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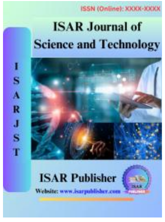

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Flood Risk Management Analysis Through Rainwater Management Approach in The Sub Watershed Area of Buah, Palembang City

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Abstract: This study aims to analyze flood risk management through a rainwater harvesting approach in the Sub-Watershed (Sub DAS) Buah area of Palembang City. The location was selected due to its frequent annual flooding caused by suboptimal drainage systems. The research employed both qualitative and quantitative methods. Data collection techniques included field surveys, observations, interviews, brainstorming, and questionnaires. A total of 25 types of flood-related risks were identified 8 adapted from previous relevant studies and 17 newly identified through direct observation and assessment of the existing drainage infrastructure and community responses. Risk acceptance analysis revealed that most risks across planning, implementation, and operation & maintenance (O&M) aspects fall into the "unacceptable" and "undesirable" categories. Differences were observed between expert and general respondents in their perception of risk levels; however, all three aspects consistently showed a significant presence of high-risk conditions requiring immediate mitigation efforts. The proposed mitigation strategies consist of four main approaches: risk retention, risk reduction, risk transfer, and risk avoidance. Among these, the implementation of a rainwater harvesting system is considered the most suitable and effective in significantly reducing risk levels. Moreover, this approach enhances drainage efficiency and strengthens the region's capacity to manage floods sustainably. The findings of this study are expected to serve as a basis for informed decision-making in flood control strategies that are adaptive and risk-based.

Keywords: Flood Risk Management, Rainwater Harvesting, Urban Drainage, Risk Assessment, Disaster Mitigatio.

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1. Introduction

In recent decades, heavy rainfall has frequently occurred in Indonesia. According to the latest data from the Meteorology, Climatology, and Geophysics Agency (BMKG), most regions in Indonesia fall into the medium to high rainfall category, with above-normal rainfall patterns dominating approximately 69.45% of the country's total area. This high rainfall intensity also affects South Sumatra Province, particularly Palembang City, which is classified in the high rainfall category (BNPB, 2021).

At the end of 2021, rainfall in Palembang reached 159.7 mm, resulting in widespread flooding and waterlogging across the city (BMKG, 2021). Furthermore, in early September 2022, most parts of South Sumatra experienced the rainy season accompanied by the La Niña phenomenon, along with intensified climatic activity in the Indian Ocean, which led to above-average rainfall without a preceding dry season (BMKG, 2023). These extreme rainfall events generate substantial surface runoff, significantly increasing the risk of urban flooding in Palembang City.

According to the Regional Disaster Management Agency (BPBD) of South Sumatra Province, flood events in Palembang City are classified as waterlogging floods, which occurred 77 times between 2012 and 2023, with an average of 7 flood events annually. An analysis of vulnerability levels in the urban villages (kelurahan) of Palembang revealed that 5% (equivalent to 5 urban villages) were categorized as highly vulnerable, and 7% (8 urban villages) were classified as having very high vulnerability levels (Zahir, 2023). One of the urban villages with a very high vulnerability level is located in the Buah Sub-Watershed (Sub-DAS Buah) area of Palembang. This condition is primarily due to the area's low-lying topography and the presence of several concave landforms. Flooding and waterlogging in Sub-DAS Buah typically last for more than three hours, with inundation depths reaching up to 50 cm (PUPR, 2008). By 2017, the location and extent of flood-prone areas within the Sub-DAS Buah had increased (PUPR, 2018). The annual expansion in flood extent, severity, and duration has led to increasingly negative impacts on the local socio-economic conditions (Manzoor et al., 2022).

Various flood control efforts have been implemented in Palembang City. These include the construction of retention ponds in flood prone areas, the normalization of drainage channels, and the restoration of river flows. However, these measures have not been fully effective in mitigating flood events, especially under extreme rainfall conditions. Therefore, sustainable solutions both structural and non-structural are needed to reduce flood risk, assess potential losses and impacts, and implement appropriate mitigation strategies. Sustainable risk mitigation can be achieved through a flood risk management approach. This begins with the identification and analysis of flood events to gain an understanding of the level of risk involved. Such analysis helps determine the extent to which the impacts and consequences of flooding are acceptable to stakeholders within a reasonable tolerance threshold. The outcomes of this assessment serve as the foundation for formulating and implementing sustainable flood management strategies, ensuring that mitigation efforts are not only reactive but also proactive and integrated.

