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The Influence of Adaptive Capacity and Participatory Governance on Community Preparedness for Flood Disasters

Rr Nafisa Alya Fathinnisa[1], Dewi Larasati *[2], Hanson E. Kusuma[3], Wahyuni Zahrah[4], Roiswahid Dimas Pangestu [2,5]

[1]*Master's Program in Architecture, School of Architecture, Planning and Policy Development, Institut Teknologi Bandung, Bandung, 40132, Indonesia*
[2]*Building Technology Research Group, School of Architecture, Planning and Policy Development, Institut Teknologi Bandung, Bandung, 40132, Indonesia*
[3]*Architectural Design Research Group, School of Architecture, Planning and Policy Development, Institut Teknologi Bandung, Bandung, 40132, Indonesia*
[4]*Department of Architecture, Faculty of Engineering, Universitas Sumatera Utara, Medan, 20155, Indonesia*
[5]*Doctoral Program of Architecture, School of Architecture, Planning and Policy Development, Institut Teknologi Bandung, Bandung, 40132, Indonesia*

*Corresponding Author: dewizr@ar.itb.ac.id

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ABSTRACT

Global climate change has increased the frequency and intensity of hydrometeorological disasters, particularly floods in urban areas of Indonesia. High settlement density, inadequate drainage systems, and limited community preparedness further exacerbate flood vulnerability. Although various flood mitigation strategies have been implemented, the relationship between mitigation effectiveness, perceptions of community participation, and community preparedness remains insufficiently examined through quantitative approaches, limiting the development of effective community-based interventions. This study analyses the influence of flood mitigation efforts—specifically adaptive capacity—and perceptions of community participation on community preparedness, measured through risk literacy and structural preparedness. A mixed-methods approach was applied, combining factor analysis to identify latent dimensions and linear regression to examine relationships between variables. Data were collected from questionnaires administered to residents with prior flood experience and analysed using JMP software. The results indicate that Adaptive Capacity has a positive and significant effect on Structural Preparedness ($\beta = 0.3930$; $p < 0.0001$) and Risk Literacy ($\beta = 0.3765$; $p < 0.0001$). The Governance dimension of participation also shows a positive and significant influence on Structural Preparedness ($\beta = 0.2499$; $p = 0.0170$). In contrast, the Environmental Action dimension exhibits a negative and significant relationship with Risk Literacy ($\beta = -0.3070$; $p = 0.0019$). These findings suggest that community preparedness is more strongly influenced by adaptive capacity and participatory governance than by physical environmental actions alone. The study highlights the need to integrate technical and social approaches and to strengthen risk literacy to enhance long-term community resilience to flood risks.

Keywords: adaptive, community, disaster, flood, participatory

1. Introduction

Global climate change has significantly increased the frequency and intensity of hydrometeorological disasters [1][2], including flood events that frequently affect urban areas in Indonesia [3]. High settlement density [4], land-use management challenges, and inadequate drainage systems—often compounded by widespread land subsidence—collectively exacerbate community vulnerability [5]. These conditions create serious challenges that disrupt social well-being, hinder economic activities, and damage infrastructure, thereby underscoring the urgent need for research aimed at understanding and enhancing community adaptation.

Despite the increasing implementation of community-based flood mitigation programs in Indonesia, recurring flood impact indicate that improvements in physical infrastructure and participatory initiatives do not always translate into higher levels of community preparedness [5][6]. In many urban areas, communities continue to experience significant losses despite the presence of mitigation efforts, raising questions about how preparedness is actually shaped at the community level [5]. This condition highlights the urgency of examining not only the existence of mitigation and participation, but also their effectiveness in strengthening different dimensions of community preparedness in the face of escalating climate-related flood risks [7].

Within the context of disaster risk management, improving community preparedness is a key strategy for minimizing losses and negative impacts caused by floods [6]. Recent studies in Indonesia have confirmed that active community involvement through Community-Based Disaster Risk Reduction (CBDRR) constitutes a crucial element in disaster management [8][9]. This approach has been shown to effectively strengthen resilience and adaptive capacity [10][11][12][13] by leveraging social capital as a fundamental pillar of resilience [14]. However, most CBDRR-related studies primarily emphasize qualitative insights into community engagement and social capital, with limited quantitative examination of how different participation mechanisms translate into measurable preparedness outcomes [11][12][15].

Flood mitigation efforts encompass a range of structural and non-structural measures designed to reduce disaster risks and impacts [7]. Structural measures include infrastructure development such as levees and drainage systems, while non-structural measures involve spatial planning policies, early warning systems, and community awareness enhancement [6]. The technical effectiveness of these measures is highly dependent on community perceptions and participation. Contemporary participation is no longer defined merely as physical involvement but as a collaborative process within governance and decision-making structures [16][17][18]. Meanwhile, community preparedness can be assessed through two primary dimensions: risk literacy, encompassing hazard understanding and risk perception [19][20], and structural or practical preparedness, referring to tangible actions and physical capacities [15]. While these frameworks clarify key dimensions of mitigation, participation, and preparedness, existing studies often examine these components in isolation—either focusing on technical mitigation measures or participatory processes. This separation limits empirical understanding of how mitigation efforts and community participation interact simultaneously to shape preparedness in urban flood contexts [14][17].

