Agromet 39 (1): 56-66, 2025

Agromet

journal.ipb.ac.id/index.php/agromet

ISSN : 0126 - 3633

Flood Management Strategy Based on Analysis of Regional Characteristics and Causal Factors in Kendari City

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ARTICLE INFO

Received
10 January 2025

Revised
19 April 2025

Accepted for Publication
29 April 2025

Published
26 June 2025

doi: 10.29244/j.agromet.39.1.56-66

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ABSTRACT

Flooding is a disaster that causes environmental damage, economic losses, and social problem. Kendari City is one of the Indonesian cities that frequently experiences floods due to various factors, including high rainfall, land use changes, poor drainage conditions, and improper spatial management. This study aims to (1) assess the factors contributing to flooding, (2) analyze government governance and community participation in flood management, and (3) formulate an integrated flood management strategy. The methods used were descriptive analysis, spatial approach, SWOT analysis, and Quantitative Strategic Planning Matrix (QSPM). The results showed that there is evidence of land use changes between 2013 – 2023 based on spatial image analysis. We found there were three sub-districts, which is categorized on high flood vulnerability namely Baruga, Kadia, and Kambu sub-districts. Based on the level of community preparedness parameters including knowledge and attitudes, emergency plans, early warning, and resource mobilization, Baruga belongs to the medium category (74.60%), while Kambu (57.42%) and Kadia (59.58%) were in low category. QSPM analysis recommends two priority strategies to reduce flood vulnerability namely accelerating drainage system improvements and replicating the Baruga model in other areas. Future research should focus on climate change-induced flood modeling, gender-sensitive vulnerability assessments, and economic loss estimation to enhance the effectiveness of flood management strategies.

KEYWORDS
community readiness, flood management, flood-prone areas, QSPM, SWOT

1. INTRODUCTION

Flooding in Kendari City, Southeast Sulawesi, is a recurring issue with 24 events recorded from 1991 to 2020 (Aba et al., 2021), followed by 11 more in just two years (2021–2022). These events typically occur between March and October, with monthly rainfall reaching up to 200 mm, primarily affecting Baruga, Kambu, Poasia, Kadia, Puuwatu, and Mandonga (BPBD, 2025).

The city's flood vulnerability is driven by a combination of geographical, structural, and anthropogenic factors (Rahayu et al., 2023). Its low-lying topography makes it prone to runoff from surrounding highlands (Kasnar et al., 2019), while extreme rainfall exceeding further intensified flood risk (Li et al., 2023; Maddi et al., 2021). In addition, land conversion and settlements has reduced infiltration capacity (Tang et al., 2024), a situation worsened by unregulated riverbank settlements and improper waste disposal into rivers (Hasddin and Tamburaka, 2021).

Frequent flooding has resulted in human suffering, displacement, worsening social problems, and extensive damage to housing and infrastructure (Kousky and Walls, 2014). Financially, flood-related losses in the region have reached up to IDR 42.7 billion (Kasim et al., 2020), underscoring the urgent need for more effective flood management.

Nowadays, flood management efforts in Kendari City still rely heavily on conventional structural measures, such as river engineering, which remain largely reactive. A more comprehensive and inclusive approach is required one that not only responds to disasters but also emphasizes sustainable, community-centered prevention efforts. This study aims to (i) examine the key factors contributing to flooding in Kendari City, (ii) assess the impacts on affected areas, and (iii) propose integrated, evidence-based flood management strategies tailored to the city's specific conditions.

2. MATERIAL AND METHODS

2.1 Study Area

This study was conducted in Kendari City, focusing on three sub-districts: Baruga, Kambu, and Kadia. These areas are characterized by lowland and hilly topography and are located downstream of the Wanggu and Kambu Rivers. The research took place from November 2023 to March 2024. The tools used included: (1) a Garmin GPSMAP 64s to record location points; (2) ArcGIS 10.8 for spatial analysis of flood-prone areas; (3) a mobile phone camera for field documentation; and (4) structured questionnaires to collect data from respondents regarding flood conditions in Kendari City. The study area is shown in Figure 1.

