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Assessing Urban Livability in Coastal Cities Facing Tidal Floods: A Quantitative Study of Public Satisfaction Factors

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Abstract Urban viability is a multidimensional issue that is increasingly important for coastal cities in developing countries facing ecological pressures due to climate change. This study aims to identify the main factors that affect public satisfaction with the feasibility of living in Pekalongan City, Indonesia, which is routinely affected by tidal floods. Using a mixed-method approach, quantitative data were obtained through a survey of 300 respondents and analyzed using Exploratory Factor Analysis (EFA) and multiple linear regression, while qualitative data were used for triangulation to deepen the understanding of the context and perception of respondents. The results of the EFA identified seven dominant factors that shape public perception, namely the physical condition of flood impacts, governance transparency, community preparedness, public trust in the government, economic instability, and access to public services. The regression analysis showed ten significant variables that contributed to public dissatisfaction, with the physical environment and infrastructure as the main determinants. The triangulation findings show that communities have adapted to tidal flooding as a routine disruption, but still demand improved adaptive infrastructure, transparent governance, and stronger social capacity to build resilient and sustainable coastal cities.

Keywords Livability, Tidal Floods, Coastal City, Public Satisfaction, Pekalongan, Urban Resilience

1. Introduction

The realization of livable cities for the majority of urban residents has become a central focus of many countries, including Indonesia. According to the Indonesian Central Bureau of Statistics, 56.7% of Indonesia's population lived in urban areas in 2020, and this figure is projected to increase to 66.6% by 2035. The Government of Indonesia is among many other countries that signed the agreement in September 2015 regarding the 2030 Sustainable Development Goals (SDGs), which consist of 17 development goals. Goal 11 emphasizes Sustainable Cities and Communities, with the specific objective of "making cities and human settlements inclusive, safe, resilient, and sustainable" [1]. Furthermore, in October 2016, the Indonesian government signed the New Urban Agenda (NUA) 2036, a mandate resulting from the Habitat III Conference. NUA 2036 sets out long-term goals for the development of new cities in Indonesia [2]. In this regard, achieving livable cities aligns closely with these two global agendas and is a shared responsibility between the government, the community, and other stakeholders. The realization of livable cities is multidimensional, complex, and closely linked to various urban issues, both physical and social, economic, and cultural [3], [4]. This has been discussed in numerous previous studies, which have contributed to a better understanding of how livable cities can be measured by factors influencing the quality of the urban environment [5], [6].

The realization of livable cities in Indonesia faces challenges generally similar to those faced by other cities worldwide. The main cause is urbanization, which fuels population growth in cities and eventually renders them uninhabitable. The livability of a number of Indonesian cities, including Jakarta, Surabaya, Medan, Bandung, and other secondary cities, has been studied by the Indonesian City Planners Association [7]. However, the results of the survey indicate that many of these cities have not attained the ideal level as livable cities, as evidenced by low assessment scores for inadequate infrastructure and environmental degradation.

In recent decades, the concept of livable cities has become a central focus in the discourse on sustainable development and urban governance. A livable city is determined not only by the availability of physical infrastructure and basic services but also by the extent to which residents feel satisfied and safe living, working, and interacting within it [8]. Public satisfaction with their residential environment reflects existing social, economic, environmental, and governance conditions and serves as a key indicator in assessing the effectiveness of urban development policies.

However, amidst efforts to create livable cities, many coastal cities in developing countries face significant ecological challenges. Global climate change has increased the frequency and intensity of environmental disasters such as tidal flooding, coastal erosion, and sea-level rise [9]. Pekalongan, located on the north coast of Java, Indonesia, is one of the cities regularly affected by tidal flooding and erosion every year [10]. The disaster has resulted in severe environmental degradation, a decline in the overall quality of life for the community, infrastructure damage, and severe disruption to economic activity. Although the Pekalongan city government has implemented various physical and environmental improvement interventions and development policies, there has been no systematic and in-depth study of the long-term impacts of tidal flooding based on public perception.

The study aims to understand how the public assesses the livability of a city under stressful environmental conditions. The Pekalongan city government's primary focus is on identifying factors influencing public satisfaction with the livability of Pekalongan City, a coastal city prone to ecological disasters. The availability of data based on public perception will support policymakers and city planners in making targeted and sustainable decisions to achieve a livable city. Therefore, it is crucial to identify the key dimensions that shape public perceptions in the specific context of coastal cities affected by tidal flooding [11], [12].

This study aims to identify and analyze the key factors influencing public satisfaction with livable cities in Pekalongan City. Using a quantitative approach based on questionnaire data, this study develops a model of public satisfaction factors that considers environmental conditions, access to public services, infrastructure quality, and social and economic aspects. The results of this study are expected to provide an empirical contribution to the development of livable city policies that are adaptive to environmental risks in coastal areas.

This study also fills a significant gap in the literature on livable cities, which has been dominated by studies in large or metropolitan cities with relatively stable geographical conditions. Most previous research tends to ignore the ecological risk dimensions faced by coastal cities, particularly in developing countries. Furthermore, quantitative approaches based on public perceptions in the context of livability in cities affected by environmental disasters are still relatively rare. This research makes a contribution to contextual and applicable problem-solving by exploring how local perceptions can be a crucial solution to achieving a livable city, using the case study of Pekalongan city. The findings can be applied or adapted to other coastal cities facing similar challenges.

2. Materials and Methods

2.1. Research Design

The design of this research uses a mixed-method approach, namely quantitative and qualitative methods. The quantitative method is used with the main purpose of analyzing important factors that affect public perception of satisfaction with the habitability of Pekalongan City, especially related to the impact of tidal floods. The quantitative approach was chosen because it provides measurable and structured data that can be statistically analyzed, thus identifying the relationships between variables. The qualitative method is used as triangulation to increase the validity, reliability, and credibility of research findings by quantitative methods [13], [14].