Although previous studies have extensively discussed the importance of mitigation and participation, a research gap remains in quantitative modelling that examines how specific dimensions of these factors simultaneously influence different aspects of community preparedness [21]. Most existing studies rely on qualitative assessments or conceptual discussions, or treat preparedness as a single aggregated outcome, which limits the understanding of how different forms of mitigation and participation shape distinct preparedness capacities [11][20][21]. Many studies focus on program effectiveness using qualitative approaches or treat preparedness as a single composite variable, while empirical investigations that disentangle these relationships within the context of urban flooding in Indonesia remain limited [22].

Therefore, this study is proposed to address the following research questions: (1) How do the dimensions of flood mitigation efforts (such as Adaptive Capacity) influence community preparedness, both in terms of Risk Literacy and Structural Preparedness? (2) How do the dimensions of perceived community participation (such as Governance and Environmental Action) affect these two preparedness dimensions?

In line with these questions, this study aims to quantitatively evaluate the influence of flood mitigation efforts and perceptions of community participation as independent variables on community preparedness for flood risks as the dependent variable. The findings are expected to contribute theoretically by enriching the literature on community-based disaster preparedness and practically by providing policy-relevant insights to support the development of more integrated and effective flood mitigation programs in the future. In addition, the findings are expected to inform urban flood management and community-based disaster risk reduction policies by identifying which forms of participation and mitigation efforts most effectively enhance preparedness.

2. Method

This study employed a mixed-methods approach with a modified sequential explanatory design [23]. The research process began with a qualitative exploration aimed at developing contextual understanding and constructing the research instruments, followed by a quantitative phase to statistically examine relationships among variables. This design was selected to integrate the depth of qualitative insights with the analytical rigor of quantitative testing, thereby providing stronger triangulation validity.

The qualitative phase served as a foundational step to ensure that the developed constructs and items were relevant to the lived experiences of flood-affected communities. Data were collected through open-ended questionnaires administered to 101 initial respondents as an exploratory sample. This instrument allowed participants to freely describe their experiences related to flood mitigation efforts, perceptions of participation, and preparedness for flood events without predefined response options. All responses were analysed using Conventional Content Analysis with an open coding technique [24][25]. The analysis involved identifying meaning units, assigning codes, and developing thematic categories that represent community behavior patterns and perceptions of flood risk. The thematic findings from this phase informed the development of five-point Likert scale items used in the subsequent quantitative phase.

The quantitative phase was conducted to test the relationships among variables derived from the qualitative findings. Data were collected through closed-ended questionnaires distributed to 208 respondents, all of which were returned; after completeness and reliability checks, 171 questionnaires were deemed valid for analysis. Respondents were selected using a combination of convenience sampling and snowball sampling to ensure the inclusion of individuals with direct flood experience [26]. All quantitative data were analysed using JMP software.

Statistical analysis was performed in two stages. First, Exploratory Factor Analysis (EFA) was applied to identify the underlying factor structure of the measurement items and to ensure that only valid and reliable dimensions were retained for further analysis. The initial sample size of 208 respondents was determined to ensure adequate statistical power for factor and regression analyses, in line with common recommendations for multivariate analysis requiring a minimum ratio of 5–10 respondents per observed variable [27]. After data screening, 171 responses met completeness and reliability criteria and were therefore retained for final analysis, ensuring robustness while maintaining acceptable sample adequacy. Principal component extraction with Varimax rotation was employed to facilitate factor interpretation. Second, Multiple Linear Regression analysis was used to examine the effects of the independent variables—flood mitigation efforts and perceptions of community participation—on the dependent variable, namely community preparedness, which encompasses risk literacy and structural preparedness.

As the study employed convenience and snowball sampling, potential sampling bias may exist, particularly in terms of overrepresenting respondents who are more engaged or accessible. However, this approach was considered appropriate given the study’s focus on flood-experienced communities, where random sampling is often constrained by accessibility and disaster-related displacement. The findings should therefore be interpreted within this contextual limitation.

Data collection was conducted between March – April, 2025. All participants were informed about the purpose of the study and provided voluntary consent prior to participation. Anonymity and confidentiality were ensured, and no personal identifying information was collected. The study adhered to ethical research principles for social research involving human participants.

By integrating qualitative and quantitative data, this study ensures that the analysis is not only empirical and measurable but also grounded in the social context of the community. This integrated approach is expected to produce more comprehensive findings and provide a robust scientific basis for developing more effective and sustainable flood mitigation strategies in urban areas.

