Analysis of the correlation urban systems and risk management floods, study case: Kaliwungu, Kendal Regency

Salmaa Shafira*

1Student of Magister Urban and Regional Planning, Diponegoro University Semarang, Jawa Tengah, Indonesia

Corresponding Author Email: afirasalmaa25@gmail.com

ABSTRACT: Flood disasters in urban areas have become a frequent occurrence, especially in cities with high activities. The climate change phenomenon marked by increased rainfall also triggers the risk of flooding in urban areas. The flood disaster also occurred in the Kaliwungu District, which is one of the urban areas in the Kendal Regency, Central Java Province. The causes of flooding in urban areas is the failure of the drainage system to accommodate flood overflows. System failure in urban areas can affect the functioning of all systems in urban areas. This is supported by the high complexity of the urban system that influences each other, there are physical, social, and economic components of the community. There are two main questions in this research, namely “What forms the relationship between urban systems and disaster risk management?” and “How are urban systems and disaster risk management related to reducing flood disasters? So the aim this research is achieved of this study is to examine the relationship between urban systems and flood risk management. The thing that links between urban systems and flood risk management is the main role of urban system functions in efforts to reduce flood disasters through comprehensive and complex disaster risk management. Thus, the urban system and disaster risk management must be interrelated in the preparation of urban spatial plans.

Keywords: disaster risk management, flood, urban system

1. Introduction
Urban areas with high community activities have a vulnerability to flooding disasters. The frequent consequences of unplanned urban growth and land use change can increase the frequency and severity of floods [1]. In addition, the uncertainty of urban development can affect the calculation of flood damage and its spatial distribution [2]. Currently, the policies and strategies used are Nature-Based Solutions as an appropriate approach to flood risk management [3]. Nature-based Solutions represent relatively new responses to disaster risk reduction, water security, and resilience to climate change, which are potentially more effective and sustainable than traditional measures [4].

Strategic land use planning by carrying out spatial planning that secures land for flood protection is one of the important things that are part of disaster risk management [5]. Recent extreme events (especially earthquakes and floods) are known to have a low level of preparedness and response in the affected cities, while the recovery process is long and expensive [6]. Designing disaster risk
management in accordance with prioritization and local capacities used in global policy frameworks is the result of utilizing decentralization and public participation [7].

The flood disaster also occurred in the Kaliwungu District, which is one of the sub-districts in the Kendal Regency, Central Java Province. Based on information from the CNN Indonesia news page, Kaliwungu was hit by floods in February 2022 due to heavy rains. The flood incident in Kaliwungu is not the first incident, the previous incident occurred in 2021. The height of the flood overflow in Kaliwungu ranged from 30 to 50 centimeters which inundated the main road and residential areas. Urban rainstorm flooding has become one of the most significant natural disasters limiting economic development and healthy societies [8]. The flood that occurs in Kaliwungu is known to have problems with the rainwater flow system, especially in the failure of the drainage function in Kaliwungu. A failed drainage system can directly affect the functioning of all other urban systems [1]. Urban systems are complex, consisting of several networks that influence each other, which consist of physical and social components [6]. The non-optimal function of the urban system in the Kaliwungu District can interfere with the surrounding area. Based on the Kendal Regency Spatial Plan for 2011-2031, it is stated that Kaliwungu District is a Center for Local Activities with the function of a service center as a center for industry, strategic economic area, trade, and services that support Kendal Regency as a joint National Activity Center, with Demak, Ungaran, Salatiga, Semarang, and Purwodadi (as Metropolitan Area). In addition, the location of Kaliwungu forms its role as the entrance gate to Kendal Regency from the east, which is supported by the presence of the Kaliwungu Toll Gate exit.

The complexity of the flood disaster that occurred in Kaliwungu can disrupt the functioning of the urban system in Kaliwungu. Complex urban systems require collaborative disaster emergency management to carry out local development, by strengthening the characteristics of participatory governance, flexibility, accountability, and transparency [9]. Based on this explanation, a research study is needed in an effort to reduce the occurrence of flood disasters to optimize the function of the Kaliwungu Urban system. There are two main questions in this research, namely “What forms the relationship between urban systems and disaster risk management?” and “How are urban systems and disaster risk management related to reducing flood disasters in Kaliwungu District?”. Thus, the purpose of this study is to examine the relationship between urban systems and disaster risk management in an effort to reduce flood disasters in Kaliwungu District, Kendal Regency, Central Java Province.