The primary data used in this study was a questionnaire survey, designed using parameters and indicators of public perceptions of satisfaction with the livability of Pekalongan City as a coastal city affected by ecological disasters. The questionnaire data were analyzed using exploratory factor analysis (EFA) and multiple linear regression, which are generally used to identify dimensions and causal relationships between factors in social research [15], [16].

In addition to questionnaire data, this study utilized open-ended, in-depth interviews, analyzed using categorization techniques, intending to understand the meaning and context of the relationships between variables and uncovering respondents' narratives, experiences, and in-depth perceptions [13], [14].

This study also employed a longitudinal method to observe the same variables over time to identify changes, trends, and dynamics that cannot be captured by surveys over time. However, this method was not conducted primarily, but rather utilized secondary studies and data from other research, supported by interviews with competent Pekalongan City Government staff.

2.2. Research Location

The object of this research is the city of Pekalongan, a city located on the northern coast of Central Java Province, Indonesia, which regularly experiences tidal flooding and abrasion. This city is one of the locations significantly impacted by climate change, primarily due to sea-level rise [17]. This research focuses on three sub-districts most severely affected by tidal flooding: West Pekalongan, North Pekalongan, and East Pekalongan (see Figure 1). These locations were chosen because of their unique ecological characteristics and the importance of understanding community perceptions of the challenges to urban livability due to recurring tidal flooding (see Figure 2). One of the causes of tidal flooding is land subsidence in Pekalongan, which, when high tides occur, results in floodwaters inundating the rivers surrounding residential areas, resulting in river levels being higher than residential areas (Figures 3 and 4).

2.3. Population and Sample

The study population included all households residing in Pekalongan City, with the sample selected using random sampling based on criteria such as areas affected by tidal flooding and length of residence (minimum two years). The population of Pekalongan City in 2024 was 318,180, while the number of residents affected by tidal flooding in three sub-districts was 94,000. Therefore, a sample size of 300 respondents was deemed sufficient for multivariate statistical analysis, in accordance with the minimum item-to-respondent ratio guidelines in EFA (10:1) [18]. Respondents in this study consisted of heads of households who hold primary responsibility for managing household income and making financial decisions, ensuring that their responses reflect the social, economic, and environmental perspectives of each family unit. Although complete income data were not available, interview results indicated that respondents' incomes ranged from Rp2,500,000 to Rp6,500,000 per month, falling within the lower-middle income bracket.

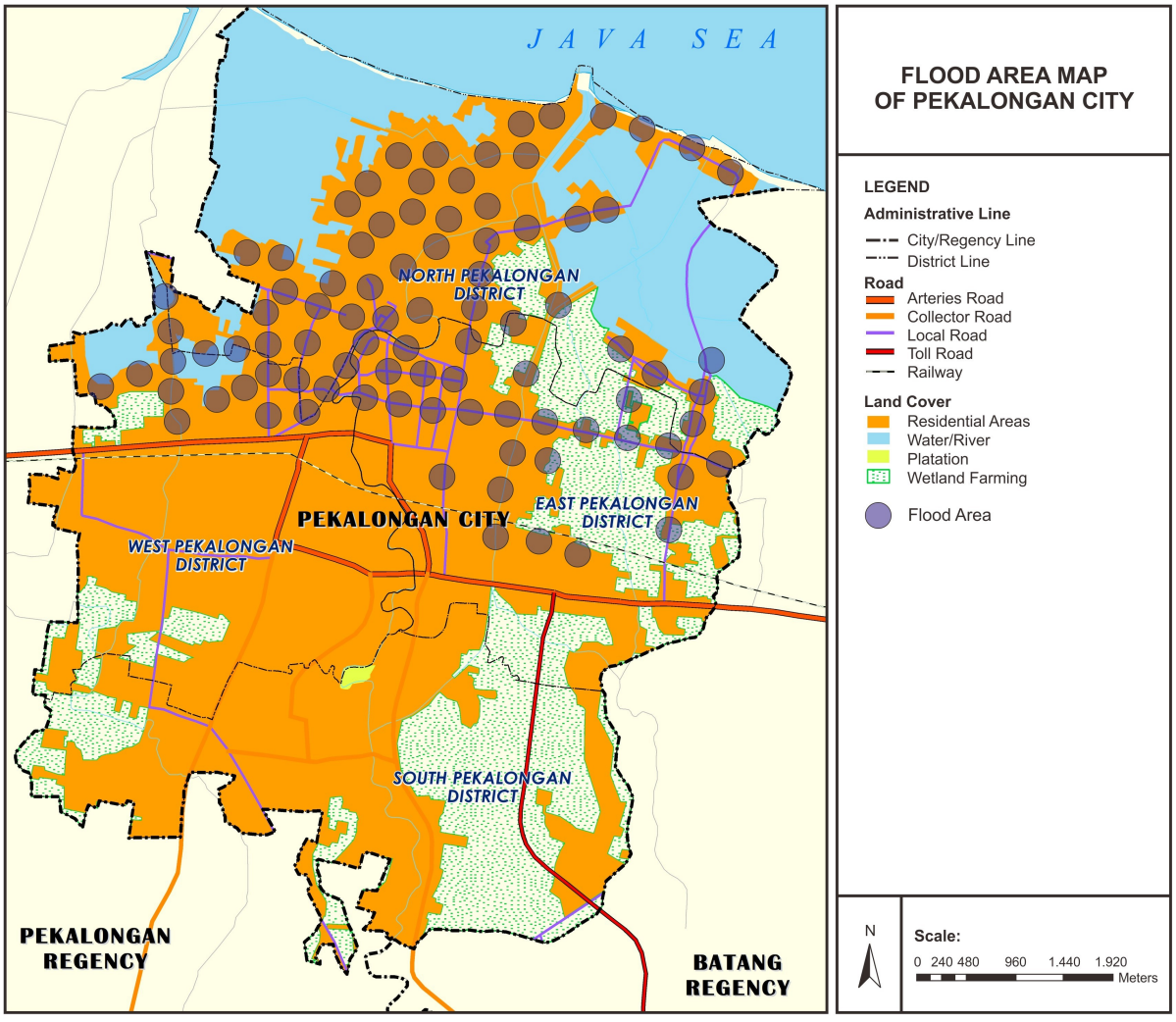

Figure 1. Flood Area Map of Pekalongan City

Figure 2. Tidal Flooding Occurred in a Residential Area

Figure 3. The river surface is higher than the settlement

Figure 4. Pekalongan City seen from above

2.4. Research Variables

The research variables consist of independent variables and dependent variables. The independent variables describe the livability of Pekalongan City, while the dependent variables describe the level of community satisfaction. Table 1 details the independent variables, while Table 2 details the dependent variables.

