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Development of data on river bank space as an effort to improve resilience to flood and fire disasters in Banjarmasin City

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Abstract. This research has a long-term objective to regulate the use of riverbank space in urban areas and increase the city's resilience to disasters. This is based on the importance of rivers for human life and the impact of disasters that arise if they are not managed properly. At present, attention to rivers is still very low and even tends to be neglected so that it often causes disasters, especially floods and fires due to uncontrolled use of riverbanks. This research was conducted in three stages. The first is to formulate a database indicator for riverbank space and the concept of data provision. Second, the development of a Database Sheet to measure the total value of the riverbank space data indicators. Third, conversion of the total value of the database indicators in the Database Sheet into spatial chart format. The database indicator includes 7 components, namely: Physical space-riverbanks, river flows, building closure, infrastructure, public facilities, vegetation, and zoning. The concept of providing data is by collecting field data every period or depending on changes that occur in the field using a database sheet. The Database Sheet is prepared in 2 formats, namely manual format and digital format using G-Form. The results of data collection are then processed using weighting formulas and weight calculations to obtain the total value of disaster risk from the riverbank space data indicator. The criteria for the calculation results seen from the level of risk are divided into 3, namely Low Risk, Medium Risk, and High Risk. The results of the calculation based on the probability of a disaster are divided into 3, namely: Often, Sometimes, Rarely. The results of the calculation of the riverbank space indicators from the Database Sheet are then converted into a graphic format according to the riverbanks in Banjarmasin City. The results of the conversion of indicator values along with the interpretation of disaster risk produce a risk map for disaster resilience. Furthermore, from the risk map of disaster resilience and database sheets, actions to reduce the threat of flood or fire can be analyzed based on the conditions of the components that affect it. The development of this spatial database is directly beneficial to the government as the basis for policy making and decisions in the preparation of Spatial Planning and Zoning Regulations because this spatial database can then be developed into an application that can be applied in urban planning (Level 6 Technology Readiness Level). The direct benefit for the community is the creation of a comfortable and safe residential environment from the threat of floods and fires.

1. Introduction

The development pattern of cities in Indonesia generally starts from the riverbanks, so that the concentration of population density and life is concentrated on the river banks. One example can be



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seen in the city of Banjarmasin. In the historical trajectory of city development, it can be seen that the city has grown from the banks of the river and continues to develop following the existing river flow [1].

This urban development pattern causes the settlements on the riverbank to grow very dense and tend to be irregular. Over a long period of time, this condition also caused some rivers to disappear. The existing data shows that the river conditions in the city of Banjarmasin tend to decrease (Figure 1).

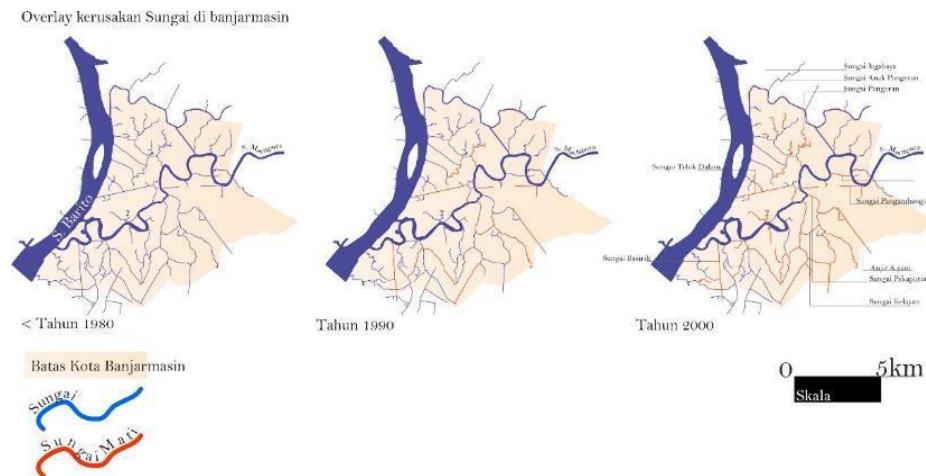


Figure 1. The phenomenon of loss of rivers in Banjarmasin City [2].

In addition to the reduction of existing rivers, the density of settlements and their irregularity resulted in frequent disasters. Based on data from BPBD for the years 2008-2012, most of the disasters that occurred in South Kalimantan were floods [3] (see Figure 2). This is understandable because there are fewer rivers that can accommodate and distribute water. Apart from floods, fires are the biggest disaster due to overcrowding that cause both material loss and casualties.

