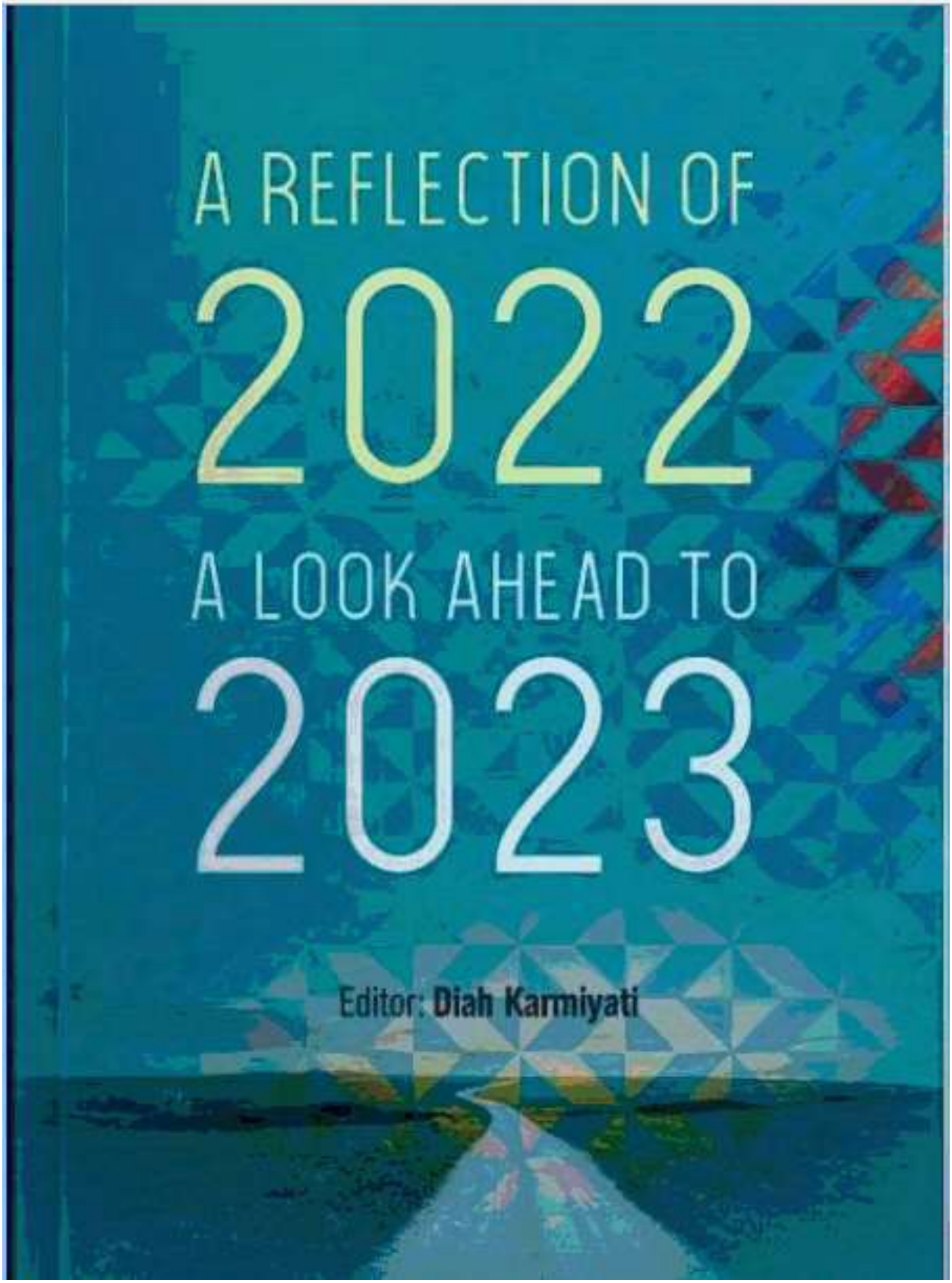
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A LOOK AHEAD TO
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Anggota IKAPI