3. Result and Discussion

3.1. *Qualitative Finding: Categories of Flood Mitigation Efforts*

The open coding analysis indicates that communities engage in various forms of flood mitigation, which can be grouped into structural, environmental, regulatory, social–community, waste management, and technology-based actions. Table 1 summarizes these categories along with their frequencies and representative respondent quotations. Overall, structural and environmental mitigation measures are the most dominant, as reflected by the high frequencies of Drainage and Water Channels (46), Infiltration and Water Storage Systems (25), and Greening and Conservation (31). Regulatory efforts such as Prohibitions on Littering (19) and Government Involvement (10) are also prominent, while categories such as Early Warning Systems (2) and technological innovations are mentioned less frequently. These findings indicate that communities tend to rely more on physical interventions and environmental management.

Table 1 Categories of Flood Mitigation Efforts Based on Open Coding Results.

Category	Sub- Category	Frequency	Examples of Respondent Quotations
Structural Mitigation	Drainage and Water Channels	46	"Regularly cleaning drainage channels to prevent blockages"
	Infiltration and Water Storage Systems	25	"Increasing water infiltration areas"
	Area Reinforcement	4	"Constructing terracing", "Repairing embankments", " Elevating houses"
Social–Community Mitigation	Community Participation	4	"Encouraging local residents to work together in regular community clean-ups of drainage channels"
	Education and Awareness	10	"Educating residents about the importance of environmental protection to prevent flooding"
Policy and Regulatory Mitigation	Regulations and Prohibitions	19	"Establishing regulations that prohibit littering "
	Spatial and Land-Use Control	4	"Improving urban spatial planning."

3.2. *Quantitative Finding: Categories of Community Participation Enhancement*

The open coding results indicate that the enhancement of community participation in addressing flood risks can be classified into several main groups, namely education, social collaboration, pro-environmental physical actions, technical support, and compliance with environmental policies. Table 2 summarizes these categories along with their frequencies and representative respondent quotations. Overall, the most prominent forms of participation are *gotong royong* (mutual- cooperation) (34) and collective work activities (*kerja bakti*) (12), followed by physical activities such as environmental actions including greening, cleaning, and hands-on practices (a total of 19), as well as waste management activities (9). In terms of capacity building, education (27), training (16), and outreach activities (6) demonstrate strong community engagement in strengthening local knowledge. In addition, participation is also reflected through community initiatives (1), community formation (4), and compliance with prohibitions and fines (3 and 2). These findings are significant as they reveal that community participation is multidimensional, encompassing social, educational, and environmental aspects.

Table 2 Categories of Community Participation Enhancement Based on Open Coding Results.

Category	Sub- Category	Frequency	Examples of Respondent Quotations
Education and Awareness	Training	16	"Being involved in greening programs" "Organizing joint greening initiatives"
	Education	27	"Providing education, particularly for affected residents"
	Simulation	1	"Conducting realistic simulation exercises to encourage preventive action"
	Socialization	6	"Organizing awareness campaigns on flood impacts"
	Awareness Raising	1	"Increasing public awareness regarding waste management"
	Awareness	1	"Introducing information on flood risk impacts in the coming years"
	Self-Awareness	2	"Community self-awareness"
	Mitigation Information	1	"Sharing engaging and interactive information on disaster mitigation"
	Campaigns	3	"Attractive campaigns: using social media, infographics, and interactive videos to communicate the importance of flood mitigation"
Incentives	Provision of Rewards	5	"Providing incentives for residents who actively contribute"
Policies and Regulations	Environmental Policies	2	"For example, requiring the installation of infiltration wells or prohibiting waste disposal into rivers"
	Prohibitions	3	"Strictly prohibiting illegal or unregulated development" "Prohibiting littering"
	Fines	2	"Imposing fines on individuals who dispose of waste into rivers or fail to maintain the environment"
Collaboration and Cooperation	Mutual Cooperation	34	"Through community mutual cooperation conducted once or twice a month on Sundays"
	Initiatives	1	"Self-initiated contributions to flood preparedness"
	Collective Work Activities	12	"Monthly community clean-up activities"
	Community Involvement	3	"Involving youth and schools in environmental programs"
	Community Formation	4	"Establishing community-based flood preparedness groups"
Technical Support	Provision of Equipment	1	"Providing equipment for use during flood events"
Pro-Environmental Physical Actions	Environmental Actions (Greening, Terracing)	14	"Organizing engaging activities, such as neighborhood cleanliness competitions" "Constructing terracing"
	Cleaning Activities	3	"Cleaning drainage channels"
	Practical Actions	1	"Hands-on preparedness practices for flood response"
	Waste Management Systems (Landfills, Recycling Programs)	9	“Hands-on preparedness practices for flood response”

3.3. *Quantitative Finding: Flood Mitigation Efforts*

The Exploratory Factor Analysis (EFA) results in Table 3 identify four latent components of flood mitigation: Adaptive Capacity, Ecological Resilience, Risk Control, and Environmental Management. The Environmental Management component provides the largest cumulative contribution (58.624%) to the variance. Based on the factor loadings, indicators such as waste management systems (0.613), environmental management (0.580), and regulations (0.518) show strong positive correlations within their respective factors. Notably, the indicator for preventing waste disposal in waterways exhibits a negative loading (–0.730). This negative sign is attributed to low response variance, as most respondents reached a consensus on this behavior, resulting in minimal analytical variation. Overall, these results indicate that structural and systemic factors, rather than individual actions, are the primary differentiators in the community's mitigation framework.

