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: Mitigation Strategi of Disaster in Semarang City based Information Technology

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Manuscript:
Mitigation Strategi of Disaster in Semarang City based Information Technology

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1. Is this topic
   A. Suitable for the journal? **yes**
   B. Of broad national interest? **yes**
   C. Significant? **yes**

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Reviewer comment in page 3-4

2. Clarity of objectives: **B**

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   A. Properly organized? **yes**
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   C. Written clearly using correct grammar? **no**

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Reviewer comment in page 3-4

7. Are the approach, results and conclusions intelligible from the abstract? **no**

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B. Of good quality? **yes**

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10. Is the referencing relevant, up to date and accessible? **yes**

11. Overall quality of the work: **B**

12. Can you suggest any improvements to the paper or any parts that could be shortened or removed? [use separate sheet of paper if necessary to answer this]

Reviewer comment in page 3-4

13. Reviewer's decision: **A. Minor revision**

1. Is this topic	A. Suitable for the journal?	**yes**	This manuscript is suitable to be published in journals.
	B. Of broad national interest?	**yes**	Following the national interest, due to Indonesia, especially in Central Java/Semarang, they are a lot of disasters in this place, example: Flood occurred in Semarang City at the end of this year, furthermore the manuscript is interest to the disaster science
	C. Significant?	**yes**	The manuscript is significant to be published in this journal.
2. Clarity of objectives:		**B**	Why the research was conducted in Semarang city? What are the special characteristics of Semarang city on the geological and disaster

			science?
3. Quality of methods:		**B**	according to the title based on information technology, it has not been reflected in what kind of information technology method
4. Quality of data:		**B**	more complete data related to the Semarang city disaster
5. Validity of assumptions and analyses		**B**	use a more detailed analysis
6. Is this paper	A. Properly organized?	**yes**	The paper is properly organized.
	B. To the point and concise	**yes**	The paper is to the point and concise.
	C. Written clearly using correct grammar?	**no**	The grammar isn't correct and many geological terms are wrong, please revise according to the comments
7. Are the approach, results and conclusions intelligible from the abstract?		**no**	The abstract is incomplete so that the results and research methods must be completed, describe information technology according to the title
8. Is the title informative and a reflection of the content?		**yes**	The title is informative and presents a reflection of the paper content.
9. Are the illustrations/tables	A. Useful and all necessary?	**yes**	The illustrations and tables are useful and all necessary with the content, but adjust it to the illustration template and table in the IJOG journal
	B. Of good quality?	**yes**	The illustrations/tables are of good quality. but adjust it to the illustration template and table in the IJOG journal
10. Is the referencing relevant, up to date and accessible?		**yes**	Additional recent references about disaster should be added to your manuscript
11. Overall quality of the work		**B**	The overall quality of the manuscript is good, but revise it according to my comment
12. Can you suggest any improvements to the paper or any parts that could be			Please correct the comments and add the suggestions that I have written on this review page.

shortened or removed? [use separate sheet of paper if necessary to answer this]			
13. Reviewer's decision			Minor revision.

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Manuscript:
Mitigation Strategi of Disaster in Semarang City based Information Technology

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1. Is this topic	A. Suitable for the journal?	**yes**
	B. Of broad national interest?	**yes**
	C. Significant?	**yes**

Please explain your answers to item 1A – C briefly.

2. Clarity of objectives: **B**

3. Quality of methods: **B**

4. Quality of data: **B**

5. Validity of assumptions and analyses: **B**

6. Is this paper	A. Properly organized?	**yes**
	B. To the point and concise?	**yes**
	C. Written clearly using correct grammar?	**no**

Please explain your answers to item 6A – C briefly.

7. Are the approach, results and conclusions intelligible from the abstract? **no**

8. Is the title informative and a reflection of the content? **yes**

9. Are the illustrations/tables A. Useful and all necessary? **yes**
B. Of good quality? **no**

Please explain your answers to item 9A – B briefly.