Bekerja sama dengan Direktorat Program Pascasarjana Universitas Muhammadiyah Malang

Table of Contents

GIS As a Tool in Hydrometeorological Disaster Mitigation Policy in Society 5.0

Retno Nalarsih[1],Wiwin Nurzanah[2],Satria Wibawa[3]

Introduction

Fukuyama 2018, explained that society started from society 1.0 in its civilization of hunting and reconciled with nature, society 2.0, people began to think more advanced and began to cultivate crops, united for development. Society 3.0, the condition of the community establishing an equipment industry to make work easier, society 4.0, the digital era of the computer industry. Society 5.0, robot-based technology, human degradation by robotics, digital-based data, development of human life towards the coast and the seashore. Mavrodieva, 2020 disaster research, experienced by the Japanese government is increasing, affecting the economic and social losses, in collaboration with the private sector that has the technological innovation to develop the concept of society 5.0, specifically on the factors causing disasters to encourage climate-related policies; so that it accelerates the achievement of development goals.

Indonesia is the longest coastline in the world after Canada with abundant coastal resources. At the same time, it also has a high vulnerability to coastal problems, frequent abrasion, erosion, rapid ecological changes, economic and social changes along with high population growth, impacting the demand for raw and clean water which triggers the disaster of water shortages, shifting settlements towards the coast resulting in tidal flooding caused by the rising sea levels that affect the clean water conditions. Based on the conditions, curved seawalls are needed as a solution for protecting tidal coastal areas. Syam, 2015 research on flood-prone levels, using *Geography Information System* tools as flood-prone directions, primary and secondary data, topographic data, slope, geology and soil structure, hydrology, and water resources, vegetation, climatology and land use in Tamalate District, three levels, namely low flood vulnerability (safe), moderate flood vulnerability (alert), high flood vulnerability (dangerous), solutions from the research results on a high flood

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vulnerability with integrated drainage with biopori and infiltration wells in densely populated areas.

In his book, Tomaszewski, B. (2020), the second edition of the Geographic Information System (GIS) for disaster management, applies a theoretical approach, field practice, and disaster management. Explanation of the full cycle of application to disaster management, local, state, national and international scales, involving the government, non-government organizations, the private sector, and volunteers [5]. Nalarsih, 2019 research on Canggu Beach Bali, sediment transport and erosion result in silting of river mouths towards the coast. 2D with a water depth of 40 cm, a slope of 30°, reflector, regular wave types, and roughness with zig-zag, resulting in a model that reduces wave reflection (Kr) by 0.141. Nalarsih, 2017 research on Canggu Beach Bali with high waves, available infrastructure sloping seawall, in front of 50 cm^3 cube concrete block, groin 90 cm diameter 100 cm, height 240 cm, slope model 52°, seawall located 20 m from the shoreline, tested with the height of storm waves, zero up crossing data which results in Reflection coefficient is 0.169 and reduces waves by 30% [7].

Aye et al., 2016, researched in Małopolska Province Poland, in Italy using Geographic Information Systems (GIS) integrated with the multi-criteria evaluator. This platform supports policy and decision-making in flood and landslide management, increasing the interaction between risk management stakeholders in formulating and selecting risk management [8]. Tomaszewski 2020, Geographic Information Systems (GIS) as a tool to create concepts and models so that the resulting infrastructure is reliable. Tools for spatial analysis, geographic mapping, and database development to create an integrated infrastructure with a policy direction model [9].

Nalarsih, 2021 states that the analysis of disaster problems, both drought and floods must refer to the land use. The results of the analysis of groundwater conditions in Pacitan show that the capacity of rainwater is only 0.339% and 29.02% of the unutilized soil is dry soil and rocky cliffs. This shows that natural resources and environmental capacity are very small so they affect disaster problems. The involvement of all efforts is carried out with the synergy of Penta Helix and the realization of a balance between technology and wise policies from and for the community to realize the era of society 5.0 [10].