Table 3 Latent Variables of Flood Mitigation Efforts (Varimax Rotation).

	Adaptive Capacity	**Ecological Resilience**	**Risk Control**	**Environmental Management**
Mean	**3.136**	**3.160**	**3.795**	**4.295**
Standard Deviation	**0.917**	**0.925**	**0.897**	**0.545**
Cronbach Alpha	**0.762**	**0.588**	**0.452**	**0.579**
Eigenvalue	**2.454**	**2.160**	**1.885**	**1.707**
Cum. Percent	**17.531**	**32.961**	**46.427**	**58.624**
Community Participation	0.817	0.096	-0.052	0.041
Education and Awareness	0.753	0.228	0.109	0.145
Government Involvement	0.592	0.053	0.502	-0.053
Drainage and Water Channels	0.522	0.374	0.052	0.321
Technological Innovation	0.500	0.264	0.451	0.004
Area Reinforcement	0.147	0.709	0.048	0.134
Infiltration and Water Storage Systems	0.278	0.673	0.102	-0.067
Greening and Conservation	0.080	0.662	0.201	0.115
Spatial and Land-Use Control	-0.056	0.011	0.777	0.130
Early Warning and Monitoring Systems	0.294	0.260	0.655	0.111
Waste Management Systems and Infrastructure	0.245	0.203	0.111	0.613
Environmental Management	0.252	0.327	0.240	0.580
Regulations and Prohibitions	-0.044	0.349	0.504	0.518
Waste Prevention in Waterways	0.164	0.393	0.052	-0.730

3.4. *Quantitative Finding: Enhancement of Community Participation*

The factor analysis results for community participation enhancement identify four latent factors: Capacity Building, Environmental Action, Governance, and Active Awareness as shown in Table 4. Environmental Action emerges as the dominant factor, explaining the largest proportion of variance (38.532%). This factor is characterized by high loads on waste management (0.757), greening or terracing (0.672), and environmental cleaning (0.658). The Governance factor is primarily defined by the prohibition indicator (0.822), followed by risk awareness (0.561) and outreach activities (0.482). The Active Awareness factor includes indicators of increased awareness (0.698), self-awareness (0.672), and gotong royong practices (0.513). Lastly, the Capacity Building factor shows the highest reliability (α = 0.8692), with significant loadings on training (0.718), simulations (0.686), education (0.614), and mitigation information (0.667).

Table 4 Latent Variables of Community Participation Enhancement (Varimax Rotation).

	Capacity Building	Environmental Action	Governance	Active Awareness
Mean	**3.609**	**4.084**	**3.854**	**3.915**
Standard Deviation	**0.820**	**0.819**	**0.837**	**0.789**
Cronbach Alpha	**0.869**	**0.879**	**0.819**	**0.759**
Eigenvalue	**4.524**	**4.338**	**2.831**	**2.677**
Cum. Percent	**19.67**	**38.532**	**50.841**	**62.483**
P - Reward	0.725	0.345	-0.154	0.063
Training	0.718	0.304	0.122	0.166
Simulation	0.686	0.336	0.090	0.084
Campaigns	0.685	0.011	0.284	0.170
Mitigation Information	0.667	0.184	0.181	0.341
Education	0.614	0.228	0.262	0.195
Socialization	0.548	0.125	0.482	0.105
Fines	0.466	0.320	0.400	0.097
Waste Management Systems (Landfills, Recycling Programs)	0.197	0.765	0.306	0.074
Waste Management (Sorting, Recycling, Incineration, etc.)	0.189	0.757	0.161	0.101
Environmental Actions (Greening, Terracing)	0.358	0.672	0.127	0.093
Cleaning Activities	0.117	0.658	0.244	0.382
Practical Actions	0.387	0.646	-0.023	0.312
Provision of Equipment	0.458	0.508	0.331	0.152
Community Formation	0.387	0.486	0.210	0.304
Prohibitions	0.055	0.210	0.822	0.230
Environmental Policies	0.281	0.328	0.642	0.257
Awareness	0.291	0.029	0.561	0.530
Mutual- Cooperation	0.184	0.513	0.540	0.171
Awareness Raising	0.376	0.019	0.144	0.698
Self-Awareness	0.180	0.256	0.247	0.672
Initiatives	-0.076	0.402	0.287	0.641
Community Involvement	0.313	0.462	0.043	0.524

