A COMMUNITY-BASED COLLABORATIVE GOVERNANCE MODEL FOR URBAN FLOOD RISK MITIGATION: A CASE STUDY FROM PALEMBANG, INDONESIA

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Highlight

The study empirically demonstrates that collaborative governance and community participation significantly enhance the effectiveness of flood risk mitigation policies in Palembang. A conceptual model is proposed to inform adaptive, participatory, and cross-sectoral approaches to urban disaster governance.

Abstract

Flooding in urban areas, including Palembang, is a serious environmental problem, triggered by poor land use and ineffective flood management strategies. This study aims to evaluate government policies in flood risk mitigation, assess community participation and collaboration between institutions, and develop a mitigation policy model based on collaboration and community participation in the city of Palembang. The study used a mixed quantitative and qualitative approach to analyze the impact of collaboration between governments, communities, and stakeholders, as well as the role of community participation in flood mitigation efforts. Data collection is done through surveys, in-depth interviews, documentation, and observation. The results show that collaboration and community involvement have a significant positive impact on the effectiveness of flood mitigation policies. However, there are obstacles such as weak coordination, limited resources, and complex bureaucracy. The implications of the study emphasize the importance of an integrated approach that includes policy innovation, community participation, and institutional collaboration to create sustainable flood mitigation. The proposed policy Model is expected to improve the resilience of the city of Palembang to the risk of flooding in the future.

Keywords

Collaborative Governance, Community Participation, Flood Risk, Urban Planning.

Introduction

Urban flooding has become a pressing environmental problem, significantly impacting cities around the world, especially in developing countries such as Indonesia. Floods not only disrupt urban infrastructure but also affect the socio-economic stability of people, especially those living in low-lying areas. In cities such as Palembang, where geographical conditions cover vast lowland areas prone to flooding, this problem is exacerbated by natural factors and human activities. Research by Azra [1] explains that environmental damage is largely due to human behavior, where nature is seen as a resource that can be exploited for human benefit, leading to unsustainable practices and worsening environmental conditions. The situation in Palembang is aggravated by uncontrolled land use changes, resulting in a reduction in natural water catchment areas such as swamps, which are increasingly being converted into residential and commercial areas. According to data from the Palembang Public Works Office, significant land conversion of up to 25.74% between 2000 and 2020 has been the main cause of flooding problems in the city, with 38 flood-prone points identified in 2020 alone. Plus, poor waste management, especially along riverbanks, leads to clogged drainage systems. [2]. The trend of the collaborative model in

government, which is based on community participation to address flood problems in Palembang city, has shown significant development. Collaboration between governments, communities, and various other stakeholders is the key to effective flood risk management. Research shows that a collaborative approach can increase trust and commitment among stakeholders, which in turn strengthens a shared understanding of the issues at hand [3]. In the context of Palembang, this cooperation is very important to formulate sustainable and inclusive strategies [4]. Community participation is also an important aspect of this collaborative model. Through the active involvement of communities in the decision-making process, they can contribute to the identification of problems and more appropriate solutions [5]. Collaborative models have also been shown to provide greater opportunities for local communities to access and manage resources that can be applied in the context of flood management [6]. In addition, research shows that community participation in flood risk management can increase awareness and preparedness for disasters. This trend also includes the use of data-driven and technological approaches to support decision-making. Two-dimensional hydrodynamic models, for example, have been used to assess flood risk and plan more effective mitigation actions [7]. By utilizing geospatial data and monitoring technology, governments and communities can better understand flood patterns and respond to them with appropriate action [8]. This is particularly relevant in Palembang, where drainage infrastructure is often inadequate to handle large volumes of water due to heavy rains [9].

Collaborative governance ensures that local actors not only contribute to policy formation but also reduce the capacity to implement contextually relevant and sustainable solutions in the long term [10]. Flood mitigation in Palembang is critical given the city's geographic vulnerability and the increasing frequency and intensity of floods. The urgency to address this problem was affirmed by the Meteorology, Climatology and Geophysics agency (BMKG), which recorded the highest level of rainfall in Palembang in 2023, contributing to heavy flooding throughout the low-lying areas of the city[11]. These floods not only disrupt daily life but also hamper economic activities and pose public health risks, particularly through the spread of waterborne diseases in affected communities [12]. In addition, current urban flood mitigation infrastructure, including retention ponds and drainage systems, is proving inadequate at managing increasing volumes of stormwater, exacerbated by urbanization and poor land-use planning. According to Alia et al. [13], the city's reliance on traditional engineering solutions, such as pumping stations and drainage networks, has not been able to keep up with growing environmental pressures. Therefore, an innovative, community-based approach is needed that leverages collaborative governance to improve cities ' resilience to flooding [14]. The city of Palembang faces severe flooding, caused in part by the loss of natural catchment areas and the degradation of river systems due to rapid urbanization. Between 2000 and 2020, Palembang experienced a drastic reduction in wetland area, which was replaced by commercial and residential development, increasing flood-prone points throughout the city. [15]. The resulting floods had an impact on urban mobility and the local economy as key infrastructure such as roads and markets were flooded [16]..As a lowland city with many swamps and high rainfall, Palembang is included in the 20 flood-prone cities in Indonesia [17]. Data from the Public Works Office shows that there are 66 priority flood mitigation points, especially in watersheds affected by land changes by 25.74% between 2000 and 2020. In 2020, 38 flood locations were recorded in the watershed, with inundations of 20-70 cm for 2-8 hours, caused by swamp reclamation and reduced green open space [18]. Regular floods soak settlements and main roads, such as at the Simpang Regional Police Dam, whenever heavy rains hit the city.[19]

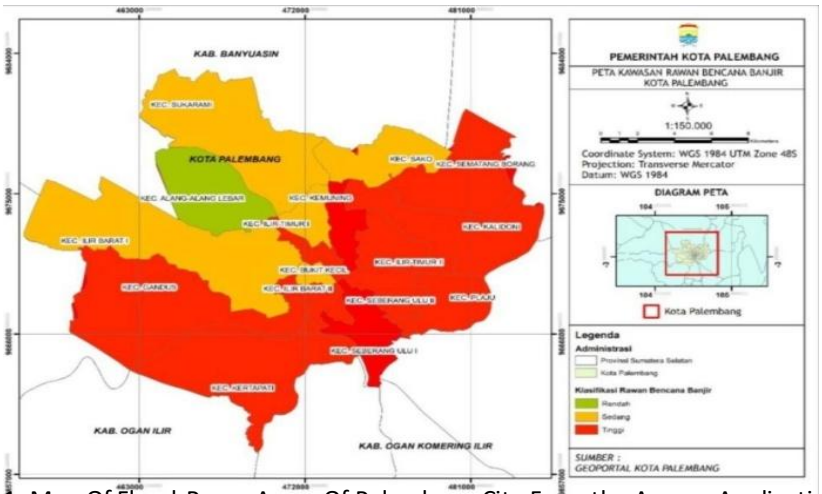

Figure 1. Map Of Flood-Prone Areas Of Palembang City From the Avenza Application

Based on various identification problems that have been described above, namely geomorphologically Palembang is a lowland with an average height of 8 m above sea level, which mostly consists of swamps and rivers, the city of Palembang including areas with high rainfall in certain months, poor drainage system conditions, people's behavior to throw garbage into the river, people's behavior to erect buildings and, land changes of 25.74% during 2000-2020 have caused some areas in the river to experience flooding, people's behavior to dispose of waste in the River area and policies issued by the government related to inappropriate land use. Then the formulation of the problem posed by researchers is how the Flood Risk Mitigation Policy Model is based on collaboration and community participation in the city of Palembang, and how the influence of community participation and institutional collaboration in flood risk mitigation in the city of Palembang.