10. Is the referencing relevant, up to date and accessible? **no**

11. Overall quality of the work: **B**

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13. Reviewer's decision:

Moderate revision

1. Is this topic	a. suitable for the journal?	**yes**	The manuscript is suitable to be published in this journal.
	b. of broad national interest?	**yes**	As Indonesia is prone to the natural disasters, I think the topic can draw the interest for the national and international readers.
	c. significant?	**yes**	The manuscript is quite significant to be published in this journal
2. Clarity of objectives:		**B**	The authors need to emphasize the position of the Information Technology in the research objectives
3. Quality of methods:		**B**	It is suggested to provide more detailed information on the research method. As the Information Technology is not much mentioned in the method section`.
4. Quality of data:		**B**	The disaster data in Semarang City need to be described in detail.
5. Validity of assumptions and analyses		**B**	The authors need to make the detailed assumptions and analyses.
6. Is this paper	a. properly organized?	**yes**	The manuscript is properly organized.
	b. to the point and concise	**yes**	The manuscript is to the point and concise enough to read.
	c. written clearly using correct grammar?	**no**	The authors need to meticulously read again the manuscript. Please check for completeness of sentences, grammar, and typos. It is suggested to kindly examine the English structure of the professional proofreading service.
7. Are the approach, results and conclusions intelligible from the abstract?		**no**	The abstract can be expanded into not more than 200 words to provide more detailed information of the methods, results, and conclusions.
8. Is the title informative and a reflection of the content?		**yes**	The title is quite informative and provide a reflection to the content of the manuscript.
9. Are the illustrations/tables	a. useful and all necessary?	**yes**	The figures and tables are useful and necessary. However, it would help a figure with the details of the map of Semarang City with the natural disasters mostly found.
	b. of good quality?	**no**	Please provide more clear and detailed figures and tables to describe the phenomena. It should be revised to become more informative to the readers.
10. Is the referencing relevant, up to date and		**no**	Please kindly provide more references with English.

accessible?			I think here it is important to underline those researchers which have investigated the disaster mitigation in the coastal area. Some useful references are: a. Dodo, A., Ningxiong X.U., Davidson, R.A., and Nozick, L.K., 2004. Optimizing the Selection of Regional Earthquake Mitigation Strategies. Proceedings, 13th World Conference on Earthquake Engineering, Vancouver b. Fang, J., Liu, W., Yang, S., Brown, S., Nicholls, R.J.., Hinkel, J., Shi, X., and Shi, P., 2017. Spatial-temporal changes of coastal and marine disaster risks and impacts in Mainland China. Ocean and Coastal Management, 139, p.125-140. c. Wahju Krisna Hidajat, Sutrisno Anggoro, Najib. Coastal Area Management Based on Disaster Mitigation: A Case Study in Purworejo Regency, Indonesia. Indonesian Journal on Geoscience Vol. 8 No. 2 August 2021: 147-156. d. Sudaryatno, Widayani, P., Wibowo, T.W., Pramono, B.A.S., Afifah, Z.N., Meikasari, A.D., and Firdaus, M.R., 2019. Visualized Information Value Model Result of Landslide Vulnerability in Purworejo. Proceedings, 6th Geoinformation Science Symposium, Yogyakarta.
11. Overall quality of the work		**B**	This is a pleasant paper to read, with clear logic, organization, and arguments. However, there are still some problems worth in-depth discussion, which can be shown on the review page.
12. Can you suggest any improvements to the paper or any parts that could be shortened or removed?			The manuscript does not need to be shortened or removed. The length of the manuscript is appropriate enough to read.
13. Reviewer's decision			**Moderate revision**

