C and Commission B of the Jember Regional People's Representative Council at the Devanka Land Housing Complex revealed not only construction non-compliance but also failures in disaster mitigation; however, these findings will only be addressed through meetings with the relevant parties (Mahrus, 2025b).This highlights the gap between legislative oversight and executive capacity—a pattern consistently identified in studies of urban flood management in Indonesia (Savirani et al., 2024a).

Second, the penalty of license revocation has not yet been enforced. The threat of license revocation issued by the Regional People's Representative Council (DPRD) and the Infrastructure and Spatial Planning Task Force has not been carried out in the documented cases, thereby reducing the deterrent effect on other developers. Setiadi et al., (2023) indicates that illegal construction and land conversion are major challenges that

consistently hinder the implementation of regulations, even when local government planning documents have provided for such controls.

Third, permits were issued without adequate on-site verification; these permits have been in effect since 2000 (Silvia & Gonsaga, 2026b) indicates that on-site verification of compliance with setback regulations is not a standard procedure in the permitting process. This situation indicates weak administrative oversight during the pre-construction phase, meaning that potential violations were already present from the outset, even before construction began. Furthermore, the lack of on-site verification increases the risk of discrepancies between permit documents and actual conditions on the ground, which ultimately complicates the monitoring and enforcement processes in subsequent stages. A comparative study of cities in Indonesia confirms that the success or failure of flood management is fundamentally linked to variations in local governments' law enforcement capacity and their willingness to enforce the regulations they themselves have established (Savirani et al., 2024b).

Land Use Planning and Damage to Watersheds

Changes in land cover at the watershed scale are a macro-level factor that systematically increases vulnerability to flooding. Urbanization in the upper reaches of a watershed significantly alters land cover characteristics and increases surface runoff, which directly contributes to an increased risk of flooding in downstream areas (Sejati et al., 2025). Land-use change in the upper reaches of the Bedadung River basin and its tributaries (Jompo, Mayang, Dinoyo) (Nawawi, 2025a) increases surface runoff and the peak flow coefficient, which ultimately increases hydrological pressure on downstream riverbanks (Sejati et al., 2025).

Changes in land use and land cover in the upstream areas of the watershed have fundamentally altered the characteristics of the drainage system, affecting surface runoff and soil infiltration capacity—one of the primary causes of flooding (Sugianto et al., 2022). Consistent with the findings of Mirza et al., (2023) regarding the mapping of erosion hazard indices in the Bedadung Watershed, this ongoing hydrological stress reduces the river's flow capacity. As a result, flooding can now occur at lower discharge thresholds than in previous periods because the river's capacity has been eroded by sediment accumulation and sudden water loads. This situation underscores that the filling of riverbanks by developers in Jember not only violates regulations but also, from a hydrological perspective, accelerates sedimentation, narrows the river's hydraulic cross-section, and reduces its flow capacity, resulting in flooding at lower discharge levels than before.

The geomorphological dynamics of rivers add a unique layer of complexity to the issue of boundary demarcation, particularly from the perspective of agrarian law. A river's physical boundary is not a static line—processes such as lateral erosion, sediment deposition, meander migration, and avulsion naturally shift the position of the riverbank over time (Belenok et al., 2021; Ielpi & Lapôtre, 2020). The implications for land tenure are substantial. Land that was located outside the river boundary when the certificate was issued may subsequently be classified as part of the riverbank area due solely to the natural shifting of the river's course, rather than any action or violation committed by the rights holder. Static boundary definitions in regulations cannot fairly accommodate this dynamic reality. Assessments of boundary compliance or violations must therefore not rely solely on existing physical conditions, but must also take into account the condition of the river channel at the time the right was first granted, as well as the geomorphological processes that have occurred since then. The failure of regulations to account for these dynamic temporal and spatial dimensions further reinforces the conclusion that the issue of riverbank boundaries in Jember Regency is fundamentally a failure of policy design, not merely a matter of violations by residents or developers.

Inadequate Infrastructure

The inability of infrastructure to handle flood discharge is a factor that exacerbates the impact of encroachment on riverbanks. Flooding in urban areas of Indonesia is generally driven by a combination of interrelated factors, including extreme rainfall, changes in land cover, sedimentation that reduces river capacity, and failures in flood control infrastructure (Wulandari et al., 2025). This vulnerability is further exacerbated by unplanned urbanization, changes in land use, inadequate drainage systems, and ineffective water management practices (Wulandari et al., 2025). On the other hand, ongoing urbanization, climate change, the loss of urban green spaces, and the deterioration of urban water management infrastructure are further increasing the risk of flooding in densely populated residential areas (Singh et al., 2021a). Furthermore, research conducted by Asmaranto et al., (2026) indicates that drainage failure is not a localized issue but rather a widespread one, with sedimentation, channel narrowing, and poor maintenance being the dominant factors causing flooding even when the channel dimensions appear adequate by design.

Hard engineering has proven unable to fully replace the ecological functions of natural riparian zones. The collapse of retaining walls and damage to slope protection infrastructure at various points along the Bedadung River(Silvia & Gonsaga, 2026c). This demonstrates that hard engineering cannot replace the ecological functions of natural riparian zones. If riparian areas along tributaries are altered through the removal of forest cover or the construction of buildings, the cumulative impact—in the form of increased flow volume and velocity into the main river—will proportionally worsen flood conditions for downstream communities. In addition, the bridge's insufficient height creates a backwater effect and accelerates the overflow of water into surrounding residential areas—a technical issue identified as one of the main causes of localized flooding in densely populated areas (Yosua et al., 2024).

Hydrology and Extreme Weather

Hydrological and weather factors act as triggers that activate the entire chain of vulnerabilities established by the five preceding factors. Without boundary violations, a healthy watershed is capable of significantly reducing the impact of extreme rainfall through its integrated ecological functions. Nugroho, (2025) findings confirm that extreme weather is merely an initial trigger; its destructive impact is greatly exacerbated by the weakening of natural defenses in the upstream areas of the watershed. Ecologically sound watersheds have been shown to significantly mitigate the impacts of extreme rainfall. In undisturbed soil conditions, up to 55% of rainfall can infiltrate the ground, resulting in only 10–20% becoming surface runoff (Nugroho, 2025). Furthermore, the BMKG's early warnings about extreme weather are not sufficient as the sole form of mitigation if structural vulnerabilities—such as the loss of buffer

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zones—are not addressed. Climate projections confirm that extreme rainfall events in Indonesia will continue to increase throughout the 21st century, with variations across seasons and regions, making adaptation and mitigation increasingly urgent, particularly for developing countries that are more vulnerable to climate-related disasters (Kurniadi et al., 2024).

Human activities in watershed areas—both upstream and downstream—are a trigger for flooding that is no less significant than natural factors such as hydrology, meteorology, and climate. Poor management of upstream watersheds exacerbates the impact of rainfall, even when it is not classified as extreme (Kurniadi et al., 2024). Research conducted by Lubis et al. (2024) demonstrates that the loss and degradation of tropical forests in watershed areas disrupt essential ecosystem services that regulate water flow, leading to severe flooding that impacts agricultural productivity and contributes to poverty among downstream communities. This study highlights the need to safeguard remaining forest areas while also promoting restoration strategies to maintain high levels of tree cover within critical watersheds.

Poor management of upstream watersheds exacerbates the impacts of rainfall that is not even considered extreme, because in degraded watersheds, increased river flooding, urban (pluvial) flooding, and coastal flooding can occur simultaneously, indicating that unmanaged land-use changes and urbanization are dominant factors that increase exposure and vulnerability to disasters (Hendrawan et al., 2025). The results of this analysis confirm that river boundary violations in Jember Regency are not isolated, incidental occurrences, but rather a systemic failure that is multidimensional and multi-layered. An analysis of the five contributing factors—regulation and permitting, oversight and law enforcement, land use planning and watershed degradation, inadequate infrastructure, and hydrology and extreme weather—revealed that these factors do not operate in isolation but rather reinforce one another, forming a chain of vulnerabilities that ultimately manifests as recurring floods.