As one of the sustainable non-structural efforts, the rainwater management system through the Rainwater Harvesting (RWH) method offers a viable solution. RWH is a simple system that utilizes rooftops as catchment areas, pipes as distribution channels, and storage tanks as collection reservoirs. The performance of the RWH system is assessed based on available rainfall data (Juliana et al., 2017). The implementation of Rainwater Harvesting provides various environmental and financial benefits. These include the ability to reduce surface runoff, alleviate pressure on groundwater aquifers, and increase the availability of clean water (Juliana et al., 2017). Additionally, harvested rainwater can be reused for a range of daily activities, such as cooling buildings and surrounding temperatures, watering plants, toilet flushing, and even for drinking purposes. RWH also contributes to energy consumption reduction, which in turn helps mitigate the urban heat island effect and reduces electricity costs (Farizan, 2018).

Research on risk management using the Rainwater Harvesting (RWH) approach is crucial, particularly due to the limited identification of risks that can serve as a guideline for flood mitigation and response efforts. Therefore, a comprehensive study on risk management is needed covering aspects of planning, construction, as well as operation and maintenance by integrating the RWH system as part of an environmentally based solution. This research is expected to serve as a reference for government agencies in formulating strategic policies and anticipating the challenges of climate change and urban growth, thereby contributing to the sustainability of urban environmental systems.

2. Literature Review

Risk is defined as the combination of the likelihood of an event occurring and its consequences (ISO/IEC Guide 73, as cited in Bagus, 2011). Risks can be either positive (upside risk) or negative (downside risk), depending on the impact they have on the achievement of objectives. Risks are also classified into pure risks which only have the potential to cause loss and speculative risks which may result in either gain or loss. Thus, risk can be understood as a form of uncertainty regarding events that may or may not occur. Since most risks have the potential to cause harm, risk analysis becomes a critical step in any business activity or program to reduce or minimize adverse impacts.

Risk management is a process that involves the identification of potential hazards, the assessment of risk levels, and the implementation of control measures to minimize resulting impacts (Ministry of Public Works Regulation No. 05 of 2005, Article 1). The procedures carried out are an integral part of comprehensive risk management and must be incorporated into the overall management process.

Risk Identification

Risk can be analyzed through three main components: the source, the event, and the resulting effect (Flanagan, 1993). According to Godfrey (1996), the magnitude of risk is determined by the product of the likelihood of occurrence and the level of consequence. Likelihood reflects the probability of losses that may lead to failure in managing flood events within the drainage system, based on predefined categories. Meanwhile, consequences indicate the extent of the impact caused by the flood event in question, with both likelihood and consequence levels presented in scale form in Table 1 and Table 2.

Table 1. Likelihood Scale

Likelihood Level	Probability (%)	Scale
Very Frequent	≥ 80	5
Frequent	60≤ - < 80	4
Occasional	40 ≤ - < 60	3
Rare	20 ≤ - < 40	2
Very Rare	< 20	1

Source: Godfrey, 1996

Table 2. Consequences Scale

Consequence Level	Probability (%)	Scale
Very High	≥ 80	5
High	45≤ - < 80	4
Moderate	15≤ - < 45	3
Low	5≤ - < 15	2
Very High	< 5	1

Source: Godfrey, 1996

Risk Assessment

The analysis of risk acceptability is conducted based on the risk value obtained from the multiplication of the likelihood of occurrence and the level of consequence of the identified risk. Based on the level of risk acceptability and the risk values calculated from the likelihood and consequence scales as shown in Table 4, the risk acceptability assessment can be structured as follows.

