**JURNAL TRIAS POLITIKA**

2026, Vol 10. No. 1 : 147 – 163

e-ISSN: 2597-7423 / p-ISSN: 2597-7431

Journal Homepage:

<https://www.journal.unrika.ac.id/index.php/jurnaltriaspolitika>**Pentahelix Model Collaboration In Disaster Risk Reduction Efforts In Bintan Regency**Suherry<sup>1\*</sup>, Alfi Husni<sup>2</sup>, Ferizone<sup>3</sup>, Azwan Rifa'i<sup>4</sup>, Muhamad Anugrahi Barus<sup>5</sup><sup>1, 4, 5</sup> Department of Government Studies, STISIPOL Raja Haji, Indonesia<sup>2</sup> Department of Sociology, STISIPOL Raja Haji, Indonesia<sup>3</sup> Department of Public Administration, STISIPOL Raja Haji, Indonesia\* Corresponding Author: [suherry89@gmail.com](mailto:suherry89@gmail.com)

**Abstract:** This study aims to examine the collaborative dynamics of the Pentahelix model in disaster risk reduction efforts in Bintan Regency. The study is grounded in the high disaster vulnerability of the region, including floods, extreme weather, high waves, coastal abrasion, forest and land fires, and drought. This research employs a qualitative approach, with data collected through in-depth interviews, Focus Group Discussions (FGDs), and document analysis, including the 2022–2026 Disaster Risk Assessment. The findings reveal that the five main actors in the Pentahelix model, namely government, academia, business sector, media, and community, actively participate in disaster risk reduction forums with different but complementary roles. The government acts as regulator and coordinator, academia contributes scientific knowledge, the business sector supports logistics and Corporate Social Responsibility (CSR) initiatives, media disseminates disaster information, and communities implement local preparedness strategies. The study identifies a sharing power pattern among actors, demonstrating that disaster risk reduction responsibility is distributed across sectors rather than centralized in government. Theoretically, these findings extend the Pentahelix model by demonstrating that disaster risk reduction collaboration is not only based on role distribution but also on adaptive power-sharing among actors, particularly in archipelagic and disaster-prone regions, thereby enriching collaborative governance theory in disaster management contexts. In conclusion, the Pentahelix model is relevant for strengthening disaster resilience in Bintan Regency through integrated local resources and capacities. However, this study is limited by its territorial scope and lack of long-term impact analysis. Future research is recommended to conduct comparative studies in other archipelagic regions and explore technological innovation and digital media in enhancing community resilience.

**Keywords :** Pentahelix model; disaster risk reduction; multi-stakeholder collaboration; sharing power; Bintan Regency.

Copyright © 2026 The Author(s). This article is published by *Department of Government Science*, Universitas Riau Kepulauan and is licensed under the CC BY 4.0 license (<http://creativecommons.org/licenses/by/4.0/>).

**1. INTRODUCTION**

Bintan Regency is one of the regions in the Riau Islands Province, covering an area of 1,318.21 km<sup>2</sup>, consisting of 10 districts, 36 villages, and 15 urban villages.

Table 1. Disaster Potential in Bintan Regency

No	Disaster Potential in Bintan Regency
1	Floods
2	Extreme Weather
3	Extreme Waves and Coastal Abrasion
4	Forest and Land Fires
5	Drought

Source: Bintan Regency Disaster Risk Assessment 2022–2026

**Article History:**

Received : (27092025)

Revised : (11062025;  
28042026)

Accepted : (30042026)

**How to Cite This Article:**

Suherry., Husni, A., Ferizone., Rifa'i, A., Barus, M.A. (2026). *Pentahelix Model Collaboration In Disaster Risk Reduction Efforts In Bintan Regency*. JURNAL TRIAS POLITIKA, 10(1), 1-15.  
<https://doi.org/10.33373/jtp.v10i1.8395>

The region has a complex geographical profile, including mountains, hills, lowlands, as well as coastal and archipelagic areas (Perbup Bintan Nomor 22 Tahun 2024). This diverse topography contributes to Bintan's high vulnerability to various natural disasters, such as floods, extreme weather, high waves, coastal abrasion, forest and land fires, and droughts. In general, Bintan has a tropical climate with two peak rainy seasons occurring in April and November (BPBD Bintan, 2022).

According to the 2022–2026 Disaster Risk Assessment (KRB) document of Bintan Regency, five major types of disasters require particular attention: floods, extreme weather, extreme waves and coastal abrasion, forest and land fires, and drought. Meanwhile, the National Disaster Management Agency of Indonesia, through the Indonesian Disaster Risk Index in 2024, recorded that all seven regencies/cities in Riau Islands fall into the moderate disaster risk category. Bintan Regency itself obtained a score of 123.17, the highest among all regencies/cities in the province (BNPB, 2025).

Table 2. Disaster Risk Index of Regencies/Cities in the Riau Islands Province

<i>Regency/City</i>	<i>IRBI Score</i>	<i>Risk Category</i>
<b>Bintan</b>	<b>123.17</b>	<b>Medium</b>
Karimun	120.40	Medium
Natuna	112.40	Medium
Batam	108.89	Medium
Tanjungpinang	108.40	Medium
Lingga	100.92	Medium
Kepulauan Anambas	90.50	Medium

Source: *Indonesia Disaster Risk Index 2024* (BNPB, 2025)

The selection of Bintan Regency as the research location is based on three main considerations, namely the high level of multi-hazard disaster risk based on the 2022–2026 Disaster Risk Assessment (KRB) of Bintan Regency, the strategic position of the region as a coastal area and a leading regional tourism destination as stated in Regent Regulation Number 22 of 2024 concerning the Regional Disaster Management Plan, and the existence of a disaster risk reduction forum involving government actors, academics, business sectors, media, and communities. Compared to other island regions in Riau Islands such as Lingga Regency, Natuna Regency, and Anambas Islands Regency, Bintan Regency demonstrates a more complex diversity of disaster threats and more active institutional capacity in disaster governance, making it relevant as a locus for multi-stakeholder collaboration research.

Disasters are multidimensional problems that affect not only physical aspects but also social, economic, and institutional dimensions (Auliya, 2025; Ritonga, 2024). The Government of Bintan Regency has integrated disaster management efforts into the 2021–2026 Regional Medium-Term Development Plan (RPJMD). However, the implementation of these policies still faces real challenges, such as weak coordination among stakeholders, limited resources, and a lack of participation from non-government sectors. Therefore, to address this complexity, an approach is needed that is not only top-down but also inclusive and collaborative.