Taken together, these relationships indicate a governance feedback loop rather than a simple cause-and-effect sequence. Weakly defined boundaries and fragmented data reduce the precision of spatial control; weak control allows continued land-use pressure; increasing development and watershed degradation then heighten flood exposure; and recurring floods generate pressure for downstream responses without necessarily resolving the upstream institutional causes. This systems interpretation explains why isolated enforcement measures are unlikely to address the problem sustainably.

The findings of this study indicate that the root of the problem lies in institutional failures at the policy design level, resulting in a gap between regulations and the implementation of riverbank policies. The ambiguity between technical recommendations and full building permits, the lack of clearly defined river boundaries that have not been fully incorporated into spatial plans, and the disregard for approved site plans reflect structural loopholes that are consistently exploited by opportunistic actors (particularly developers) to convert protected areas into commercial land.

Therefore, this situation underscores the urgent need to formulate public policy alternatives that are both integrative and preventive. Ad-hoc approaches that rely solely on downstream law enforcement have proven inadequate to address the complexity of issues rooted in gaps in policy design and the absence of operational boundaries at the upstream level of regulation. Policy reforms should focus on synchronizing spatial data across agencies (a single data policy for spatial planning) and strengthening oversight functions that have full authority to automatically revoke permits if inconsistencies with land-use plans are identified at an early stage. Without policy reforms that address bureaucratic gaps and prioritize the sustainability of river ecosystems over commercial interests, flood vulnerability will continue to rise and could lead to far greater social and economic costs in the future.

Public Policy Alternatives for Riverbank Management in Jember Regency: An Administrative Operability Approach

To ensure that the ensuing proposals are both normative and constitutional, it is necessary to first clarify one doctrinal principle before developing policy alternatives. In essence, the creation of river boundaries restricts use rather than eliminating ownership. Ministry of Public Works and Public Housing Regulation No. 28/2015 explicitly recognizes the existence of property rights within the boundary lines. Therefore, the state is not justified in unilaterally taking over the designated use of border areas without going through a lawful and fair land acquisition process. Under Indonesia's agrarian legal framework, restrictions on the designated use of certified land can only be imposed through two constitutional channels: First, the acquisition of land for public purposes with fair compensation, as provided for in Law No. 2 of 2012; or second, legally recognized restrictions on land use without revoking existing ownership rights. The implications of this principle for policy formulation are very concrete: Whichever policy option is selected, it must have procedures for addressing existing constitutional rights rather than just methods for enforcement or unilateral permission revocation, which could actually cause local governments to face new legal challenges.

Next, the identification of policy alternatives was based on a systematic synthesis of 30 articles from reputable journals, which served as the foundation for the analysis of policy alternatives. These articles were selected through a systematic literature review (SLR) using the following criteria: (1) indexed in the Scopus, Web of Science, or Sinta databases; (2) published between 2019 and 2026; (3) substantially relevant to issues of riverbank management, flood governance, risk-based permitting, and institutional capacity; and (4) have a minimum ranking of Q2 (international) or Sinta 2 (national). Based on the article index classification, the majority of the literature used in this study came from reputable Q1 journals, totaling 26 articles, or 86.7% of the total 30 articles. There were 3 Q2 articles, or 10.0%, while there was 1 Sinta 2-indexed national article, or 3.3%. Specifically, the following are the findings of the literature review.

Table 1. Sintesis Literature Review

Study Focus	Related articles	Sintesis Literature Review
Design, width, and effectiveness of riparian buffers	(Arif et al., 2021; Duan et al., 2021; Endarwati, Hari, et al., 2021; Ghimire et al., 2022; H. Han et al., 2025; Kuglerová et al., 2024; Majumdar	These various studies indicate that river buffers cannot be determined solely based on a uniform size. The width of the buffer zone must take into account the river's characteristics, water quality, vegetation,

Study Focus	Related articles	Sintesis Literature Review
	& Avishek, 2025b; Paarlberg, Sena, Loc, et al., 2025; Singh et al., 2021b; Stutter et al., 2021)	slope, land use, and development pressures. Han et al., (2025) found that the optimal buffer width can vary between segments within a single river, while Majumdar & Avishek, (2025) emphasizes the need for an adaptive approach, rather than a one-size-fits-all approach.
Spatial monitoring, GIS, remote sensing, and integrated spatial data	(Atesoglu et al., 2025; Duan et al., 2021; Endarwati, Hari, et al., 2021; Mwasenga & Mjemah, 2023b; Stutter et al., 2021; Tellman et al., 2021b; Zhu et al., 2025)	This study highlights the importance of spatial data for detecting land-use changes, monitoring floods, and assessing the condition of riverbanks. Tellman et al., (2021) uses satellite imagery to map global flood exposure, whereas Stutter et al., (2021) emphasizes that spatial data can be used to delineate riparian management functions and zones.
Governance, institutional coordination, and policy implementation capacity	(Enu et al., 2025; Fenten & Dieperink, 2024; Gwapedza et al., 2026; Mwasenga & Mjemah, 2023b; Novalia et al., 2025; Paarlberg, Sena, Loc, et al., 2025; Singh et al., 2021b)	The literature emphasizes that riverbank issues are not merely technical matters, but also matters of governance. The success of policies depends on interagency coordination, the distribution of authority, operational regulations, monitoring capacity, funding, and stakeholder support. Fenten & Dieperink, (2024) shows that river restoration requires legislation, governance structures, funding, scientific information, and stakeholder support.
Flood risk, climate change, and social vulnerability	(Endarwati, Hari, et al., 2021; Enu et al., 2025; Rentschler et al., 2022b; Serra-Llobet et al., 2022; Tabari, 2020b; Tellman et al., 2021b; Vagheei & Boano, 2025)	These articles show that flooding is influenced by climate change, an increase in extreme rainfall, the expansion of settlements in flood-prone areas, and urbanization. Rentschler et al., (2022) emphasizes that flood risk is also linked to poverty and social vulnerability, so the protection of riverbanks must be viewed as part of both disaster mitigation and the protection of vulnerable groups.
Spatial policies, legal boundaries, and land-use controls	(Endarwati, Hari, et al., 2021; Gwapedza et al., 2026; Q. Han et al., 2022; Majumdar & Avishek, 2025b; Mwasenga & Mjemah, 2023b; Spurlock, 2019; Stutter et al., 2021)	These studies showed that riverbank regulations are often ineffective when they are not accompanied by clear and enforceable spatial boundaries. Han et al., (2022) emphasizes the importance of minimum thresholds, ecological redlines, and coordination with spatial planning. Gwapedza et al., (2026) also indicates that weak spatial thresholds in regulations can open the door to encroachment.
River restoration, floodplains and nature-based solutions	(Davis et al., 2025; Duan et al., 2021; Enu et al., 2025; Paarlberg, Sena, Loc, et al., 2025; Serra-Llobet et al., 2022; Singh et al., 2021b; Vagheei & Boano, 2025; Zingraff-Hamed et al., 2022)	Resolving riverbank issues cannot be achieved only through physical regulation; it must be combined with ecological restoration. The literature advocates for the restoration of riparian vegetation, floodplains and ecological connectivity, as well as nature-based solutions, to reduce flooding whilst improving ecosystem quality. Serra-Llobet et al., (2022) showed that multi-benefit floodplain projects can