Table 3. Risk Acceptability Assessment

Assessment of Risk Acceptability					
Concequense	*Catastropic*	*Critical*	*Serious*	*Marginal*	*Negligible*
Likelihood	*5*	*4*	*3*	*2*	*1*
Frequent	*Unacceptable*	*Unacceptable*	*Unacceptable*	*Undesirable*	*Acceptable*
5	*25*	*20*	*15*	*10*	*5*
Probable	*Unacceptable*	*Unacceptable*	*Undesirable*	*Undesirable*	*Acceptable*
4	*20*	*16*	*12*	*8*	*4*
Occasional	*Unacceptable*	*Undesirable*	*Undesirable*	*Acceptable*	*Acceptable*
3	*15*	*12*	*9*	*6*	*3*
Remote	*Undesirable*	*Undesirable*	*Acceptable*	*Acceptable*	*Negligible*
2	*10*	*8*	*6*	*4*	*2*
Improbable	*Acceptable*	*Acceptable*	*Acceptable*	*Negligible*	*Negligible*
1	*5*	*4*	*3*	*2*	*1*

Source: Godfrey, 1996

Description:

Unacceptable : Risk cannot be accepted

Undesirable : Risk is undesirable

Acceptable : Risk is acceptable

Negligible : Risk can be disregarded

Risk Acceptance

By considering the level of risk acceptance along with the frequency and consequence values, the risk acceptance scale can be formulated as shown in the following table.

Table 4. Risk Acceptance Scale

Risk Acceptance	**Acceptance Scale**
Unacceptable	$X \geq 15$
Undesirable	$5 \leq X < 15$
Acceptable	$3 \leq X < 5$
Negligible	$X < 3$

Source: Godfrey, 1996

Based on the results of the risk acceptability scale, an evaluation was conducted on the identified risks through the questionnaire. Risks categorized as unacceptable and undesirable require prioritized handling through appropriate mitigation measures.

Mitigation Analysis

Risk mitigation actions are carried out after the identification process reveals that certain risks have the potential to significantly impact an activity or system. Risk management strategies can be implemented through four main approaches: risk retention, risk reduction, risk transfer, and risk avoidance. The selection of an appropriate strategy is based on the level of probability and the magnitude of the potential impact of each risk, taking into account both efficiency and effectiveness in the context of flood management in the study area.

$$\text{Risk} = \text{Probability (P)} \times \text{Consequences (D)}$$

After mitigation measures are implemented, the residual risk is obtained using the following formula:

$$\text{Risk} = \frac{\text{Probability (P) x Consequences (D)}}{\text{Effectiveness of Mitigation (M)}}$$

3. Methods and Materials

Research Location

This research was conducted in the Buah Sub-watershed (Sub-DAS Buah) area, located in Palembang City, South Sumatra Province. This location was selected because it is a flood-prone area that experiences regular flooding and waterlogging each year due to an underperforming drainage system. The Buah Sub-watershed contains a main river approximately 7.93 km long with a meandering course and is equipped with riverbank reinforcement structures. With a total area of around 10.79 km², this region is predominantly occupied by residential settlements, industrial zones, and swamplands.

Research Design

The types of data used in this study consist of both qualitative and quantitative data. Qualitative data were obtained through risk identification, interviews, questionnaires, and brainstorming sessions, while quantitative data were derived from the numerical processing of questionnaire results. The data collection methods included field studies, observations, interviews, brainstorming, and the distribution of questionnaires.

Instrument Testing

Instrument testing in this study includes validity and reliability tests. The validity test was conducted by correlating each questionnaire item with the total score using the Pearson Product Moment method. An item is considered valid if the correlation between the item score and the total score is statistically significant. Meanwhile, the reliability test was conducted internally by analyzing the data from a single distribution of the questionnaire. The reliability of the instrument was measured using Cronbach's Alpha coefficient, where an instrument is considered reliable if the alpha value is greater than 0.60.