Theoretically, collaborative governance emphasizes the involvement of government and non-government actors in collective decision-making processes based on consensus to address complex public issues (Ansell & Gash, 2008). Furthermore, the success of collaboration is determined by principled engagement, shared motivation, and capacity for joint action as the foundations of effective collaborative governance (Emerson et al., 2011). In the context of disaster risk reduction, this approach becomes relevant because disaster risks are multidimensional and require role distribution and power sharing among actors. Recent studies

also show that coastal and island areas require adaptive collaboration models, particularly in the integration of resources, information, and community resilience strengthening (Bonfanti et al., 2024). This concept serves as an important foundation in understanding role distribution and power sharing among actors in disaster risk reduction.

One relevant approach is the Pentahelix collaboration model, which involves five main elements: government, academics, business sectors, communities, and media (Arfani, 2022; Erokhin & Komendantova, 2024; Kumar, 2022; Pelling, 2014). In the context of disaster risk reduction, each of these elements has a strategic role: the government as regulator, academics as providers of scientific studies, business sectors as supporters of technology and funding, communities as preparedness actors, and the media as information disseminators (Herdian et al., 2024). Pentahelix plays a role in strengthening cooperation in supervision, maintaining the security of facilities and infrastructure, disseminating information, and carrying out disaster mitigation efforts (Pasaribu et al., 2023). This synergy creates a platform for sharing knowledge, experiences, and resources that can improve collective capacity in dealing with disaster risks (Centre, 2022; Putra Pratama et al., 2024).

Research on multi-stakeholder collaboration in disaster risk reduction (DRR) has been widely conducted, but most studies still emphasize the role of actors sectorally. For example, the study by (Fransiska, 2019) highlights the contribution of academics, while (Tunggali et al., 2019) emphasizes the role of the media, and (Ahmad & Arundina, 2020) examines the synergy between government and communities in urban areas. These studies are important, but they have not been able to comprehensively describe the dynamics of collaboration as a whole. These findings are in line with international studies which emphasize that the effectiveness of disaster risk reduction is strongly determined by cross-sector coordination capacity, resource distribution, and adaptive power-sharing mechanisms (Bonfanti et al., 2024; Erokhin & Komendantova, 2024). However, empirical studies on the implementation of the Pentahelix model in island areas with their own socio-geographical complexities remain limited.

Recent research by (Putra Pratama et al., 2024) indicates that the implementation of the Pentahelix model can improve the effectiveness of disaster mitigation through strengthening social networks and knowledge exchange across sectors. However, empirical literature on the implementation of this model in island regions is still limited. Therefore, this study fills this gap by analyzing in depth the forms, effectiveness, and dominant actors in the Pentahelix collaboration model in Bintan Regency.

Thus, this study offers novelty in four main aspects. First, the Pentahelix collaboration approach is applied comprehensively in the context of disaster risk reduction in Bintan Regency, not only focusing on one particular actor. Second, this study is based on empirical data through in-depth interviews and focus group discussions (FGDs), enabling it to describe the actual dynamics of interaction among Pentahelix elements. Third, this study not only maps the forms of collaboration but also identifies dominant actors and the effectiveness of their roles in building cross-sector synergy. Fourth, this study offers a theoretical contribution by expanding the understanding of the Pentahelix model through a power-sharing perspective, namely that the success of disaster risk reduction depends not only on role distribution but also on the distribution of power and responsibility among actors.

Based on these problems, this study aims to analyze the forms of Pentahelix collaboration, identify dominant actors, and assess the effectiveness of multi-stakeholder collaboration in disaster risk reduction in Bintan Regency. Thus, this study is expected to provide theoretical contributions through enriching the literature on multi-stakeholder collaboration in DRR, as well as practical contributions in the form of collaborative strategy recommendations that can serve as references for local governments and other stakeholders in strengthening disaster resilience in Bintan Regency.

## 2. LITERATURE REVIEW

This study employs collaborative governance theory as the main theoretical foundation for analyzing the dynamics of multi-stakeholder collaboration in disaster risk reduction (DRR). Collaborative governance is understood as a collective decision-making process involving governmental and non-governmental actors in the formulation and implementation of public policies to address complex problems through consensus-based approaches, cooperation, and shared responsibility (Ansell & Gash, 2008). In the context of disaster management, this approach is highly relevant because disaster risks are multidimensional and require cross-sectoral integration.

Furthermore, (Emerson et al., 2011) developed an integrative framework of collaborative governance through three main dimensions: principled engagement, shared motivation, and capacity for joint action. Principled engagement refers to the process of dialogue, negotiation, and goal alignment among actors. Shared motivation is related to the development of trust, legitimacy, and mutual commitment. Meanwhile, capacity for joint action emphasizes the importance of resources, leadership, knowledge, and institutional structures as the foundation of collective action. These three dimensions serve as the analytical basis for examining the effectiveness of collaboration in disaster risk reduction.

In this study, the Pentahelix model is positioned as the operational form of collaborative governance involving five main actors: government, academia, business sectors, media, and communities. This model emphasizes the importance of synergy among actors in the distribution of roles, resources, information, and authority. The government acts as the regulator and policy coordinator, academia as the provider of evidence-based knowledge, business sectors as supporters of innovation and resources, media as the channel for public information dissemination, and communities as the primary actors of community-based preparedness.

In addition to role distribution, this study also employs a power-sharing perspective to understand the distribution of authority and responsibility among actors. This perspective emphasizes that the success of collaboration is determined not only by the distribution of functions but also by the distribution of power in the decision-making process. Thus, collaborative governance serves as the main theory, the Pentahelix model as the operational framework, and power-sharing as the analytical perspective in explaining the effectiveness of collaboration in disaster risk reduction. The conceptual framework of this study is illustrated in Figure 1.

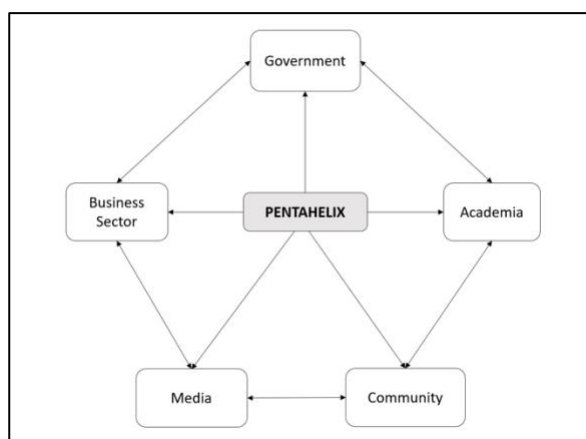


Figure 1. Conceptual Framework of the Pentahelix Collaboration Model in Disaster Risk Reduction (DRR) in Bintan Regency  
Source: Author's Compilation, 2025

The conceptual framework above illustrates the reciprocal relationships among Pentahelix elements in disaster risk reduction. The government serves as the main connector among actors through its coordinating and policy-making functions. Communities act as the primary implementers at the field level by integrating local wisdom into disaster mitigation practices. Academics function as knowledge providers who support evidence-based planning. The business sector contributes through funding innovation and the provision of adaptive technologies. The media plays a role in ensuring transparency, disaster literacy, and social oversight of public policies. The interaction among these actors forms an adaptive and sustainable collaborative system that strengthens disaster resilience in Bintan Regency.