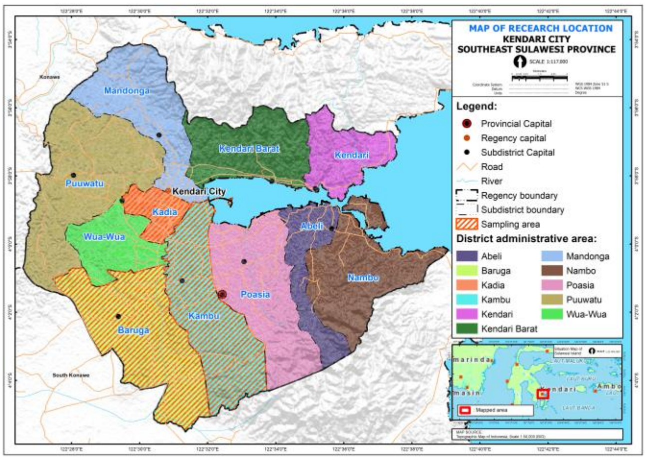

Figure 1. Map of research location

2.2 Datasets

This research used both primary and secondary data. Primary data were collected through a survey of flood-affected communities in Kendari City. The sample size was determined using Slovin's formula (Table 1 no. 1) with a 10% margin of error to ensure representative sampling of the population (N = 364, 220 individuals; BPS, 2023). The sampling frame included registered household heads in the three flood-affected sub-districts (Baruga, Kambu, and Kadia) in 2023. These respondents were selected using a purposive sampling technique based on the following criteria: (1) household heads aged 30–70 years, (2) directly experienced the flood disaster, and (3) willing to provide in-depth information. A total of 100 respondents were obtained, including 40 from Baruga, 30 from Kambu, and 30 from Kadia. These sub-districts were selected based on historical flood data, severity of damage, and the BNPB flood risk zoning map (BPBD, 2023), which classifies Baruga as high-risk, Kambu as medium-risk, and Kadia as low-risk.

Secondary data were collected from various relevant agencies, including the Regional Disaster Management Agency (BPBD), BMKG, the Public Works and Spatial Planning Agency, the Environment and Forestry Agency, the Watershed Management Agency, the Sulawesi River Basin IV Agency, the Regional Development Planning Agency (Bappeda), as well as literature reviews, maps, and related documents.

2.3 Data Analysis

2.3.1 Analysis factors causing flooding

Factors causing flood is determined based on expert judgment, considering key factors such as rainfall, slope, soil type, land use, and the Topographic Wetness Index (TWI). Rainfall data were obtained from CHIRPS (2024) and BMKG (2023). Land use and soil type data were collected from BIG. We derived TWI and slope maps from DEMNAS data (8-meter resolution), with processed by ArcGIS v10.8. Flood-prone areas were identified using overlay analysis by assigning weights and scores to the five key parameters through normalized weighting calculations (Table 1 no. 2)

The weights calculated were then used to formulate the flood vulnerability model (Table 1 no. 3), which integrates the influence of each parameter on flood susceptibility. The flood vulnerability value for each area was calculated based on the weighted sum of parameter class scores (Table 1 no. 4). These vulnerability values were then classified into five categories very low, low, medium, high, and very high using the class interval formula (Table 1 no. 5).

2.3.2 Flood management analysis

Flood governance was assessed through document review to evaluate the effectiveness of government flood management programs. Content analysis and data triangulation were applied to ensure alignment between policy documents and field implementation. To complement this, in depth interviews were conducted with key stakeholders, including

Table 1 List of Formulas Used in Flood Vulnerability and Management Analysis

No	Equation	Description
1	$n = \frac{N}{1 + N(e)^2}$	**Slovin's formula** used to determine the number of survey respondents. Where: n = number of respondents, N = total population, e = margin of error (10%).
2	$Wj = \frac{(n - rj + 1)}{\sum(n - rj + 1)}$	**Normalized weight value** for each parameter influencing flood vulnerability. Where: W_j = normalized weight, r_j = rank of the parameter, n = total number of parameters.
3	$V = a(R) + b(S) + c(ST + d(LU) + e(TWI)$	**Flood vulnerability score** based on weighted parameters: Rainfall (R), Slope (S), Soil Type (ST), Land Use (LU), Topographic Wetness Index (TWI). A = 0.03; B = 0.27; C = 0.9; D = 0.02; E = 0.04
4	$X = \sum_{i=1}^{n}(W_i * X_i)$	**Final flood vulnerability value** computed from the weight and class score of each parameter. Where: W_i = weight, X_i = class score for parameter i.
5	$CI = \frac{t - r}{n}$	**Interval class** used to categorize flood vulnerability into levels. Where: t = highest score, r = lowest score, n = number of classes
6	$\text{Index} = \frac{\text{Total real paramters}}{\text{Parameters maximum score}} \times 100$	**Community flood preparedness index**, measuring readiness based on knowledge, emergency

government officials, field officers, and affected communities, to capture their perceptions, experiences, and evaluations of the programs.

Community-based flood governance was evaluated using open-ended questionnaires, allowing residents to express their experiences, participation, challenges, and independent mitigation efforts. Responses were analyzed thematically to identify key issues and recurring patterns. The assessment focused on four parameters proposed by LIPI-UNESCO/ISDR (2006): Knowledge and Attitude (KAP), Emergency Response Plan (EP), Early Warning System (EWS), and Resource Mobilization Capacity (RMC). The community preparedness index for flood disasters was calculated using Equation (Table 1 no.6) and categorized as high (80–100), medium (60–79), or low (<60).