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Study Focus	Related articles	Sintesis Literature Review
		reduce flood risk and restore habitats.
Community participation, public perception and stakeholder engagement	(Enu et al., 2025; Gumiero et al., 2025; Mwasenga & Mjemah, 2023b; Novalia et al., 2025; Paarlberg, Sena, Loc, et al., 2025; Singh et al., 2021b; Zingraff-Hamed et al., 2022)	This study shows that riverbank management policies will struggle to succeed if the community is treated merely as the subject of enforcement measures. Risk communication, community engagement, education, technical support and stakeholder collaboration are required. Gumiero et al., (2025) highlights the importance of citizen science in improving public perceptions of riparian functions, whilst Paarlberg, Sena, Loc, et al., (2025) emphasising collaboration, compliance monitoring and technical support for stakeholders in the buffer zone.
Rivers as socio-ecological systems	(Davis et al., 2025; Enu et al., 2025; Fenten & Dieperink, 2024; Q. Han et al., 2022; Novalia et al., 2025; Rentschler et al., 2022b; Zingraff-Hamed et al., 2022)	These articles view rivers not merely as hydrological channels, but as socio-ecological systems that link water functions, ecology, the economy, culture, recreation, and governance. Therefore, Riverbank policies need to strike a balance between environmental protection, public safety, development needs and social legitimacy.
River typology, ecological corridors and assessment indicators	(Arif et al., 2021; Atesoglu et al., 2025; Q. Han et al., 2022; Kuglerová et al., 2024; Lyche Solheim et al., 2019; Zhu et al., 2025)	This series of articles provides a methodological framework for classifying rivers, assessing ecological risks and determining management indicators. Lyche Solheim et al., (2019) helps to understand the importance of river typology in ecological assessments, whereas Zhu et al., (2025) developing ecological risk assessments based on spatial and temporal indicators.
Planning permission, development control and prevention of encroachment	(Endarwati, Hari, et al., 2021; Gwapedza et al., 2026; H. Han et al., 2025; Majumdar & Avishek, 2025b; Mwasenga & Mjemah, 2023b; Spurlock, 2019; Stutter et al., 2021; Tellman et al., 2021b)	The literature indicates that encroachment occurs when regulations, spatial planning and licensing systems are not properly coordinated. Spurlock (2019) highlights the importance of the quality of plans and regulations in the implementation of buffers, whereas Mwasenga & Mjemah, (2023) indicates that socio-economic activity in the buffer zone may increase when compliance and monitoring are weak.

Administrative feasibility is one of the criteria for policy evaluation that assesses the viability of a policy alternative from the perspective of the government's administrative capacity to implement it effectively (Dunn, 2017). In this study, Administrative Operability is operationalized through four common criteria applied consistently to each alternative: (1) technical and administrative feasibility; (2) availability of human and institutional resources; (3) clarity of legal authority; and (4) political and social acceptability. The assessment is qualitative rather than a numerical scoring exercise. For each criterion, the analysis identifies supporting conditions, institutional requirements, and foreseeable constraints, allowing the two alternatives to be compared on the same analytical basis.

Administrative feasibility is one of the criteria for policy evaluation that assesses the viability of a policy alternative from the perspective of the government's administrative capacity to implement it effectively (Dunn, 2017). These criteria cover four main dimensions: (1) technical and administrative feasibility; (2) availability of human and institutional resources; (3) clarity of legal authority; and (4) political and social acceptability.

Evaluation of Policy Alternatives

Policy Alternative 1 (A1) – Single Spatial Data Policy (SSDP):

A policy for the integration of a single spatial database linking land data from the National Land Agency (BPN), technical river data from the Ministry of Public Works and Public Housing (PUPR)/Regional Water Resources Management Agency

(BBWS), Regional Spatial Planning (RTRW) data from the Regional Development Planning Agency (BAPPEDA), and the Jember Regency OSS-RBA system through a geofencing mechanism for licensing. Every licence application submitted to the Investment and One-Stop Service Agency (DPMPTSP) is automatically verified against standardised river boundary layers, as a result, permits in the buffer zone are automatically rejected by the system and cannot be manually overridden. This model adopts best practices for spatial data integration from Alpine Flood Risk Governance (Zhou et al., 2025).

Policy Alternative 2 (A2) – Risk-Based Licensing Reform (RBLR):

Reform of the development licensing mechanism based on flood risk zoning, which requires a hydrological analysis (Q25–Q50 discharge) as a mandatory prerequisite prior to the issuance of construction permits in flood-prone areas, accompanied by the establishment of the Integrated Riverbank Monitoring Implementation Unit (UPSST), tasked with carrying out regular post-licensing monitoring. The UPSST is an inter-agency unit that integrates the technical functions of the BBWS, the enforcement functions of the Satpol PP, and the licensing functions of the DPMPTSP.

Table 2. An Analysis of Policy Alternatives for Boundary Issues in Jember Regency Using the Administrative Operability Approach

Administrative Operability Criteria	Policy Alternative 1 (A1): Single Spatial Data Policy	Policy Alternative 2 (A2): Risk-Based Licensing Reform
Technical and Administrative Eligibility	The Jember District Government can be considered technically capable of implementing a policy for integrated single spatial database management, given its existing access to the RBI base map provided by BIG, RTRW data from BAPPEDA, and technical river data and spatial imagery from PUPR/BBWS. This data integration can be channelled into a location-based licensing mechanism via the OSS-RBA system, so that the licence verification process does not rely solely on administrative documents, but also on spatial alignment with river boundary layers and flood risk. This approach is consistent with the study. Tellman et al., (2021) which highlights the importance of spatial data and satellite imagery in identifying flood-affected areas, as well as Rentschler et al., (2022a) which emphasises the need for flood exposure mapping as a basis for policies to protect vulnerable areas. Furthermore, the use of remote sensing to monitor landscape changes resulting from human activity is also relevant as a tool for the spatial verification of permits (Belenok et al., 2021). The main technical challenge is the lack of data interoperability or an API linking the National Land Agency (BPN), the Regional Water Resources Management Agency (BBWS)/Ministry of Public Works and Public Housing (PUPR),	A flood-risk-based licensing mechanism requires more complex technical standard operating procedures, particularly regarding the assessment of design flow, flood hazard zoning, and the requirement for a hydrological analysis prior to the issuance of a building permit. The Jember District Government already has flood incident data from the BPBD and can use the flood hazard map from the BNPB as a starting point, but technical capacity The capacity to conduct hydrological risk assessments at the DPMPTSP level still needs to be strengthened. This reform is relevant because extreme flooding is becoming increasingly unpredictable based solely on historical data, meaning that risk management must take into account the possibility of unprecedented extreme events (Kreibich et al., 2022). Furthermore, the increase in extreme rainfall due to climate change underscores the urgency of applying hydrological analysis standards in the development licensing process in flood-prone areas (Tabari, 2020a).