4. Results and Discussion

Research Respondents

In this study, respondents were selected using a purposive sampling method, which is a deliberate technique of selecting respondents based on specific criteria aligned with the research objectives. The respondents were divided into two categories: the special category and the general category. The special category included key stakeholders such as government agencies responsible for addressing flood issues and academics with expertise in flood risk management. Meanwhile, the general category consisted of community members living in the Sub-DAS Buah area of Palembang City who are directly affected by flood events. The respondents involved included:

No	Respondent Description	Number of Respondents
1	Head of Water Resources Department (PSDA), South Sumatra Province – Expert in Drainage and Irrigation	1
2	Head of Construction Division, PSDA Department, South Sumatra Province – Expert in Drainage and Irrigation	1
3	Head of Irrigation Maintenance Section, PSDA Department, South Sumatra Province – Expert in Drainage and Irrigation	1
4	Head of Public Works and Spatial Planning Department (PUPR), Palembang City – Expert in Drainage	1
5	Subdivision Head of Water Resources and Environmental Infrastructure, PUPR Palembang City – Expert in Drainage	1
6	Subdivision Head of Spatial Planning, PUPR Palembang City – Expert in Land Use and Settlement	1
7	Head of Irrigation Operations and Maintenance Section, PUPR Palembang City – Expert in Drainage	1
8	Head of Regional Development Planning and Research Agency (Bappeda Litbang), Palembang City – Expert in Urban Infrastructure	1
9	Head of Infrastructure and Regional Development Division, Bappeda Litbang Palembang City – Expert in Urban Infrastructure	1
10	Head of Facilities Division, Food Security and Agriculture Department, Palembang City – Expert in Irrigation	1
11	Academic, Faculty of Engineering, Sriwijaya University – Expert in Hydrology	1
12	Academic, Faculty of Engineering, Sriwijaya University – Expert in Hydraulics	1
13	Academic, Faculty of Engineering, Sriwijaya University – Expert in Drainage and Irrigation	1
14	Community members residing in the Sub-watershed area of Buah River, Palembang City	15
	Total Number of Respondents	**28**

Results of Validity and Reliability Tests

Based on the analysis of the research instrument, all questionnaire items were declared valid, as they had a correlation coefficient with the total score greater than 0.500 or a significance value less than 0.05. In addition, the reliability test results indicated that the Cronbach's Alpha coefficient exceeded 0.6, thus the instrument used can be categorized as reliable.

Flood Risk Identification Analysis

This study successfully identified 29 types of risks related to flood management in the drainage system of Palembang City. Of these, 8 risks were adapted and developed from relevant previous studies, serving as an initial reference in constructing the risk framework. These risks were selected based on their relevance to the characteristics of the study area and the context of the urban drainage system. Meanwhile, the remaining 21 risks were directly identified through field observations, interviews, focus group discussions, and analysis of the existing drainage infrastructure conditions and community responses to flooding events. This identification process aimed to enrich the risk mapping by incorporating specific local conditions, ensuring that the resulting risk analysis is more representative and contextual to the Sub-DAS Buah area in Palembang City.

Table 5. Identified Risks in Flood Management in Palembang City

No.	Risk Identification
Planning Aspect	
1	Drainage system planning is carried out in an integrated manner, taking into account environmental aspects, waste management, and wastewater treatment.
2	Drainage system planning is supported by adequate data, surveys, or studies.
3	There are frequent technical and non-technical obstacles encountered in drainage system planning.
4	Land-use changes.
5	Barriers in providing compensation for the use of community land for planned diversion/drainage channels.
6	Lack of coordination among stakeholders.
7	Lack of community support.
8	The number of trash filters installed in the drainage channels in Palembang City is still very limited.
9	There are drainage networks that have not undergone normalization
Implementation Aspect	
1	Flood management implementation is still patchwork (not comprehensive and only repairs damaged parts).
2	The construction of drainage channel profiles follows the recommended planning profile.
3	The dimensions of drainage facility structures are built according to the drainage channel dimensions.
4	There is control over the slope of the drainage channel base during implementation.
5	Placement of street inlets is appropriate for inundation conditions.
6	Most drainage street inlets are not functioning.
7	The work implementation methods proposed by contractors are often inappropriate.
8	Utility networks are embedded at the base of the drainage channels.
9	Occupational health and safety conditions are not guaranteed, especially in drainage channels contaminated with waste.
10	Closure of drainage channels for parking and roadside purposes
11	The community still disposes of waste into drainage channels and rivers
Operational and Maintenance Aspect	
1	Lack of planning transparency between organizations and institutions in flood management.
2	Weak supervision of residential development along drainage channels by relevant agencies.
3	Lack of monitoring and evaluation of the physical condition of drainage channels.
4	Weak monitoring and evaluation of the drainage system due to the absence of Standard Operating Procedures (SOPs).
5	Limited funding for the operation and maintenance of the drainage network and its facilities.
6	Limited funding for the operation and maintenance of the drainage network and its facilities.
7	Weak coordination and supervision of utility network development.
8	Lack of staff capacity-building efforts in drainage operation and maintenance.
9	Suboptimal use of call centers by the community in flood management.