The SWOT analysis was applied to identify internal factors (strengths, weaknesses) and external factors (opportunities, threats) through the following steps:

a. Collection and grouping of secondary and primary data to evaluate the internal and external situation
b. Identification of internal factors (IFE) and external factors (EFE).
c. IFAS and EFAS analysis with weight and rating assessment on each factor determines the size or smallness of the level of strengths, weaknesses, opportunities, and threats. The weighting in the IFAS and EFAS matrix is obtained from the average value of each respondent using the AHP (Analytic Hierarchy Process) method. The rating or ranking value is obtained from 7 experts and practitioners working in Kendari City.
d. Develop a SWOT matrix diagram consisting of 4 quadrants, namely strengths, weaknesses, opportunities, and threats to summarise strategic factors to obtain clear flood management indicators to formulate effective strategies.
e. Determining strategy priorities using a Quantitative Strategic Planning Matrix with Attractiveness Score (AS) assessment by six experts in Kendari City. The calculation of the Total Attractiveness Score (TAS) determines the ranking of strategy priorities.

By using this SWOT Analysis, stakeholders can develop more targeted strategies to reduce flood risks and increase the resilience of the region. The stages of data processing and analysis in this study are presented in the flow chart. This research begins with mapping flood-prone areas through spatial analysis of flood-causing factors, such as rainfall, topography, soil type, slope, TWI, and land use. Each factor was weighted and overlaid to produce a map of flood-prone areas. Next, flood governance from the government and community sides was analyzed.

Government governance was analyzed through document review and in-depth interviews. Document analysis was conducted using content analysis and data triangulation to measure the effectiveness of policies and their implementation. In-depth interviews were conducted with stakeholders involved such as the Regional Disaster Management Agency, the Public

Works and Spatial Planning Agency, the Environment and Forestry Agency, the Watershed Management Centre, the Sulawesi River Basin IV Centre, and the Regional Development Planning Agency, to gain deeper insights into policy implementation.

The final stage is formulating flood management strategies with IFAS & EFAS analysis using the SWOT approach. Internal and external factors are weighted to determine the X-Y coordinates, which are then used in QSPM to prioritize flood management strategies. This final stage integrates spatial data and governance findings to produce a comprehensive flood mitigation strategy.

3. RESULTS AND DISCUSSION

3.1 Factors causing flooding in Kendari City

The monthly rainfall distribution in Kendari City from 2013 to 2023 shows a clear seasonal pattern, with the highest rainfall occurring between May to July (Figure 2). May exhibits the largest variability, with rainfall exceeding 600 mm, while the driest months are August to October, marked by consistently low rainfall.

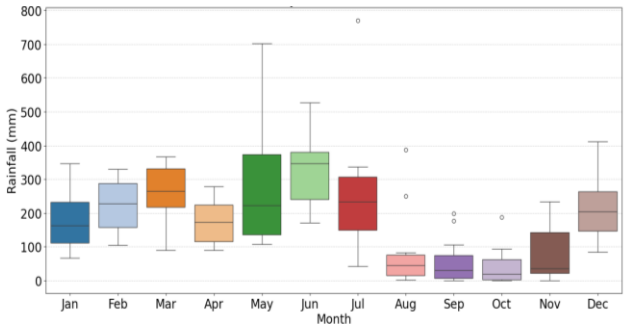

Figure 2. Boxplot of monthly rainfall for 2013-2023 in the study site.

The annual rainfall varied across Kendari City, with the 32% area having more than 2,459 mm/year is the largest of area receives about 2,429-2,459 mm/year, and the remaining proportion (~2%) having annual rainfall below 2,358 mm/year.

Land use in Kendari City has changed significantly between 2013 and 2023. The area of settlements increased from 8.23% to 22.60%, reflecting rapid urban development. In contrast, mixed dryland agriculture declined sharply by 26.70%. Expansion of shrubs and secondary dryland forests also occurred, indicating widespread land conversion from agriculture and forests to infrastructure and housing. However, this development often lacks proper drainage systems, increasing surface water accumulation during intense rainfall and worsening flood risks (Saleh and Setiadi, 2020; Wang et al., 2021). Combined with high rainfall, land use change is a major driver of flooding in many areas (Tang et al., 2024).

The flood vulnerability map shows that Kambu, Baruga, Kadia, and Nambo sub-districts face high to very high flood risk due to flat terrain, high rainfall, and land conversion to residential and industrial areas (Figure 3). These conditions reduce water absorption and increase runoff, highlighting the urgent need for improved flood risk management (Li et al., 2023).

Topographic characteristics and land use management are critical in determining the level of flood vulnerability (Hannum et al., 2022; Sun et al., 2022). Meanwhile, Wua-was sub-district and Poasia sub-district are at a moderate level of vulnerability with gentle slopes. Mandonga sub-district. Puuwatu sub-district. Kendari west sub-district. Kendari sub-district. and Abeli sub-district are still at a low to very low level of vulnerability with steep to very steep slopes.