This study is very important because it aims to know how the policies made by the government related to flood risk mitigation, how community participation and institutional collaboration on flood risk mitigation in Palembang, and how the Flood Risk Mitigation Policy Model is based on collaboration and community participation in Palembang. The problem of flooding is an interesting thing to study because flooding is a problem that, until now, still requires special handling from various parties, both from the government and the community. Flooding is not a mild problem because flooding can cause various risks, including environmental damage, casualties, material damage, people attacked by various diseases (skin diseases, diarrhea, and others), damage to buildings, the density of economic activities of residents, holes, and even trauma experienced by residents, and others.

Research Novelty

Research Novelty The scientific study of flood policy has developed rapidly in the last seven years, as seen from a bibliometric analysis of 300 international articles using VOSviewer. The mapping results show that there are five main clusters of keywords, with a dominant focus on technocratic Flood Risk Management, Development Policy integration, resilience-based policy evaluation, and Community Adaptation and vulnerability issues. However, aspects of community participation and cross-actor collaboration still lack attention. Therefore, this study offers a flood risk mitigation policy model that is based on collaboration and active participation of the community. This Model shifts the top-down approach towards a collaborative governance paradigm, involving governments, civil society organizations, and local communities in the flood mitigation process in an inclusive, adaptive, and sustainable manner.

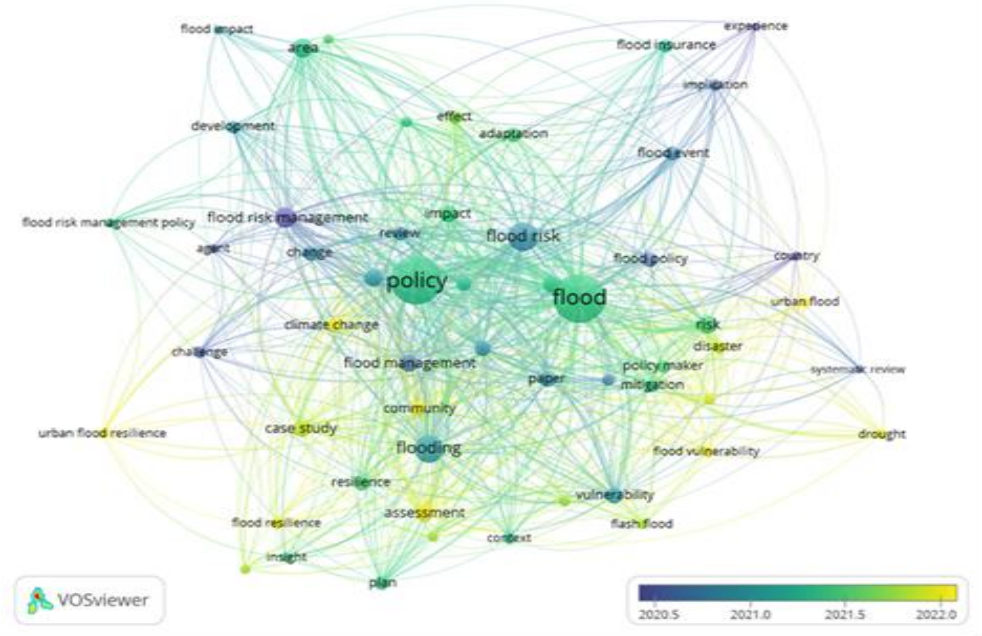

Figure 2: Visualization of 300 articles with VOSviewer analysis

Visualization of 300 articles around the world from 2018-2025 that examine flood policy from sources such as Scopus, Scimago, Elsevier, Wiley and Francis, Springer, obtained from Publish or Perish with VOSviewer analysis.

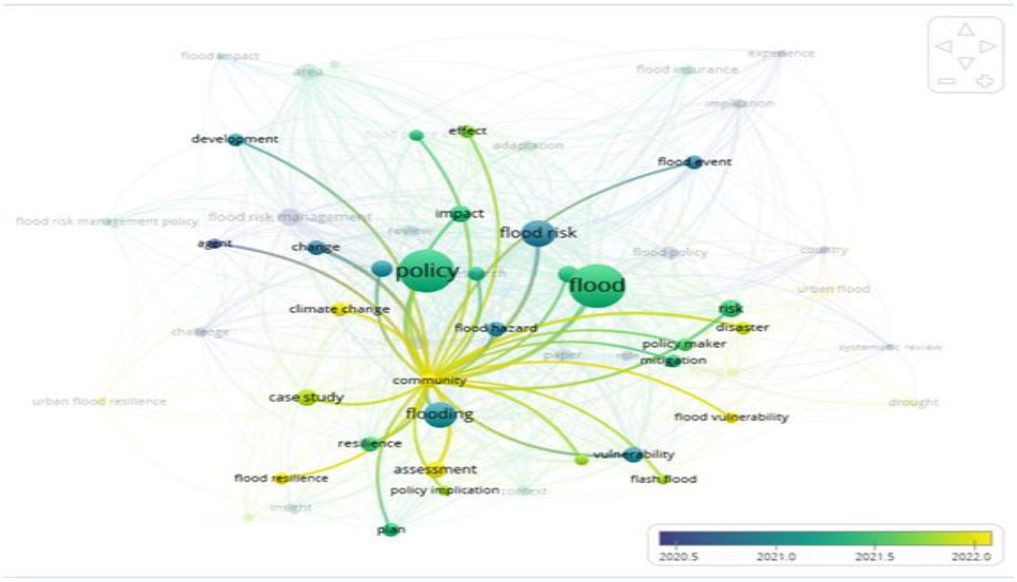

Figure 3. Visualization of Novelty with VOSviewer analysis

In the network picture above, it can be seen that flood and policy studies are not studied simultaneously. The emerging study Trend is precisely the community-based flood study starting in 2022. The novelty of this research connects several studies that so far have not been related to each other, namely the study of flood habits, risk mitigation, and community participation-based studies in the form of a community. When seen in the picture all of these studies have never been discussed simultaneously, but discussed each, while this research discusses all of these components to produce a study of flood risk mitigation policy model based on community participation. In addition to that, in the picture above, it can be seen that there have been no studies that use a collaborative approach. While this study, in addition to discussing the study of community participation in flood risk mitigation policies, also uses a collaborative approach.

Materials and Methods

3.1 Research Design

This study employs a mixed-methods approach, combining quantitative and qualitative methodologies to examine the relationship between collaborative governance and community participation in urban flood risk mitigation. The quantitative phase utilizes Structural Equation Modeling (SEM) with Partial Least Squares (PLS) to analyze causal relationships between variables, while the qualitative phase provides descriptive insights supported by thematic analysis using NVivo software.

3.2 Variables and Conceptual Framework

The study focuses on two primary variables:

- Independent Variable (X): Collaborative Governance — representing government-led initiatives and multi-stakeholder collaboration in flood mitigation.
- Dependent Variable (Y): Community Participation — reflecting public engagement and involvement in flood risk governance.

The conceptual framework is grounded in William N. Dunn's policy analysis theory, emphasizing indicators such as effectiveness, efficiency, adequacy, alignment, and responsiveness.

3.3 Sample and Sampling Technique

The target population comprises 210 community members from flood-prone areas in Palembang, Indonesia. To determine the appropriate sample size, the Cochran formula for finite populations was used with a 95% confidence level and 5% margin of error:

First Step: Calculate the Sample for an Unlimited Population. Cochran's basic formula for infinite populations is:

$$n_0 = \frac{Z^2 . P . (1 - P)}{e^2} \quad (1)$$

With the following information:

- Z = 1.96 (for a 95% confidence level)
- P = 0.5P (assumed population proportion)
- e=0.05 (5% margin of error)

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Substitute these values into the formula:

$$n_0 = \frac{(1.96)^2 \, x \, 0.5 \, x \, (1-0.5)}{(0.05)^2}$$

$$n_0 = \frac{3.8416 \, x \, 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16 \quad (3)$$

So, the sample size for an unlimited population is 384.16 (rounded to 384).