### 3. METHODOLOGY

This study employs a qualitative approach aimed at gaining an in-depth understanding of the dynamics of Pentahelix model collaboration in disaster risk reduction (DRR) in Bintan Regency. The qualitative approach is chosen because it enables the researcher to explore the experiences, perspectives, and practices of actors directly involved in disaster risk reduction, as well as to understand the underlying social and institutional contexts (Creswell & Poth, 2018; Mukhlis, 2022; Sugiyono, 2024).

The research subjects consist of 30 informants representing the five main elements of the Pentahelix model, namely government, academia, community, business sector, and media, with each element comprising six informants. Informants were selected using purposive sampling based on the following criteria: (1) having sufficient knowledge of disaster and disaster risk reduction issues, (2) being directly involved in disaster management or risk reduction activities in Bintan Regency, (3) having active experience in disaster-related forums, programs, or activities, and (4) holding strategic positions or roles within institutions or communities related to disaster governance. To ensure confidentiality, informants are identified only based on institutional categories and functional roles, such as local government actors, academics, business actors, media representatives, and community members.

Data collection was conducted through in-depth interviews, Focus Group Discussions (FGD), and document analysis. In-depth interviews were carried out using semi-structured guidelines to explore the views, experiences, and forms of involvement of each actor in disaster risk reduction. Document analysis included the examination of Regent Regulation Number 22 of 2024 concerning the Disaster Management Plan of Bintan Regency and the Disaster Risk Assessment Document of Bintan Regency 2022–2026.

The FGD was conducted in a single session lasting approximately 120 minutes, using a semi-structured discussion guide developed based on the research focus. The FGD was moderated by the Regional Secretary of Bintan Regency, who *ex officio* serves as the Head of the Regional Disaster Management Agency, ensuring that the discussion was structured and aligned with the local disaster governance context. Participants of the FGD included representatives from the five Pentahelix elements, particularly actors involved in the Disaster Risk Reduction Forum (FPRB) of Bintan Regency, as well as several strategic stakeholders in disaster governance, including regional executive and legislative representatives. The FGD aimed to capture interaction dynamics, coordination patterns, role distribution, and power-sharing mechanisms among actors within the collaborative disaster risk reduction forum.

Prior to the interviews and FGD, all informants were informed about the research objectives, data confidentiality, and their right to refuse or withdraw participation at any time. All informants provided informed consent to participate in this study.

To ensure data validity and reliability, this study applied triangulation techniques, including source triangulation and method triangulation (Sugiyono, 2024) Source triangulation

was conducted by comparing information from informants across different Pentahelix elements, while method triangulation was carried out by combining interview results, FGDs, and document analysis. In addition, member checking was conducted by asking several informants to review interview transcripts and summary findings to ensure that the researcher's interpretations accurately reflected their intended meanings.

Data analysis followed the model of Matthew B. Miles and A. Michael Huberman, consisting of three main stages: data reduction, data display, and conclusion drawing (Sugiyono, 2024). In the data reduction stage, the researcher selected, simplified, and categorized data from interviews, FGDs, and documents based on the research focus. The data were then classified into main themes such as inter-actor coordination patterns, role distribution, resource allocation, and power-sharing mechanisms. The data display stage involved presenting the findings in thematic matrices and descriptive narratives to facilitate the identification of relationships among themes. The final stage, conclusion drawing, involved interpreting patterns, data consistency, and the dynamics of collaboration among actors in the Pentahelix model within the context of disaster risk reduction in Bintan Regency.

#### 4. RESULTS

The findings of this study show that the implementation of the Pentahelix model in disaster risk reduction (DRR) in Bintan Regency has formed a multi-stakeholder collaboration pattern involving government, academia, business sector, media, and community elements. Based on in-depth interviews with 30 informants, Focus Group Discussion (FGD), and document analysis, it was found that collaboration among actors has taken place across various stages of disaster management, including pre-disaster, emergency response, and post-disaster phases. This multi-actor involvement indicates that disaster risk reduction in Bintan Regency is no longer understood as the sole responsibility of the government, but rather as a collective responsibility requiring the integration of roles and resources from multiple stakeholders.

The quotations presented in the findings section are representative excerpts selected based on information-rich cases to reflect the overall findings from all 30 informants. Thus, the quotations are not intended to represent each informant individually, but rather to illustrate dominant thematic patterns emerging from the data analysis process.

However, the findings also indicate that the effectiveness of collaboration is still in a strengthening phase. Several fundamental issues remain, such as weak inter-actor synchronization, imbalanced resource distribution, fragmentation of data across institutions, and non-proportional allocation of authority. In practice, local government still acts as the dominant actor in driving the collaborative system, while other actors primarily function as supporting elements according to their respective capacities.

Based on the processes of data reduction, categorization, and thematic analysis, this study identifies five main themes that represent the dynamics of Pentahelix collaboration in DRR in Bintan Regency, namely: (1) collective perception of disaster risk, (2) cross-sector coordination patterns, (3) barriers to collaboration, (4) inter-actor resource distribution, and (5) dynamics of power sharing.

##### **Collective Perception of Disaster Risk as the Foundation of Collaboration**

The findings of this study indicate that disaster risk perception serves as an initial foundation for building collaboration among actors in disaster risk reduction in Bintan Regency. Almost all informants share a similar view that Bintan Regency is a region with a relatively high level of vulnerability to various disaster threats, particularly hydrometeorological hazards. The most frequently mentioned types of disasters include floods,

strong winds or tornadoes, coastal abrasion, forest and land fires, storm surges, and maritime accidents.

The dominance of hydrometeorological disaster perceptions is influenced by the geographical condition of Bintan Regency as an archipelagic area surrounded by waters and characterized by extensive coastal zones. These conditions make hazards originating from weather changes, tidal fluctuations, and strong winds more strongly perceived by the community compared to geological hazards.