2.5. Research Instrument

Based on the operationalization of the independent and dependent variables, parameters, and indicators of public satisfaction perception were further detailed, measured using a Likert scale with five response variations: strongly agree, agree, abstain, disagree, and strongly disagree. These indicators essentially assess public satisfaction (the dependent variable) with urban livability: the physical environment, infrastructure, public services, socioeconomic conditions, and community participation (the independent variable). To determine and measure the validity and reliability of the questionnaire, a pilot test was conducted on 30 respondents outside the main sample using Cronbach's Alpha [19].

The questionnaire content operationalizes the independent and dependent variables into parameters and indicators, as shown in Tables 1 and 2.

2.6. Data Collection

Data collection activities were carried out using the environmental observation method of Pekalongan city through recording and documenting photos and videos. After conducting environmental observations, data collection was carried out by filling out a questionnaire that had to be answered directly by respondents. The respondent criteria were heads of families who had lived in Pekalongan city for at least the last 10 years. The process of filling out the questionnaire was carried out with the guidance of a surveyor for 20-30 minutes, carried out for one month from the beginning of July to the beginning of August 2025. The surveyor must guide the filling out of the questionnaire so that respondents do not have difficulty in understanding the substance in order to get answers with a high level of response and accuracy [20].

2.7. Data Analysis Techniques

Data analysis was conducted to identify respondent characteristics using descriptive statistics. The next step was Exploratory Factor Analysis (EFA), which aims to identify and understand important factors in the relationship between independent and dependent variables in a dataset. Exploratory Factor Analysis greatly assists researchers in reducing data dimensionality, discovering patterns, and developing theories or models that explain the relationships between variables. Using Exploratory Factor Analysis makes it easier for researchers to validate measurement tools used in research that utilizes descriptive statistics.

The second analysis, in addition to EFA, utilized multiple linear regression analysis to examine the influence of each factor on public satisfaction perceptions [21]. Both analyses were conducted using the statistical software SPSS (Statistical Package for the Social Sciences).

Table 1. Independent Variables

X1	Available Infrastructure	
	X1.1	Availability of flood mitigation infrastructure, such as embankments or pumps
	X1.2	Availability of drainage systems in residential areas.
	X1.3	Availability of roads and transportation facilities
	X1.4	Government efforts to improve infrastructure
X2	Physical Environment of Residential Areas	
	X2.1	Residential areas are always flooded
	X2.2	Road elevations cause tidal flooding
	X2.3	Tidal flooding impacts health
	X2.4	Tidal flooding impacts environmental squalor
X3	Public Services to the Community	
	X3.1	The community has access to health services
	X3.2	The community has access to educational services
	X3.3	The government's response time in providing assistance when tidal flooding occurs
	X3.4	The government's efforts to provide early warnings of impending tidal flooding
X4	Socioeconomic Conditions of the Community	
	X4.1	The community has sufficient income to meet basic needs during tidal flooding
	X4.2	The cost of living in this area remains affordable
	X4.3	The floods that occurred had a huge impact on the economic conditions of the community.
	X4.4	The community has stable employment despite disruptions caused by tidal flooding
X5	Governance and Community Participation	
	X5.1	The government is transparent in decision-making regarding tidal flood management
	X5.2	The community is given the opportunity to convey its aspirations to the local government
	X5.3	Direct community involvement in regional development planning
	X5.4	Community trust in the government's commitment to addressing tidal flooding
X6	Risk Perception & Community Preparedness	
	X6.1	The community feels anxious every rainy season due to the potential for tidal flooding
	X6.2	The community lacks understanding of evacuation routes and safety procedures during tidal flooding
	X6.3	The community lacks an emergency plan for tidal flooding
	X6.4	The community feels inadequate in dealing with tidal flooding and is overly dependent on government assistance

Table 2. Dependent Variables

Y	Community Satisfaction with the Livability of the City	
	Y1	The community feels dissatisfied with living in this city
	Y2	The community feels dissatisfied with public services provided by the government in this city
	Y3	The community feels dissatisfied with access to public facilities such as transportation, clean water, and waste management
	Y4	The community feels dissatisfied with daily life
	Y5	The community feels dissatisfied with the security and order of the neighborhood

3. Results and Discussion

3.1. Results

3.1.1. Validity and Reliability Test

Before interpreting the data, a validity and reliability test was conducted on 30 respondents outside the main sample. The purpose of this test was to measure whether the questionnaire administered to respondents met the requirements for validity and reliability. Validity testing of the four variables yielded a Pearson Correlation value of >0.7 and a Sig. (2-tailed) value of <0.05, indicating that the questionnaire is valid and reliable (see Table 3).

The Cronbach's Alpha value of 0.902 was obtained from the reliability test on four variables, indicating that the questionnaire tested on 30 respondents was declared reliable (see Table 4).

3.1.2. Interpretation of Exploratory Factor Analysis (EFA)

Of the 24 predictor variables used in the research modeling, four variables were excluded because they had MSA values <0.5: X1.1, X2.2, X4.2, and X4.3. Furthermore, in the factor analysis stage, the KMO requirement must be greater than 0.5. In this case, the modeling met the requirement with a KMO value of 0.636. Furthermore, a sig. value of 0.000 also met the requirement, as the applicable standard requires a sig. value <0.05. Based on the two aspects produced in the KMO table and Bartlett's test (see Table 5), the analysis can proceed to view the results of the scree plot.