Risk Acceptance Analysis

Based on the analysis of flood risk acceptance in Palembang City, the results can be described as follows:

In the planning aspect, a total of seven risks identified by special respondents were categorized as unacceptable. Among these, one risk had a probability percentage of 100%, one risk had a probability of 80%, and five risks had a probability of 64%. Meanwhile, five risks were identified by general respondents, with one of them classified as unacceptable at a probability percentage of 64%, and the remaining four risks categorized as undesirable with a probability percentage of 48%.

Table 6. Risk Assessment Results of the Planning Aspect - Special Respondents

No. Risk	***Likelihood***	***Consequences***	**Inherent Risk Value**	**Qualitative Inherent Risk Probability (%)**	***Acceptability Of Risk***
1	4	4	16	64%	*Unacceptable*
2	4	4	16	64%	*Unacceptable*
3	5	5	25	100%	*Unacceptable*
4	4	4	16	64%	*Unacceptable*
5	4	5	20	80%	*Unacceptable*
6	4	4	16	64%	*Unacceptable*
7	4	4	16	64%	*Unacceptable*

Table 7. Risk Assessment Results of the Planning Aspect - General Respondents

No. Risk	***Likelihood***	***Consequences***	**Inherent Risk Value**	**Qualitative Inherent Risk Probability (%)**	***Acceptability Of Risk***
5	4	3	12	48%	*Undesirable*
4	4	4	16	64%	*Unacceptable*
8	4	3	12	48%	*Undesirable*
9	4	3	12	48%	*Undesirable*
10	4	3	12	48%	*Undesirable*

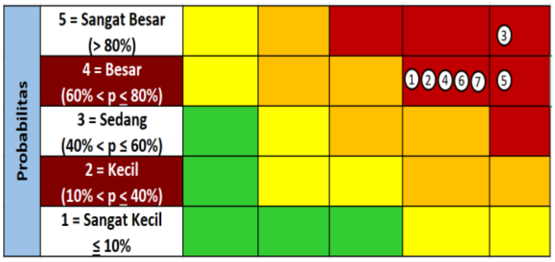

Figure 1. Risk Map of the Planning Aspect - Special Respondents

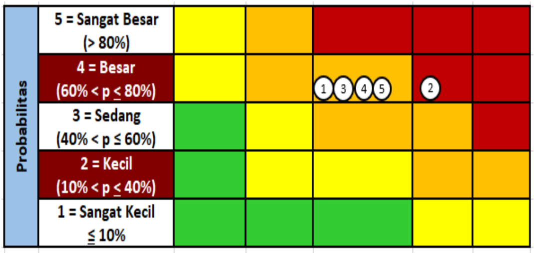

Figure 2. Risk Map of the Planning Aspect - General Respondents

In the implementation aspect, 8 out of 9 risks identified by the key respondents were categorized as *Undesirable*, with 5 risks having a probability percentage of 48%, 1 risk at 40%, and 2 risks at 36%. One risk was classified as *Unacceptable* with a probability percentage of 60%. Meanwhile, for the general respondents, a total of 5 risks were identified, of which 2 were categorized as *Unacceptable* with a probability percentage of 64%, and 3 were considered *Undesirable* 2 risks with a probability percentage of 48% and 1 risk at 36%.