3.5. Quantitative Finding: Community Preparedness

The factor analysis for community preparedness identifies two latent dimensions: Structural Preparedness and Risk Literacy in Table 5. The Risk Literacy dimension explains the largest proportion of variance (54.673%). It is characterized by high factor loadings on flood warning sign recognition (0.771), evacuation actions (0.776), and asset management (0.711). The Structural Preparedness dimension, while explaining a smaller proportion of variance, shows strong concentrations on logistics mobilization (0.780), early warning technology (0.758), rapid information dissemination (0.745), and emergency response teams (0.730). Other indicators, such as policy-based environmental cleaning (0.577) and structured evacuation planning (0.458), show moderate to low loadings. Overall, these results indicate that the community's preparedness is more heavily weighted toward cognitive risk understanding than structural and coordinated response mechanisms.

Table 5 Latent Variables of Community Preparedness (Varimax Rotation).

	Structural Preparedness	Risk Literacy
Mean	**3.419**	**3.781**
Standard Deviation	**0.939**	**0.777**
Cronbach Alpha	**0.896**	**0.726**
Eigenvalue	**4.989**	**2.664**

	Structural Preparedness	Risk Literacy
Cum. Percent	**35.639**	**54.673**
Resource Mobilization – Logistics Support	0.780	0.035
Early Warning – Technology	0.758	0.290
Early Warning – Rapid Information	0.745	0.216
Resource Mobilization – Equipment	0.735	0.172
Resource Mobilization – Emergency Response Team	0.730	0.085
Emergency Response Plan – Simulation	0.711	0.343
Policy – Risk Reduction	0.703	0.019
Early Warning – Awareness of Warning Signs	0.678	0.266
Policy – Environmental Cleaning	0.577	0.237
Knowledge – Evacuation Procedures	0.179	0.776
Knowledge – Flood Indicators	0.012	0.771
Knowledge – Asset Storage	0.100	0.711
Emergency Response Plan – Evacuation	0.458	0.559
Knowledge – Communication Networks	0.368	0.486

3.6. Multivariate Regression Analysis Results: Determinants of Community Preparedness

The multivariate regression analysis was conducted to identify the determinants of Risk Literacy and Structural Preparedness. Table 6 summarizes the regression coefficients, significance levels, and R-square values for both models. The results indicate that Adaptive Capacity is the most consistent and significant predictor for both Risk Literacy (β = 0.3765, $p < 0.01$) and Structural Preparedness (β = 0.3930, $p < 0.01$). In contrast, Environmental Action shows a significant negative effect specifically on Risk Literacy (β = -0.3070, $p < 0.01$), while having no significant impact on Structural Preparedness. Furthermore, Governance emerged as a significant predictor only for Structural Preparedness (β = 0.2499, $p < 0.01$). Other variables, including Ecological Resilience, Risk Control, and Environmental Management, did not show statistically significant effects in either model.

Table 6 Results of Multivariate Regression Analysis on Community Preparedness.

Dependent Variables / Independent Variables	Risk Literacy		Structural Preparedness	
		0.34		0.28
		<.0001		<.0001
	β	Pvalue	β	Pvalue
Environmental Action	**-0.3070**	**0.0019**	-0.0946	0.3765
Capacity Building	0.1189	0.1734	0.0495	0.6041
Governance	0.1307	0.1689	**0.2499**	**0.0170**
Active Awareness	0.0488	0.5944	0.0138	0.8904
Adaptive Capacity	**0.3765**	**<.0001**	**0.3930**	**<.0001**
Ecological Resilience	0.1047	0.1811	0.0798	0.3511
Risk Control	0.0639	0.4122	-0.0760	0.3730
Environmental Management	0.1311	0.0972	0.0246	0.7755

The interrelationships between these variables are further visualized in Figure 1 and Figure 2. Figure 1 presents a comparative diagram of the β coefficients, highlighting the dominance of Adaptive Capacity. Figure 2 provides a path diagram illustrating the direct effects and the disparity between physical environmental actions and cognitive/structural preparedness.