To be a factor, the Eigenvalue on the scree plot must be greater than 1. Figure 5 shows that there are 7 components formed with Eig. values greater than one. This means that 7 factors can be used to predict people's daily dissatisfaction with the livability of their city.

Table 3. Correlations

		X1_1	X1_2	X1_3	X1_4	TOTAL_X1
X1_1	Pearson Correlation	1	.911**	.543**	.770**	.935**
	Sig. (2-tailed)		.000	.002	.000	.000
	N	30	30	30	30	30
X1_2	Pearson Correlation	.911**	1	.572**	.812**	.944**
	Sig. (2-tailed)	.000		.001	.000	.000
	N	30	30	30	30	30
X1_3	Pearson Correlation	.543**	.572**	1	.795**	.756**
	Sig. (2-tailed)	.002	.001		.000	.000
	N	30	30	30	30	30
X1_4	Pearson Correlation	.770**	.812**	.795**	1	.926**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	30	30	30	30	30
TOTAL_X1	Pearson Correlation	.935**	.944**	.756**	.926**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	30	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS data processing, 2025

Table 4. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.902	.917	4

Source: SPSS data processing, 2025

Table 5. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.636
Bartlett's Test of Sphericity	Approx. Chi-Square	1088.991
	df	190
	Sig.	.000

Source: SPSS data processing, 2025

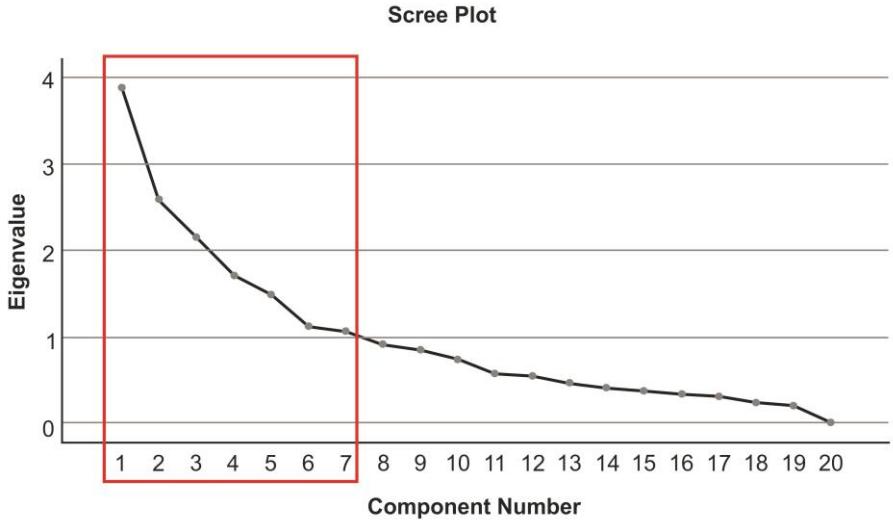

Figure 5. Scree Plot Results. **Source:** SPSS Data Processing, 2025

Table 6. Component matrix rotation

Variable/Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**
X1.2	.270	.031	.030	-.091	.229	-.772	-.037
X1.3	.707	.024	.074	-.033	-.040	-.110	.007
X1.4	.682	.019	-.091	.159	-.272	.052	-.277
X2.1	.261	.586	-.089	.012	.078	.003	-.446
X2.3	.777	.107	.085	-.094	.224	-.032	-.107
X2.4	.791	.015	.037	-.116	-.121	-.068	-.045
Variable/Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**
X3.1	.120	.260	-.018	.163	.153	.650	.337
X3.2	-.162	-.071	.039	-.019	.045	.098	.828
X3.3	-.195	.012	-.004	.745	-.102	-.019	-.087
X3.4	-.030	.053	-.013	.824	.088	.106	.025
X4.1	-.043	-.049	.018	-.185	.507	.626	-.244
X4.4	-.081	.022	-.003	.102	.798	.001	.077
X5.1	.041	.877	.080	.039	.012	.065	.178
X5.2	-.144	.386	.748	-.054	-.194	-.003	.131
X5.3	.457	.068	-.123	.435	.352	-.135	.338
X5.4	.446	-.108	.203	.552	.192	.065	.092
X6.1	-.022	.799	.209	-.005	-.008	.034	-.171
X6.2	-.149	.424	.666	-.002	-.184	-.020	.001
X6.3	.490	-.130	.735	.069	.262	-.016	-.023
X6.4	.510	-.138	.723	.085	.262	-.019	-.031
Source: SPSS data processing, 2025							

Table 6 explains that to ensure a variable belongs to a factor group, the highest correlation value between the variable and the components formed is determined. From the 20 predictor variables above, the correlated variables were grouped into 7 factors (see Table 7):

Table 7. Grouping of 7 Correlated Factors

Factor Groups	Correlated variables
Factor 1: Physical aspects affected by flood residue	Transportation facilities, infrastructure improvements, waterlogging impacts health, and waterlogging impacts slums
Factor 2: Lack of government transparency creates public anxiety	Inundated environments, government transparency in decision-making, and public anxiety during rain
Factor 3: Lack of aspirations linked to public misunderstanding and dependency	Lack of opportunities for the public to express their aspirations, lack of understanding of evacuation routes, lack of emergency plans, and high reliance on government assistance
Factor 4: Low public trust in government assistance and preparedness	Government assistance, early warnings from the government, and public trust in the government's commitment to mitigating tidal flooding
Factor 5: Employment instability during high tides	Unstable employment
Factor 6: The community's income is unable to cope with flooding	Inadequate flood mitigation infrastructure, difficult access to health services, and low incomes are all factors impacting tidal flooding
Factor 7: Education services	Education services are not functioning well during tidal flooding

Source: SPSS data processing, 2025

Table 8. R-squared Results in the Model Summary

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	.929[a]	.863	.828	.20574

Source: SPSS data processing, 2025

3.1.3. Interpretation of Multiple Linear Regression Results

In interpreting the results of the multiple linear regression analysis, Table 4 explains the "Model Summary" by providing information on the coefficient of determination, which is the simultaneous contribution of all independent variables to the dependent variable Y4, namely community satisfaction with daily life. Based on the output table (Table 8), the R-squared coefficient is 0.863 = 86.3%. It can be concluded that 24 variables can simultaneously be used as predictors of community dissatisfaction with the livability of their city, amounting to 86.3%, while the remainder is influenced by other variables outside this model.