Second Step: Calculate the Sample for a Limited Population. Because the known population
There are 210 people; we need to adjust the sample size using the formula for a finite population:

$$n = \frac{n_0}{1 + \left(\frac{n_0 - 21}{N}\right)} \quad (4)$$

With:

- n_0 = 384.16
- N = 210

Substitute these values into the formula:

$$n = \frac{384.16}{1 + \left(\frac{384.16 - 1}{210}\right)} \quad (5)$$

$$n = \frac{384.16}{1 - \left(\frac{383.16}{210}\right)} = \frac{384.16}{1 + 1.8246} = \frac{384.16}{2.8246} \approx 135.99 \quad (6)$$

Thus, a sample of 136 respondents was deemed sufficient for statistical analysis. This means that in a population of 210 people, a sample of 136 people is needed to achieve the desired level of accuracy.

3.4 Quantitative Data Analysis: SEM-PLS

The SEM-PLS method was employed to test hypotheses and validate the measurement model. This approach integrates:

- Factor analysis for dimensionality assessment,
- Path analysis for estimating causal relationships,
- Structural modeling for assessing latent constructs.

This analytical method is appropriate for exploratory studies with complex variable relationships and smaller sample sizes.

3.5 Qualitative Data Collection and Analysis Using NVivo

In the qualitative phase, data were collected through interviews, field observations, and document analysis. NVivo software was used to manage and analyze this data systematically.

Key Steps:

1. Data Preparation: Transcripts, notes, and documents were imported into an NVivo project.
2. Coding: Both inductive and deductive coding were applied, classifying text into themes such as forms of participation, motivation, barriers, and stakeholder roles.
3. Thematic Analysis: NVivo's tools (e.g., word frequency, matrix coding) facilitated pattern recognition and theme development.
4. Data Triangulation: Cross-validation of findings was conducted across data sources (e.g., interviews and official reports).
5. Visualization and Reporting: Findings were summarized through conceptual models, graphs, and coded excerpts.

The use of NVivo improved analytical transparency and enhanced the validity and reliability of qualitative findings.

Results and Discussion

3.1. Quantitative Analysis

3.1.1. Respondent Characteristics

The data in the following table displays the characteristics of the respondents involved in this research, including demographic variables such as gender, age, number of children, occupation, and income:

Table 1. Respondent Characteristics.

Respondent Profile	Frequency (n)	Percentage (%)
Gender		
Man	87	64
Women	49	36
Age		
20 - 30 years	62	45.6
31 - 40 years old	24	17.6
41 - 50 years old	25	18.4
>50 years	25	18.4
Number of children		
1 child	24	17.6
2 children	23	16.9
3 children	32	23.5
>3 children	18	13.2
Not married yet	44	32.4
Work		
Civil Servant	1	0.7
Freelance	2	1.5
Housewife	3	2.2
Teacher	7	5.1
Private sector employee	32	23.5
Student	37	27.2
Self-employed	73	53.7
Not yet working	1	0.7
Income		
<Rp 1,000,000	8	5.9
IDR 1,000,000 - IDR 2,000,000	46	33.8
IDR 2,000,000 - IDR 5,000,000	50	36.8
>Rp 5,000,000	7	5.1
Not yet working	25	18.4

(Source: Results of Questionnaire Processing).

3.1.2. Level of Community Participation

The following table presents data regarding the level of Community Participation in three important aspects: flood risk mitigation policies, collaboration, and community participation.

Table 2. Level of Community Participation.

Level of Community Participation	Frequency (n)	Percentage (%)
Collaboration		
High	17	13
Currently	66	49
Low	53	39
Community Participation		
High	21	15
Currently	71	52
Low	44	32

(Source: Results of Questionnaire Processing).

3.2. SEM-PLS Model Analysis

This research uses an approach model variance-based or component-based with the method Partial Least Squares (PLS). The following is a model obtained by the method of Partial Least Squares (PLS):

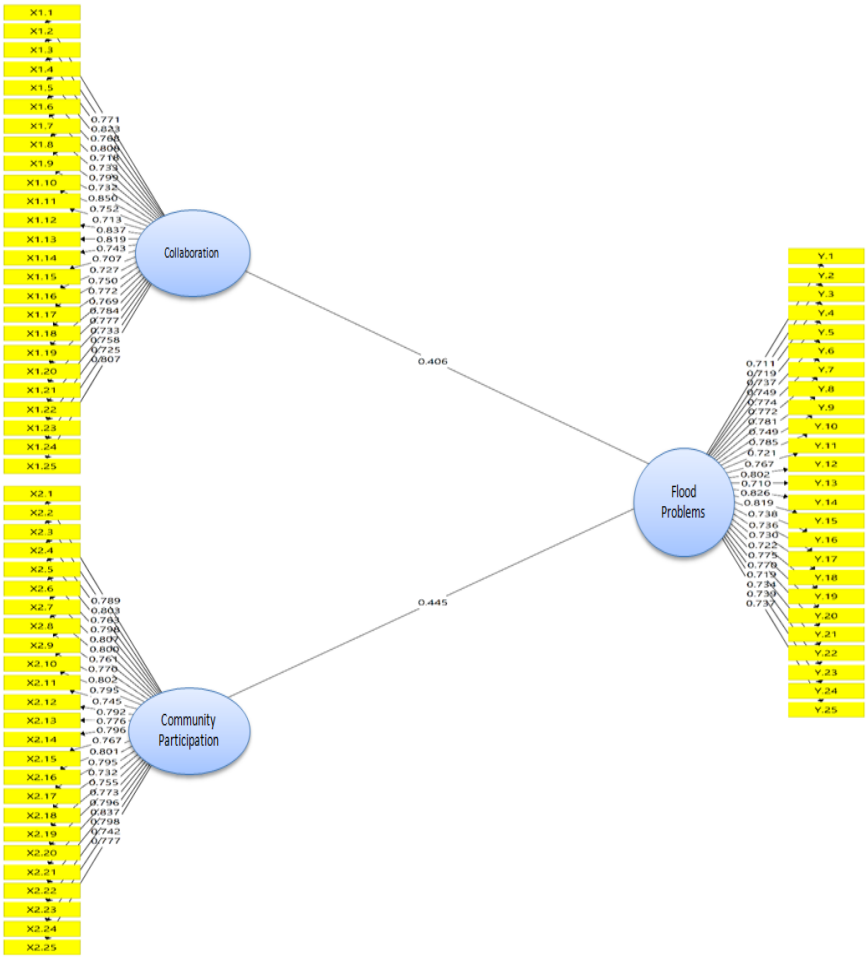

Figure 4. Algorithm Model. Source: SEM PLS Data Processing Result

Discriminant Validity

Discriminant validity testing criteria, the Fornell-Larcker Criterion is used to determine the proof of discriminant validity of two or more factors/constructs. The average value of each construct is compared with the value of the variance shared between the constructs. When the Ave construct is greater than the variance shared with other constructs, then the validity of the discriminant can be supported. The results of the discriminant validity test based on the Fornell-Larcker Criterion are presented in the following table:

Table 3 Fornell-Larcker Criterion value Source Data analysis

Variable	Y	X1	X2
Flood Risk Mitigation Policy	**0.745**		
Collaboration	0.666	**0.769**	
Community Participation	0.687	0.657	**0.789**

Internal Consistency To determine the reliability of each construct of this study, internal consistency testing was conducted by looking at the value of Composite Reliability and Cronbach's Alpha of each construct. To be able to meet good reliability, the composite reliability value must be greater than 0.7, and the Cronbach's alpha value must be greater than 0.6. Internal consistency results in the following table:

Table 4. Internal Consistency Test Results Source Data Analysis

Variable	*Cronbach's Alpha*	*Composite Reliability*	Description
Flood Risk Mitigation Policy	0.967	0.969	Reliabel
Collaboration	0.971	0.973	Reliabel
Community Participation	0.975	0.976	Reliabel

Based on the table above, it can be explained that the results of the composite reliability test show good results because all latent variables have been reliable, as they have a composite reliability value greater than 0.7. This shows that all indicators become measuring tools for their respective constructs. Then, from the table, it can be seen that all latent variables have a value of Cronbach's alpha above 0.6.