Informant I-01 (ASD), an academic and Chair of the Disaster Risk Reduction Forum of Bintan Regency, stated:

*“Most people only realize the potential disaster risks after experiencing their impacts directly.”*

This statement indicates that community risk perception tends to be reactive in nature. Awareness of the importance of mitigation has not yet been fully developed in a preventive manner.

This finding is reinforced by Informant I-14 (MA), a Malay customary community leader, who explained that the people of Bintan generally still perceive their region as relatively safe from major disasters such as earthquakes and tsunamis. However, they remain aware of maritime hazards such as storm surges, strong winds, and tornadoes, which frequently affect the livelihoods of fishing communities.

A similar view was also expressed by Informant I-21 (SN), a representative from the business sector of PT Tirta Madu, who emphasized that disaster risks not only affect communities but also impact business activities and the sustainability of operational infrastructure.

Overall, these findings indicate that collective disaster risk perception in Bintan Regency is shaped by a combination of empirical experience, geographical conditions, economic dependence on the environment, and the level of community disaster literacy.

### **Cross-Sector Coordination Patterns in Disaster Risk Reduction**

The findings of this study indicate that cross-sector coordination patterns in disaster risk reduction (DRR) in Bintan Regency are formed through both formal and informal mechanisms involving government, academia, business sector, media, and community actors. In the formal context, coordination is facilitated through the Disaster Risk Reduction Forum (FPRB), which serves as a shared platform for developing mitigation agendas, mapping risks, and building consensus among stakeholders. Meanwhile, in the informal context, coordination develops through field-based communication networks involving volunteers, community leaders, local media, and geographically based communities.

Most informants view the existence of FPRB as an important instrument in transforming previously sectoral coordination patterns into a more open and participatory system. Prior to the establishment of the forum, disaster coordination tended to operate in a fragmented manner according to the authority of each institution. However, following the establishment of the forum, interaction among actors began to develop within a more integrated space, particularly in disaster mitigation planning and preparedness stages.

Informant I-02 (RM), Head of the Disaster Management Agency (BPBD) of Bintan Regency, explained that BPBD plays a central role in coordination due to its institutional mandate as the leading sector in disaster management. This role includes risk mapping, facilitating the establishment of Disaster Resilient Villages, and integrating cross-sector programs within the regional disaster management system. This position indicates that the

coordination structure in Bintan Regency still relies on a centralized model that places the government as the main control center.

However, the findings also show that coordination does not only operate vertically through government structures but also develops horizontally through the involvement of non-government actors. Informant I-18 (RD), a community volunteer representative from the Scout Movement, explained that during emergency response situations, field coordination involves BASARNAS, the military, the police, and community volunteers who play a role in accelerating early information dissemination, evacuation processes, and victim handling. This finding indicates that operational coordination is more flexible and needs-based compared to formal coordination mechanisms.

In terms of resources, the study reveals that the business sector has begun to play a strategic role in supporting technical mitigation capacity. Informant I-21 (SN), a business sector representative, stated that corporate contributions are realized through the provision of heavy equipment for river dredging, opening firebreaks for forest and land fire prevention, and logistical support during disaster events. This involvement demonstrates the integration of material resources into the DRR coordination system, although contributions are still largely driven by situational needs.

On the other hand, the media plays a crucial role in building disaster risk communication systems. Informant I-25 (SA), a local media representative, explained that the media serves as the main channel for disseminating weather information, early warnings, and emergency updates to the public. In an archipelagic context such as Bintan, the speed of information distribution is critical because geographical conditions often hinder direct governmental response. Thus, the media functions not only as an information provider but also as a social coordination bridge between the government and the community.

The findings also indicate that coordination patterns in DRR in Bintan Regency vary across disaster phases. In the pre-disaster phase, coordination focuses on mitigation, education, and risk mapping, primarily dominated by government and academic actors. During the emergency response phase, coordination becomes faster, more flexible, and directly involves volunteers, security forces, and communities. In the post-disaster phase, coordination is directed toward socio-economic recovery and aid distribution involving government, business sector, and community actors.

Overall, these findings suggest that cross-sector coordination patterns in DRR in Bintan Regency have evolved toward a network governance model, where interactions among actors are no longer solely dependent on formal bureaucratic structures, but also on communication flexibility, resource distribution, and response speed across stakeholders. However, local government remains the dominant actor in determining coordination direction, indicating that strengthening the capacity of non-government actors is essential to achieve a more balanced and sustainable collaboration system.

### **Barriers to Collaboration in DRR Implementation**

Although cross-sector coordination in disaster risk reduction (DRR) in Bintan Regency has been established through the Disaster Risk Reduction Forum (FPRB) and various field-based coordination networks, the findings of this study indicate that the implementation of collaboration still faces a range of structural and operational barriers. These barriers not only affect the effectiveness of inter-actor cooperation but also directly impact response speed, resource distribution efficiency, and the sustainability of mitigation programs.

One of the most dominant barriers identified in the findings is sectoral ego. Most informants explained that although collaborative forums have been established, in practice there is still a tendency for dominance by certain actors, particularly government institutions

as formal authority holders. This dominance often places other actors in a complementary rather than equal partnership position in decision-making processes.

Informant I-01 (ASD), an academic and Chair of the Disaster Risk Reduction Forum of Bintan Regency, stated:

*“When one actor is too dominant, others tend to feel they do not have space to contribute.”*

This statement indicates that sectoral ego in DRR is not merely an inter-agency relational issue, but also closely related to power distribution within the collaboration system. When one actor becomes overly dominant, innovation, participation, and contributions from other actors tend to be constrained. In the long term, this condition may reduce the quality of collaboration, as relationships become more subordinative rather than participatory.

In addition to sectoral ego, another significant barrier is the limitation of technical regulations and operational procedures. Informant I-02 (RM), Head of the Disaster Management Agency (BPBD) of Bintan Regency, explained that while disaster management policies are formally available, not all types of disaster threats have detailed technical guidelines at the local level. This situation causes coordination processes to rely heavily on individual interpretations and situational decision-making in the field.

The absence of specific technical regulations has resulted in weak standardization of actions, particularly during emergency response phases. In several cases, unclear operational mechanisms have led to delays in task allocation, aid distribution, and resource mobilization. This issue is further emphasized by Informant I-25 (SA) from the media sector, who highlighted the absence of specific standard operating procedures (SOPs) for certain disaster types.

These conditions indicate that the main weakness of the system does not lie in the lack of actors involved, but rather in the immaturity of collaborative working instruments that regulate inter-actor relations at a more operational level.

Another significant barrier is data fragmentation across institutions. The study found that in several disaster events, data regarding the number of victims, level of damage, and affected areas were not always openly shared among actors. Each institution tends to maintain its own data system according to organizational needs.