Verburg, Peter H., et al., 2009 stated that the change of land cover is very necessary for the change of land use, characteristics, careful surveys, remote sensing, and land functions in integrated geospatial mapping. Increasing the multifunctionality of land use

requires methods of quantifying and mapping the spatial level of land use and functions, identified with a model approach to produce things that cause inconsistencies in land change assessments. There is a non-linear relationship between land cover, land use, and its function that must be consistent with the land change analysis [11].

Muwahid, 2019, research on flood modeling in Sirnoboyo Village, Pacitan, using small format aerial photo software (fufk) filtering analysis of Digital Terrain Model (DTM) extracts, for mapping flood vulnerability due to the overflow of the Jelok River. using the software HEC-RAS 5.0.3 analysis of planned discharge analysis with a return period of 50 years river geometric analysis, flood modeling, potential flood hazard analysis, flood vulnerability analysis, and flood risk analysis. Depth validation by comparison of model results with interview results and indicators using flood depth investigations, building risk parameters ranging from low, medium, high, and very high ranges [12].

Asselin, 2013 researched land cover change or intensification using CLU Mondo through an innovative spatial approach, land-use modeling: simulation of land system change with a global scale land change model to support integrated assessments, simulated land system changes with regional goods demand factors, and influenced by local factors that inhibit or encourage the conversion of land systems in which the demand for goods and services is supplied by various land systems characterized by land cover mosaics, the intensity of agricultural management, and livestock. This shows that the conditions of integration in the land-use change are the causes and effects of achieving various biophysical, economic, and social changes [13].

Tran, 2017 characterizes the relationship between land cover changes and land use temperatures which analyzes the relationship between changes in land cover, land use, and soil surface temperature patterns in the urbanization area. Starting from the relationship between soil surface temperature patterns and existing vegetation, then from human engineering infrastructure, and agricultural land use to normalized vegetation, and index number related to land cover changes in land use. Assessment of the impact of these changes and urbanization with statistics for each hot spot and analysis of the urban landscape, with the application of nonparametric regression models to estimate future urban climate patterns using the prediction of land cover and land-use change [14].

Ahmad, 2013 this research applies a comprehensive or thorough study for flood prediction using Geographic Information Systems (GIS), conducting population assessments, geographic

surveys, and identifying tsunami that has huge potential and economical damage, then arranges mitigation steps, analyzes the impact of damage to flood areas using Arc GIS simulation to identify flood risk analysis before and after a disaster. The data involved in this simulation such as air pressure, wind direction, humidity levels, rainfall, and soil moisture. These variables are very influential in mapping and modeling scenarios in a real condition approach [15].

Mansour, 2020 the research focuses on spatial dynamics of land use and simulation of urban expansion from 2008 to 2018, assessing and projecting urban growth and land cover changes using geospatial and Cellular Automata (CA)-Markov, parameters used in the spatial simulation process are population density, proximity to the city center, and proximity to main roads. The output of this model is a spatial guideline as a monitoring trend for future land cover dynamics, as disaster mitigation, and as a control for declining development or carrying capacity in the mountain town of Oman [16].

Discussion

Based on the high frequency of flooding in Pacitan, the locus of research in Ngadirojo Subdistrict in Hadiwarno Village is the Taman coast. Sidomulyo Village is the Soge coast and Tulakan District, Jetak Village is the Pidakan coast. Figure 1.