Based on Table 9, the Analysis of Variance (ANOVA) shows the significance value in the F test is 0.000 with the required standard <0.005. It can be concluded that 24 variables together influence people's satisfaction in daily life regarding the livability of their city because they have a significant value <0.005. To be able to see the normality of the data, a histogram and a P-P Plot diagram can be used. A good data distribution is represented by a bell-like curve shape, and the data distribution approaches a line, as can be seen in Figure 6.

To ensure that the interpretation of the multiple linear regression analysis meets applicable standards, a t-test is required to proceed to the next stage of the analysis. Table 10 presents the t-test results, which show that 10 independent variables of urban livability influence public dissatisfaction.

The Coefficients table (Table 10) provides information on the regression equation and whether or not there is an overall influence of variable X on variable Y4 (public dissatisfaction in daily life regarding the livability of Pekalongan city). This study begins with the initial hypothesis that there are suspected aspects of infrastructure support, socio-economic readiness, and community participation that influence dissatisfaction with daily life. The results of the multiple linear regression analysis summarize the following: 1) Flood mitigation infrastructure: sig. 0.001 < 0.05; therefore, H1 is accepted; there is an effect; 2) Transportation facilities: sig. 0.001 < 0.05, therefore H1 is accepted; there is an effect; 3) Infrastructure improvements: sig. 0.002 < 0.05; therefore, H1 is accepted; there is an effect; 4) Inundated environment: sig. 0.000 < 0.05; therefore, H1 is accepted; there is an effect; 5) Inundation impacts health: sig. 0.000 < 0.05; therefore, H1 is accepted; there is an effect; 6) Inundation impacts slums: sig. 0.000 < 0.05; therefore, H1 is accepted; there is an effect; 7) Health services: sig. 0.048 < 0.05, therefore H1 is accepted; there is an effect; 8) Decision making: sig. 0.021 < 0.05; therefore, H1 is accepted; there is an influence. 9) Public trust in government commitment (significance 0.006 < 0.05); therefore, H1 is accepted, and there is an influence. 10) The absence of a government emergency plan (significance 0.028 < 0.05), H1 is accepted; there is an influence.

This research modeling produces 10 independent variables of Pekalongan city's livability that influence public dissatisfaction with daily life. These variables include inadequate flood management infrastructure, inaccessible transportation facilities during floods, government inactivity in infrastructure repairs, flooded environments, flooding impacting health, flooding impacting slums, inaccessible health services, lack of transparency in government decision-making, public trust in government commitment, and the absence of an emergency plan. These variables influence public dissatisfaction with daily life.

Table 9. Analysis of Variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	25.304	24	1.054	24.909	.000[b]
	Residual	4.021	95	.042		
	Total	29.325	119			