This condition leads to data duplication, delays in information validation, and slow distribution of aid to affected communities. Data fragmentation also indicates that information integration within the DRR system in Bintan Regency is still not functioning optimally.

In addition to institutional barriers, the study also identifies community-level constraints, particularly low disaster literacy. Several informants noted that public awareness of mitigation remains limited, as disasters are often perceived as incidental events whose handling is fully the responsibility of the government.

This perception results in suboptimal community participation in pre-disaster phases, such as mitigation training, evacuation simulations, and risk mapping. In fact, within the DRR context, community involvement from the early stages is a crucial element in building community resilience.

Overall, the findings show that these barriers are interrelated. Sectoral ego weakens coordination, weak technical regulations create procedural uncertainty, data fragmentation slows response, and low community literacy limits social participation. Thus, the main challenge in implementing DRR collaboration in Bintan Regency is not the absence of forums or actors, but rather the quality of inter-actor relationships, system integration, information

openness, and strengthening collective capacity to build a more adaptive and sustainable disaster governance system.

### **Resource Distribution and Capacity Inequality Among Actors**

The findings of this study indicate that resource distribution within the Pentahelix model for disaster risk reduction (DRR) in Bintan Regency still reflects unequal capacities among actors. The government emerges as the most dominant actor due to its formal legitimacy, authority, budget allocation, and access to policy and institutional structures. This position places the Regional Disaster Management Agency (BPBD) as the main driving force across nearly all phases of disaster management, including mitigation, emergency response, and recovery.

In contrast, academics contribute through knowledge production, risk assessments, disaster research, and capacity building for communities through education and training. Informant I-27 (TKY), an academic and disaster researcher, emphasized that strengthening disaster literacy through formal education is a strategic step in building early community preparedness.

The business sector holds relatively strong capacity in material resources, particularly through the provision of heavy equipment, logistics, and funding via Corporate Social Responsibility (CSR) programs. Informant I-21 (SN), a business sector representative, stated:

*“Usually, the community or relevant stakeholders submit a request first. After the request is submitted, we respond and conduct an evaluation.”*

This statement indicates that business sector involvement remains largely responsive in nature and has not yet been fully integrated into disaster mitigation planning stages.

Meanwhile, communities possess strong social capital, such as mutual cooperation, community solidarity, and local wisdom practices. Informant I-14 (MA), a customary community leader, explained that traditions such as *tolak balak* and *semah kampung* are still maintained as forms of social and environmental balance preservation.

On the other hand, the media plays an important role in disaster information dissemination, public education, and early warning communication, although it faces limitations in material and operational resources.

Overall, these findings show that inequality in resource distribution among actors remains a challenge in building a more balanced collaboration system. The government and business sector possess stronger material capacities, while academia, communities, and media are stronger in knowledge, social networks, and information dissemination. This condition indicates that the effectiveness of collaboration depends heavily on the ability to integrate the comparative advantages of each actor in a proportional manner.

### **Dynamics of Power Sharing in the Pentahelix Collaboration**

One of the key findings of this study is the emergence of a power-sharing mechanism within the Pentahelix collaboration system for disaster risk reduction in Bintan Regency. The results show that disaster risk reduction is no longer perceived as the sole responsibility of the government, but rather as a collective responsibility involving all Pentahelix elements.

The distribution of roles reflects a functional division based on each actor's capacity. The government acts as the main coordinator and decision-maker, academia serves as knowledge provider and research-based recommender, the business sector supports material resources, the media functions as an information and public education channel, and communities act as local-level implementers.

Informant I-18 (RD), a community volunteer representative, explained that in field practice, role distribution has been relatively effective, particularly during emergency response phases. Collaboration between BPBD, BASARNAS, the military, police, and volunteers is considered capable of accelerating response and aid distribution to affected communities.

However, this distribution of roles has not yet been fully proportional. Informant I-27 (TKY), an academic and disaster researcher, noted that academic contributions to policy-making processes are still limited because research outputs have not been fully integrated into regional policy.

Meanwhile, Informant I-25 (SA), a local media representative, emphasized the importance of clearer operational systems to avoid overlapping roles in field implementation. This indicates that the lack of detailed structural arrangements in authority distribution may still lead to inefficiencies in collaboration.

Overall, the findings show that the power-sharing mechanism in the Pentahelix model in Bintan Regency has been established, but its implementation remains dynamic and continuously evolving. The stability of role distribution is still influenced by institutional capacity, resource access, levels of trust among actors, and the clarity of the coordination system in place.

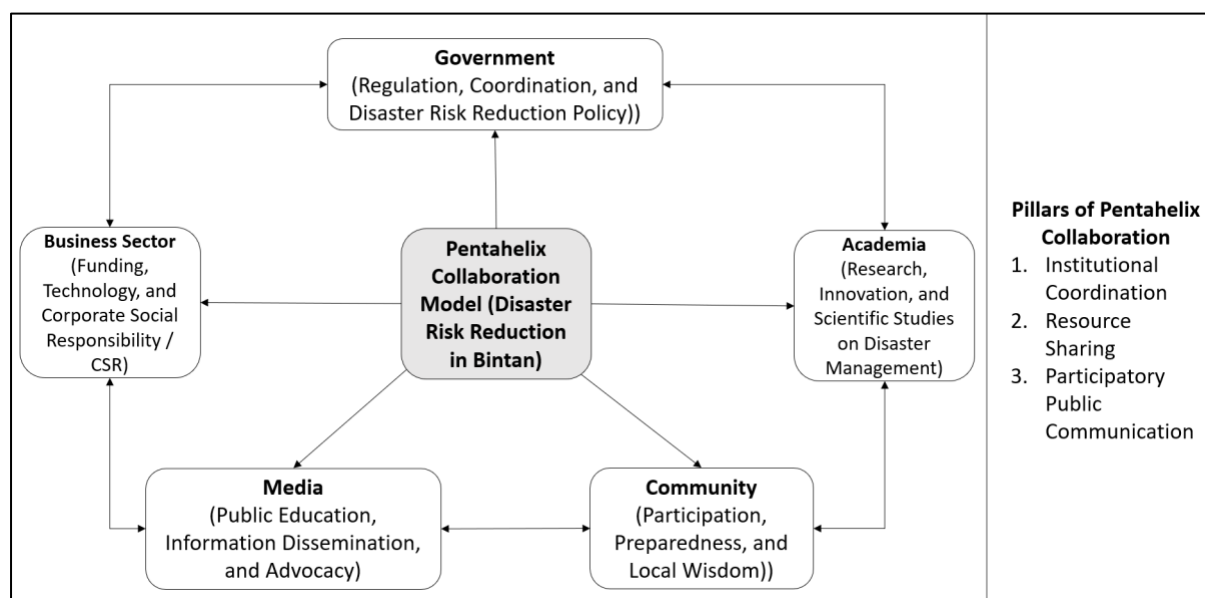


Figure 2. Pentahelix Collaboration Model  
Source: Author's Compilation, 2025

The figure above represents the construction of the Pentahelix collaboration model in disaster risk reduction in Bintan Regency which is developed based on data reduction, categorization, and thematic analysis of the study. The model illustrates an interdependent relationship among five main elements, namely government, academia, business sector, media, and community, which are interconnected within a single collaborative system.