To achieve the recommendations of the Regional Government, it is necessary to direct the handling of flood-prone areas in the most flood-affected zones, using variables: hazard index, Population Exposure Index, Loss Index, and Vulnerability Index to tidal flooding. Figure 1 shows that the results of research in Pacitan Regency on tidal flooding show the tidal flood threatening index is "low", the average value of the exposed population index is "low", the average value of the loss index is "moderate", the average vulnerability index is "low"

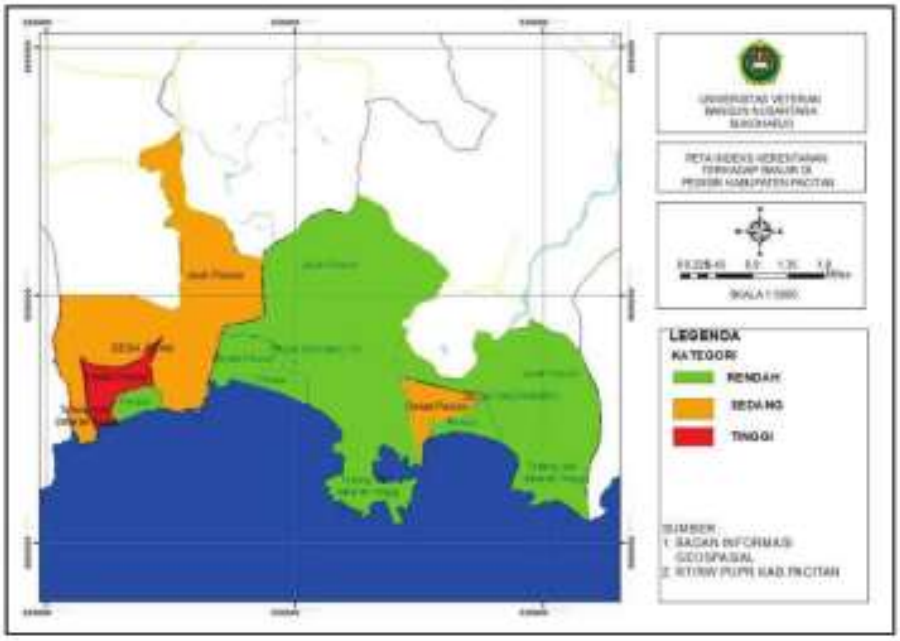


Figure 1. Result of Flood Hazard Map Analysis

(Source: Fitrianissa, Nalarsih, Ristanto, 2021)

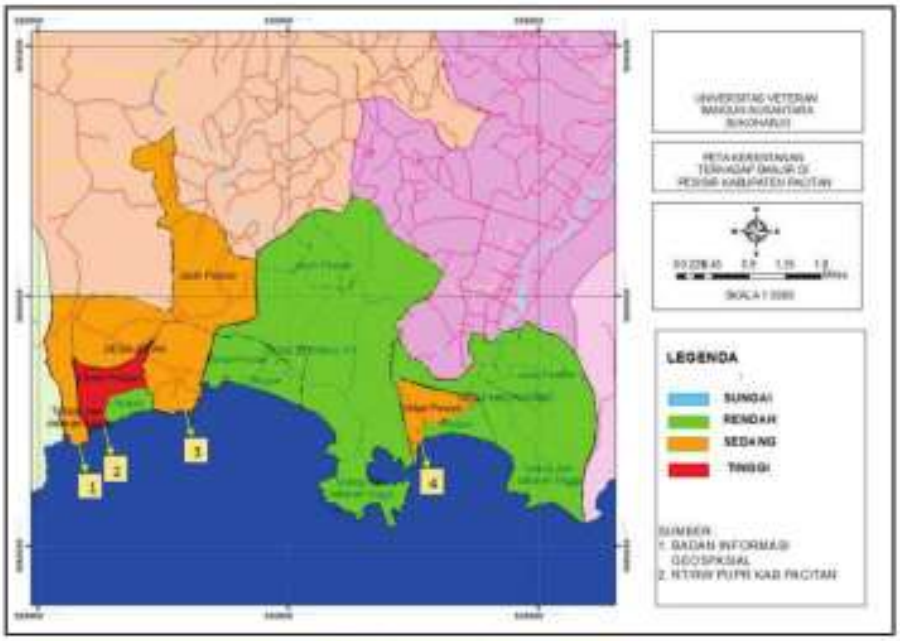
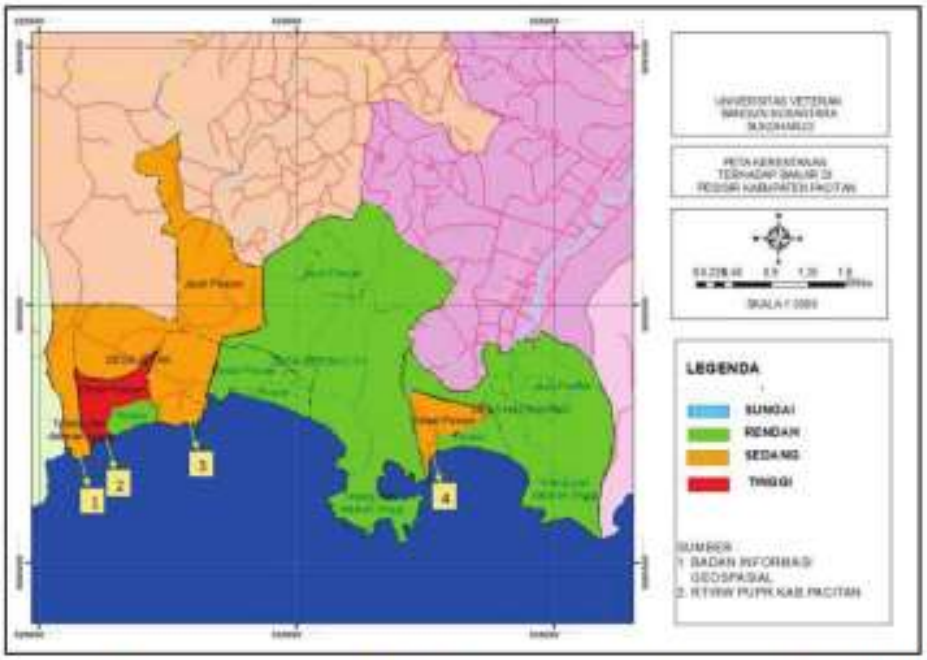