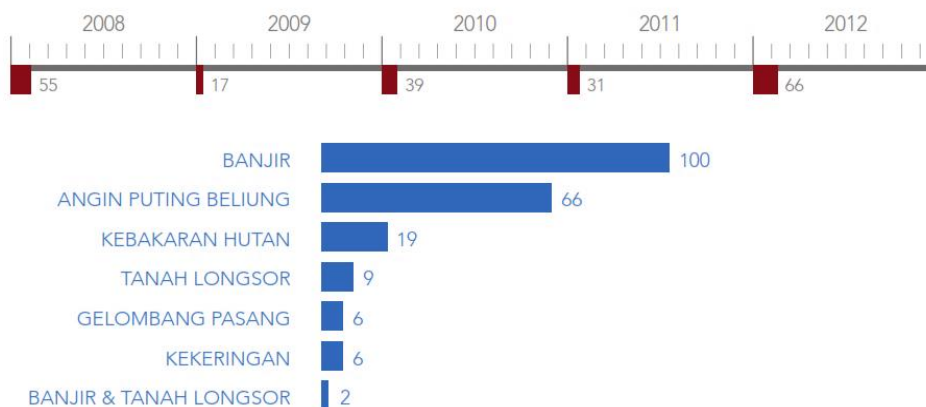
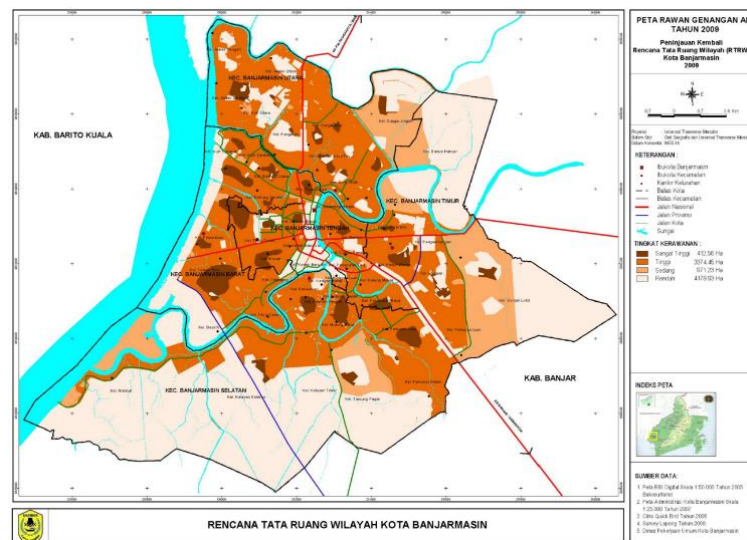


Figure 2. Disaster data in South Kalimantan 2008-2012 [3].

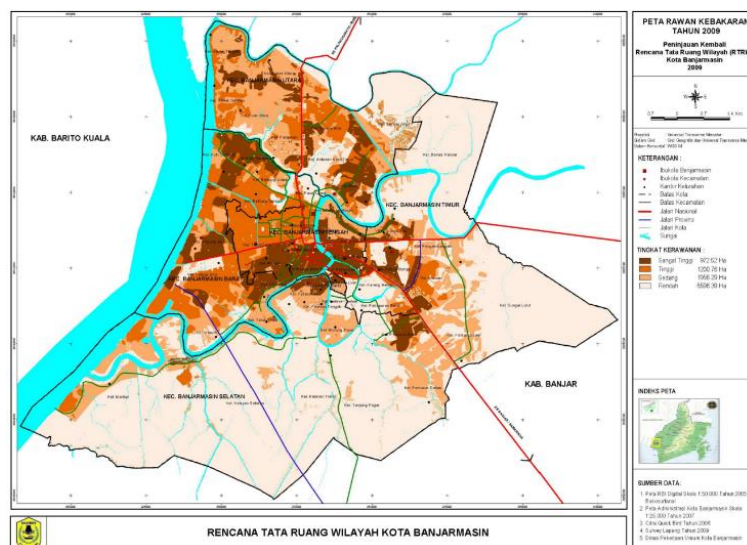
The phenomenon of rivers as the origin of settlements and cities cannot be separated from the importance of rivers, both as a transportation route, a water source, and also a livelihood [4]. The management of rivers and river borders is very little attention to the management. Almost every day there is pollution in the river, both by industry and household waste. The riverbank even becomes an

uncontrolled settlement area and other functions. This condition eventually causes frequent disasters, especially floods and fires.

Based on the available measurement data, it is known that there are still quite a lot of flood-prone and fire-prone areas in Banjarmasin City (see Figure 3). This vulnerability cannot be separated from the unmanageable factor of environmental areas and settlements along the river banks which are within the boundary line.



(a)



(b)

Figure 3. Map of flood (a) and fire prone (b) areas in Banjarmasin City [5].

In the context of urban development, there are planning instruments that should be able to control development. Development in each city area should be planned according to the norms stipulated in the Guidelines for the Preparation of Spatial Plans and Zoning Regulations. In fact, the product of planning documents is not able to control the use of space because it is unable to distinguish the characteristics of riverbanks which are indeed different from the characteristics of urban areas in general. The riverbanks are a very specific area, in terms of boundaries, functions, closures, and uses.