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Administrative Operability Criteria	Policy Alternative 1 (A1): Single Spatial Data Policy	Policy Alternative 2 (A2): Risk-Based Licensing Reform
	the Regional Development Planning Agency (BAPPEDA), and the Regional Investment and One-Stop Service Agency (DPMPTSP) at district level.	
Human Resources and Institutional Capacity	The establishment of the Jember Regency Government's Infrastructure and Spatial Planning Task Force demonstrates the existence of initial institutional capacity to manage spatial planning and riverbank issues. Spatial data integration can be achieved by strengthening the GIS teams at BAPPEDA, DPMPTSP and PUPR without the need to establish a new government agency. Institutionally, this model is more efficient as it emphasises data synchronisation, standardisation of geospatial layers, and the utilisation of existing digital infrastructure. The literature on multifunctional landscape design suggests that data-driven spatial management can	The establishment of the Integrated River Bank Monitoring Unit (UPSST) requires a more diverse range of human resources, including expertise in hydrology, GIS, spatial planning law, building supervision and the enforcement of local regulations. As the Jember District Government does not yet have a functional unit specifically responsible for cross-agency river bank supervision, This model should not be established directly as a new government agency, but rather as a collaborative working unit involving the Regional Water Resources Management Agency (BBWS)/Ministry of Public Works and Public Housing (PUPR), the Investment and One-Stop Service Agency

Administrative Operability Criteria	Policy Alternative 1 (A1): Single Spatial Data Policy	Policy Alternative 2 (A2): Risk-Based Licensing Reform
	help integrate ecological, social and administrative functions within a single planning framework. On the other hand, Fagerholm et al., (2020) emphasises that the landscape makes a significant contribution to people's well-being, and therefore Riverbank management should be understood not merely as a technical matter, but also as part of spatial planning that supports public safety and quality of life. Riverbanks should be understood not merely as a technical matter, but also as part of spatial planning that supports public safety and quality of life.	(DPMPTSP), the Public Order Agency (Satpol PP), the Regional Disaster Management Agency (BPBD), the Regional Development Planning Agency (BAPPEDA), and the sub-district government. Monitoring functions can be strengthened through remote sensing technology and the monitoring of land-use changes, as demonstrated by (Belenok et al., 2021). Furthermore, the socio-ecological landscape approach emphasises the importance of involving institutional and community actors in safeguarding the functions of the landscape from development pressures (Sahle & Saito, 2021; Shiferaw et al., 2023).
Clarity of Legal Authority	A1 has a relatively strong legal basis because it can be linked to policies on geospatial information, spatial planning, and risk-based business licensing. Law No. 4 of 2011 on Geospatial Information provides the basis	A2 also has a legal basis, as Law No. 17 of 2019 on Water Resources and Government Regulation No. 38 of 2011 on Rivers grant the government the authority to protect the functions of rivers and their riparian zones. However, implementing

Administrative Operability Criteria	Policy Alternative 1 (A1): Single Spatial Data Policy	Policy Alternative 2 (A2): Risk-Based Licensing Reform
	for the standardization and integration of geospatial data, while Government Regulation No. 21 of 2021 on Spatial Planning and Government Regulation No. 8 of 2025 on Risk-Based Business Licensing provide scope for the integration of spatial planning into the licensing process. Conceptually, the integration of spatial data into the permitting process is also consistent with a risk-informed spatial planning approach, which integrates information on hazards, exposure, and vulnerability as the basis for administrative decision-making. Tellman et al., (2021) and Rentschler et al., (2022) This indicates that spatial data can be used to identify areas at high risk of flooding, making it relevant as a basis for restricting or denying permits in river buffer zones.	this policy is more complex because it involves on-site inspections, administrative sanctions, and the potential restriction of rights to land or buildings that have already been legally registered. Therefore, risk-based licensing reforms must distinguish between new permits and existing buildings. For new permits, the government can implement strict hydrological standards and risk zoning. For existing buildings, a legality audit, a participatory approach, and a constitutionally sound resolution scheme are required. This approach is consistent with the literature on flood risk, which emphasizes that flood control policies must take into account both the technical and socio-economic dimensions of the affected communities (Rentschler et al., 2022a; Wing et al., 2022).
Political and Social Acceptability	Option A1 has a relatively high level of political and social acceptability	A2 has moderate social acceptability. Communities frequently

Administrative Operability Criteria	Policy Alternative 1 (A1): Single Spatial Data Policy	Policy Alternative 2 (A2): Risk-Based Licensing Reform
	because it is technical and administrative in nature and does not directly threaten existing community property rights. Geofencing for permitting serves primarily as a preventive measure to stop new violations from occurring. As a result, this policy is likely to be more readily accepted by the public because the goal is increase transparency, prevent permit manipulation, and reduce the risk of future flooding. From a social perspective, this policy can be seen as a safeguard for public safety and the ecological functions of the area. Fagerholm et al., (2020) shows that landscapes contribute to human well-being, while Lavorel et al., (2022) emphasizes the importance of landscape design that can accommodate multiple functions simultaneously. In the context of Jember, riverbanks should be understood as	affected by flooding are likely to support stricter permitting requirements, particularly for new housing development in flood-prone areas. However, resistance may arise from developers and investors because this policy adds technical requirements, the cost of hydrological studies, and the risk of permit denial. Therefore, A2 requires mechanisms for public outreach, a transition period, and transparent appeal procedures. The literature on flood risk inequality indicates that certain community groups often bear a greater burden of risk as a result of unfair land-use decisions (Wing et al., 2022). Therefore, risk-based licensing should be viewed not as a barrier to investment, but as a tool for spatial justice and for protecting communities from flood risks.

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Administrative Operability Criteria	Policy Alternative 1 (A1): Single Spatial Data Policy	Policy Alternative 2 (A2): Risk-Based Licensing Reform
	ecological infrastructure that protects the community, not as vacant land that can be freely converted.	

Based on the administrative operability approach, the Single Spatial Data Policy is considered the more immediately operable policy option for implementation in Jember Regency. This assessment rests on its preventive character, its compatibility with existing spatial-data institutions, and its ability to address the coordination gap before new permits are issued. The integration of land data, technical river data, RTRW/RDTR, flood-risk maps, and the OSS-RBA system enables each permit application to be checked against riverbank boundary layers. In contrast, the Risk-Based Licensing Reform requires additional hydrological procedures, technical expertise, and a dedicated interagency monitoring mechanism. The difference between the alternatives therefore concerns administrative requirements and implementation sequence rather than a simple judgment that one policy is universally superior.

Based on the administrative operability approach, the Single Spatial Data Policy is considered the most viable policy option for implementation in Jember Regency. This policy has several advantages: it is preventive in nature, addresses technical and administrative issues, and does not directly conflict with existing land ownership rights. The integration of land data, technical river data, RTRW/RDTR, flood risk maps, and the OSS-RBA system enables each permit application to be automatically verified against riverbank boundary layers. This approach is consistent with the literature, which emphasizes the importance of flood mapping based on spatial data and satellite imagery in identifying high-risk areas (Rentschler et al., 2022a; Tellman et al., 2021a).

(Belenok et al., 2021)(Kreibich et al., 2022; Tabari, 2020a)However, because the Risk-Based Licensing Reform has the potential to increase the technical burden on developers and requires additional institutional capacity, its implementation would need to be gradual, transparent, and supported by integrated spatial and hydrological data. The findings suggest that SSDP can function as an initial preventive mechanism, while RBLR can complement it by strengthening post-permit risk assessment and monitoring. Both alternatives also require attention to existing land rights, inter-agency data sharing, financing, digital infrastructure, and political commitment. These implementation conditions are central to administrative operability and should be considered before either policy is translated into local regulations or operational procedures.

Therefore, based on the comparative assessment presented above, the Single Spatial Data Policy emerges as the more immediately operable option for riverbank management in Jember Regency, while Risk-Based Licensing Reform functions as a complementary medium-term measure. The analytical value of the comparison lies in showing how the same administrative criteria can be used to connect root causes with concrete implementation requirements. SSDP emphasizes integration of spatial data from BPN, PUPR/BBWS, RTRW, and the OSS-RBA system so that permitting can be checked against standardized riverbank and flood-risk layers. Its implementation, however, still depends on data standardization, inter-agency agreements, digital infrastructure, institutional authority, and sustained political commitment.