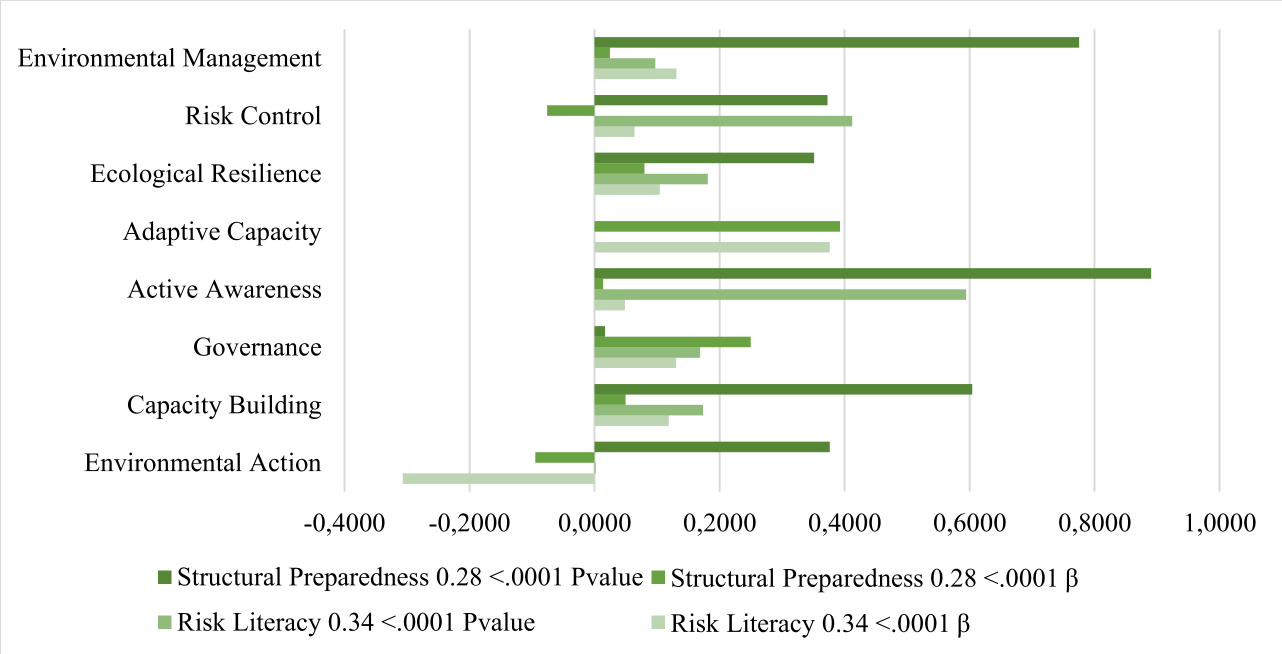

Figure 1 Comparative Diagram of β Coefficients for Each Variable.

3.7. Discussion and Analysis

This section synthesizes the qualitative and quantitative findings to provide a deeper interpretation of the factors shaping community flood preparedness, by integrating the open coding results, factor analysis, and regression outcomes presented in the previous sections.

The Paradox of Environmental Action and Risk Literacy

One of the most critical findings of this study is the significant negative effect of Environmental Action on Risk Literacy. Although qualitative results presented in Table 1 indicate that communities are highly active in physical mitigation measures such as drainage cleaning, greening, and environmental maintenance, these actions do not necessarily translate into stronger cognitive preparedness. This condition reflects what has been described as behavioral superficiality, in which visible pro-environmental participation becomes routine and symbolic without enhancing deeper understanding of disaster risk [28].

This pattern is consistent with findings from earlier studies showing that repeated exposure to flood events does not automatically improve preparedness knowledge, as experiential learning often remains informal, fragmented, and poorly institutionalized [29]. Communities in the study area tend to frame flooding primarily as a technical–physical problem that can be addressed through direct interventions in drainage systems, rather than as a systemic risk requiring anticipatory decision-making and structured preparedness.

From a behavioral perspective, preparedness actions are influenced not only by risk knowledge but also by perception, interpretation of information, and social cues. The Protective Action Decision Model emphasizes that individuals may engage in protective behavior without fully internalizing hazard information if actions are driven by habit or social expectations rather than informed risk assessment [30]. Consequently, intensive engagement in environmental activities may generate a false sense of security, leading residents to underestimate the importance of early warning systems, evacuation planning, and formal risk communication mechanisms.