2. Literature Review

2.1 Urban System

The urban system is an important component of the regional system in the form of an urban spatial system with structure, function, and inter-regional relations under the relationship and interaction of humanity, economy, resources, and the environment [10]. In addition, urban systems can influence urban development in many ways that can have a spatial, temporal, and geographical impact on the natural and built environment [11]. Along with new developments, it will allow urbanization to have an influence on the consequences of natural drainage and open spaces in urban areas that require modification of drainage channels that are waterproof, paved, and watertight areas [12]. The explanation of the urban system can be seen in Figure 1.

![Figure 1. The complexity of Urban Systems in Urban [10]](image)
2.2 Disaster Risk Management
One of the efforts in the form of the ability to respond to disasters efficiently has an important role as it aims to save lives. Besides that, prevention and preparedness efforts before events also have the potential to save the danger of an event becoming a disaster [13]. The leading cause of local flooding due to heavy rains is clogged drainage with garbage [14]. The results of identification that have been carried out in flood research in urban environments, it is known that flood disaster management efforts can be supported by information from flood simulation models based on document reviews and social networks [15].

Actions to reduce flood risk can be based on the integration of customary community systems mixed with modern flood management strategies [16]. In addition, social capital that can be used in flood disaster management is social capital for the prevention of flood impacts, flood moments, and flood impact recovery [17]. The form of preparedness through ecosystem-based adaptation has created a shift from conventional adaptation approaches, while the presence of ecosystem-based adaptation has the potential to be more comprehensive, cost-effective, multifunctional, and protects in flood risk management [18].

3. Methodology
This study uses a descriptive case study method, which is based on qualitative material from various sources including scientific articles, observation of study sites, and in-depth interviews.

4. Discussion
The urban system in Kaliwungu District has urban characteristics with a centralized system with various activities, namely processing industry activities, trade and services, settlements, and religious tourism. The diversity of activities that exist in Kaliwungu attracts people to come even stay Kaliwungu, giving rise to the phenomenon of urbanization in Kaliwungu.

Industrial activities dominate in the northern part, while tourism and settlement activities, as well as trade in services, are in the southern part of the Kaliwungu District. The high activity, especially in the Kaliwungu urban area, with the attraction of the Kendal Industrial Estate, has an impact, especially on development, especially in Kaliwungu. The complexity of urban activities in Kaliwungu, which is not accompanied by the effectiveness of the urban element system, has caused the problem of flood disaster that hit Kaliwungu. Floods that occurred in the Kaliwungu, which occurred in early 2021 hit residential areas located in Sumberejo Village (which is located east of Kaliwungu) due to heavy rains and failure of the drainage system. Figure 2 will show the location of the flood in Kaliwungu.
Figure 2 Flood Locations in Kaliwungu District

Figure 3 Drainage Condition in Kaliwungu District
(a) neighborhood drainage (b) primary drainage

Flood disaster management in Kaliwungu District is handled in detail by the government in Kendal Regency and the Sumberejo Village government. Social capital plays an important role in reducing the impact of the flood disaster. The village government takes cooperative actions to reduce the impact of the flood disaster. What is done by the community is using the customary system of gotong royong, which is carried out by a cooperative system to reduce the impact of flooding by improving the drainage system which is expected to function optimally to drain rainwater.
Figure 4 Activities of the “Gotong Royong” is Society’s Traditional System for Reducing the Impact of Flood Disasters

Based on the analysis that has been carried out, it can be seen that in handling flood disasters there are two important elements, namely the urban system must function effectively and disaster risk reduction management which must be cooperative and aims to prepare spatial plans that pay attention to disaster mitigation components.

Figure 5 Correlation of Urban Systems and Flood Disaster Management in Kaliwungu

5. Conclusion
Things that can be concluded in this study are:
1. There is correlation between the urban system and risk reduction management to overcome flood disasters, this link is related to the agenda for preparing a spatial plan in Kaliwungu that can support Kaliwungu as an urban center with economic and industrial activities in Kendal Regency.
2. The correlation between urban systems and disaster risk reduction management is an important component in disaster mitigation efforts in Kaliwungu District, by repair the drainage system (part of urban system) and social capital to disaster management.
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