Mitigation Strategi of Disaster in Semarang City based Information Technology

[**Abstract**] - Semarang is a city located on the coast of the Java Sea. This makes Semarang one of the cities that are threatened by tidal floods. Apart from the tidal flood, several other disasters that occurred in Semarang were: fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. This study identifies disaster events that occurred in Semarang City from 2012-2021, as well as mitigation strategies in general and specifically using information technology. The research data was obtained from the Regional Development Planning Agency, the Regional Planning Agency, the Public Works Agency, the Central Statistics Agency (Semarang in Figures 2022), Semarang City Social Service, and several related stakeholders. The results of the study indicate that mitigation that can be used is using GIS, using algorithms, and combining GIS and fuzzy logic methods.
[Keywords] 4 - 7 GIS, flood inundation, coastal mitigation

[INTRODUCTION]

Background

Indonesia is a disaster-prone country. According to the National Disaster Management Agency (BNPB), 1,205 disaster incidents occurred, from January 1 to April 30, 2021. Disasters were dominated by hydrometeorological incidents, for example, floods, hurricanes, and erosions. Floods occur most frequently, with 501 incidents, tornadoes 339 incidents, landslides 233 incidents, forest and land fires 97 incidents, earthquakes 18 incidents, tidal waves and abrasion 16 incidents, and drought. The number of natural disasters increased by 1% from the previous year (Ichsan, 2022). Semarang is a coastal area located on the island of Java. The population of Semarang City, in 2021 is 1,656,564 people (BPS Semarang, 2022). Tidal floods often occur, because Semarang is a coastal area. In 2022, there will be tidal flooding in the coastal area of Semarang. This happened because the embankment broke in the industrial area in the coastal area. As a result, the water level overflowed from 1.25 meters to 1.5 meters. Tidal flooding is a frequent problem in coastal areas of Indonesia because the coast has complex dynamics and processes that make coastal areas vulnerable to disasters. The city of Semarang has tidal flood pressures that last for a long time. The causes of tidal flooding are sea level rise, global warming, and land subsidence (especially in North Semarang). The areas in Semarang that experienced the highest land subsidence were

Tanjung Mas, Terboyo Kulon, Purwodinatan, and Central Semarang, with as much as 12-15 cm/year (Nugroho, 2015).

Several previous studies have explained tidal flooding: research on prediction analysis of the largest tidal flood inundation occurred in the center of Semarang city which is flanked by the Banjir Kanal Barat and Banjir Kanal Timur rivers. The area is dominated by settlements, trade areas, industry, and strategic objects for the government and economy of Semarang (Nugroho, 2015), some coastal areas of Semarang City have an adaptive capacity to tidal flooding that ranges between medium and low which is 58 urban villages (58 villages). ,(62%) of the total coastal sub-districts in Semarang City (Suhelmi, 2013), the occurrence of bacterial contamination due to poor water quality contaminated from water affected by tidal flooding, both provider and distribution levels have a very high risk of contamination, while the level of customers has a high risk (Budiyono *et al.*, 2015). This tidal flood becomes chronic stress because this disaster causes the structure of the city to weaken (Egaputra, Ismunarti and Pranowo, 2022). In addition to tidal flooding, several disaster incidents occurred in Semarang City, namely: flood, landslide, tornado, collapsed house, fire, and fallen tree (BPS Semarang, 2022). This study describes several disaster incidents that occurred in the city of Semarang and their mitigation is based on community empowerment, especially in communities.