Table 8. Risk Assessment Results for the Implementation Aspect - Spesial Respondents

No. Risk	***Likelihood***	***Consequences***	**Inherent Risk Value**	**Qualitative Inherent Risk Probability (%)**	***Acceptability Of Risk***
1	2	5	10	40%	*Undesirable*
2	4	3	12	48%	*Undesirable*
3	4	3	12	48%	*Undesirable*
4	3	4	12	48%	*Undesirable*
5	3	5	15	60%	*Unacceptable*
6	3	4	12	48%	*Undesirable*
7	3	3	9	36%	*Undesirable*
8	3	3	9	36%	*Undesirable*
9	3	4	12	48%	*Undesirable*

Table 9. Risk Assessment Results for the Implementation Aspect - General Respondents

No. Risk	***Likelihood***	***Consequences***	**Inherent Risk Value**	**Qualitative Inherent Risk Probability (%)**	***Acceptability Of Risk***
1	4	4	16	64%	*Unacceptable*
5	3	3	9	36%	*Undesirable*
6	4	3	12	48%	*Undesirable*
11	4	4	16	64%	*Unacceptable*
8	4	3	12	48%	*Undesirable*

Figure 3. Risk Map of the Implementation Aspect - Special Respondents

Figure 4. Risk Map of the Implementation Aspect - General Respondents

In the operational and maintenance aspect, 2 out of 9 risks for key respondents were categorized as *Undesirable* risks, with a probability percentage of 64%. Meanwhile, 7 risks were categorized as *Unacceptable*, consisting of 1 risk with a probability percentage of 48%, 5 risks at 36%, and 1 risk at 32%. As for general respondents, 3 risks were identified, with 2 of them categorized as *Unacceptable* with a probability percentage of 64%, and 1 risk classified as *Undesirable* with a probability percentage of 24%.

Table 10. Risk Assessment Results for the Operational & Maintenance Aspect - Special Respondents

No. Risk	***Likelihood***	***Consequences***	**Inherent Risk Value**	**Qualitative Inherent Risk Probability (%)**	***Acceptability Of Risk***
1	3	3	9	36%	*Undesirable*
2	3	3	9	36%	*Undesirable*
3	3	4	12	48%	*Undesirable*
4	3	3	9	36%	*Undesirable*
5	4	4	16	64%	*Unacceptable*
6	4	4	16	64%	*Unacceptable*
7	3	3	9	36%	*Undesirable*
8	2	4	8	32%	*Undesirable*
9	3	3	9	36%	*Undesirable*

Table 10. Risk Assessment Results for the Operational & Maintenance Aspect - General Respondents

No. Risk	***Likelihood***	***Consequences***	**Inherent Risk Value**	**Qualitative Inherent Risk Probability (%)**	***Acceptability Of Risk***
2	4	4	16	64%	*Unacceptable*
3	4	4	16	64%	*Unacceptable*
9	2	3	6	24%	*Undesirable*

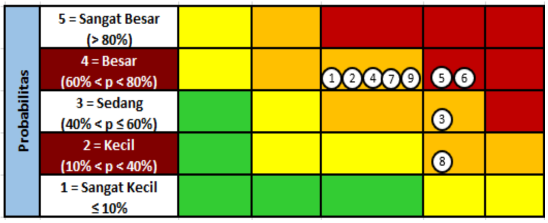

Figure 5. Risk Map of Operational & Maintenance Aspect - Special Respondents

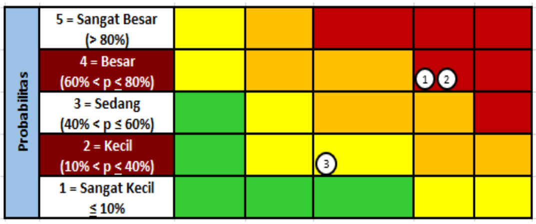

Figure 6. Risk Map of Operational & Maintenance Aspect - General Respondents

Mitigation

Based on the analysis results, all identified risks in the planning, implementation, and operation and maintenance aspects fall into the categories of unacceptable and undesirable risks. Therefore, mitigation efforts are necessary to address these risks. The mitigation measures applied in this study are divided into two main approaches: structural and non-structural. Structural mitigation was carried out through the implementation of a Rainwater Harvesting (RWH) system aimed at reducing the volume of stormwater runoff entering the drainage system. By lowering the surface runoff discharge, the potential for drainage channel overflow can be minimized, thus significantly decreasing the probability of flooding, particularly in flood-prone areas.