Therefore, based on the findings visualized in the figure above, the most recommended policy alternative is the Single Spatial Data Policy for riverbank management in Jember Regency. This visualization also serves as research finding, as it demonstrates that the SSDP policy alternative has a high level of feasibility when assessed through the lens of administrative operability. This policy emphasizes the integration of spatial data from the National Land Agency (BPN), the Ministry of Public Works and Public Housing (PUPR)/Regional Water Resources Management Agency (BBWS), the Regional Spatial Plan (RTRW), and the Online Single Submission (OSS)-Regulatory Business Analysis (RBA) system so that the permitting process can be automatically verified through a geofencing system. Each stage indicates that this policy is deemed feasible because it has a clear conceptual foundation, is supported by technical data and digital infrastructure, can be implemented by existing institutions, has a strong legal basis, and is relatively acceptable politically and socially. The core of the policy is to prevent new permits in riverbank areas and flood-prone zones before spatial planning violations occur.

This study confirms that violations of river boundaries in Jember Regency are not merely a technical issue or a matter of public noncompliance, but rather a systemic failure in policy design that is multidimensional in nature. Five contributing factors have been identified—weak regulations and permitting processes, inadequate oversight and law enforcement, spatial planning issues and watershed degradation, infrastructure limitations, as well as hydrological conditions and extreme weather—which reinforce one another in creating a chain of vulnerabilities that leads to recurring floods.

Theoretically, this study contributes to public policy analysis by showing how riverbank governance problems can be examined as interacting failures of policy implementation, institutional coordination, spatial integration, and environmental management. The combination of Fishbone Analysis and Administrative Operability does not constitute a new standalone theory; rather, it provides a structured analytical sequence that links diagnosis of interacting causes with assessment of the administrative conditions required for policy implementation. This framework can be adapted to other districts facing similar riverbank governance problems, provided that local regulatory, institutional, spatial, and environmental conditions are incorporated.

Based on the administrative operability approach, the Single Spatial Data Policy (SSDP) emerges as the more immediately operable policy option because it is preventive in nature, relies on cross-agency spatial data integration, and can be connected to existing planning and licensing functions without automatically altering existing property rights. Risk-Based Licensing Reform (RBLR) remains a complementary medium-term policy requiring additional technical and institutional capacity. The limitations of this study include the exclusive use of secondary data, possible incompleteness and selection bias in documentary and media sources, the absence of direct stakeholder interviews, the absence of hydrological modelling, and the limited transferability of

findings from a single regional case. Further research should combine documentary analysis with stakeholder perspectives, spatial data, and hydrological assessment to test the applicability of the proposed analytical sequence in other regions.

Based on the administrative operability approach, the Single Spatial Data Policy (SSDP) is considered the most viable policy option because it is preventive in nature, relies on cross-agency spatial data integration, and does not directly threaten existing property rights. Risk-Based Licensing Reform (RBLR) remains important as a medium-term policy. The limitations of this study include the use of secondary data without direct interviews with stakeholders, the absence of hydrological modeling, and the limited generalizability to a single region. Further research is needed to strengthen the empirical validity and test the policy's applicability in other regions.

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CRediT authorship contribution statement

Ghilman Afifuddin: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft. Dina Suryawati: Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. Edy Wahyudi: Formal analysis, Methodology, Supervision, Validation, Writing – review & editing.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data available on request from the authors: The data that support the findings of this research are available from the corresponding author, upon reasonable request.

REFERENCES

Adam, A. K., Puluhulawa, F. U., & Bakung, D. A. (2025). Mekanisme Pemberian Hak Pengelolaan dan Penguasaan Tanah Sempadan Sungai Bone: Perspektif Hukum Agraria dan Perlindungan Ekosistem Sungai. *AL-Zayn: Jurnal Ilmu Sosial Dan Hukum*, *3*(5), 7963–7981. https://doi.org/https://doi.org/10.61104/alz.v3i5.2455 Mekanisme

Alwajdi, M. F., & Spaltani, B. G. (2023). Quo Vadis Pengaturan Garis Sempadan Sungai di Indonesia. *Legislasi Indonesia*, *20*(2), 1–13.

American Society for Quality. (2023). *Cause-and-effect diagram (fishbone)*. Asq.Org.

Amin, M., Mubarak, Zulkarnain, & Gunawan, F. (2025). Ketidaksesuaian Penggunaan Kawasan Sempadan Sungai Sebagai Pemukiman. *Integrative Perspectives of Social and Science Journal*, *2*(6), 8485–8495.

Arif, M., Tahir, M., Jie, Z., & Changxiao, L. (2021). Impacts of riparian width and stream channel width on ecological networks in main waterways and tributaries. *Science of the Total Environment*, *792*. https://doi.org/10.1016/j.scitotenv.2021.148457

Asmaranto, R., Harisuseno, D., & Palla, A. (2026). Evaluation of Urban Drainage Capacity in Relation to Surface Flooding in Lowokwaru District, Malang City. *Journal of Engineering and Technological Science*, *2*(1), 1–10.

Atesoglu, A., Bulut, F. S., Ozel, H. B., & Zeren Cetin, I. (2025). Large-scale earth observation and monitoring of riparian zone land-cover changes in Türkiye. *International Journal of Environmental Science and Technology*, *22*(12), 11843–11858. https://doi.org/10.1007/s13762-025-06399-0

Belenok, V., Noszczyk, T., Hebryn-Baidy, L., & Kryachok, S. (2021). Investigating anthropogenically transformed landscapes with remote sensing. *Remote Sensing Applications: Society and Environment*, *24*, 100635. https://doi.org/10.1016/j.rsase.2021.100635

Clegg, G., Haigh, R., Amaratunga, D., & Rahayu, H. P. (2023). Coordination Challenges Facing Effective Flood Governance in the Ciliwung River Basin. In *Environmental Governance in Indonesia* (pp. 313–324). Springer.

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Sage Publication, Inc.

Davis, S., Grainger, M., Pfeifer, M., Pattison, Z., Stephens, P., & Sanderson, R. (2025). Restoring riparian habitats for benefits to biodiversity and human livelihoods: a systematic map protocol for riparian restoration approaches in the tropics. *Environmental Evidence*, *14*(1). https://doi.org/10.1186/s13750-025-00355-8

Djibran, R. O., & Susilowati, I. F. (2020). Tinjauan Yuridis Penertiban Sertifikat Hak Atas Tanah Di Sempadan Sungai Serinjing Desa Jambu Kabupaten Kediri. *Novum: Jurnal Hukum*, *7*(4), 94–106.

Duan, Y., Tang, J., Li, Z., Yang, B., Yan, Y., & Yang, Y. (2021). Vegetated buffer zone restoration planning in small urban watersheds. *Water (Switzerland)*, *13*(21). https://doi.org/10.3390/w13213000

Dunn, W. N. (2003). Pengantar Analisis Kebijakan Pulblik. In *Gadjah Mada Universitas Press* (pp. 1–710). https://www.pdfdrive.com/pengantar-analisis-kebijakan-pulblik-e176089208.html

Dunn, W. N. (2017). *Public Policy Analysis*. Routledge. https://doi.org/10.4324/9781315181226

Dwirahmadi, F., Barnes, P., Wibowo, A., & Amri, A. (2023). Linking Disaster Risk Reduction and Climate Change Adaptation through Collaborative Governance : Experience from Urban Flooding in Jakarta. *Geosciences*, *13*, 1–14. https://doi.org/https://doi.org/10.3390/geosciences13110353

Endarwati, M. C., Hari, W., Widodo, S., & Hamidah Imaduddina, A. (2021). *Arahan Penataan Ruang Sempadan Sungai Di Wilayah Perkotaan Kabupaten Bojonegoro*. *17*(1), 108–118. https://doi.org/10.14710/pwk.v17i1.36535

Endarwati, M. C., Widodo, W. H. S., & Imaduddina, A. H. (2021). Arahan Penataan Ruang Sempadan Sungai Di Wilayah Perkotaan Kabupaten Bojonegoro. *Pembangunan Wilayah Dan Kota*, *17*(1), 108–118. https://doi.org/https://doi.org/10.14710/pwk.v17i1.36535 1.