Figure 2. Result of Flood Hazard Map Analysis

(Source: Nalarsih, 2021)

Based on the results of the study, using the same indicators,

rainfall map is overlaid with the results of a flood-prone map with the same indicators as the previous study. The results of the research



on overlaying rainfall in all locus researches in Figure 3. **Result of Flood Hazard Map Analysis**

(Source: Nalarsih, 2021)

Ngadirojo District, Hadiwarno Village, which is the Taman coast, Sidomulyo Village is the coast of Soge and Tulakan District, Jetak Village is the coast of Pidakan, has low rainfall intensity, this shows that the rainfall variable has not dominated due to flooding at the research location, so it says that for a temporarily the flooding was caused by high tides.

Comparing the map of previous research, it can be made a safety direction for coastal areas and regions near the coast within the ecological type, Pidakan Beach has high waves because it is an unprotected offshore, making it possible for all waves or storms to hit the coastal area. Based on the threat to coastal areas. Jetak Village has a low flood vulnerability as its elevation is higher than the regions near the coast, because it has a lower elevation it becomes the highest threatening area.

mapping of flood locations based on the height of vulnerability, a solution was prepared as a recommendation for area 1 in the form of a cliff with moderate vulnerability. Location 2 is an area near the coast that has high flood susceptibility to create a curved sloping beach safety wall, location 3 with moderate vulnerability is secured with a sloping beach safety wall, and location 4 is an area near the coast with the moderate vulnerability being secured by sloped safety seawalls.

Conclusion

Based on Geographic Information Systems (GIS) analysis, it concludes that the flooding in Ngadirojo Subdistrict, Hadiwarno Village is a Taman coast, Sidomulyo Village is a Sage coast, and Tulakan Subdistrict Jetak Village is a Pidakan coast. It possibly happened due to high rainfall or tidal factors of sea level so the construction of coastal protection is necessary. Some important suggestions to strengthen the direction for further research are involving community behavior factors in managing waste, and watershed characteristics of the River Basin Area from upstream to downstream to obtain closer direction to local wisdom.

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