Meanwhile, non-structural mitigation includes community education, the development of an early warning system, and institutional capacity strengthening. Community education is intended to improve behavior regarding waste disposal and to raise awareness of individual roles in rainwater management. An early warning system allows communities and authorities to respond more quickly before risks escalate into disasters. Strengthening institutional capacity involves inter-agency coordination, enhancement of technical competencies, and the development of more responsive risk management procedures.

The impact of mitigation on risk reduction can be observed by comparing inherent risk values (before mitigation) and residual risk values (after mitigation). For instance, in the planning aspect, a risk initially categorized as unacceptable with a probability of 80% and a very high impact can be reduced to undesirable or even acceptable following the implementation of a highly effective mitigation measure. Quantitatively, the observed level of risk reduction varies depending on the combination of risk type, mitigation strategy, and implementation effectiveness. Some risks showed a reduction in probability by more than 30%, and in certain cases, the risk classification shifted from unacceptable to undesirable, or even to acceptable with monitoring. The following section presents the results of the mitigation analysis that has been conducted.

Table 12. Mitigation Analysis of Flood Risk Reduction in the Planning Aspect - Specific Respondents

No. Risiko	***Likelihood***	***Consequences***	***Mitigation***	**Inherent Risk Value**	**Inherent Risk Probability (%)**	***Acceptability Of Risk***	**Residual Risk**	**Residual Risk Probability (%)**	***Acceptability Of Risk***
1	4	4	3	16	64%	*Unacceptable*	3	12%	*Acceptable*
2	4	4	3	16	64%	*Unacceptable*	3	12%	*Acceptable*
3	5	5	3	25	100%	*Unacceptable*	3	12%	*Acceptable*
4	4	4	3	16	64%	*Unacceptable*	3	12%	*Acceptable*
5	4	5	3	20	80%	*Unacceptable*	2	10%	*Negligable*
6	4	4	3	16	64%	*Unacceptable*	3	12%	*Acceptable*
7	4	4	4	16	64%	*Unacceptable*	4	16%	*Acceptable*

Table 13. Mitigation Analysis of Flood Risk Reduction in the Planning Aspect - General Respondents

No. Risiko	***Likelihood***	***Consequences***	***Mitigation***	**Inherent Risk Value**	**Inherent Risk Probability (%)**	***Acceptability Of Risk***	**Residual Risk**	**Residual Risk Probability (%)**	***Acceptability Of Risk***
5	4	3	4	12	48%	*Undesirable*	3	12%	*Acceptable*
4	4	4	4	16	64%	*Unacceptable*	4	16%	*Acceptable*
8	4	3	3	12	48%	*Undesirable*	4	16%	*Acceptable*
9	4	3	5	12	48%	*Undesirable*	2	10%	*Negligable*
10	4	3	4	12	48%	*Undesirable*	3	12%	*Acceptable*

Table 14. Flood Risk Reduction Mitigation Analysis Implementation Aspect - Special Respondents

No. Risiko	**Probabilitas/ *Likelihood***	**Dampak**	**Mitigasi**	**Risiko Inherent**	**Probabilitas Risiko Kualitatif (%)**	***Acceptability Of Risk***	**Risiko Residual**	**Probabilitas Risiko Kualitatif (%)**	***Acceptability Of Risk***
1	2	5	3	10	40%	*Undesirable*	3	13%	*Acceptable*
2	4	3	3	12	48%	*Undesirable*	4	16%	*Acceptable*
3	4	3	3	12	48%	*Undesirable*	4	16%	*Acceptable*
4	3	4	3	12	48%	*Undesirable*	4	16%	*Acceptable*
5	3	5	3	15	60%	*Unacceptable*	5	20%	*Undesirable*
6	3	4	3	12	48%	*Undesirable*	4	16%	*Acceptable*
7	3	3	3	9	36%	*Undesirable*	3	12%	*Acceptable*
8	3	3	3	9	36%	*Undesirable*	3	12%	*Acceptable*
9	3	4	3	12	48%	*Undesirable*	4	16%	*Acceptable*

Table 15. Flood Risk Reduction Mitigation Analysis Implementation Aspect - General Respondents