The riverbanks are a characteristic of Banjarmasin City and are part of a wetland area which is very important to be studied for the benefit of the life of the people of this city. This requires a comprehensive study related to riverbank spaces.

2. Purposes

The purpose of this research is to collect all information and present it in a DBMS system that can assist in controlling development and become a predictor of possibilities in planning and designing in the future.

3. Research methodology

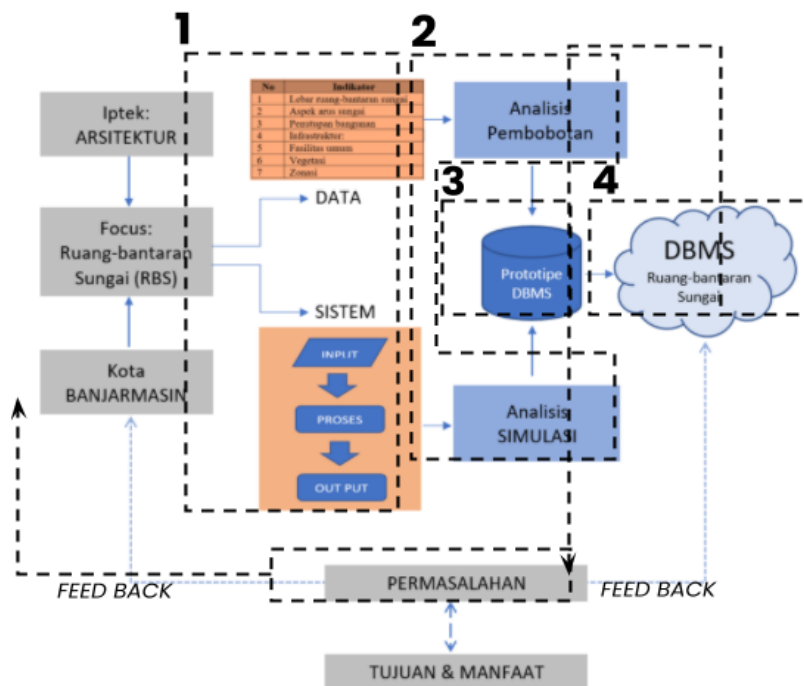


Figure 4. Research methodology.

The course of the research starts from the formulation of data on indicators that affect the riverbank space. Furthermore, a weighting analysis is carried out on the data indicators of the riverbank space according to the level of its influence on riverbank conditions. On the other hand, a database system is formulated according to the guidelines for drafting spatial planning documents. After the system is built, a simulation analysis of the system that has been built is then carried out. The results of weighting analysis and simulation analysis are combined into a DBMS Prototype. The DBMS prototype was then tested in order to determine the level of importance of the research objectives (disaster mitigation). The trial results will be used as input for the improvement of the DBMS in the future (Figure 4).

4. Results and discussion

The geographical condition of the city of Banjarmasin is dominated by the appearance of the landscape in the form of swamps and rivers. For the people of Banjarmasin, rivers and swamps are not only sources of water, but also as places for daily activities such as living, socializing, playing, working, farming, gardening and trading. The adaptation of the people of Banjarmasin to its environmental conditions creates a distinctive form of settlement, both on the banks of rivers and on swamps. The concentration of population and settlements in this city started in the riverbank area and

then expanded towards the land and swamps, but in recent developments the settlements developed towards the river so that the river space was reduced and several rivers disappeared.

4.1. Riverbank space indicators

The development of settlements resulted in reduced river space, making it prone to flooding and fires. Riverbanks are an important space to be addressed in an effort to protect the existence of rivers and protect residents from the risk of floods and fires. To measure the disaster risk on riverbanks 7 (seven) indicators are used, such as:

- The area of the riverbanks: River without embankment (Riparian border dan slope) and River with embankment (river boundary line dan slope)
- River currents: River currents are affected by rainfall
- Building coverage, include: population density, building density, and Building Coverage Ratio
- Infrastructure, include: road width, road condition
- Public facilities, include: Critical Facilities, Public Facilities
- Vegetation, include: vegetation density, amount and type of vegetation
- Zoning, include: agriculture, settlement, and green open space.

4.2. Disaster risk classification

Table 1 shows the result of a disaster risk analysis in a riverbank space in Banjarmasin City:

Table 1. Disaster risk classification.