Flood vulnerability in Kendari City is mostly categorized as very low, covering an area of 9.641.04 hectares or 36.42% of the total area. Low vulnerability accounts for 6,229 hectares (23.53%), while medium vulnerability covers 2,822 hectares (10.66%). Areas with high flood vulnerability reach 3,614 hectares (13.66%), and very high vulnerability covers 15.72 %.

3.2 Government and Community Governance in Flood Management

One of the key government agencies involved in flood disaster management is the Regional Disaster Management Agency (BPBD). This agency plays a central role in: (1) establishing Disaster Preparedness Groups at the village level and facilitating the Disaster Risk Reduction Forum; (2) promoting disaster resilient cities, managing drainage systems, and addressing potential disaster risks; (3) conducting disaster education programs in disaster-prone schools; and (4) disseminating information through social media and daily reports related to evacuation, provision of basic needs, and post-disaster reconstruction and rehabilitation. As a non-departmental institution, BPBD serves as the leading sector in coordinating disaster management at the regional level (Heryati, 2020).

Community interview results show that the flood disaster knowledge parameter in Baruga Sub-district reached 83.04%, Kambu 79.76%, and Kadia 80.48%, all falling within the moderate category. However, the emergency response plan parameter shows a concerning gap. Baruga scored 66.00%, categorized as almost ready, while Kambu (38.33%) and Kadia (42.67%) fall into the not ready category, indicating limited preparedness in responding to flood events. Research shows that anxiety and panic during disasters can significantly hinder effective action, even among individuals with sufficient knowledge (James et al., 2019; Netzel et al., 2021).

Table 2. Land use change of Kendari City from 2013 to 2023

Land Use	Year 2013		Year 2023		Changes 2013-2023	
	Ha	%	Ha	%	Ha	%
Water Body	164.31	0.62	114.03	0.43	-50.28	-0.19
Shrub	3,302.83	12.48	6,752.40	25.51	3,449.57	13.03
Primary dryland forest	39.43	0.15	555.14	2.10	515.71	1.95
Secondary dryland forest	2,352.48	8.89	3,737.32	14.12	1.384.84	5.23
Secondary mangrove forest	92.12	0.35	103.53	0.39	11.41	0.04
Open land	4.01	0.02	184.38	0.70	180.37	0.68
Settlement	2,165.22	8.18	6,386.76	24.13	4,221.54	15.95
Dryland Agriculture	6,996.00	26.58	4,756.51	17.97	-2,239.49	-11.17
Mixed Dryland Agriculture	10,516.06	39.73	2,910.89	11.00	-7,605.17	-28.73
Rice Field	244.89	0.93	409.43	1.55	164.54	0.62
Pond	592.79	2.24	490.07	1.85	-102.72	-0.39
Sea/Air Harbour	-	-	53.29	0.20	53.29	0.20
Plantation	-	-	10.21	0.04	10.21	0.04
Mining	-	-	6.18	0.02	6.18	0.02
Total	**26,470.14**	**100**	**26,470.14**	**100**		

The flood early warning system parameter shows Baruga at 77.19% (ready), Kambu at 60.83% (almost ready), and Kadia at 70.83% (ready) in facing flood disasters. For resource mobilization, Baruga scored 68.50% (ready), while Kambu (41.33%) and Kadia (42.00%) remain in the less ready category, reflecting limited community capacity to mobilize resources during emergencies.

The combined index results show that Baruga District has a preparedness score of 74.60%, categorized as Medium, while Kambu and Kadia fall into the Low category with scores of 57.42% and 59.58%, respectively. This suggests that overall community readiness in flood-prone areas remains low, largely due to limited risk awareness and a lack of preventive actions. Even in Baruga, where preparedness is relatively higher, gaps in risk perception and proactive planning are evident. Research shows that flood risk perception significantly affects preparedness levels, highlighting the importance of improving public awareness and strengthening community participation in disaster risk reduction (Elum ZA, 2017; Li et al., 2022; Netzel et al., 2021).

Baruga Sub-district, which is categorized as having medium preparedness, reflects a relatively good level of community knowledge regarding flood risks. Early warning systems in this area are fairly effective, supported by sirens, river level monitoring (petascale), public announcements through local media, and traditional indicators by the local community. These mechanisms contribute to better anticipation and response, although challenges remain in translating awareness into comprehensive preparedness and long-term mitigation planning.

However, this knowledge is often not translated into concrete planning or action when disasters occur. Financial constraints, lack of skills, and fear of potential threats remain major barriers to effective community preparedness (Pang et al., 2023). When the perceived cost of taking recommended protective measures is high, individuals are less likely to implement them, even if they are considered feasible (Bajracharya et al., 2021). In Kambu Sub-district, which has a low preparedness index (56.62%), limited community knowledge is compounded by weak emergency response capacity.