Geological Information in Semarang

In the Geomorphological Map of Indonesia: Semarang area is generally occupied by alluvial plains with several embankments and swamps. Deposits which are stuffed in inter-mountain basins and hilly fold complexes are found in parts of southern and eastern Semarang. The other area is a complex morphology of volcanic deposits to the east of Semarang cutting through the sedimentary quarter Merbabu dan Merapi volcano to the bottom of the Java Sea to the north of Semarang. The stratigraphy of the Semarang area is mostly covered by the Pleistocene Damar Formation and along the north coast by alluvium deposits. According to Van Bemmelen (1970a), the Damar Formation is composed of tuffaceous sandstone, conglomerate, and volcanic breccia. Sandstone is composed of dark minerals, feldspar, and quartz, as well as vertebrate remains, faults in the south of Semarang as a result of the collapse of Mount Ungaran in the Late Pleistocene (Poedjoprajitno, Wahyudiono and Cita, 2008). The stratigraphic structure of Semarang City is as follows: Alluvium (Qa): is an alluvial deposit of beaches, rivers and lakes, Gajah Mungkur Fire Rock (Qhg) The rocks are: andesite lava, blackish gray in color, fine grained, holocrystalline, the composition consists of feldspar, hornblende and augite, hard and compact; Kali Gesik

Commented [A1]: Gajah mungkur volcanic rock

Volcano Rock (Qpk): the rock is basalt lava, blackish gray in color, smooth, mineral composition consists of feldspar, olovine and augite, very hard; Jongkong Formation (Qpj): augite hornblende andesite breccia and lava flows, formerly known as Ungaran Lama volcanic rocks. Andesite breccia is blackish brown, components measuring 1 - 50 cm, angular – slightly rounded with tuffaceous base mass, medium pososity, compact and hard; Damar Formation (Qtd): the rock consists of tuffaceous sandstone, conglomerate, and volcanic breccia. The tuffaceous sandstone is brownish yellow in color with fine-coarse grain, the composition consists of mafic minerals, feldspar, and quartz with a tuffaceous base mass, moderately hard porosity; Kali Getas Formation (Qpkg): the rock consists of breccia and lahars with insertions of lava and fine tuff to coarse, local at the bottom found claystone containing mollusks and tuffaceous sandstone; Kalibening Formation (Tmkl): the rock consists of marl, tuffaceous sandstone and limestone. The marl is greenish gray to blackish in color. The composition consists of clay minerals and carbonate cement, low porosity to impermeable, somewhat hard in the dry state and easily crushed in the wet state; Kerek Formation (Tmk): alternating claystone, marl, tuffaceous sandstone, conglomerate, volcanic breccia and limestone. Light-dark gray claystone, calcareous, partly interlaced with siltstone or sandstone, containing foram fossils, molluscs, and coral colonies (Soedarsono, 2012).

Commented [A2]: Olivine

Commented [A3]: Massa dasar....groundmass

Commented [A4]: porosity

Commented [A5]: sisipan....intercalation

Commented [A6]: kedapair...impermeable

Commented [A7]: wet condition

[METHODS AND MATERIALS]

Methods

The research was conducted in Semarang City, Central Java Province, Indonesia. The city of Semarang is located on the northern coastline of the island of Java and is directly adjacent to the Java Sea. The area around the coast of the Java Sea is prone to tidal flooding, as well as other coastal disasters. Disaster mitigation measures need to be taken so that the affected community is reduced. Several studies use strategic analysis in coastal disasters, especially coastal erosion (Sugianto *et al.*, 2022), contributed ICZM to mitigation coastal erosion (Cantasano *et al.*, 2021), climate change mitigation based economy (Gouldson *et al.*, 2016), community planning, and public participation (Pearce, 2003), landslide (Puri and Khaerani, 2018), dan flood (Budiarti, Gravitiani and Mujiyo, 2018). The mitigation described in this study identifies mitigation in general and specifically using information technology.

Materials

Collecting data in this study using literature study, interviews, field observations, and documentation. Data to support the results of this study were obtained from the Regional Development Planning Agency, the Regional Planning Agency, the Public Works Agency, the Central Statistics Agency (Semarang in Figures 2022) and the Semarang City Social Service.

[RESULT (AND ANALYSIS)]

Population and Social Vulnerability

The number of population by age in Semarang City is more female than male population, which in 2021, namely: 819,785 male residents and 836,779 female residents, with a sex ratio of 98.01%. The total population in 2021 is 1,656,564 people. (BPS Semarang, 2022). The graph of the population by age group and sex in Semarang municipality is presented in Figure 2.