From the above table, it follows that all constructs differ from each other. The Diagonal shows the square root of the AVE value of each construct, and the correlation value of the construct is higher than the other correlation values between the constructs. Accordingly, the value of all these parameters exceeds the minimum hinted value. Therefore, all construct data is valid for use in this model.

The relationship between latent variables can be considered significant if the t-statistic value is higher than the t-table value. The following are the results of hypothesis testing in this study:

Table 5. Hypothesis Testing Results.

Construct Relationships	Path Coefficient	T Statistics	P-Value	Information
Collaboration > Mitigation of Flood Problems	0.406	3.898	0	Significant
Community Participation > Mitigation of Flood Problems	0.445	4.669	0	Significant

Based on the table above, it can be seen that the relationship between collaboration and Flood Problem Mitigation has a path coefficient value of 0.406, with a T-statistic of 3.898 and a P-value of 0.000. Because the P-value is less than 0.05, this relationship is declared significant. This shows that collaboration has a positive and significant effect on Flood Problem Mitigation. Apart from that, the relationship between community participation and Flood Problem Mitigation shows a higher path coefficient value, namely 0.445, with a T-statistic of 4.669 and a P-value of 0.000. Just like the previous relationship, a low P-value indicates that the influence of community participation on Flood Problem Mitigation is also positive and significant. These results confirm that both collaboration and community participation have a significant role in influencing Flood Problem Mitigation. These two variables make a significant contribution to the effectiveness of policies in reducing flood risk.

3.3. Qualitative Analysis

3.3.1. Collaborative Process in Mitigating Flood Problems in Palembang City

The collaboration process in the context of handling flood problems (or in other fields) involves several structured stages to ensure successful cooperation between parties. Each stage requires good communication, a clear division of roles, and commitment from all parties [25]. The collaboration process is carried out in several steps, namely Identification of Problems and Needs, Preparation of a Joint Action Plan, Division of Duties and

Responsibilities between agencies, Coordination and Communication, Implementation and Monitoring [26]. So the results of good collaboration in flood management can be seen from various aspects, both in terms of disaster mitigation, reducing the impact of floods, and increasing community capacity and infrastructure. Collaboration can result in more effective infrastructure development, such as improved drainage systems, embankments, flood control reservoirs, and well-planned water canals. This infrastructure is designed to reduce the risk of flooding and its impact on residential areas. Collaboration that actively involves the community in flood mitigation actions, such as cooperation in cleaning rivers, protecting water catchment areas, and maintaining the sustainability of environmental programs that have been implemented, and through collaboration, use resources (both financial, technological, and labor) can be optimized. By sharing roles and responsibilities, each party can take advantage of their respective strengths, so that the results are. Achievements are more efficient and sustainable. The following is a visualization of the interview results and data processing.

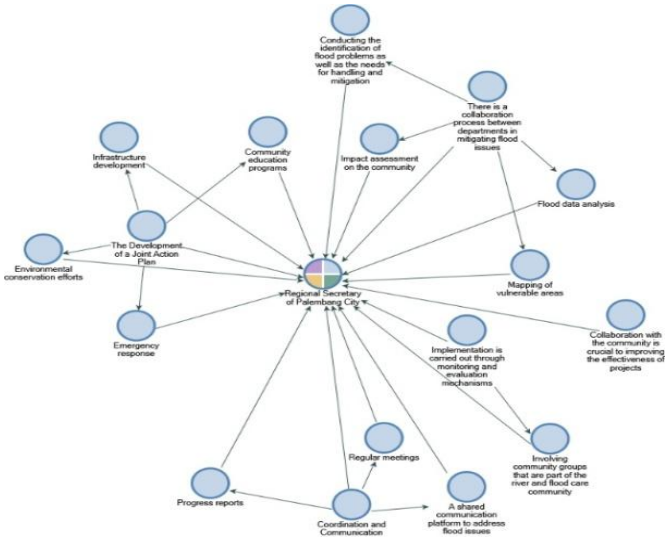

Figure 5. Data Analysis of the Collaboration Process in Flood Risk Mitigation Policy in Palembang City (Source: Processed by the author using NVivo 12 Pro Software).

3.3.2. Obstacles to the Collaboration Process in Mitigating Flood Problems in Palembang City

Obstacles in the collaboration process are various obstacles or challenges that arise during collaborative efforts between various parties to achieve common goals. These obstacles can come from various factors, including technical, social, communication, and resource issues, which can hinder collaboration and the achievement of the desired results. In the context of flood management, this obstacle can affect the effectiveness of the solution expected from the collaboration of various parties [27]. Obstacles to the Collaboration Process in mitigating flood problems in the City of Palembang include a Lack of Inter-departmental Coordination, Complicated Bureaucracy, Different Priorities and Visions for Each Service, Lack of Integrated Data, Technical Constraints and Human Resource Capacity, Lack of Public Participation, Overlapping Regulations and Policies and Limited Resources Power and Budget. To overcome these obstacles in collaboration, open and transparent communication that creates clear and effective communication mechanisms between parties is needed; then it is necessary to develop trust through positive experiences, openness, and consistent commitment. Strong Leadership is needed that can coordinate, inspire, and facilitate each party to achieve common goals. It is necessary to carry out continuous monitoring and evaluation to identify problems early and make necessary adjustments. These obstacles can be obstacles, but with good management and commitment from all parties, collaboration can still run effectively and produce useful solutions in mitigating flood problems in Palembang City. The following is a visualization of the interview results and data processing:

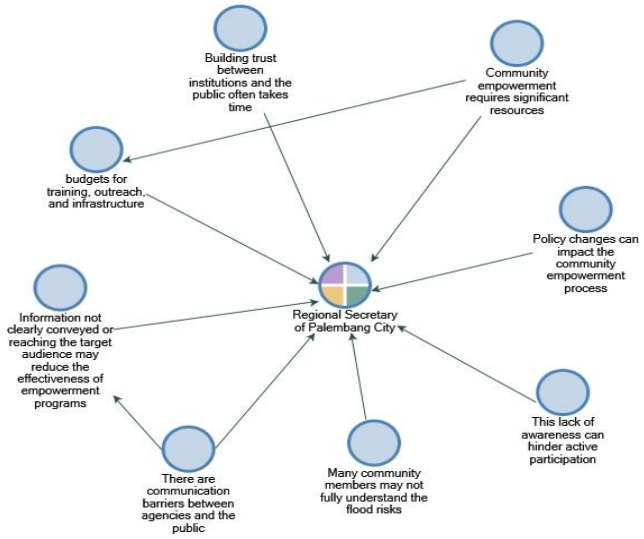

Figure 6. Data Analysis of the Challenges in the Collaboration Process for Flood Issue Mitigation in Palembang City (Source: Processed by the author using NVivo 12 Pro Software).