Kambu Sub-district, with a low preparedness index (56.62%), illustrates that community knowledge does not always translate into effective emergency response. The community shows limited participation in flood prevention training and simulations, lacks task distribution during evacuations, and has not prepared basic emergency resources such as first aid kits, emergency contact information, or self-rescue equipment (e.g., life buoys, rubber or wooden boats). Structured emergency response plans, including evacuation routes, disaster response simulations, and logistics preparedness, are largely absent. Education and training are recognized governance tools to improve community behavior, but their effectiveness depends on collaboration between local information sources, emergency services, and families (Forsyth et al., 2023).

Kadia Sub-district, also categorized with low preparedness (59.58%), demonstrates similarly weak emergency response and resource mobilization. The

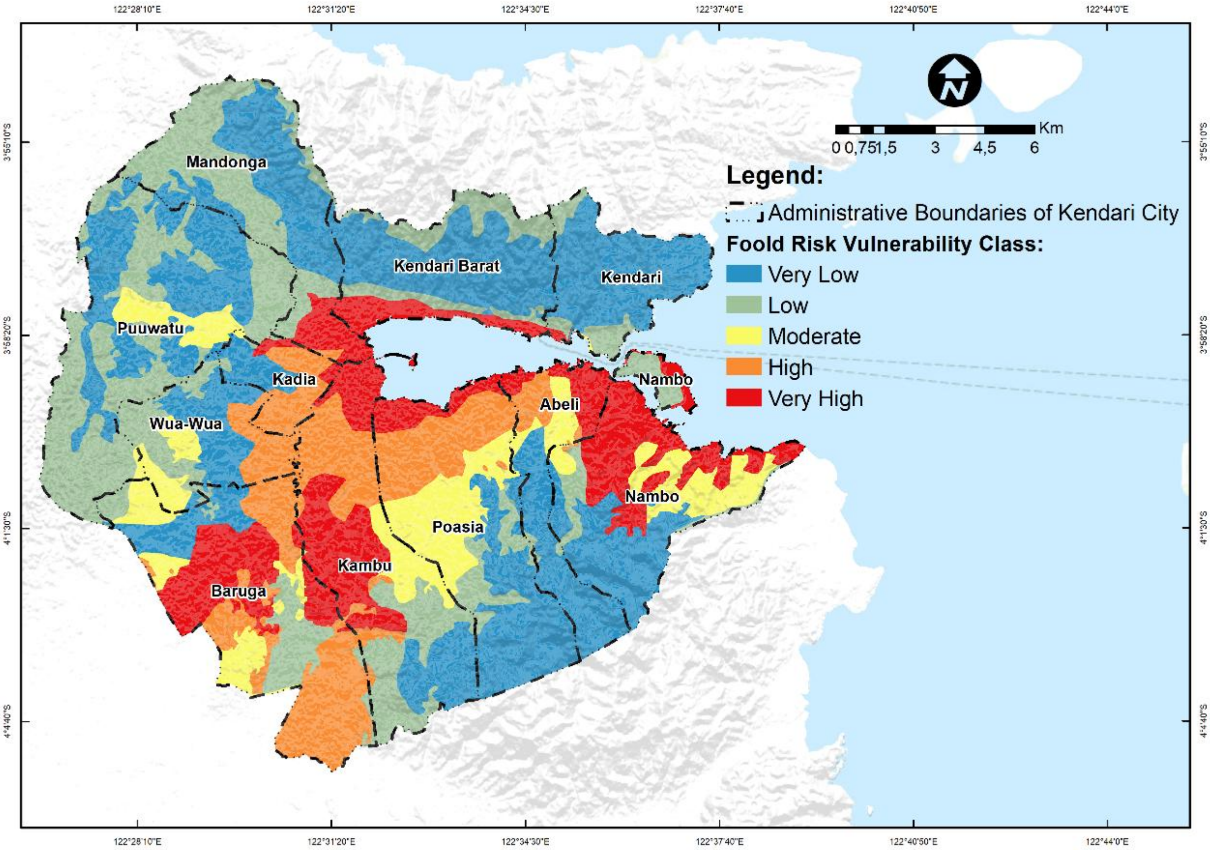

Figure 3. Spatial distribution of flood vulnerability in Kendari City in 2023

community lacks designated evacuation sites, training participation, and basic emergency resources. Financial limitations, skill gaps, and fear remain key barriers to preparedness (Ejeta et al., 2016; Li et al., 2022). High perceived costs of recommended actions further reduce community willingness to adopt protective measures, even when feasible (Banerski and Abramczuk, 2023).