Enu, K. B., Zingraff-Hamed, A., Lupp, G., Raum, S., Moors, E., & Pauleit, S. (2025). Stakeholder priorities and navigating barriers in urban river restoration: Comparative insights from Germany and Ghana. *Environmental and Sustainability Indicators*, *26*. https://doi.org/10.1016/j.indic.2025.100683

Fagerholm, N., Martín-López, B., Torralba, M., Oteros-Rozas, E., Lechner, A. M., Bieling, C., Stahl Olafsson, A., Albert, C., Raymond, C. M., Garcia-Martin, M., Gulsrud, N., & Plieninger, T. (2020). Perceived contributions of multifunctional landscapes to human well-being: Evidence from 13 European sites. *People and Nature*, *2*(1), 217–234. https://doi.org/10.1002/pan3.10067

Fenten, T., & Dieperink, C. (2024). Governance Conditions for a Successful Restoration of Riverine Ecosystems, Lessons

from the Rhine River Basin. *Water (Switzerland)*, *16*(20). https://doi.org/10.3390/w16202983

Firdaus, M. A., Ristiawati, R., & Saphira, S. (2021). Formulasi Kebijakan Pelaksanaan Perlindungan Kawasan Sempadan Sungai Di Kota Banjarmasin. *Ius Constituendum*, *6*(2), 407–424.

Ghimire, S. R., Nayak, A. C., Corona, J., Parmar, R., Srinivasan, R., Mendoza, K., & Johnston, J. M. (2022). Holistic Sustainability Assessment of Riparian Buffer Designs: Evaluation of Alternative Buffer Policy Scenarios Integrating Stream Water Quality and Costs. *Sustainability (Switzerland)*, *14*(19). https://doi.org/10.3390/su141912278

Gumiero, B., Veronesi, L., Galgani, L., Di Grazia, F., Corsi, A., Cirrone, R. G., & Loiselle, S. A. (2025). Seeing is believing: How citizen science challenges riparian misconceptions. *Open Research Europe*, *5*, 89. https://doi.org/10.12688/openreseurope.19783.1

Gwapedza, D., Lazar, S., Mqoqi, N., Xoxo, S., Niipele, J., Tanner, J., & Falayi, M. (2026). Riparian zone transformation in South Africa: Evaluating changes, causes, and the role of legal frameworks. *Environmental Challenges*, *23*. https://doi.org/10.1016/j.envc.2026.101448

Haidar, M., & Rozak, A. M. (2024). Analisis Pelanggaran Garis Sempadan Sungai di Perumahan Wahyu Utomo Ngaliyan Semarang. *Misterius: Publikasi Ilmu Seni Dan Desain Komunikasi Visual*, *1*(4), 52–59. https://doi.org/https://doi.org/10.62383/misterius.v1i4.433

Hai-Jew, S. (2020). *NVivo 12 Plus's New Qualitative Cross-Tab Analysis Function*. Kansas State University.

Han, H., Yan, X., Li, X., Huang, Z., Yan, X., & Xia, Y. (2025). Significant differences in optimal riparian buffer zone on water quality between different segments within the same river. *Journal of Environmental Management*, *381*. https://doi.org/10.1016/j.jenvman.2025.125306

Han, Q., Wang, X., Li, Y., & Zhang, Z. (2022). River Ecological Corridor: A Conceptual Framework and Review of the Spatial Management Scope. In *International Journal of Environmental Research and Public Health* (Vol. 19, Number 13). MDPI. https://doi.org/10.3390/ijerph19137752

Hendrawan, V. S. A., Rahardjo, A. P., Mawandha, H. G., Aldrian, E., Muhari, A., & Komori, D. (2025). *Review article: Past and future climate–related hazards in Indonesia*. https://doi.org/10.5194/egusphere-2025-584

Ielpi, A., & Lapôtre, M. G. A. (2020). A tenfold slowdown in river meander migration driven by plant life. *Nature Geoscience*, *13*(1), 82–86. https://doi.org/10.1038/s41561-019-0491-7

Innes, J. E. (1996). Planning Through Consensus Building: A New View of the Comprehensive Planning Ideal. *Journal of the American Planning Association*, *62*(4), 460–472. https://doi.org/10.1080/01944369608975712

Jesica, J., & Cristiana, E. (2023). Kebijakan Pemanfaatan Ruang pada Sempadan Sungai Kahayan, Kota Palangka Raya. *Satya Dharma: Jurnal Ilmu Hukum*, *6*(1), 63–79.

jtvjember. (2026, January 29). *Perumahan Dekat Sungai Disorot, Tata Ruang Jember Terancam*. Www.Jtvjember.Com. https://www.jtvjember.com/2026/01/perumahan-dekat-sungai-disorot-tata.html

Kreibich, H., Van Loon, A. F., Schröter, K., Ward, P. J., Mazzoleni, M., Sairam, N., Abeshu, G. W., Agafonova, S., AghaKouchak, A., Aksoy, H., Alvarez-Garreton, C., Aznar, B., Balkhi, L., Barendrecht, M. H., Biancamaria, S., Bos-Burgering, L., Bradley, C., Budiyono, Y., Buytaert, W., … Di Baldassarre, G. (2022). The challenge of unprecedented floods and droughts in risk management. *Nature*, *608*(7921), 80–86. https://doi.org/10.1038/s41586-022-04917-5

Kuglerová, L., Muotka, T., Chellaiah, D., Jyväsjärvi, J., & Richardson, J. S. (2024). Protecting our streams by defining measurable targets for riparian management in a forestry context. *Journal of Applied Ecology*, *61*(2), 206–214. https://doi.org/10.1111/1365-2664.14549

Kurniadi, A., Weller, E., Salmond, J., & Aldrian, E. (2024). Future projections of extreme rainfall events in Indonesia. *International Journal of Climatology*, *44*(1), 160–182. https://doi.org/10.1002/joc.8321

Kusuma, M. B. A., Yudha, H. F. A., & Al Amin, M. N. F. (2024). Analisis Fishbone Pengambilan Keputusan Kebijakan Normalisasi Sungai di Kota Surabaya. *Sosial Dan Humaniora*, *1*(4), 106–111. https://doi.org/https://doi.org/10.62017/arima

Lavorel, S., Grigulis, K., Richards, D. R., Etherington, T. R., Law, R. M., & Herzig, A. (2022). Templates for multifunctional landscape design. *Landscape Ecology*, *37*(3), 913–934. https://doi.org/10.1007/s10980-021-01377-6

Lyche Solheim, A., Globevnik, L., Austnes, K., Kristensen, P., Moe, S. J., Persson, J., Phillips, G., Poikane, S., van de Bund, W., & Birk, S. (2019). A new broad typology for rivers and lakes in Europe: Development and application for large-scale environmental assessments. *Science of the Total Environment*, *697*. https://doi.org/10.1016/j.scitotenv.2019.134043

Mahrus, Moh. A. (2025a). *Komisi C DPRD Jember Sidak Perumahan Devanka Land, Temukan Sempadan Sungai Diuruk dan Picu Banjir Luapan*. Jatimtimes.Com. https://jatimtimes.com/baca/349761/20251118/085000/komisi-c-dprd-jember-sidak-perumahan-devanka-land-temukan-sempadan-sungai-diuruk-dan-picu-banjir-luapan

Mahrus, Moh. A. (2025b). *Komisi C DPRD Jember Sidak Perumahan Devanka Land, Temukan Sempadan Sungai Diuruk dan Picu Banjir Luapan*. Jatimtimes.Com. https://jatimtimes.com/baca/349761/20251118/085000/komisi-c-dprd-jember-sidak-perumahan-devanka-land-temukan-sempadan-sungai-diuruk-dan-picu-banjir-luapan

Majumdar, A., & Avishek, K. (2025a). Mitigating riparian buffer zone degradation through policy interventions and learnings from best practices. *Discover Environment*, *3*(84).