3.3.3. Institutional Collaboration Has an Influence on Mitigating Flood Problems in Palembang City

Institutional collaboration, which is influential in mitigating flood problems in Palembang City, refers to cooperation between various institutions that have an important role in overcoming and preventing floods [28]. These institutions can come from the government, the private sector, community organizations, academics, and international institutions. The main objective of this institutional collaboration is to unite the resources, expertise, and authority of each institution to create more effective and sustainable solutions in dealing with flood risks. The following is a visualization of the interview results and data processing:

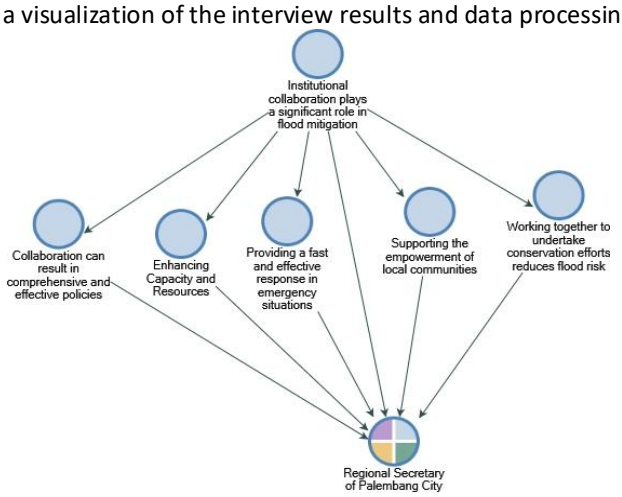

Figure 7. Data Analysis of the Institutional Collaboration Has an Impact on Flood Mitigation in Palembang City(Source: Processed by the author using NVivo 12 Pro Software).

Institutional collaboration has a big influence on mitigating flood problems in Palembang City. Several things that can influence include Integrated Policy Preparation, Capacity and Resource Building, Community Empowerment, and Disaster Management Coordination. Overall, institutional collaboration allows for greater utilization of expertise and resources. Broadly, it creates a more holistic approach to dealing with flood problems.

3.4. Aspects of Community Participation

3.4.1. Community Participation Process Carried Out by the Palembang City Government in Mitigating Flood Problems in Palembang City

The Community Participation process carried out by the Palembang City government in mitigating flood problems involves several steps and approaches designed to increase community involvement and strengthen mitigation efforts. These steps include Education and Counseling, Training and Capacity Building, Formation of Community Groups, Collaboration with Non-Institutions -Government, Participation in Planning and Implementation,

Participatory Monitoring and Evaluation, Providing Incentives and Rewards, as well as Communication and Information Dissemination [29]. The following is a visualization of the interview results and data processing:

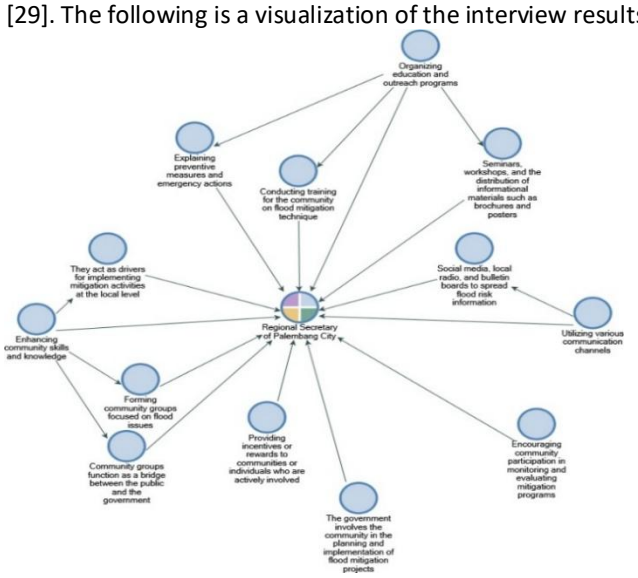

Figure 8. Data Analysis of the Community Participation Process Carried Out in Palembang City (Source: Processed by the author using NVivo 12 Pro Software).

3.4.2. Obstacles to the Community Participation Process in Mitigating Flood Problems in Palembang City
Obstacles in the Community Participation process in mitigating flood problems in Palembang City include various factors that hinder the involvement, effectiveness, and sustainability of community efforts to actively participate in preventing and reducing flood risks. These factors can be internal (from society itself) or external (coming from outside parties such as government, policies, or environmental conditions) [30]

Obstacles to the Community Participation Process in mitigating flood problems in Palembang City include a Lack of Community Awareness and Participation, Limited Resources and Budget, Ineffective Communication, a Lack of Support from Stakeholders, Limited Human Resource Capacity, Logistics and Infrastructure Constraints as well as Challenges in Building Community Trust and Policy and Regulatory Changes. The following is a visualization of the interview results and data processing:

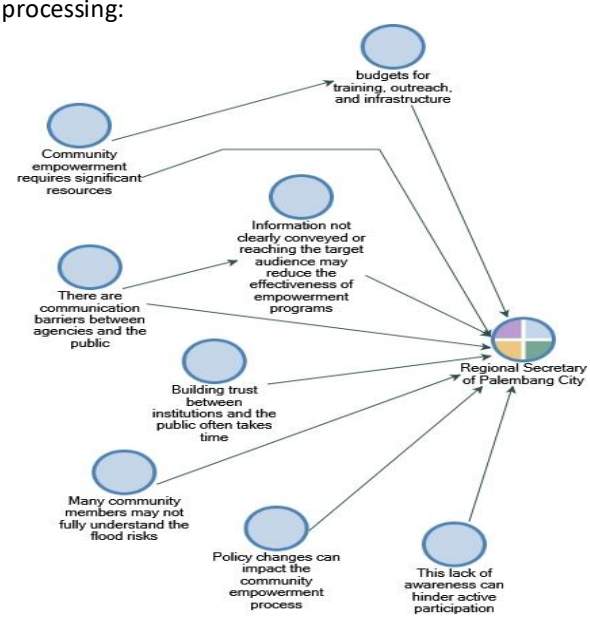

Figure 9. Data Analysis of the Community Participation Impact on Flood Mitigation in Palembang City(Source: Processed by the author using NVivo 12 Pro Software).

3.4.3. Community Participation Has an Influence on Mitigating Flood Problems in Palembang City

Community Participation is influential in mitigating flood problems in Palembang City, meaning that efforts to actively involve and strengthen the role of the community in preventing, reducing, and dealing with the impacts of flooding have a significant impact on the success of disaster mitigation. Community Participants become agents of change who can contribute to flood solutions through participation, knowledge, skills, and collective actions that support flood control efforts [31]. The following is a visualization of the interview results and data processing:

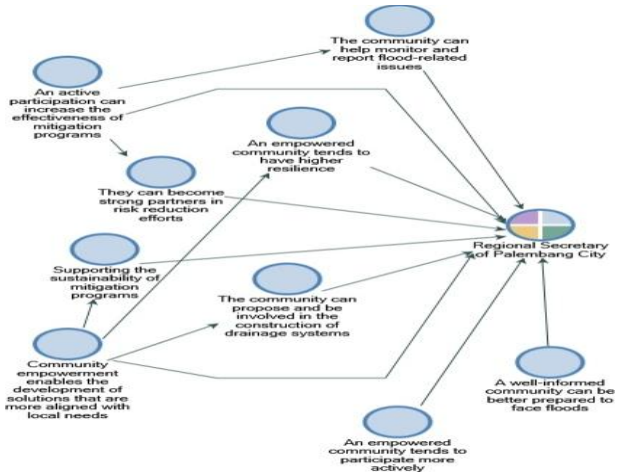

Figure 10. Data Analysis of the Community Participation Impact on Flood Mitigation in Palembang City
Source: Processed by the author using NVivo 12 Pro Software.

Community Participation influences mitigating flood problems in Palembang City, several things that can influence include: Increasing community awareness and knowledge, active participation in flood management, monitoring and reporting, developing community-based solutions, strengthening social resilience, implementing sustainable mitigation programs, and collaborating with the government and institutions [32].