In both sub-districts, ineffective communication, low trust in authorities, and limited resources undermine emergency response efforts (Mas'Ula et al., 2019). Communities face difficulties in pooling and distributing resources during flood events, lack savings or valuable assets, and are not engaged in disaster preparedness groups, making them unable to perform self-rescue. Consequently, they remain heavily dependent on government assistance for evacuation and relief. In addition, limited financial and human resources continue to hinder timely and effective flood response and recovery efforts.

3.3 Integrated Flood Disaster Management Strategy in Kendari City

Flood disaster management efforts in Kendari City were evaluated using the Internal Factor Analysis Summary (IFAS) and External Factor Analysis Summary (EFAS) matrices. Weighting for both matrices was derived from the average scores of six local experts. The analysis aims to identify strategies that leverage strengths and opportunities while addressing existing weaknesses and threats. The IFAS matrix yielded a total score of 2.18, comprising 1.41 for strengths and 0.77 for weaknesses (Table 3). Although structural weaknesses exist, the higher strength score suggests internal potential that can be optimized. The primary strength is S1 – Baruga's integrated infrastructure and preparedness (score: 0.56), which could serve as a model for other sub-districts. In contrast, the main weakness is W1 – inadequate infrastructure and emergency response in Kadia (score: 0.20), indicating an area requiring urgent improvement.

The EFAS matrix shows a total score of 2.56, with opportunities (2.02) far more dominant than threats (0.54). The highest opportunity is O1-Government Infrastructure Development Programme (0.88), which reflects strong support from national policy towards strengthening disaster management infrastructure. Meanwhile, the main threat is T1-Extreme Flood Intensity (0.20), which indicates the significant impact of global climate change (Glasser, 2020).

The results of the strategy coordinate calculation obtained: X = Strength - Weakness = 1.41 - 0.77 = 0.64; Y = Opportunity - Threat = 2.02 - 0.54 = 1.48, this value places the strategy in Quadrant I (Growth Strategy),

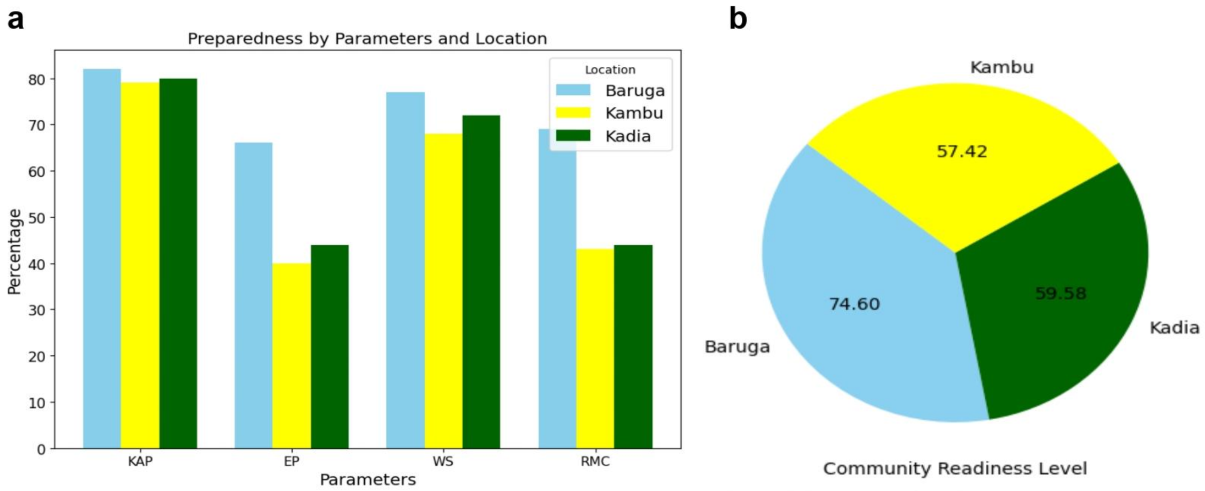

Figure 4. (a) Preparedness index by parameter; (b) Overall community readiness levels in Baruga, Kambu, and Kadia. (KAP = Knowledge and Attitude; EP = Emergency Planning; WS = Warning System; RMC = Resource Mobilization Capacity).

which can be seen in Figure 5. This position indicates the ability to leverage internal strengths to optimize external opportunities with implementation priorities (David, 2016): SO (primary), WO (secondary), ST, and WT (supporting) strategies.