Majumdar, A., & Avishek, K. (2025b). Mitigating riparian buffer zone degradation through policy interventions and learnings from best practices. In *Discover Environment* (Vol. 3, Number 1). Springer Nature. https://doi.org/10.1007/s44274-025-00288-6

Mirza, M. I., Ussy Andawayanti, & Dian Sisinggih. (2023). Pemetaan Sebaran Indeks Bahaya Erosi dan Arahan Penggunaan Lahan Berbasis Sistem Informasi Geografis pada DAS Bedadung Kabupaten Jember. *Jurnal Teknologi Dan Rekayasa Sumber Daya Air*, *3*(2), 334–345. https://doi.org/10.21776/ub.jtresda.2023.003.02.029

Mwasenga, J. M., & Mjemah, I. C. (2023a). Socio-Economic Feasibility for Implementation of Environmental Legislation along the Riparian Buffer Zones in Urban Rivers of Northern Tanzania. *Urban Science*, *7*(3).

Mwasenga, J. M., & Mjemah, I. C. (2023b). Socio-Economic Feasibility for Implementation of Environmental Legislation along the Riparian Buffer Zones in Urban Rivers of Northern Tanzania. *Urban Science*, *7*(3). https://doi.org/10.3390/urbansci7030073

Nawawi, I. (2025a). *Banjir Rendam 21 Titik di Jember, 1.271 Keluarga Terdampak*. Jatim-Timur.Tribunnews.Com. https://jatim-timur.tribunnews.com/jember/34726/banjir-rendam-21-titik-di-jember-1271-keluarga-terdampak

Nawawi, I. (2025b). *Jadi Salah Satu Penyebab Banjir, Pemkab Jember Evaluasi Perumahan di Bantaran Sungai*. Jatim-Timur.Tribunnews.Com. https://jatim-timur.tribunnews.com/jember/34759/jadi-salah-satu-penyebab-banjir-pemkab-jember-evaluasi-perumahan-di-bantaran-sungai#:~:text=Bupati Jember%2C Muhammad Fawait%2C menyebut salah satu penyebab,tersebut membuat kawasan permukiman rentan terdamp

Nawawi, I. (2025c). *Pemkab Jember Bentuk Satgas, Tertibkan Perumahan di Bantaran Sungai*. Jatim-Timur.Tribunnews.Com. https://jatim-timur.tribunnews.com/jember/35683/pemkab-jember-bentuk-satgas-tertibkan-perumahan-di-bantaran-

sungai#:~:text=Pemkab Jember membentuk Satgas Infrastruktur dan Tata Ruang.,Pemkab siap mengambil langkah hukum jika relokasi ditolak.

Nawawi, I. (2026). *104 Perumahan di Jember Rawan Banjir, Satgas Tata Ruang Siapkan Penertiban Pengembang*. Jatim.Tribunnews.Com. https://jatim.tribunnews.com/jember/534362/104-perumahan-di-jember-rawan-banjir-satgas-tata-ruang-siapkan-penertiban-pengembang

Novalia, W., Suwarso, R., & Nurdin, I. (2025). Connecting place and multilevel governance for urban river restoration. *Territory, Politics, Governance*, *13*(10), 1461–1486. https://doi.org/10.1080/21622671.2024.2336608

Noviani, E., Wulandari, C., Kusumastuti, D. I., Yuwono, S. B., Wahono, E. P., Bakri, S., Suhohar, A., Arianti, T., & Hardito, J. (2025). Analisis Hukum Kebijakan Pengelolaan Sempadan Sungai Perkotaan Terhadap Pertumbuhan Penduduk. *Justicia Sains: Jurnal Ilmu Hukum*, *10*(2).

Nugroho, A. (2025, December 2). UGM Expert: Severe Sumatra Flash Floods Driven by Upper Watershed Forest Degradation. *Https://Ugm.Ac.Id/En/News/Ugm-Expert-Severe-Sumatra-Flash-Floods-Driven-by-Upper-Watershed-Forest-Degradation/*.

Paarlberg, A., Sena, G., Huu, H., & Jannik, L. (2025). Understanding Stakeholder Perspectives on the Implementation and Management of Riparian Buffer Zones in the Santa Lucía River Basin , Uruguay. *Environmental Management*, 2596–2613. https://doi.org/10.1007/s00267-025-02230-1

Paarlberg, A., Sena, G., Loc, H. H., & Schultner, J. (2025). Understanding Stakeholder Perspectives on the Implementation and Management of Riparian Buffer Zones in the Santa Lucía River Basin, Uruguay. *Environmental Management*, *75*(10), 2596–2613. https://doi.org/10.1007/s00267-025-02230-1

Pasaribu, P. C., Marwa, J., Kesaulija, F. F., Wanggai, C. B., & Sadsoeitoeboen, B. M. G. (2022). Kajian Penggunaan Lahan Terhadap Peraturan Sempadan Sungai Arui. *Jurnal Kehutanan Papuasia*, *8*(1), 25–32.

Patton, C. V., Sawicki, D. S., & Clark, J. J. (2015). Basic methods of policy analysis and planning. In *Basic Methods of Policy Analysis and Planning*. https://doi.org/10.4324/9781315664736

Rentschler, J., Salhab, M., & Jafino, B. A. (2022a). Flood exposure and poverty in 188 countries. *Nature Communications*, *13*(1), 3527. https://doi.org/10.1038/s41467-022-30727-4

Rentschler, J., Salhab, M., & Jafino, B. A. (2022b). Flood exposure and poverty in 188 countries. *Nature Communications*, *13*(1). https://doi.org/10.1038/s41467-022-30727-4

Rusdi, & Rosidi, I. (2025). *Sidak DPRD Jember Bongkar Rekayasa Sungai Pemicu Banjir Wirolegi*. Www.Ngopibareng.Id. https://www.ngopibareng.id/read/sidak-dprd-jember-bongkar-rekayasa-sungai-pemicu-banjir-wirolegi

Sahle, M., & Saito, O. (2021). Assessing Nature's Contributions to People by Jefoure Roads for Sustainable Management in the Gurage Socio-Ecological Production Landscape in Ethiopia. *Sustainability*, *13*(7), 3806. https://doi.org/10.3390/su13073806

Savirani, Amarinda, & Aspinall, E. (2024a). Drainage Politics: The Political Economy of Flood Management In Indonesian Cities. *Governing Urban Indonesia*.

Savirani, Amarinda, & Aspinall, E. (2024b). Drainage Politics: The Political Economy of Flood Management In Indonesian Cities. *Governing Urban Indonesia*.