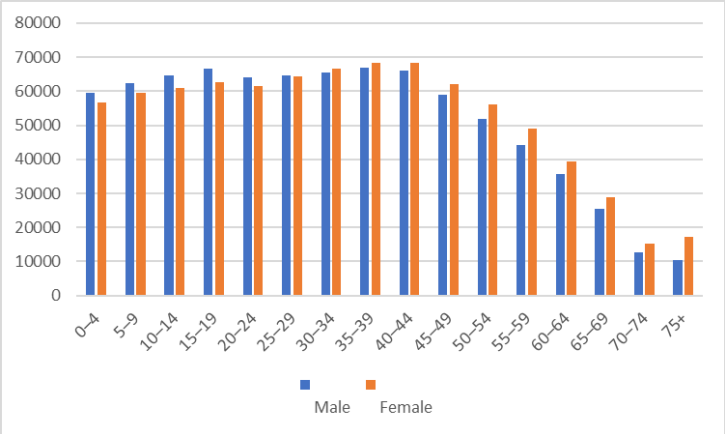

Figure 2. Population by Age Group and Sex in Semarang Municipality

The high population density affects the social vulnerability of the community in potentially disaster-prone areas. Areas with a dense population represent a higher chance of loss of life and loss of property. The elderly population (60 years and over) is 184,798 people, the population of children aged 0-14 years is 363,757 people. The elderly population and the age of children (0-14 years), is one of the variables of social vulnerability. When the disaster process occurs, the elderly population and children have a low capacity, so they depend on the productive age. The productive age population (15-60 years) is 1,108,0009 people. The female population aged over 20 years (mother) is 596,814 people, of the total

female population of 836,779 people. The high ratio of the number of women in the composition of the population by sex illustrates the relatively low ability in the evacuation process. This is based on the condition of women who are generally considered lower than the physical condition of men. With this condition, the female population will be more vulnerable than the male population (Hapsoro and Buchori, 2015).

Climate Condition

Climatic conditions in an area affect the potential of the area, both the potential for disasters and the potential for natural resources. The city of Semarang has a tropical climate, and 2 seasons, namely the dry and rainy seasons. The air temperature in Semarang City ranges from 26.50°C to 28.90°C, with an average monthly rainfall in 2021 ranging from 206.58 mm (BPS Semarang, 2022). High rainfall has the potential to cause floods and landslides. Observation of Climate Elements by Months at Semarang Station is presented in Figure 3.

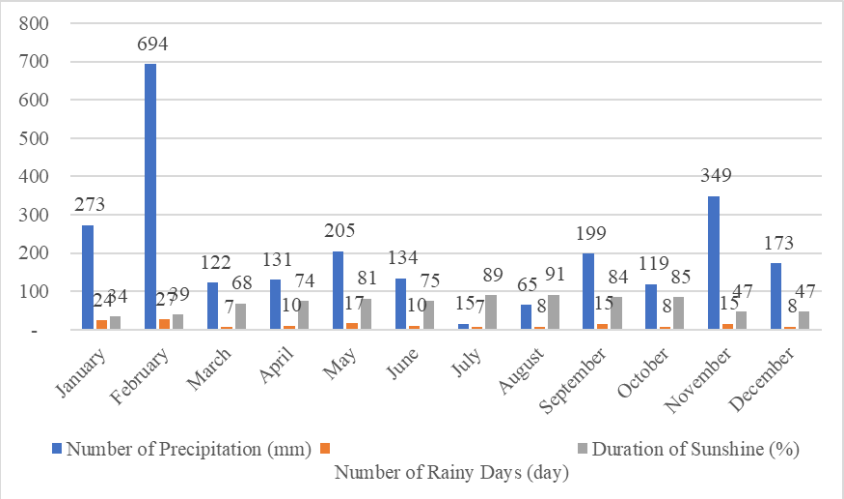

Figure 3. Observation of Climate Elements by Months at Semarang Station

Land Use

Land use (2012-1016) in Semarang City consists of 9 categories, namely: ricefield, garden, farm, plantation, planted trees, grassland, temporary land, pond road/residential/office/river, etc. The largest land use is road/residential/office/river covering an area of 17,768.23 Ha, and the smallest land use is temporary land covering an area of 105.3 Ha. The Graph of Use of Semarang City in 2012-2016 is presented in Figure 4.