In this model, the government plays a role as regulator, coordinator, and policy director in disaster management. Academia contributes through research, innovation, and strengthening knowledge capacity. The business sector provides support in material resources, technology, and funding through Corporate Social Responsibility (CSR). The media functions as an information bridge, public educator, and disseminator of early warning messages. Meanwhile, the community serves as the primary foundation for social participation, preparedness, and the strengthening of local wisdom in disaster mitigation.

The findings show that the effectiveness of this collaboration rests on three main pillars, namely institutional coordination, resource sharing, and participatory public communication. These three pillars serve as the main foundation for building a more adaptive, integrated, and sustainable disaster risk reduction system in Bintan Regency.

## 5. DISCUSSION

The research findings indicate that the implementation of the pentahelix model in disaster risk reduction (DRR) efforts in Bintan Regency emphasizes the principle of *sharing power* among actors. This principle represents a paradigm shift from the traditional bureaucratic model toward *collaborative governance*, in which all actors including government, business sector, academia, media, and the community hold equal positions in disaster policy decision making. This finding reinforces Jan Kooiman's thesis in (Stoker, 2004) which asserts that the complexity of public issues cannot be resolved through the sole capacity of the state but rather through multi actor interactions that are complementary in nature. Thus, governance in Bintan can be characterized as adaptive and network based rather than hierarchical.

These findings illustrate how the collaboration process operates dynamically. The government, through the Regional Disaster Management Agency (BPBD), still acts as the initiator and policy coordinator, yet its leadership is facilitative rather than dominant. This transformation aligns with the concept of *enabling government* (Masser et al., 2008), in which the government functions as a facilitator that creates participatory spaces for non-state actors. A concrete manifestation of this shift can be seen in the policy of disaster data transparency, the involvement of academics in the preparation of the Disaster Risk Assessment document, and cross-sectoral coordination through the DRR forum. Thus, the effectiveness of DRR in Bintan is no longer determined by vertical instructions but by the actors' ability to build networks, negotiate, and share resources.

Academics in this model act as knowledge brokers, bridging the gap between scientific evidence and practical policy (evidence-based policy). This role addresses the government's limited technical capacity in conducting disaster research. Through the contribution of academics, disaster risk reduction (DRR) policies become more data-driven and risk-informed. This finding reinforces the theory of knowledge co-production (Armitage et al., 2011), which emphasizes the importance of collaboration between researchers and policymakers to produce adaptive solutions to local challenges.

The business sector plays a dual role as both a financial supporter and a technological innovator. Their contributions through CSR reflect the concept of corporate citizenship (Matten & Crane, 2005), which views companies as social citizens responsible for their environment and communities. However, this study finds that CSR in Bintan remains responsive rather than proactive. In other words, contributions tend to arise only upon request, rather than from initiatives based on long-term risk analysis. This highlights the need to strengthen the governance capacity of the private sector through incentive policies and the integration of CSR programs into the Regional Medium-Term Development Plan (RPJMD).

Mass media function as both an information conduit and a public policy watchdog. In line with the theory of media functions in democracy (McQuail, 1994), the media in Bintan act as watchdogs and educators that promote transparency and enhance public disaster literacy. The presence of local media enables the process of public deliberation to take place, as disaster-related issues are reported intensively and educationally, compelling the government to be more responsive to early warnings and community reports.

Meanwhile, the community serves as the frontline actor in the disaster risk reduction (DRR) system. Local wisdom such as *gotong royong*, *tolak balak*, and *semah kampung*

functions as a source of social capital that strengthens community solidarity and preparedness. This finding confirms the theory of Community-Based Disaster Risk Reduction (CBDRR), which emphasizes the importance of community empowerment as the main pillar of DRR. In the context of Bintan, community-based action is not merely a complement to policy but serves as the foundation of social resilience.

Overall, the pentahelix model in Bintan demonstrates a synergistic integration that produces three main pillars of DRR effectiveness.

1. inclusive institutional coordination;
2. inter-actor resource sharing; and
3. participatory public communication.

This synergy distinguishes Bintan from other regions such as East Java (Khoirurrosyidin et al., 2021) where inter-actor relations remain top-down. Bintan demonstrates a form of horizontal governance, with local social capital serving as the differentiating factor.

### **Theoretical Implications**

Theoretically, these findings reinforce the concept of *collaborative governance* (Ansell & Gash, 2008) by adding a contextual dimension grounded in local wisdom and the social structure of archipelagic regions. This study also extends the understanding of the *pentahelix model* (Arfani, 2022) by demonstrating that the effectiveness of collaboration does not merely depend on the number of actors involved but also on the quality of social interaction and the level of *trust capital* among them. In this context, the study contributes to the development of a new conceptual framework of *adaptive collaborative governance*, a governance model capable of adapting to the socio-ecological conditions of coastal and island regions.

This research also synthesizes the theories of *corporate citizenship* (Matten & Crane, 2005) and *knowledge co-production* (Armitage et al., 2011) within a single pentahelix synergy model, where each element has a complementary function: government as a regulator, academia as a knowledge provider, business as a source of innovation and resources, media as an information disseminator and social watchdog, and the community as the foundation of collective action. Thus, this study provides a conceptual contribution in the form of an integrative model that combines both structural (governance) and cultural (local wisdom) approaches within disaster risk reduction studies.

### **Practical and Policy Implications**

Practically, the findings of this study provide three key recommendations. First, local governments need to strengthen cross-sectoral disaster risk reduction (DRR) forums as permanent coordination platforms among pentahelix actors. These forums can be institutionalized in the form of *Public–Private–Community Partnerships (PPCP)* that include mechanisms for resource sharing and annual collaborative evaluations. Second, corporate social responsibility (CSR) programs should be directed toward developing innovative mitigation measures and early warning systems based on information technology to become more proactive. Third, media and academia should be engaged in disaster literacy campaigns and in the development of community-based preparedness indicators.