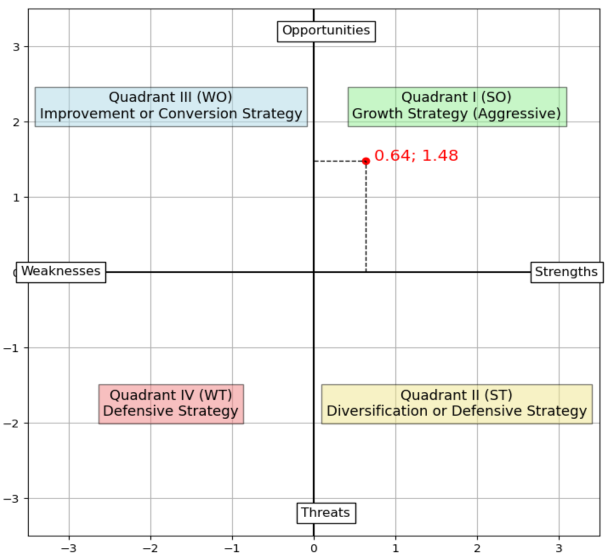

Figure 5. SWOT quadrant matrix

The results of SWOT Matrix Table A1 show the prioritisation Strategy: SO1 - Replicate the Baruga Model: adopt the integrated infrastructure and community preparedness system from Baruga to other more vulnerable areas. Knowledge transfer according to knowledge management theory (Muñoz-erickson et al., 2017). SO2 - Optimisation of Kambu Drainage: make the drainage system in Kambu sub-district a pilot project through a phased development approach as per Ruess and Lindner's incremental implementation (2023). SO3 - Resilient City Development in Kadia: Utilise the area density and community adaptation in Kadia to build a disaster-resilient city based on an integrated early warning system (Zert et al., 2024).

WO Strategy: WO1-Kadia Infrastructure Upgrade: addressing the 408.2 ha flood-prone area with a technology-based infrastructure program in line with the smart city concept. WO2-Strengthening Kambu-Kadia Emergency Response to improve community preparedness through training, simulation, and multi-platform early warning, in line with the community-based disaster risk management approach (Zhao et al., 2025). WO3-Baruga Drainage Improvement: improving the effectiveness of the drainage system through participatory maintenance in line with social capital theory that emphasizes community collaboration.

The results of Table A2 QSPM analysis show methodological consistency with the Total Attractiveness Score (TAS) ranging from 5.14-6.36, reflecting clear differences among the various strategies. Strategy SO2 (Accelerated Integrated Drainage) took the top in line with the global approach to urban flood risk reduction through integrated infrastructure management (GFDRR, 2024). Strategy ST1 (Infrastructure Capacity Building), which ranks third, emphasizes the importance of strengthening physical structures as the foundation of resilience. This supports previous findings that improving infrastructure capacity and accessibility requires an integrated approach (Mohamad et al., 2024).

The integrated flood management strategy in Kendari City requires funding of IDR 321.7 billion, comprising 95.1% for structural programs (IDR 306 billion) and 4.9% for non-structural programs (IDR 15.7 billion). The budget allocation is based on vulnerability based budgeting, namely Kambu (IDR 71.85 billion), Kadia (IDR 68 billion), and Baruga (IDR 65.35 billion).

Table 3. Matrix Internal Factors Analysis Summary (IFAS) and Matriks External Factors Analysis Summary (EFAS)

A. Strength	Weight	Rating	Score
S1 - Integrated Infrastructure and Preparedness Baruga	0.14	4	0.56
S2 - Solid Institutional and Drainage System Kambu	0.13	4	0.52
S3 - Regional Compactness and Community Adaptation Kadia	0.11	3	0.33
Total			**1,41**
B. Weaknesses			
W1 - Infrastructure Deficit and Emergency Response Kadia	0.20	1	0.20
W2 - Emergency Preparedness-Response Paradox Baruga	0.17	1	0.17
W3 - Environmental Degradation and Low Capacity Kambu	0.15	2	0.30
W4 - Low Community Participation All 3 Sub-districts	0.10	1	0.10
Total			**0.77**
Total Strength and Weaknesses	**1.00**		**2.18**
C. Opportunities			
O1 - Government Infrastructure Development Programme	0.22	4	0.88
O2 - Multi-Platform Early Warning System	0.16	3	0.48
O3 - Disaster Resilient City Development	0.12	3	0.36
O4 - Multi-Stakeholder Collaboration	0.08	3	0.30
Total			**2.02**
D. Threat			
T1 - Extreme Flood Intensity	0.20	1	0.20
T2 - Land Use Change	0.12	2	0.24
T3 - Extreme Rainfall and Discharge	0.06	1	0.06
T4 - Dependency and Sedimentation	0.02	2	0.04
Total			**0.54**
Total Opportunities and Threat	**1.00**		**2.56**

Interventions include infrastructure, institutional strengthening, and community empowerment. The program is projected to reduce household losses by IDR 500,000-IDR 3,000,000 per event, demonstrating economic viability and social relevance in building disaster resilience.