Source: SPSS data processing, 2025

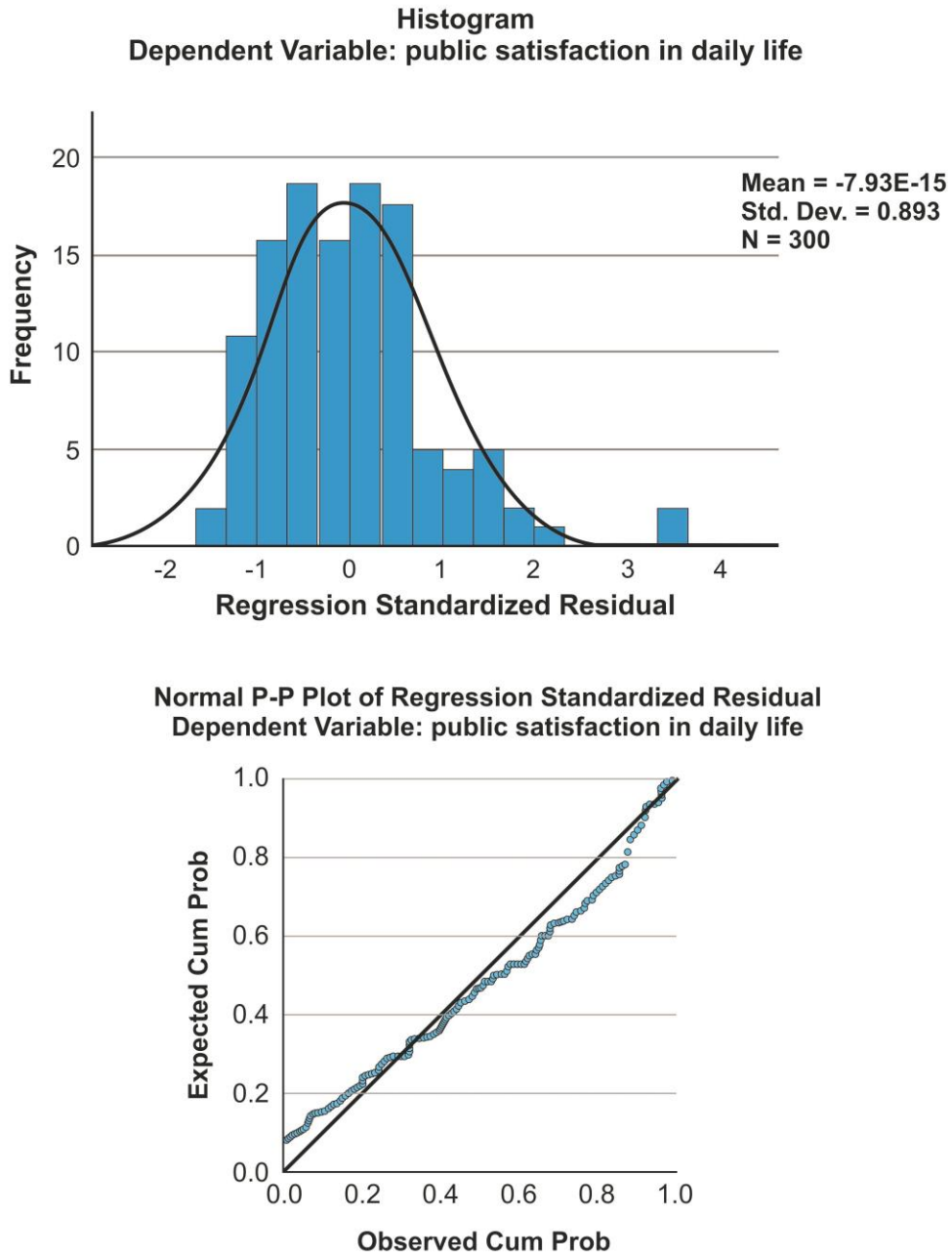

Figure 6. A Histogram and P-P Plot Diagram. **Source:** SPSS Data Processing, 2025

Table 10. Coefficients[a]

Variable/ Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
	-1.114	.564		-1.977	.051
X1.1	.119	.036	.165	3.352	.001
X1.2	-.068	.038	-.084	-1.792	.076
X1.3	.160	.047	.173	3.403	.001
X1.4	.116	.037	.161	3.140	.002
X2.1	.157	.044	.177	3.613	.000
X2.2	.070	.043	.079	1.632	.106
X2.3	.182	.047	.219	3.847	.000
X2.4	.322	.047	.394	6.877	.000
X3.1	.098	.049	.097	2.004	.048
X3.2	.040	.042	.046	.956	.342
X3.3	-.049	.041	-.054	-1.189	.237
X3.4	.052	.049	.053	1.072	.286
X4.1	-.019	.036	-.023	-.519	.605
X4.2	.017	.037	.020	.450	.654
X4.3	.052	.032	.069	1.633	.106
X4.4	.005	.036	.006	.130	.897
X5.1	-.172	.073	-.147	-2.350	.021
X5.2	.105	.060	.110	1.754	.083
X5.3	-.099	.054	-.101	-1.827	.071
X5.4	.150	.054	.160	2.789	.006
X6.1	.058	.072	.048	.809	.420
X6.2	-.111	.064	-.110	-1.723	.088
X6.3	.535	.240	.537	2.231	.028
X6.4	-.443	.248	-.444	-1.785	.077

a. Dependent Variable: Public dissatisfaction with the livability of cities in daily life

Source: SPSS data processing, 2025

The variable with the highest significant value contributing significantly to public dissatisfaction with daily life is variable X2, namely the physical environment, which consists of flooded conditions (X2.1); flooding impacts health (X2.3), and flooding impacts environmental aesthetics and creates a slum (X2.4). All three sub-variables within variable X2 significantly influence public dissatisfaction with daily life.

The next variable with the highest significant value is Infrastructure (X1), which consists of inadequate flood mitigation infrastructure (X1.1), inaccessible roads and transportation facilities during tidal flooding (X1.3), and the government's inaction in improving infrastructure to mitigate the impact of tidal flooding (X1.4). These three sub-variables within variable X1 significantly influence public dissatisfaction with daily life.

3.1.4. Interpretation of In-Depth Interview Results of Respondents

The triangulation method used helped to sharpen and strengthen the questionnaire analysis results. Overall, the questionnaire revealed respondents' dissatisfaction with the city's livability, which was consistent with the facts. In-depth interviews with several respondents analyzed using the categorization method yielded insights that demonstrate that the perception of dissatisfaction with the city's livability is not passively addressed; rather, the community actively and collectively constructs various adaptations, as shown in Table 11.

1. Changes in Risk Perception and Normalization of Disasters

The public's perception of danger is greatly influenced by repeated experiences and perceived control. The tidal floods occur regularly and predictably, and people begin to adjust their expectations and perceptions. For them, tidal floods are no longer "extraordinary events" that cause deep trauma, but are considered seasonal events that can be anticipated.

2. Structural and Functional Adaptation on a Household Scale

People in the city of Pekalongan are adapting to use micro strategies, for example, raising the floor of the house, using waterproof materials, or making stilt houses. Then adjust daily activities (e.g., working at low tide or using a boat for local mobility).

3. Creating Social Resilience and Community Collectivity

Creating social resilience explains that the community will be strongly connected to each other in developing a help-to-help system, organizing a cooperation mechanism when the tide comes, and lowering the psychological burden of individuals because problems are considered to be a shared responsibility. This social resilience transforms the meaning of disaster into a "community ritual"—a disruption that can be dealt with collectively, not a destructive threat.

4. Absence of Effective Structural Interventions

The community is well aware that when the structural adaptation policies undertaken by the local government (e.g., building embankments or drainage systems) do not completely solve the problem, the community tries to adjust independently.

5. Paradigm Change from "Disaster" to "Disturbance."

The community is trying to fully understand that routine tidal floods are no longer interpreted as disasters, but are considered routine disturbances that must be faced. This understanding will help people survive without experiencing emotional exhaustion or loss of productivity.

3.1.5. Interpretation of Longitudinal Study Results

The results of secondary studies and interviews with Pekalongan city government staff on the results of longitudinal studies and field facts do show that tidal floods in Pekalongan City occur almost all year round, with different causes, intensities, and characteristics between seasons.

1. Rainy Season: Dominance of Inundation Due to River Runoff and Overflow

In the rainy season period (around November-April), the main cause of flooding in Pekalongan city is not only rob, but a combination of high rainfall, overflowing rivers, and poor drainage systems. Large rivers such as the Bremi, Banger, and Loji Rivers receive water discharge from the upstream region. When high rainfall in the upstream along with the tide downstream, there is a backwater effect, which is that river water cannot flow into the sea because it is held back by the tide, so it overflows into settlements. The city's drainage conditions, which have undergone a lot of sedimentation, exacerbate inundation, so that the sub-districts of North Pekalongan, East Pekalongan, and West Pekalongan are almost always flooded during the peak period of the rainy season.