In addition, the findings of this research can serve as policy input for BNPB and BPBD to develop national guidelines for implementing the pentahelix model based on local contexts. The Bintan model has the potential to be replicated in other archipelagic regions with similar disaster risks, such as Natuna or Karimun, with necessary adjustments to each region's socio-ecological characteristics.

## Comparative Insight

Compared to studies conducted in urban areas such as Surabaya (Khoirurrosyidin et al., 2021) and Bandung (Tunggali et al., 2019), the collaborative model in Bintan Regency demonstrates a distinctive characteristic, namely adaptive localized governance. Unlike urban contexts that tend to possess more established bureaucratic structures and institutional networks, collaboration in coastal regions like Bintan evolves through adaptive mechanisms rooted in local social practices and cultural values. This adaptiveness reflects the capacity of local actors including local governments, educational institutions, business entities, and community groups to construct governance arrangements that align with the environmental dynamics and resource constraints of archipelagic settings.

The main strength of the Bintan model lies in the integration of cultural values and the participation of coastal communities as a local knowledge system that reinforces the sustainability of collaboration. In this context, local knowledge functions not merely as a supplement but as the primary foundation for designing community-based disaster risk reduction strategies. This approach aligns with the ideas of (Armitage et al., 2011) regarding the importance of knowledge co-production in collaborative governance, where the interaction between science, policy, and local experience generates a continuous process of social learning.

Thus, the Pentahelix collaboration model in Bintan not only reinforces the theory of collaborative governance as proposed by (Ansell & Gash, 2008) but also extends it by offering a new, contextualized form of adaptation for Indonesia's archipelagic regions. This model demonstrates that the effectiveness of collaboration does not solely depend on formal structures or institutional capacity, but on the collective ability to integrate values, culture, and local wisdom into public policy practices. Therefore, the Bintan experience can serve as a conceptual reference for developing an island-based governance model that prioritizes cross-sector collaboration and is grounded in the socio-ecological characteristics of archipelagic areas.

## 6. CONCLUSION

Referring back to the objective of this study, which is to understand the dynamics and effectiveness of the Pentahelix model in disaster risk reduction (DRR) in Bintan Regency, this research concludes that the Pentahelix model has formed a relatively adaptive multi-stakeholder collaboration pattern in responding to the complexity of disaster risks in an archipelagic context. The findings indicate that disaster risk reduction in Bintan Regency is no longer understood as the sole responsibility of the government, but rather as a collective responsibility involving government, academia, business sector, media, and community within a single collaborative system.

This study finds that the effectiveness of Pentahelix collaboration is based on three main elements, namely institutional coordination, resource sharing, and participatory public communication. The government remains the dominant actor as the main regulator and coordinator, while other actors perform complementary functions according to their respective capacities. However, the effectiveness of collaboration is still constrained by sectoral ego, data fragmentation among actors, unequal resource distribution, and the suboptimal integration of academic knowledge into local policy.

From a theoretical perspective, this study strengthens the collaborative governance framework in disaster risk reduction by demonstrating that the Pentahelix model can function as an adaptive mechanism for building resilience in archipelagic regions. The findings emphasize that the success of collaboration is not only determined by the presence of actors, but also by the quality of interaction, distribution of roles, and integration of resources among those actors.

From a practical perspective, this study provides implications for local governments and stakeholders to strengthen the Disaster Risk Reduction Forum (FPRB), develop an integrated data system, clarify operational standards for collaboration, and enhance the participation of the private sector and communities in mitigation and preparedness phases.

This study is limited to the scope of Bintan Regency and does not yet measure the long-term impact of Pentahelix implementation on disaster risk reduction outcomes. Therefore, future research is recommended to conduct comparative studies across other archipelagic regions and evaluate the impact of collaboration on community resilience and the effectiveness of disaster management systems.

Thus, the Pentahelix model can be positioned as a strategic governance approach in disaster risk reduction in archipelagic areas, provided that it is supported by strong coordination, proportional role distribution, and sustained collaborative commitment.

### **Author Contribution**

Conceptualization and research design, Suherry; data collection and quality control, Alfi Husni; methodology and data analysis, Ferizone; research assistance in data collection, Azwan Rifa'i; data recapitulation and reduction, Muhamad Anugrahi Barus. All authors have read and approved the published version of this manuscript.

### **Acknowledgment**

The author would like to express sincere gratitude to the Directorate of Research and Community Service (DPPM), Directorate General of Research and Development, Ministry of Higher Education, Science, and Technology of the Republic of Indonesia, for the financial support provided through the Early Career Lecturer Research (PDP) scheme. This support has enabled the research to be carried out effectively, from the planning stage to the preparation of this scientific article.

Thanks are also extended to STISIPOL Raja Haji Tanjungpinang, the institution to which the author is affiliated, for providing various forms of support, both administrative and academic, including research facilities, scholarly guidance, and access to resources necessary during the research process. The assistance and facilitation provided by the institution played a significant role in the smooth and successful implementation of this study.

Furthermore, the author expresses deep appreciation to the Government of Bintan Regency and the informants from the government, academia, private sector, media, and local communities, who have willingly provided valuable data, information, and insights. Their active participation in in-depth interviews, focus group discussions, and the provision of supporting documents was crucial in ensuring that this study comprehensively reflects the dynamics of pentahelix collaboration.

Finally, the author acknowledges that without the cooperation, support, and engagement of these various stakeholders, the completion of this article would not have been possible. It is hoped that this research can contribute both theoretically and practically to the development of disaster risk reduction strategies and serve as a reference for future studies on multi-stakeholder collaboration in Indonesia's island regions.

### **Data Availability Statement**

All data supporting the findings of this study are available from the corresponding author upon reasonable request.

### **Conflict of Interest Declaration**

The authors declare no conflict of interest.