No	Indicator	Parameter	Criteria	Condition
1	Physical space- riverbanks	River without embankment: Riparian border and slope	High Risk	Riparian border: 10 meter, Steep Slope >45 ^o
			Medium Risk	Riparian border: 15 meter, Slope 8-45 ^o
			Low Risk	Riparian border: 30 meter, Gentle Slope 0-8 ^o
2	River with embankment: river boundary line and slope		High Risk	River boundary line: <2 meter, Steep Slope >45 ^o
			Medium Risk	River boundary line: 3-5 meter, Slope 8-45 ^o
			Low Risk	River boundary line: >5 meter, Gentle Slope 0 – 8 ^o
3	River flows	River currents are affected by rainfall	High Risk	High Rainfall (300-500 mm)
			Medium Risk	Medium Rainfall (0-100 mm)
			Low Risk	Low Rainfall (100-300 mm)
4	Infrastructure	Road width & Road Condition	High Risk	Road width < 1,5 meter, Damaged roads 70%
			Medium Risk	Road width 1,5-3 meter, damaged roads 50%- 70%
			Low Risk	Road width > 3 meter, damaged roads <50%
5	Public facilities	Critical Facilities, Public Facilities		Was found Critical Facilities Was found Public Facilities there is no critical & public facilities

Table 1. Cont.

6	Vegetation	Vegetation density, amount and type of vegetation	Low Vegetation Density & Non vegetation Medium Vegetation Density with 1 - 2 spesies;/are High Vegetation Density with > 2 spesies
7	Zoning	Agriculture, settlement, and green open space	Settlement Green Open Space Agriculture

4.3. Mapping of potential disaster risks based on LBD

Disaster Risk Classification which contains indicators of riverbank space, the parameters of each indicator that determine disaster risk, as well as criteria and conditions, data collection is used to formulate an overview at the research location using Database Sheets (LBD). The results of LBD filling show the value (score) of each area of the riverbank. The results of the analysis of the LBD data were compared with the typology data on the riverbanks of the Banjarmasin City and the results can be seen in Figure 5.

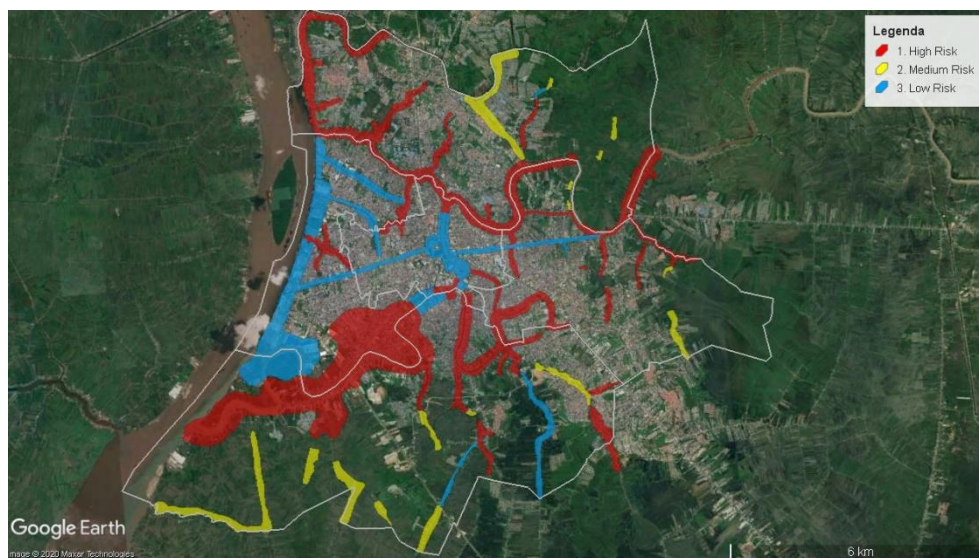


Figure 5. Banjarmasin city riverbank disaster risk map.

5. Conclusion

Based on the research, has been found that:

- River Border Spatial Database Instruments have been compiled.
- From the typological conditions that exist so far, the risks of each riverbank space in the city of Banjarmasin are as follows:
 - Riverbanks with Typologies 1, 2, 5 and 6 are considered to have High Disaster Risk.
 - Riverbanks with Typology 3 are considered to have Medium Disaster Risk.
 - Riverbanks with Typology 4 and Typology 7 considered to have Low Disaster Risk.
- Management of Disaster Risk Based on Typology of Riverbanks and Potential Risks, as follows:
 - In Typologies 1 & 2 with a high disaster risk value, what must be done is to maintain the density of buildings, widen roads, and add green areas (Open Space / Green Belt) so that disaster risk will be low risk.

- In Typologies 5 & 6 with a high disaster risk value, what must be done is to clean the buildings that are above the river, if possible restore the riverbank space, widen roads, and add green areas (Open Space / Green Belt) so that disaster risk will be low risk.
- In Typology 3 with a moderate risk value, what must be done is to maintain / keep the bank area clean from buildings, widen roads, and add green areas so that disaster risk will be low risk.
- In areas with low risk, a regulation on riverbank space is needed so that the risk of disaster does not become high.

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