Hydrologically, this combination of land runoff and sea tides creates a complex mixed flood pattern that is difficult to overcome with just one type of structural intervention, such as embankments or polders.

2. Dry Season: Dominance of the Rob due to Sea-Level Rise

During the dry season (around May–October), the frequency of rain decreases drastically, but tidal waves continue to occur periodically due to sea-level rise and the influence of monthly tidal gravity. During this period, high tide seawater slowly seeped through the pores of the soil and open channels, then entered the lowland area. Inundation usually occurs in the morning and evening, along with the maximum tide cycle, and can last for hours even without rain. People refer to this phenomenon as daily rob, which is now considered a routine nuisance because it always appears at a certain time.

Data from the Meteorology, Climatology, and Geophysics Agency (BMKG) shows that there is a trend of sea-level rise on the north coast of Java of around 0.8–1.2 cm per year, which further aggravates seawater intrusion into the coastal area of Pekalongan city.

3. Land Subsidence as the Main Triggering Factor

The most significant factor that explains why rob in Pekalongan city is chronic and year-round is land subsidence. Based on geotectonic studies and remote sensing, Pekalongan city has experienced land subsidence of around 5-10 cm per year, even at some points exceeding 12 cm per year. The causes are excessive groundwater uptake, building loads on soft alluvial soils, and consolidation of water-saturated soil layers. As a result, the land level in most coastal areas is already below the mean sea-level.

This explains why inundation persists even when there is no rain, and why drainage systems or pumps cannot work optimally, because the direction of the water flow is gravitationally towards the lower land.

Table 11. Five reasons why people no longer consider tidal floods as disasters

No.	Aspects	Explanation
1.	Risk Perception	Tidal flooding has been normalized as a routine occurrence, not an extreme event.
2.	Physical Adaptation	The house and environment have been modified to deal with water.
3.	Social Adaptation	Community solidarity makes the burden of rob feel light.
4.	Psychological Adaptation	Long-term habits change perceptions from "threats" to "living conditions."
5.	Absence of Structural Solutions	Self-adaptation has become the norm because government intervention is less effective.

3.2. Discussion

Based on the research findings outlined previously, four groups of city livability factors influence the satisfaction of residents. These will be discussed in conjunction with the literature and other research findings relevant to this study.

3.2.1. The Important Role of the Physical Environment in Creating a City's Livability

This finding aligns with the opinions of Veenhoven [22], Birkmann et al. [23], Zevenbergen et al. [24], and Zhan et al. [25], who stated that poor physical environmental quality reduces well-being. Waterlogging causes health risks and poor environmental aesthetics. The impact of waterlogging can also harm the local economy and reduce the productivity of people living in the surrounding area [26]. Therefore, it is important for the government and community to collaborate in efforts to reduce waterlogging and improve the quality of the physical environment to maintain and improve community well-being. Community well-being depends not only on physical health but also on the surrounding environment that supports a healthy and productive life [27]. Cooperation between the government and the community in maintaining a water-free environment will provide significant benefits for all parties. With a clean and safe environment free from waterlogging, people will be able to live more comfortably and productively. Therefore, efforts to reduce waterlogging and improve environmental quality must be a priority for all parties to maintain and continuously improve community well-being [28]. For example, if the surrounding environment is not properly maintained and stagnant water forms, which can become a breeding ground for mosquitoes, it will increase the risk of infectious diseases such as dengue fever. Furthermore, stagnant water can also cause economic losses for the community due to the disruption of daily activities caused by flooding.

3.2.2. The Crucial Role of Infrastructure as a Determining Factor

Non-adaptive infrastructure hinders mobility and disrupts residents' daily activities. This aligns with the opinions of Ahern [29]; UN-Habitat [30]; Zhan et al. [25]; and Bosher & Dainty [31], who emphasize the importance of resilient infrastructure in sustainable cities. They highlight that good infrastructure not only improves the daily lives of residents but also supports economic growth and a healthy environment [32]. With robust infrastructure, cities can more easily face the challenges of growing urbanization and climate change. Therefore, appropriate investment in urban infrastructure should be a priority for governments and relevant stakeholders. Policies focused on developing resilient infrastructure can also help reduce social and economic inequalities within cities. Furthermore, robust infrastructure can also improve citizens' quality of life, such as by providing better access to healthcare, education, and transportation. Therefore, efforts to build reliable and integrated infrastructure must be continuously encouraged so that cities can develop sustainably and provide maximum benefits to all residents, particularly in creating livable cities.

3.2.3. Community Resilience and Preparedness Factors

Community unpreparedness for tidal flooding reflects low adaptive capacity. According to Cutter et al. [33], Twigg [34], and Paton & Johnston [35], social capacity and local knowledge are crucial in reducing the risk of tidal flooding. Low adaptive capacity can also be caused by a lack of coordination between agencies and limited access to accurate information. Increasing community social capacity through training and education on tidal flood mitigation is expected to improve public preparedness in facing this threat. Furthermore, strengthening collaboration between the government, institutions, and the community in tidal flood prevention and response efforts is crucial [36]. Therefore, tidal flood mitigation efforts rely not only on technical knowledge but also on active community involvement in the decision-making process [37]. This will create a more resilient environment and effectively mitigate the impact of disasters. Therefore, collaboration between all relevant parties is essential for optimal preventive and responsive measures. Thus, it is hoped that communities will be better prepared and responsive to future tidal flood threats. For example, in cities prone to tidal flooding, the government collaborates with local communities to develop early warning and disaster management systems. Local communities are involved in evacuation training and the development of emergency plans so they can respond quickly when tidal flooding occurs.