Sejati, A. W., Waskitaningsih, N Sukmawati, D. P., Buchori, I., Putri, S. N. A. K., Muzaki, A. J., & Sugiyantoro, Y. (2025). More developed means dangerous: spatial evidence of multi-decadal urbanising watershed and its impact to flash flood in metropolitan Semarang-Indonesia. *Environmental Hazards*, *24*(1), 23–44. https://doi.org/https://doi.org/10.1080/17477891.2024.2341720

Serra-Llobet, A., Jähnig, S. C., Geist, J., Kondolf, G. M., Damm, C., Scholz, M., Lund, J., Opperman, J. J., Yarnell, S. M., Pawley, A., Shader, E., Cain, J., Zingraff-Hamed, A., Grantham, T. E., Eisenstein, W., & Schmitt, R. (2022). Restoring Rivers and Floodplains for Habitat and Flood Risk Reduction: Experiences in Multi-Benefit Floodplain Management From California and Germany. *Frontiers in Environmental Science*, *9*. https://doi.org/10.3389/fenvs.2021.778568

Setiadi, S., Sumaryana, A., Bekti, H., & Sukarno, D. (2023). The flood management policy in Bandung city: Challenges and potential strategies. *Coegent Social Sciences*, *9*. https://doi.org/10.1080/23311886.2023.2282434

Shiferaw, A., Hebo, M., & Senishaw, G. (2023). Landscape multifunctionality and dynamic aspects of 'Jefore' in the Western Gurageland, Central-South Ethiopia. *Environmental Challenges*, *13*, 100743. https://doi.org/10.1016/j.envc.2023.100743

Silvia, M., & Gonsaga, A. (2026a). *54 Perumahan di Jember Berdekatan dengan Sempadan Sungai, Ada yang Belum Kantongi Izin*. Surabya.Kompas.Com. https://surabaya.kompas.com/read/2026/01/29/052613678/54-perumahan-di-jember-berdekatan-dengan-sempadan-sungai-ada-yang-belum

Silvia, M., & Gonsaga, A. (2026b). *Perumahan di Sempadan Sungai Terjepit Ancaman Banjir tapi Cicilan Tetap, Warga Minta Relokasi*. Surabya.Kompas.Com. https://surabaya.kompas.com/read/2026/01/20/225207678/perumahan-di-sempadan-sungai-terjepit-ancaman-banjir-tapi-cicilan-tetap

Silvia, M., & Gonsaga, A. (2026c). *Perumahan di Sempadan Sungai Terjepit Ancaman Banjir tapi Cicilan Tetap, Warga Minta Relokasi*. Surabya.Kompas.Com. https://surabaya.kompas.com/read/2026/01/20/225207678/perumahan-di-sempadan-sungai-terjepit-ancaman-banjir-tapi-cicilan-tetap

Singh, R., Tiwari, A. K., & Singh, G. S. (2021a). Managing riparian zones for river health improvement: an integrated approach. *Landscape and Ecological Engineering*, *17*(2), 195–223. https://doi.org/10.1007/s11355-020-00436-5

Singh, R., Tiwari, A. K., & Singh, G. S. (2021b). Managing riparian zones for river health improvement: an integrated approach. In *Landscape and Ecological Engineering* (Vol. 17, Number 2, pp. 195–223). Springer Japan. https://doi.org/10.1007/s11355-020-00436-5

Siregar, W., Nurlinda, I., & Priyanta, M. (2021). Kebijakan Penegakan Hukum Lingkungan Atas Pelanggaran Administrasi Tata RUang Dan Alih Fungsi Lahan Sempadan Sungai Dalam Rangka Terwujudnya Tata Ruang Yang Berkelanjutan. *Poros Hukum Padjadjaran*, *3*(1), 130–149. https://doi.org/https://doi.org/10.23920/jphp.v3i1.710

Spurlock, D. (2019). Using plan and ordinance quality to evaluate the implementation of riparian buffer policies. *Landscape and Urban Planning*, *183*, 1–11. https://doi.org/10.1016/j.landurbplan.2018.10.007

Stutter, M., Baggaley, N., Ó hUallacháin, D., & Wang, C. (2021). The utility of spatial data to delineate river riparian functions and management zones: A review. In *Science of the Total Environment* (Vol. 757). Elsevier B.V. https://doi.org/10.1016/j.scitotenv.2020.143982

Sugianto, S., Deli, A., Miswar, E., Rusdi, M., & Irham, M. (2022). The Effect of Land Use and Land Cover Changes on Flood Occurrence in Teunom Watershed, Aceh Jaya. *Land*, *11*(8), 1271. https://doi.org/10.3390/land11081271

Tabari, H. (2020a). Climate change impact on flood and extreme precipitation increases with water availability. *Scientific Reports*, *10*(1), 13768. https://doi.org/10.1038/s41598-020-70816-2

Tabari, H. (2020b). Climate change impact on flood and extreme precipitation increases with water availability. *Scientific*

Reports, *10*(1). https://doi.org/10.1038/s41598-020-70816-2

Tellman, B., Sullivan, J. A., Kuhn, C., Kettner, A. J., Doyle, C. S., Brakenridge, G. R., Erickson, T. A., & Slayback, D. A. (2021a). Satellite imaging reveals increased proportion of population exposed to floods. *Nature*, *596*(7870), 80–86. https://doi.org/10.1038/s41586-021-03695-w

Tellman, B., Sullivan, J. A., Kuhn, C., Kettner, A. J., Doyle, C. S., Brakenridge, G. R., Erickson, T. A., & Slayback, D. A. (2021b). Satellite imaging reveals increased proportion of population exposed to floods. *Nature*, *596*(7870), 80–86. https://doi.org/10.1038/s41586-021-03695-w

Vagheei, H., & Boano, F. (2025). Freshwater riparian zones in a changing climate: A comprehensive review. In *Ecological Indicators* (Vol. 176). Elsevier B.V. https://doi.org/10.1016/j.ecolind.2025.113600

Wahyuningsih, Y. Y., Tarina, D. D. Y., & Satino. (2022). Implementasi Kebijakan Pemanfaatan Tanah Untuk Pemukiman Di Wilayah Garis Sempadan Sungai DKI Jakarta. *Jurnal Hukum Dan Kenoktariatan*, *6*(2), 851–869.

Wing, O. E. J., Lehman, W., Bates, P. D., Sampson, C. C., Quinn, N., Smith, A. M., Neal, J. C., Porter, J. R., & Kousky, C. (2022). Inequitable patterns of US flood risk in the Anthropocene. *Nature Climate Change*, *12*(2), 156–162. https://doi.org/10.1038/s41558-021-01265-6

Wulandari, S., Pratama, F., Andika, N., Wongso, P., Wijayasari, W., & Rohmat, F. I. W. (2025). Identifying dominant river contributions to urban flooding: a scenario-based study of Makassar City. *Frontiers in Built Environment*, *11*. https://doi.org/10.3389/fbuil.2025.1612416

Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). SAGE Publication, Inc.

Yosua, H., Kusuma, M. S. B., & Nugroho, J. (2024). An assessment of pluvial hazard in South Jakarta based on land-use/cover change from 2016 to 2022. *Frontiers in Built Environment*, *9*. https://doi.org/10.3389/fbuil.2023.1345894

Za, A. U., Putri, S. S., Stevany, F., Putri, E., Susanti, W., & Desy, H. (2025). Analisis Yuridis Penerapan Sempadan Sungai Berdasarkan Perda Nomor 4 Tahun 2021. *Jurnal Hukum Dan Kewarganegaraan*, *13*(4).

Zhou, L., Li, H., Gu, Z., Guo, Y., Wang, X., Wu, B., Wu, L., Zhou, C., & Niu, Z. (2025). Improving Four-pre ability for flood in alpine regions. *Eco-Environment & Health*, *4*(4), 100189. https://doi.org/10.1016/j.eehl.2025.100189

Zhu, Z., Zhang, C., Lu, Y., Ye, J., Fang, G., Sun, C., & Yang, Y. (2025). Ecological risk assessment and prediction of riparian zones in the Jiangsu section of the Yangtze River from a spatiotemporal perspective. *Ecological Indicators*, *174*. https://doi.org/10.1016/j.ecolind.2025.113492

Zingraff-Hamed, A., Serra-Llobet, A., & Kondolf, G. M. (2022). The Social, Economic, and Ecological Drivers of Planning and Management of Urban River Parks. *Frontiers in Sustainable Cities*, *4*. https://doi.org/10.3389/frsc.2022.907044