## REFERENCES

- Ahmad, F., & Arundina, R. (2020). Usulan Mitigasi Bencana Kota Bandung Dengan Pendekatan Penta Helix. *Setia Mengabdikan: Jurnal Pengabdian Kepada Masyarakat*, 1(2), 55–62. <https://doi.org/10.31113/setiamengabdikan.v1i2.7>
- Ansell, C., & Gash, A. (2008). Collaborative governance in theory and practice. *Journal of Public Administration Research and Theory*, 18(4), 543–571. <https://doi.org/10.1093/jopart/mum032>
- Arfani, M. (2022). Kolaborasi Pentahelix dalam Upaya Pengurangan Risiko Bencana pada Destinasi Wisata Di Desa Kalanganyar Sidoarjo. *Jurnal Syntax Transformation*, 3(01), 104–120. <https://doi.org/10.46799/jst.v3i1.497>
- Armitage, D., Berkes, F., Dale, A., Kocho-Schellenberg, E., & Patton, E. (2011). Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. *Global Environmental Change*, 21(3), 995–1004. <https://doi.org/10.1016/j.gloenvcha.2011.04.006>
- Auliya, A. (2025). Penerapan Nilai Dan Norma Global Melalui Model Penta-Helix Dalam Respons Terhadap Bencana Non-Alam: Studi Kasus Tragedi Kanjuruhan Dalam Perspektif Hubungan Internasional. *Jurnal Sosial Dan Sains*, 5(9), 6939–6945. <https://doi.org/10.59188/jurnalsosains.v5i9.32476>
- Bintan. (2024). *Peraturan Bupati Bintan Nomor 22 Tahun 2024 Tentang Rencana Penanggulangan Bencana Kabupaten Bintan*. Bintan: Pemerintah Kabupaten Bintan.
- BNPB. (2025). *Indeks Risiko Bencana Indonesia (IRBI) Tahun 2024*. Badan Nasional Penanggulangan Bencana. [https://www.bnpb.go.id/storage/app/media/Buku\\_BNPB/BUKU\\_IRBI\\_2024\\_BNPB\\_lowres.pdf](https://www.bnpb.go.id/storage/app/media/Buku_BNPB/BUKU_IRBI_2024_BNPB_lowres.pdf)
- Bonfanti, R. C., Oberti, B., Ravazzoli, E., Rinaldi, A., Ruggieri, S., & Schimmenti, A. (2024). The Role of Trust in Disaster Risk Reduction: A Critical Review. *International Journal of Environmental Research and Public Health*, 21(1). <https://doi.org/10.3390/ijerph21010029>
- BPBD. (2022). *Dokumen Kajian Risiko Bencana Kabupaten Bintan Tahun 2022-2026*. Bintan: Badan Penanggulangan Bencana Daerah Kabupaten Bintan.
- Centre, P. (2022). Study on Pentahelix Collaboration in Disaster Risk Management in Indonesia. *Final Report*, 1–9.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4 ed.). SAGE Publications.
- Emerson, K., Nabatchi, T., & Balogh, S. (2011). An Integrative Framework for Collaborative Governance. *Journal of Public Administration Research and Theory*, 2(June 2009). <https://doi.org/10.1093/jopart/mur011>
- Erokhin, D., & Komendantova, N. (2024). Social media data for disaster risk management and research. *International Journal of Disaster Risk Reduction*, 114(June), 104980. <https://doi.org/10.1016/j.ijdrr.2024.104980>
- Fransiska, L. (2019). Peran Perguruan Tinggi Dalam Penanggulangan Bencana Di Indonesia. *Journal Pendekatan Multidisiplin Ilmu Dalam Manajemen Bencana, Volume 1*, 5. <https://prosiding.respati.ac.id/index.php/PSN/article/view/47>
- Herdian, N., Marsono, & Hermawan, H. B. (2024). *Strategi Kerjasama Pentahelix Penelitian dan Pengembangan (Litbang) Alutsista dalam Pemenuhan Kebutuhan Pokok TNI (Studi Kasus di PT. Pindad - Bandung)*. 13(2), 214–226.
- Khoirurrosyidin, Nasution, R. D., Triono, B., & Hilman, Y. A. (2021). Dinamika Praktik

- Collaborative Government Di Bidang Kebencanaan Di Desa Ngabar Kecamatan Siman Kabupaten Ponorogo, Jawa Timur. *Jurnal Agregasi : Aksi Reformasi Government Dalam Demokrasi*, 9(2), 13–20. <https://doi.org/10.34010/agregasi.v9i2.5281>
- Kumar, D. (2022). Disaster Risk Management. *Knowledgeable Research*, 1(03), 69–75. <https://doi.org/10.57067/hva1tr46>
- Masser, I., Rajabifard, A., & Williamson, I. (2008). Spatially enabling governments through SDI implementation. *International Journal of Geographical Information Science*, 22(1), 5–20. <https://doi.org/10.1080/13658810601177751>
- Matten, D., & Crane, A. (2005). Corporate citizenship: Toward an extended theoretical conceptualization. *Academy of Management Review*, 30(1), 166–179. <https://doi.org/10.5465/AMR.2005.15281448>
- McQuail, D. (1994). *McQuail's Mass Communication Theory*. British Library Cataloguing in Publication data. <http://docshare04.docshare.tips/files/28943/289430369.pdf>
- Mukhlis, S. (2022). *Metodologi Penelitian Sosial*. Purbalingga: Eureka Media Aksara.
- Pasaribu, L. P., Apsari, N. C., & Sulastris, S. (2023). Kolaborasi Penta Helix Dalam Penanganan Pasca Bencana Gempa Bumi. *Share : Social Work Journal*, 13(1), 140. <https://doi.org/10.24198/share.v13i1.47909>
- Pelling, M. (2014). *Disaster Risk Reduction and Sustainable Development BT - Encyclopedia of Natural Hazards* (pp. 211–216). Springer, Cham. [https://doi.org/10.1007/978-3-319-04999-1\\_27](https://doi.org/10.1007/978-3-319-04999-1_27)
- Putra Pratama, J., Dewo, L. P., & Rahmat, H. K. (2024). Model Sinergitas Pentahelix dalam Rangka Pengurangan Risiko Bencana di Indonesia: Sebuah Tinjauan Pustaka. *Journal of Current Research in Disaster Response and Emergency Management E-ISSN: Xxxx-Xxx*, 1(1), 1–6.
- Ritonga, A. (2024). Tinjauan Kebijakan: Evaluasi Efektivitas Upaya Penanggulangan Bencana di Desa Ciwangi. *PUBLIKA : Jurnal Ilmu Administrasi Publik*, 10(1), 102–127. <https://doi.org/10.25299/jiap.2024.16404>
- Stoker, G. (2004). Review Essay: Governing as Governance by Jan Kooiman. *International Public Management Journal*, 7(3), 439–442.
- Sugiyono. (2024). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D Edisi Kedua*. Bandung: Alfabeta.
- Tunggali, A. P. P. W., Rasyid, E., & Rahmawati, W. (2019). Peran Komunikasi Pembangunan Media Massa dalam Proses Mitigasi Bencana di Indonesia. *Komunikasi Lingkungan Dan Komunikasi Bencana Di Indonesia*, 189. <http://eprints.ums.ac.id/85738/1/4>. Komunikasi Lingkungan dan Komunikasi Bencana di Indonesia.pdf#page=88