Flood risk mitigation policies that have been made by the Government of Palembang
Some flood risk mitigation policies that have been made by the Government of Palembang in the form of local regulations, namely:

- Mayor Of Palembang Regulation No. 55 Of 2014 On the Provisions of The Arrangement of Buildings on The Banks of the River
- Local Regulation of Palembang City No. 11 of 2012 on Swamp Control and Utilization.
- Regional regulation of Palembang City No. 3 of 2015 on the management of Household Waste and similar household waste

Violation of Regulations

1. Regulation of the Mayor of Palembang No.55 of 2014 on the provisions for the arrangement of buildings on the banks of the river.

This regulation aims to prevent the growth of arbitrary or irregular buildings that can damage the essence and disrupt the watershed in the city of Palembang. The Mayor's Decree No.55 of 2014, regulated in Chapter II Article 2 explained that the river boundary is only reserved for buildings that include roads inspection of water resources infrastructure buildings, Bridge and dock facilities, gas and drinking water pipelines, stretches of electricity and telecommunications cables and buildings that support tourism to realize Palembang as a Riverside City. The Mayor's Decree No.55 of 2014 is also regulated in Chapter II Article 4 that the distance between the river and the building that is allowed is a depth of less than 3 (three) meters border of the river 10 (ten) meters, a depth of between 3 (three) to 20 (twenty) meters border of the river 15 (fifteen) meters, a depth of more than 20 (twenty) meters border of the river at least 30 (thirty) meters. According to the article, the Musi River has a depth of 15-20 meters, and the border of the river is 15 (fifteen) meters. This means that the distance between the building and the riverbank is 15 meters. Then in Chapter III Article 6, the provisions of the facade are regulated, namely: every activity to build a building whose land location is located on the riverbank must expose the facade of the building to the river. This policy applies to erecting new buildings, erecting additional buildings on existing buildings, and changing or revising part or all of existing buildings [33]. The existing policy aims to organize the development on the banks of the Musi River so that the beauty of the city of Palembang is maintained, and so as not to interfere

with the function of the watershed. Then, in order to support the government's efforts to create order and beauty in the city, it is necessary to regulate the presence of buildings located in the riverbank area. To optimally arrange the city space, buildings located on the banks of the river, need to be arranged with the layout of the facade facing the river so that the river can improve its functions and benefits while creating an orderly, neat, neat, and beautiful environment on the banks of the local river for the comfort of people's lives.

Some of the fundamental problems in the aspect of river regulation and river maintenance are aimed at ensuring the preservation of the function of the river as a resource because in essence river maintenance is a real form of activity aimed at ensuring the physical balance of the river itself to preserve its function river maintenance in general is more aimed at securing flood efforts. [34]. But in reality, there is still a violation of these rules. From the picture below it can be seen that the implementation of the provisions of the arrangement of buildings on the river bank has not gone well, it can be seen that the river bank building does not have a river boundary as required in the regulation of the mayor of Palembang, the building is made directly related to the river lips and also the direction of the face of the building does not face the river as stipulated in the regulation.

Figure 11. Riverside Building in the area of stairs, Buntung, Palembang

2. Palembang Regional Regulation No. 11 of 2012 on Swamp Control and Utilization

In the regulation of the mayor of Palembang No. 11 of 2012, article 1 Paragraph 7 explains that conservation marshland is a natural standing water swamp that is flooded continuously or seasonally due to natural drainage that is hampered and has special characteristics physically, chemically, biologically, and plains that cannot be converted to function. About 48.42% of the total area of swamp land in Palembang is in the form of reclaimed swamp land, where the swamp can be used for urban sector activities by taking into account the function of the swamp land itself as a water storage area [35]. The remaining swamp land is in the form of cultivated swamp land, namely, swamp land that retains its function as a swamp based on technical, economic, and environmental considerations for plantation and agricultural management activities. Implementation of swamp conservation based on local regulations on development and levy control of swamp utilization based on balance and sustainability to protect and secure the functions and benefits of swamp land [36]. The existence of policies or rules issued by the government is very influential on the achievement of common goals and desires. The political policy of the Palembang city government in the preservation of swamp land has long been one of them in the city of Palembang, but what distinguishes political policy from public policy is that political policy contains elements of power in making and implementing it, while public policy rules are the basis for the life of the general public [37]. So, the preservation of marshland is closely related to political policies because many people do not know the existence of these policies. The shrinking of swamp land has an impact, such as damage to an ecosystem or loss of habitat for animals living in it, such as the habitat of the Cork fish in swamps and rivers, which causes this type of fish to be difficult to obtain in the city of Palembang for now.

Many fishermen look for these types of fish outside the city of Palembang because the swamp land in the city of Palembang is almost gone and reduced. The area of swampy land in Palembang City of South Sumatra province shrank from -/+ 22,000 Ha in 2001 to -/+ 11,800 Ha in 2018. Where the reduced amount of swamp land is used to create some interest in the private sector and the Local Government of Palembang [38]. Many impacts caused by the shrinking area of swamp land are felt by the people of Palembang. Preservation of swamp land, appropriate efforts to maintain the potential with all the advantages and functions possessed, should be followed up with Real action by the government and the community, to be utilized as well as possible. In order to protect the swamp ecosystem as a source of water storage and to improve its function and benefits, it is necessary to develop control over the marshland so that it is not easy to change its function and usefulness, following the regulations that have been issued. With the natural potential generated from swamp land for the government and the people of Palembang itself [39]. The city government, as a policymaker, should be more active in implementing its political

policies to preserve the swamp land. The shrinking of the marshland in the city of Palembang from year to year due to the closure of private activities, offices, and public activities can have a major impact that will slowly damage the area, and other impacts such as flooding due to reduced places for water absorption.

Figure 12. Swamp backfilling for housing development in Talang Jambe and Jakabaring.

3. Palembang City Regional Regulation No. 3 of 2015 on the management of Household Waste and similar household waste

The main objectives of the regional regulation are: 1) to grow, maintain, and develop behavior, and public awareness about environmentally sound waste handling and reduce flood risk 2) coordination between local governments, businesses, and the community so that there is integration in handling and reducing waste; and 3) Improving Public Health and Environmental Quality, and making waste as a resource. Waste handling activities based on the regional regulations regulate waste handling that is safe for health and the environment, including (1) Waste Sorting (organic/inorganic waste grouping); (2) waste collection (collecting in a sorted manner); (3) waste transportation (carrying waste to the final processing site); (4) Prohibition of waste disposal to watersheds. (5) waste processing (reducing/ changing waste to meet quality standard requirements); (6) final processing of waste (where to process waste/residues that cannot be processed so that it is safe for the environment) [40]. The task of the Local Government in the regulation is first to foster, improve, and develop awareness of the community and businesses in the handling/reduction of waste, especially about the behavior of throwing garbage into the watershed the second to conduct research and development of technology related to the handling/reduction of waste third facilitate, develop and implement efforts; Fifth, encourage and facilitate the development of utilization of waste handling/reduction results; sixth, facilitate the application of local specific technologies that develop in the community related to waste handling/reduction; seventh, coordinate between government agencies, communities, and business actors so that there is integration in waste handling [41].