No. Risiko	***Likelihood***	***Consequences***	***Mitigation***	**Inherent Risk Value**	**Inherent Risk Probability (%)**	***Acceptability Of Risk***	**Residual Risk**	**Residual Risk Probability (%)**	***Acceptability Of Risk***
1	4	4	4	16	64%	*Unacceptable*	4	16%	*Acceptable*
5	3	3	4	9	36%	*Undesirable*	2	9%	*Negligable*
6	4	3	3	12	48%	*Undesirable*	4	16%	*Acceptable*
11	4	4	5	16	64%	*Unacceptable*	3	13%	*Acceptable*
8	4	3	4	12	48%	*Undesirable*	3	12%	*Acceptable*

Table 16. Flood Risk Reduction Mitigation Analysis Operational and Maintenance Aspect Special Respondents

No. Risiko	***Likelihood***	***Consequences***	***Mitigation***	**Inherent Risk Value**	**Inherent Risk Probability (%)**	***Acceptability Of Risk***	**Residual Risk**	**Residual Risk Probability (%)**	***Acceptability Of Risk***
1	3	3	3	9	36%	*Undesirable*	3	12%	*Acceptable*
2	3	3	3	9	36%	*Undesirable*	3	12%	*Acceptable*
3	3	4	3	12	48%	*Undesirable*	4	16%	*Acceptable*
4	3	3	3	9	36%	*Undesirable*	3	12%	*Acceptable*
5	4	4	4	16	64%	*Unacceptable*	4	16%	*Acceptable*
6	4	4	3	16	64%	*Unacceptable*	5	21%	*Undesirable*
7	3	3	3	9	36%	*Undesirable*	3	12%	*Acceptable*
8	2	4	3	8	32%	*Undesirable*	3	11%	*Negligable*
9	3	3	4	9	36%	*Undesirable*	2	9%	*Negligable*

Table 16. Flood Risk Reduction Mitigation Analysis Operational and Maintenance Aspect General Respondents

No. Risiko	***Likelihood***	***Consequences***	***Mitigation***	**Inherent Risk Value**	**Inherent Risk Probability (%)**	***Acceptability Of Risk***	**Residual Risk**	**Residual Risk Probability (%)**	***Acceptability Of Risk***
1	4	4	3	16	64%	*Unacceptable*	5	21%	*Undesirable*
2	4	4	3	16	64%	*Unacceptable*	5	21%	*Undesirable*
3	2	3	3	6	24%	*Undesirable*	2	8%	*Negligable*

5. Conclusion

Based on the analysis conducted, the following conclusions can be drawn:

1. The analysis results indicate that in the planning aspect, specific respondents identified seven risks with a very high level, while general respondents identified five risks, consisting of one very high risk and four high-level risks. In the implementation aspect, specific respondents identified six high-level risks and three medium-level risks, while general respondents identified two very high risks, two high risks, and one medium risk. In the operational and maintenance aspect, specific respondents found two very high risks, one high risk, and six medium risks. Meanwhile, general respondents identified two very high risks and one medium risk. These findings affirm that all aspects of flood management in Palembang City still face considerable risk levels, thus requiring appropriate and comprehensive mitigation strategies.

2. The analysis of risk acceptance levels in flood management in Palembang City reveals significant variations across aspects and respondent groups. In the planning aspect, specific respondents identified seven risks categorized as *unacceptable*, while general respondents recorded five risks, comprising one *unacceptable* and four *undesirable*. In the implementation aspect, specific respondents identified eight *undesirable* and one *unacceptable* risk, while general respondents noted two *unacceptable* and three *undesirable* risks. In the operational and maintenance aspect, specific respondents recorded seven *unacceptable* and two *undesirable* risks, while general respondents identified two *unacceptable* and one *undesirable* risk. These findings indicate that most of the identified risks especially in the planning and operational & maintenance aspects fall within low acceptance levels, thus requiring more serious and targeted mitigation interventions.
3. All identified risks across planning, implementation, and operational & maintenance aspects fall into the categories of *unacceptable* or *undesirable* risks. Therefore, appropriate mitigation efforts are required to reduce these risks to acceptable levels. One potential mitigation strategy is the implementation of a rainwater harvesting system, which can significantly reduce risk impacts and enhance water management efficiency in the context of flood control.

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