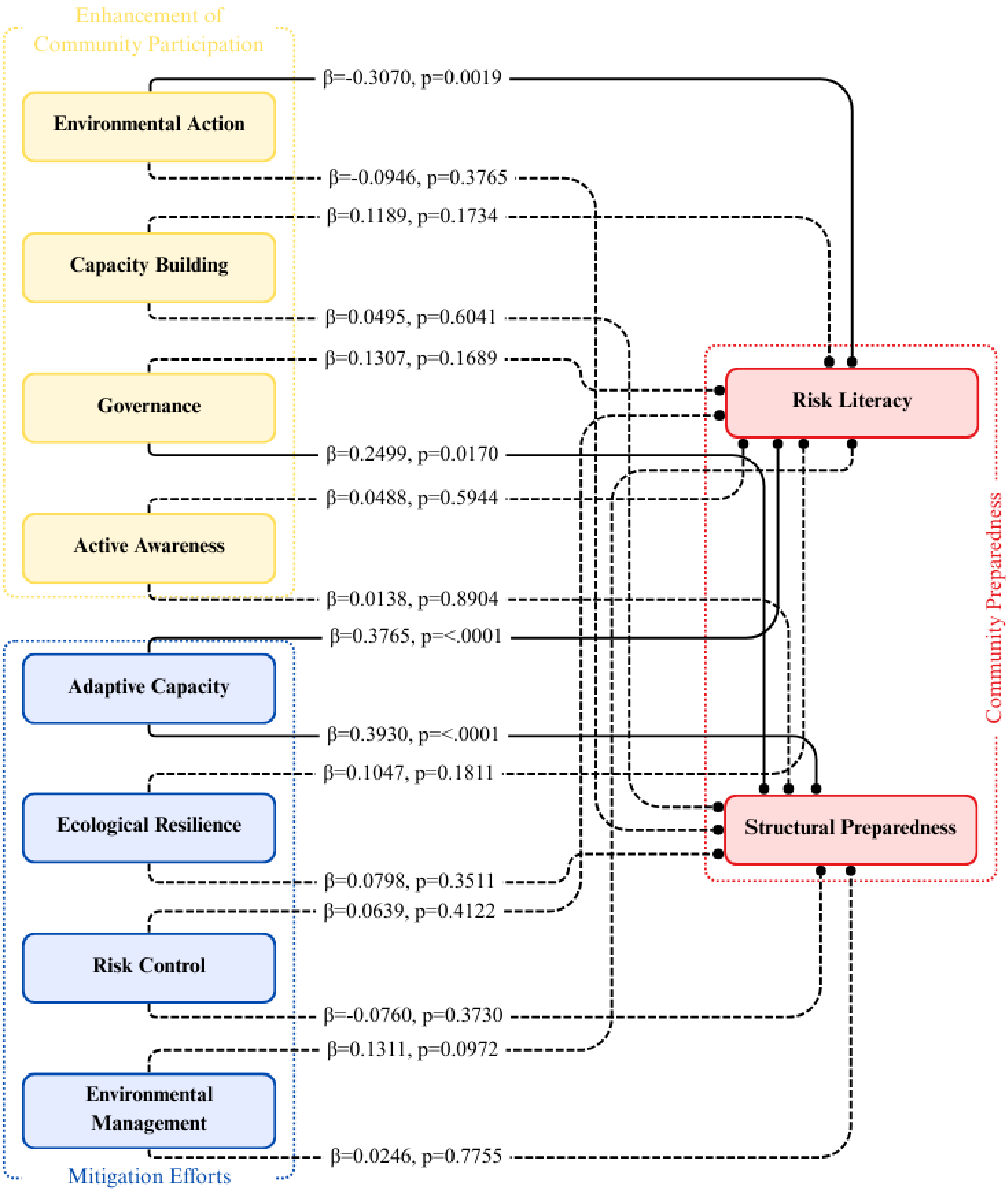

Figure 2 Path Diagram of Intervariable Effects on Risk Literacy and Structural Preparedness.

Social Capital, Gotong Royong, and Governance

The findings confirm that collective action—particularly *gotong royong* and *kerja bakti*—remains the primary mechanism through which communities respond to flood threats, as shown in Table 2. This reflects strong bonding social capital, which has been widely recognized as a key contributor to collective resilience, trust, and mutual support in disaster-prone communities [31][32][33][34][35][36]. Such practices are effective because they are easily mobilized, culturally embedded, and capable of producing visible outcomes in a short period.

However, prior research cautions that strong bonding social capital alone is insufficient to address structurally embedded flood risks, particularly in urban areas where vulnerability is shaped by socio-economic inequality, land-use pressures, and governance constraints [37][38]. Without institutional support, collective action tends to remain reactive and limited to short-term responses rather than contributing to long-term preparedness.

This limitation is clearly reflected in the regression results presented in Table 6, which show that Governance is the only variable with a significant positive effect on Structural Preparedness. This finding indicates that while informal social networks are robust, they require clear regulatory frameworks, coordination mechanisms, and institutional leadership to translate collective effort into structured preparedness outcomes. Similar conclusions have been emphasized in studies on disaster risk governance, which argue that effective preparedness depends on the alignment of community initiatives with formal institutions capable of managing systemic and cross-sectoral risks [39][40][41][42].

The Gap Between "Knowing" and "Doing" in Global South Context

An imbalance in community preparedness is evident in the study area: relatively high levels of risk literacy are not matched by equally strong structural preparedness. As shown in Table 5, communities demonstrate adequate cognitive awareness—such as recognizing flood warning signs and understanding evacuation actions—yet lack the institutional resources, infrastructure, and technological systems required for coordinated emergency response.

This “knowing but not doing” gap is characteristic of disaster-prone urban areas in the Global South, where individual adaptive capacity often develops faster than institutional and infrastructural capacity [38]. Similar patterns have been identified in participatory flood risk management studies, where high awareness does not lead to institutionalized preparedness due to limited access to formal support systems and governance mechanisms [43].