Local Regulation Of Palembang City No.3 the year 2015 on how the management of Household Waste and similar household waste, Article 59 reinforces the regulation on criminal provisions in the local regulations such as violation of the provisions in Article 35, Article 36 paragraph (1) and Article 56 paragraph (1) shall be punishable by imprisonment for a maximum of 6 (six) months or a maximum fine of Rp.50.000.000,- (fifty million rupiah), violation of the provisions governing waste management is subject to criminal sanctions following Law No. 18 of 2008 On Waste Management, violation of the provisions of Article 56 is subject to a fine of Rp.500.000, - (five hundred thousand rupiah), and the crime referred to in Paragraph (1) is a violation. as we know the unification of criminal confinement has been regulated in the Criminal Code Article 18 paragraph (1) which reads: criminal confinement shall be imposed for a minimum of 1 day and a maximum of 1 year. Article 35 Of The Palembang Regional Regulation No.3 the year 2015 explained Every person/entity in the management of household waste or waste similar to household waste *wajib* reduces and handles waste in an environmentally sound manner, the management of household waste and waste similar to household waste must be carried out in the RT/RW scale and/or village/Sub-District with instructions from the office, every public transport, private vehicles, public facilities, social facilities, offices, companies, must provide

Trash in the form of tubs, barrels, or baskets. Managers of residential areas, business areas, or shopping areas are required to provide TPS and TPS3R. Article 36 of Palembang Regional Regulation No.3 of 2015 explained that every legal entity that conducts waste management business activities must have permission from the mayor [42]. Article 56 of Local Regulation No.3 of 2015, the mayor supervises and controls the implementation of waste management supervision carried out by the mayor, as referred to in Paragraph (1), is based on the norms, standards, procedures, and criteria of supervision. (3) Supervision and control of waste management includes Planning, Research, Development, Monitoring, and evaluation of waste management with the implementation of Palembang City Regional Regulation No. 3 of 2015, the government hopes to help maximize the handling of existing waste

problems [43] In Palembang City Regional Regulation Number 3 of 2020 Article 6 Paragraph 3, it is explained that the determination of the number of polling station locations needed for each district as referred to in Paragraph (1) letter d is based on the number of residents with a calculation of 1000 (one) people per 1 (one) polling station while the polling stations in Palembang city are 333 polling stations with a population of 1,623,099 people, which means that there is a comparison of 1 polling station for 4,874 people [44]. This indicates that the number of polling stations is still very minimal. Seeing the increasing number of waste problems in the city of Palembang which partly comes from household activities, the industrial market to overcome this problem the Palembang city government issued a regional regulation, Palembang City Regional Regulation Number 3 of 2015 on the management of household waste and similar household waste, large volumes of waste every day this requires the government to provide a proper waste landfill (TPA) and meet the standards [45]. However, even though there is this regulation, there are still very many groups of people who throw garbage carelessly, including throwing garbage in rivers and watersheds.

Figure 13. Piles of garbage are in the Sekanak River Basin and on the banks of the Musi River

Model Existing

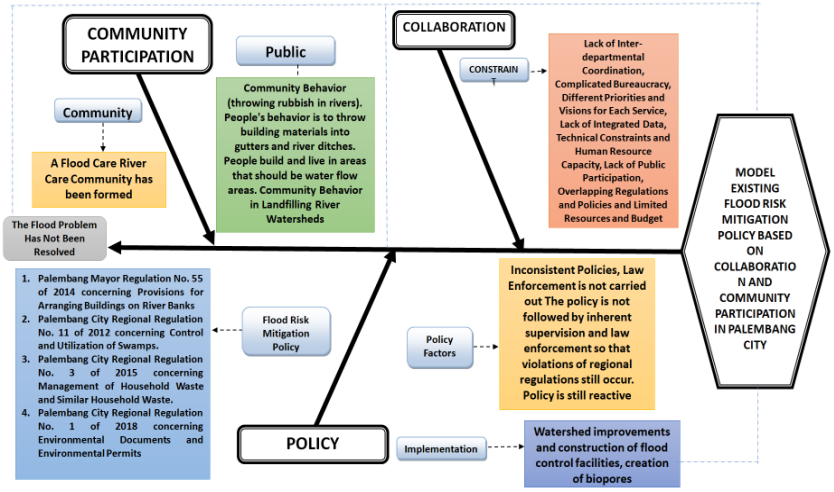

Figure 14. Existing Model of Flood Risk Mitigation Policy Based on Collaboration and Community Participation in Palembang City.

Model Recommendation

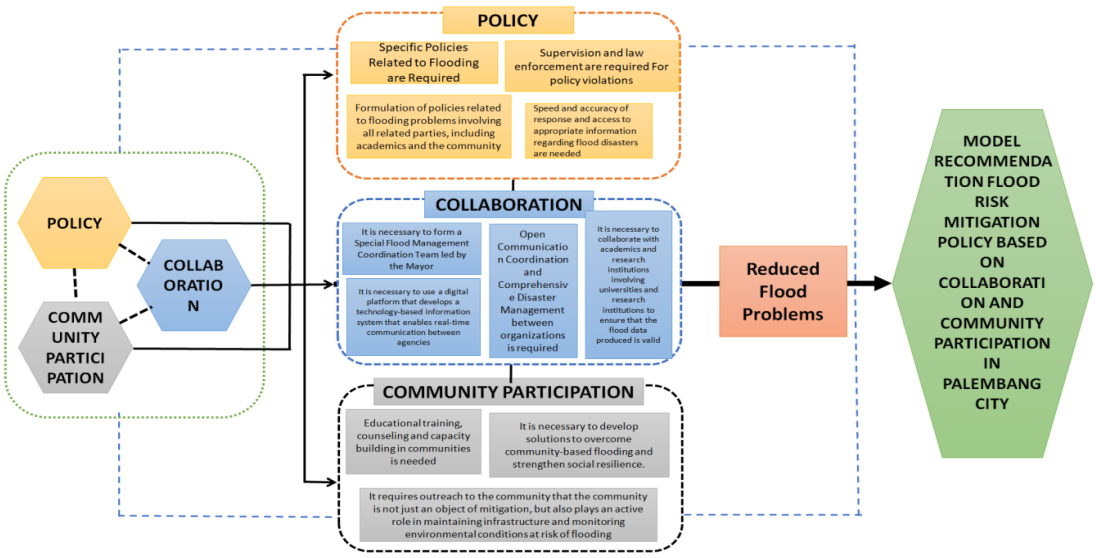

Figure 15. Flood Risk Mitigation Policy Recommendation Model Based on Collaboration and Community Participation in Palembang City

Description and narrative image model: Flood Risk Mitigation Policy Recommendations Based on Collaboration and Community Participation in the City of Palembang.

The image is a conceptual model that describes the relationship and process in developing flood risk mitigation policies in Palembang City with an approach based on collaboration and community participation. This Model shows how three key components-Policy, Collaboration, and community participation produce effective mitigation solutions that reduce flood problems. Main components: Policy, Collaboration, and Community Participation. Policies serve as the foundation that governs flood mitigation frameworks. In it, there are four important items needed for specific policies related to flooding. Oversight and enforcement of policy violations are required. Policy-making involves all relevant parties, including academics and the community. Required speed and accuracy of response and access to information on flood disasters. The collaboration illustrates the need for the formation of specialized teams and the utilization of technology to comprehensively manage flood risk. The details: the establishment of a Special Flood Management Coordination Team led by the mayor, the use of technology-based digital platforms for real-time and inter-agency communication, the coordination of open communication and comprehensive disaster management between organizations, and collaboration with academics, research institutions, and universities to ensure the validity of flood data and information. Community participation emphasizes the active role of communities in mitigation. The contents of the points: training, counseling, and capacity building of the community, development of community-based solutions, and strengthening of social resilience, socialization that the community is not just an object of mitigation, but an active actor in infrastructure maintenance and monitoring of flood risk conditions.

Relationship Between Components:

- Policy, Collaboration, and community participation are dynamically linked, with Arrow lines showing the flow of interaction between these components.
- Community participation and collaboration contribute to the strengthening of effective and well-implemented policies.
- Both components also support each other so that the flood management process can run integrated and responsive. Final objectives of the Model: flood problem reduction and policy recommendations
- In the center-right, it is shown that through the synergy of Policy, Collaboration, and community participation, "reduced flood problems" are produced — that is, significant reductions in flood problems.
- * The result of this model is a model of Flood Risk Mitigation Policy Recommendations, based on collaboration and community participation in the city of Palembang, which is the strategic output of the entire process

The model emphasizes that flood risk reduction cannot rely solely on top-down governance. Instead, it must be grounded in multi-stakeholder collaboration, data-driven coordination, and empowered community participation. By fostering this synergy, Palembang can achieve a more resilient and sustainable flood management system.