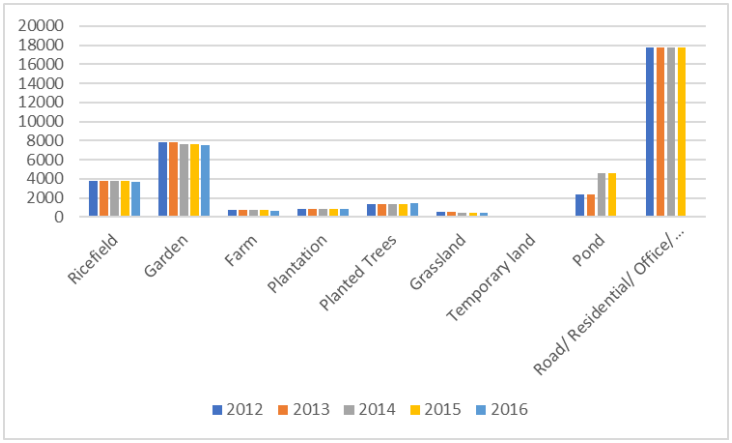

Figure 4. Land Use at Semarang

Land use, especially rice fields is useful for food security management, accurate land evaluation helps decision makers in planning appropriate area management (Kumar *et al.*, 2021). Area of Rice Field Use (Ha) presented in figure 5.

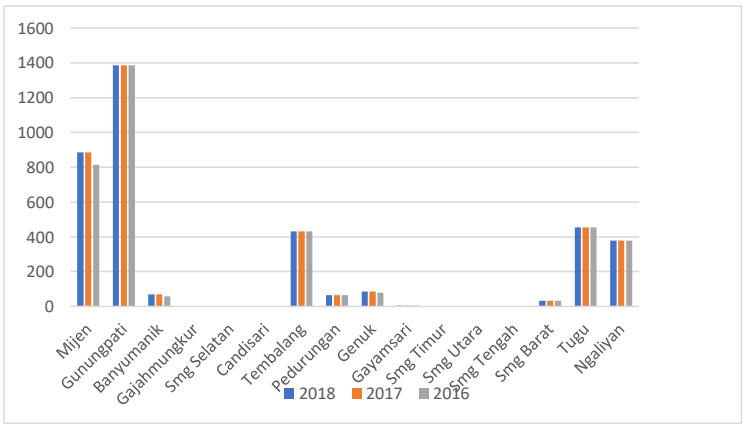

Figure 5. Area of Rice Field Use (Ha)

Disasters Incident in Semarang City

The most common disasters that occurred in the period 2012-2021 were landslides. In 2020, there were 175 landslides. The average disaster with the least frequency is tidal flooding, because this tidal flood only affects the Java Sea coastal area (Semarang which is

close to the coast), while the upper Semarang area is not affected by this disaster. Disaster that occurred in Semarang During the years 2012-2021 are presented in Figure 6.