These findings reflect broader challenges in disaster risk governance, where resilience is frequently framed at the individual or community level rather than embedded within coordinated, multi-level institutional arrangements [44]. As a result, preparedness remains uneven, with strong cognitive preparedness but weak system-based response capacity.

Synthesis of Determinants for Sustainable Preparedness

The path diagrams illustrated in Figure 1 and Figure 2 clarify that Adaptive Capacity constitutes the core foundation of community resilience, influencing both cognitive (Risk Literacy) and structural dimensions of preparedness. This finding aligns with resilience theories emphasizing that the ability to learn, adapt, and respond to changing risk conditions is central to sustainable disaster preparedness [14][45].

The relatively marginal effects of Ecological Resilience and Environmental Management in the regression model suggest that technical and environmental controls alone are insufficient unless they are internalized through education, supported by governance structures, and reinforced by social coordination [38], [46]. Ultimately, sustainable flood preparedness cannot rely solely on symbolic physical activities. It requires the integration of three interconnected layers: physical environmental actions, institutional strengthening through governance, and continuous capacity building through education and training [44].

This integrated perspective is consistent with ecosystem-based disaster risk reduction approaches, which emphasize the interdependence between environmental management, institutional capacity, and social learning processes in achieving long-term resilience [47]. It also aligns with polycentric governance theory, which highlights that resilience emerges from interactions among multiple actors operating across different decision-making scales [48].

3.8. Research Limitations & Implications

This study acknowledges several limitations that should be considered when interpreting the results. First, data collection relied on a non-random snowball sampling approach, which may limit the generalizability of the findings beyond the studied context [29]. Second, the use of self-reported perceptions from interviews and surveys introduces the potential for social desirability bias, as respondents may overstate positive environmental behaviors. Third, the cross-sectional design captures community preparedness at a single point in time and does not account for long-term behavioral or institutional changes.

Despite these limitations, the findings offer important implications for disaster risk reduction (DRR) strategies. The observed negative relationship between environmental action and risk literacy confirms a persistent gap between pro-environmental behavior and cognitive preparedness [28]. This suggests that DRR interventions should move beyond promoting physical gotong royong alone and instead integrate structured risk education, simulations, and formal communication strategies to prevent the emergence of a false sense of security [44], [47].

Furthermore, the significant role of governance in shaping structural preparedness underscores the importance of strengthening local regulations, policy coordination, and institutional capacity to support community initiatives [48][49]. Without complementary institutional strengthening, intensive community-based physical engagement may reinforce perceptions of safety that are not supported by actual response capacity, a condition frequently observed in disaster-prone urban environments [37][38].

These findings reinforce the need for balanced DRR strategies that integrate social capital, formal governance mechanisms, and adaptive capacity development. Such integration is essential to shift from reactive, behavior-based responses toward sustainable flood preparedness that is both cognitively informed and structurally supported [34][35][44][50].

4. Conclusion

This study demonstrates that community preparedness for flood risk is not merely the outcome of physical mitigation efforts, but a function of how adaptive capacity, governance, and risk understanding are integrated at the community level. The findings highlight that preparedness is shaped less by the presence of mitigation activities alone and more by the ability of communities to interpret risk information, coordinate collective actions, and adaptively utilize available resources. This underscores the importance of viewing preparedness as a multidimensional and governance-sensitive process rather than a purely technical or infrastructural outcome.

From a policy perspective, the results suggest that local governments should prioritize strengthening adaptive capacity and governance mechanisms alongside physical flood mitigation investments. Policies that focus solely on infrastructure development without embedding risk education, coordination mechanisms, and institutional support may fail to enhance community preparedness effectively. Integrating preparedness indicators into local disaster risk management frameworks and urban resilience strategies could help ensure that mitigation efforts translate into tangible preparedness at the household and community levels.

For urban planners and practitioners, the findings imply that flood mitigation programs should be designed as integrated socio-technical interventions. Environmental actions such as drainage maintenance or river cleaning should be systematically linked with community learning processes and participatory governance structures. This integration is essential to avoid situations where physical engagement does not contribute to improved risk literacy. Urban flood planning should therefore move beyond spatial and engineering solutions toward approaches that align physical design with community capacity-building.

This study is not without limitations. The use of non-random sampling may limit the generalizability of the findings, and the cross-sectional design does not capture changes in preparedness over time. Future research could address these limitations by employing longitudinal approaches to examine how adaptive capacity and governance evolve, as well as by integrating geospatial analyses to explore the interaction between physical flood exposure, social networks, and preparedness dynamics. Such approaches would further support the development of context-sensitive and evidence-based flood mitigation strategies.

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6. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. The research was conducted objectively and independently, without any financial, institutional, or personal relationships that could have influenced the results or interpretations presented in this study.

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