3.4 Future Research Directions

This study's findings highlight three critical areas for future research. First, flood modelling incorporating climate change scenarios (2030-2050) specific to Kendari City is essential for long-term risk assessment, integrating IPCC projections with local hydrological characteristics. Second, gender-based vulnerability analysis is needed, as preliminary observations indicate women show higher preparedness proactivity despite greater socioeconomic vulnerability, which could inform targeted interventions. Third, comprehensive economic loss estimation covering both direct damages (property, infrastructure) and indirect impacts (business disruption, health costs) would provide crucial cost-benefit data for infrastructure investment decisions. These research directions would strengthen evidence-based flood management policies for urban Southeast Asian contexts.

4. CONCLUSION

The main factors causing flooding in Kendari City are rainfall, slope, soil type, and land use where priority areas are located in 3 sub-districts, namely Baruga, Kambu, and Kadia sub-districts. The effectiveness of flood governance has 22 flood management activity programs in the short-term, medium-term, and long-term with the cooperation of the Regional Disaster Management Agency, the Public Works and Spatial Planning Office, the Environment and Forestry Office, the Watershed Management Center, the Sulawesi IV River Basin Center, and the Regional Development Planning Agency with the highest level of community preparedness in Baruga District at 74.60% (Medium Category), Kambu 57.42% (Low Category) and Kadia 59.58% (Low Category). The strategic position in Quadrant I (Growth Strategy), identified through SWOT analysis, resulted in 12 alternative integrated strategies based on the QSPM (Quantitative Strategic Planning Matrix) evaluation. The top priorities include the acceleration of integrated drainage (TAS: 6.36) and the optimization of the Baruga model for replication (TAS: 6.20). The integrated flood management strategy in Kendari City requires funding of IDR 321.7 billion, including structural and non-structural interventions.

ACKNOWLEDGMENT

The authors thank BPBD, PUPR, DLHK, BPDAS, BWSS IV, BAPPEDA, and the sub-districts of Baruga, Kambu, and Kadia for their data support, field facilitation, and community participation. Special thanks to the reviewers and the editorial team for their valuable feedback and support during the publication process.

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ANNEX

Table A1. SWOT matrix of integrated flood disaster management in Kendari City

IFAS / EFAS	STRENGTHS (S)	WEAKNESSES (W)
	S1. Integrated Infrastructure and Baruga Preparedness S2. Solid Institutional and Drainage System Kambu S3. Regional Compactness and Community Adaptation Kadia	W1. Infrastructure Deficit and Emergency Response Kadia W2. Baruga Emergency Preparedness Response Paradox W3. Environmental Degradation and Low Capacity Kambu W4. Low Community Participation All three Sub-districts
OPPORTUNITY (O)	**STRATEGI SO**	**STRATEGI WO**
O1. Infrastructure programme O2. Multi-Platform Early Warning O3. Disaster Resilient City O4. Multi-Stakeholder Collaboration	SO1. Optimization of the Baruga Model for Replication SO2. Acceleration of Integrated Drainage SO3. Development of Resilient City Kadia	WO1. Prioritised Rehabilitation of Kadia Infrastructure WO2. Strengthening Emergency Response Capacity WO3. Drainage Revitalisation- Baruga Participation
THREAT (T)	**STRATEGI ST**	**STRATEGI WT**
T1. Extreme Flood Intensity T2. Land Use Change T3. Extreme Rainfall T4. Dependency-Sedimentation	ST1. Increased Infrastructure Capacity ST2. Strengthening Integrated Early Warning ST3. Infrastructure Adaptation- Land Use	WT1. Community Capacity Emergency Programme WT2. Multi-Functional Emergency Infrastructure WT3. Mitigation Degradation-Sedimentation

Table A2 Prioritisation of Integrated Flood Management Strategies with TAS and Ranking

Ranking	Alternatif Strategi	Kode	TAS	Kategori
1	SO2. Acceleration of Integrated Drainage	(S+NS)	6.36	Top Priority
2	SO1. Optimization of Baruga Model for Replication	(S+NS)	6.20	Top Priority
3	ST1. Infrastructure Capacity Building	(S)	6.15	High Priority
4	WO2. Strengthening Emergency Response Capacity	(NS)	6.09	High Priority
5	ST3. Land Use Infrastructure Adaptation	(S+NS)	6.09	High Priority
6	WO1. Priority Rehabilitation of Kadia Infrastructure	(S)	6.02	Medium Priority
7	SO3. Development of Resilient City Kadia	(S+NS)	5.98	Medium Priority
8	WO3. Revitalisation Drainage-Participation Baruga	(S+NS)	5.86	Medium Priority
9	ST2. Strengthening Integrated Early Warning	(NS)	5.58	Low Priority
10	WT2. Multi-Functional Emergency Infrastructure	(S)	5.50	Low Priority
11	WT1. Community Capacity Emergency Programme	(NS)	5.36	Low Priority
12	WT3. Mitigation Degradation-Sedimentation	(NS)	5.14	Low Priority

** S = Structural, NS = Non Structural*