Discussion

This study aimed to investigate the influence of collaborative governance and community participation on flood risk mitigation policies in the city of Palembang. Employing a quantitative approach through multiple linear regression analysis, the findings reveal that both collaboration and community participation have a statistically significant and positive effect on flood mitigation efforts. The model's R-squared value of 0.537 indicates that these two variables explain approximately 53.7% of the variation in mitigation policy outcomes.

The results showed the effect of collaboration on flood risk mitigation policies. Based on the results of the analysis, the calculated t value is 4,729 with a significant value (Sig.) of 0.000. Since the value of the t-count is greater than the t-table (1.978) and the significance value is smaller than ③0.05, the hypothesis of the study is accepted. This means that collaboration has a positive and significant effect on flood risk mitigation in Palembang City. The results showed the effect of community participation on flood risk mitigation policies. Based on the results of the analysis, the calculated t value is 5,756 with a significant value (Sig.) amounting to 0,000. Since the value of the t-count is greater than the t-table (1.978) and the significance value is smaller than ③0.05, the hypothesis of the study is accepted. This means that community participation has a positive and significant effect on flood risk mitigation in the city of Palembang. The results of the analysis showed the value of F-count of 77,849 with a significant value (Sig.) of 0.000. A significance value well below the confidence level of 0.05 indicates that the F-count is greater than the F-table (3.064), which in this case indicates that the regression model as a whole is significant. This means that collaboration and community participation simultaneously have a significant effect on flood risk mitigation policies. This result suggests that flood risk mitigation policies are needed based on collaboration and community participation in overcoming flood problems in the city of Palembang. R-Square value of 0.537 indicates that flood risk mitigation policies based on collaboration and Community Participation have an effect of 53.7% in overcoming flood problems in the Palembang watershed improvement and construction of flood control facilities and biopic making are not very effective in overcoming flood problems in Palembang City although the Channel area of several retention ponds and drainage in Palembang city, causing rainwater in large intensity can no longer be accommodated so that flooding floods still occur.

However, several practical challenges continue to hinder effective policy implementation. These include limited institutional coordination, insufficient public awareness, weak law enforcement, and inadequate integration of stakeholder roles. Although local authorities have issued various regulations concerning environmental and swamp area management, the absence of a comprehensive and dedicated flood mitigation policy framework remains a critical gap. Moreover, weak oversight mechanisms have allowed violations to persist without appropriate enforcement, undermining the intended outcomes of existing policies.

The findings align with the broader literature emphasizing the importance of participatory approaches in disaster risk management (DRM). Prior studies suggest that when communities are actively engaged, they can play critical roles in infrastructure maintenance, real-time risk monitoring, and policy feedback (e.g., Shaw et al., 2010; Allen, 2006). Yet, challenges such as budget limitations, low human resource capacity, and fragmented interagency coordination continue to limit the full realization of these participatory potentials.

This research study reinforces the theory of collaborative governance, which highlights the significance of joint policymaking by government, civil society, and other stakeholders. As Ansell and Gash (2008) argue, effective collaboration depends on trust, mutual commitment, and open communication—all of which are relevant to the context of flood risk governance in Palembang.

Moreover, the findings resonate with Elinor Ostrom's (1990) theory on common-pool resource management, which advocates for inclusive, community-driven decision-making processes to enhance sustainability and effectiveness in environmental governance. In the Palembang case, the active participation of residents serves as a tangible example of how local engagement can enhance the legitimacy and efficacy of flood mitigation policies. The study also supports empirical research within the Indonesian context. For example, Wulandari and

Fauzi (2021) found that participatory planning in flood-prone areas significantly reduces disaster impacts and enhances resilience. Similarly, Sutopo and Sulastri (2020) emphasized the need for inter-agency cooperation and grassroots mobilization to implement disaster policies effectively. Thus, this study not only corroborates theoretical models but also adds to the growing body of empirical evidence advocating for participatory disaster governance.

This study contributes to the development of collaborative and participatory governance theories within the field of disaster risk management. It provides empirical validation that collaborative frameworks enhance policy effectiveness, foster institutional synergy, and improve community adaptive capacity. The model proposed in this research can serve as a reference point for future studies aimed at enriching public policy frameworks responsive to dynamic urban disaster risks. Academically, this research expands the discourse on the roles of collaboration and participation in public policy, especially in disaster mitigation. It offers a grounded case study that can inform teaching materials and future research across disciplines such as public administration, urban planning, and environmental governance.

The findings provide actionable insights for local policymakers. Strengthening cross-sectoral coordination, institutionalizing participatory planning mechanisms, and enhancing community capacities through targeted education and training are vital next steps. The Palembang city government is encouraged to develop a comprehensive flood mitigation policy and establish collaborative forums that include government agencies, academics, civil society, and local communities.

While the study provides valuable insights, several limitations should be noted. The quantitative design limits the ability to capture the socio-political dynamics influencing collaborative efforts on the ground. The study is geographically constrained to Palembang City, limiting generalizability to other regions. The cross-sectional nature of the data precludes understanding temporal changes in collaboration and participation.

Future studies should adopt longitudinal and mixed-method approaches to better capture the evolution of stakeholder dynamics. Expanding the geographical scope would also allow for comparative analysis across different flood-prone urban areas. Further, collaborations with universities and research institutions are recommended to support evidence-based policymaking and develop adaptive technologies for real-time flood risk management.

Conclusion

This study empirically substantiates the pivotal role of collaborative governance and community participation in shaping effective flood risk mitigation policies in the urban context of Palembang City. Employing a quantitative approach through multiple regression analysis, the findings indicate that these two variables exert a statistically significant and positive influence on mitigation outcomes, with an R^2 value of 0.537, suggesting a substantial explanatory power for policy variation. Notwithstanding these encouraging results, several structural and operational challenges remain evident. These include limited inter-institutional coordination, insufficient public awareness, and inadequate enforcement of existing environmental regulations. Although the local government has issued numerous environmental directives, the absence of a comprehensive and integrated flood mitigation policy continues to constrain policy coherence and efficacy. The deficiency in monitoring and sanction mechanisms further undermines the successful translation of policy into practice.

The findings reinforce theoretical frameworks in collaborative governance (Ansell & Gash, 2008) and align with Ostrom's (1990) institutional analysis of common-pool resource management, which underscores the efficacy of inclusive and participatory governance arrangements. Furthermore, the results corroborate existing empirical research within the Indonesian context (e.g., Wulandari & Fauzi, 2021), emphasizing the instrumental role of community engagement in enhancing policy responsiveness, legitimacy, and sustainability in disaster risk reduction. From a practical standpoint, the study offers critical implications for policymakers and urban planners. Effective flood governance necessitates a multi-actor, cross-sectoral approach, wherein government agencies, civil society, academic institutions, and local communities collaboratively design and implement context-sensitive mitigation strategies. The conceptual model presented herein illustrates the synergistic integration of policy, collaboration, and community participation as a strategic framework for sustainable urban flood management.

Prospectively, this model bears relevance beyond the Palembang context and may serve as a replicable framework for cities confronting analogous hydrometeorological risks. Future efforts should prioritize institutional capacity-building, the formalization of participatory mechanisms, and the co-production of knowledge with academic and research institutions. By doing so, urban disaster risk governance can evolve into a more adaptive, inclusive, and evidence-based system, capable of addressing the multifaceted challenges posed by climate-related hazards.

Author Contributions

IYP: Writing, compiling, and designing concepts, collecting data, conducting analysis. IRP: compiling and designing, concepts, Supervision. TY: compiling and designing the analysis. BPP: compiling and designing methodology.

Conflict of Interest

We declare that there is no conflict of interest whatsoever related to financial and personal interests with other people or organizations related to the discussion of the material in the manuscript.

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