3.2.4. Governance and Public Trust in Government

The research results illustrate that a lack of government transparency will impact public trust. This is in line with the opinions of Arnstein [38], OECD [39], and Agrawal & Perrin [40], that public participation is very important and needed to strengthen legitimacy in making policies based on public satisfaction perceptions. In addition, public participation will provide a clear picture that the governance built by the government is transparent and accountable, thereby increasing public trust in the government. Furthermore, every decision and development policy made by the government, as long as it involves public participation, will result in policies and development that are in line with the needs and expectations of residents. Therefore, the results of development in urban areas will make the city a livable place to live, according to what they expect. Public participation can also help encourage the creation of innovation and creativity in policy development with diverse and effective solutions. Public involvement in every decision made will provide a stronger sense of ownership and will foster collective awareness to protect and care for the city's environment. Thus, public participation is expected to strengthen social bonds and solidarity among its citizens [41]. One real example of community participation is holding an open discussion forum, providing the community with the opportunity to discuss and provide constructive input from the planning stage to the execution of development, especially those related to environmental infrastructure.

3.2.5. Adaptation: A Paradigm Shift from Disaster to Disturbance

The results of this study show that people in the coastal area of Pekalongan City have experienced fundamental changes in the interpretation of the tidal flood event. Most respondents no longer consider tidal floods as a disaster, but rather as a routine disruption that is part of daily life. This change in perception reflects a long and dynamic process of socio-ecological adaptation in the face of repeated environmental pressures.

Based on the perspective of risk perception, this phenomenon can be explained through the concept of risk normalization [42]. The people of Pekalongan city have been dealing with tidal floods for more than two decades, and these events occur with relatively predictable frequency and patterns. As a result, the rob is no longer considered an extreme threat, but as part of the rhythm of coastal life. Interviews with residents show that they have adjusted life expectations and strategies, such as postponing activities when the tide is high and resuming economic activities when the tide is low. This condition shows that risk has been normalized within the framework of people's daily experiences.

In terms of physical adaptation, the people of Pekalongan city develop various forms of everyday adaptation [43] to maintain the habitability of their homes and environment. The adaptation includes the gradual elevation of the house, the use of waterproof building materials, the construction of simple stilt houses, and the rearrangement of the interior space in the house so that the main activities can continue despite inundation. On an environmental scale, a temporary circulation route is formed in the form of small boards or bridges used when the tide hits. This micro-adaptation creates a sense of control over the situation, which contributes to the transformation of the perception of the tide from a disaster to a seasonal disturbance that can be faced.

In addition to physical adaptation, social resilience plays a major role in reducing psychological burden and improving collective ability to deal with stress [44]. In some areas of the research object, the solidarity of residents can be seen through the gotong royong system to improve road access, build prayer rooms, or drain the inundation together. The existence of these social networks strengthens local adaptive capacities and encourages the emergence of informal mechanisms to survive in structurally vulnerable conditions.

However, this adaptation phenomenon is also inseparable from the limitations of the government's structural intervention. Mitigation efforts, such as the construction of sea embankments and river embankments in the city of Pekalongan, often do not reach all affected areas or experience functional degradation due to sedimentation and land subsidence. In such conditions, the community relies on the strategy of self-reliant adaptation [45], which is not always in sync with city policies. While showing remarkable resilience, these adaptations have the potential to mask long-term structural vulnerabilities, as key issues—sea-level rise and land subsidence—have not been addressed systemically.

The performance of local governments in addressing tidal flooding in Pekalongan City still faces a gap between technical adaptation and governance. Policy approaches have been predominantly physical-structural—such as the construction of embankments, retention ponds, and polders—but have not addressed the root of the problem, namely land subsidence due to groundwater exploitation and coastal ecological degradation. Fragmented coordination between levels of government weakens the effectiveness of adaptation, as large projects are often initiated by the central government without adequate institutional support and fiscal capacity at the city level [46]. Limited technical capacity and regional budgets mean that city governments are only able to take reactive, not transformative, measures [47]. On the other hand, development policies are still oriented towards economic growth, encouraging coastal land conversion that increases environmental vulnerability [44]. The government's inability to provide systemic solutions encourages independent community adaptation, but this condition actually creates an "adaptation trap" [48], where survival efforts mask the need for more sustainable structural community policy changes.

This phenomenon in Pekalongan city can be understood

as a transition from the disaster paradigm to disturbance [49], where people no longer view rob as an extraordinary event, but as a new normal condition that needs to be managed. This transition signifies the emergence of urban resilience that is adaptive, experience-based, and relies on the social capacity of the community. Thus, even though the physical quality of the environment has decreased due to chronic inundation, people are still able to maintain urban habitability through creativity, solidarity, and sustainable adaptation to changes in the coastal environment.

The community's position is caught between feelings of dissatisfaction with the livability of the urban environment and, on the other hand, having to adapt to continue living when the option to move is completely absent due to a lack of adequate funds.

4. Conclusions

This study shows that public satisfaction with the livability of Pekalongan City is significantly influenced by its physical environment, which is vulnerable to tidal flooding and limited adaptive infrastructure. Air inundation, which impacts health and environmental squalor, along with limited transportation and flood mitigation infrastructure, proved to be the most significant factors shaping public dissatisfaction. Furthermore, low community preparedness, limited participation in decision-making, and weak trust in government commitments contributed to the worsening public perception of the city's quality of life.

The main implication of these findings is the need for a coastal city development strategy that emphasizes three key elements: (i) improving infrastructure that is resilient and adaptive to tidal flooding, (ii) strengthening socioeconomic capacity and community preparedness, and (iii) more transparent, participatory, and accountable city governance. Therefore, efforts to realize livable cities in coastal areas depend not only on technical interventions but also on close collaboration between the government, local communities, and other stakeholders in creating a more resilient and sustainable urban system.

Community adaptation develops independently through micro-strategies and social solidarity, creating everyday resilience despite structural vulnerabilities. Meanwhile, local governments remain trapped in short-term technical approaches and fragmented coordination, hampering their ability to drive sustainable and systemic adaptation transformation. Therefore, community participation in building collaboration with the Pekalongan city government is crucial for effective and targeted technical approaches.

The results of this study provide a great opportunity to be transferred to other coastal cities in Indonesia that have similar problems.

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