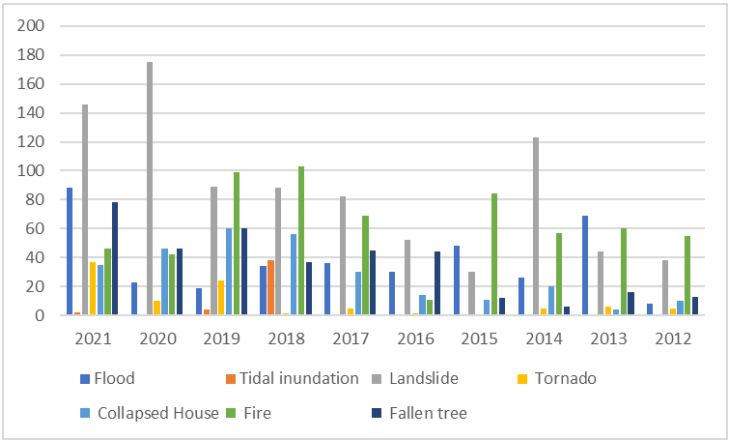

Figure 6. Disaster that Occurred in Semarang During the years 2012-2021

In the period 2012-2021, there were 381 flood incidents (BPBD Semarang, 2022). A flood is a condition in which an area is inundated by large amounts of water. The cause of the flooding is heavy rainfall; rainwater that is not absorbed in the upstream area (because of deforestation); rivers that experience narrowing or siltation (due to the garbage and uncontrolled development in the vicinity), or topographical conditions in the form of basins that tend to become water collection areas (Aritama and Dharmadhiatmika, 2019).

There were 44 tidal floods, the worst of which was in 2022 which attacked the industrial area of Semarang which is close to the coast (BPBD Semarang, 2022). The existing condition of land elevation which is lower than sea level causes greater land subsidence. The tidal flood in Semarang caused damage to infrastructure and residential areas while simultaneously affecting the lives of people, households, and individuals. Problems caused by tidal flooding are productive land no longer functioning properly, damage to public infrastructure, and increasing conditions in slum settlements (Ikhwanudin, Wahyudi and Soedarsono, 2020).

A landslide is a disaster incident with the highest frequency, which is 867 incidents (BPBD Semarang, 2022). Landslides are natural disasters that can cause casualties, loss of homes, and environmental damage. Landslides are not only natural phenomena, but also caused by human activities (Sudaryatno *et al.*, 2019). Heavy rainfall and earthquakes can trigger landslides (Hadi *et al.*, 2021). Indonesia has a tropical climate which always gets

rain every year. Indonesia is crossed by a plate subduction path, namely the cross of the Eurasian, Pacific and Australian plates which often cause earthquakes (Karnawati, 2005) (Widiastutik and Buchori, 2018).

There were 626 fire disasters (BPBD Semarang, 2022). Fire is a disaster based on the cause of its occurrence classified as natural disasters: lightning, earthquakes, volcanic eruptions, droughts, and others, as well as non-natural disasters caused by human negligence: gas leaks, electrical short circuits, cigarette butts, sabotage, the low level of the building construction safety system against fires (Nurwulandari, 2017).

Another disaster that occurred was 357 fallen trees (BPBD Semarang, 2022). Triggers for the occurrence of fallen trees: the load force received by the trunk/top of the tree exceeds its resistance capacity, and the presence of sudden strong winds and/or rainwater falling on and stored in the tree canopy will increase the load capacity.

[DISCUSSION]

Disasters Mitigation

1. Flood

Floods are the most frequent disasters in Indonesia and have quite a detrimental impact on many parties (Pratiwi, 2019). It is very important for policy makers to know the characteristics of flood hazards in order to choose mitigation measures in the future (Purwitaningsih *et al.*, 2022). The rapid development of cities and changes in the characteristics of rain due to climate change cause flooding and inundation in the rainy season (Sedyowati *et al.*, 2020). Communities benefit economically from drainage channels used for fish and vegetable cultivation. The current flood control project not only reduces the flood risk level by 30% but also provides the resulting economic efficiency of the flood risk management system by up to 90% over the project's 6-year effective life (Sedyowati *et al.*, 2020). To overcome these problems, the Semarang City Government chose the Banger Polder drainage system. Indications of land subsidence in Semarang can be known from several data sources. Based on measurements and data, land subsidence in hilly areas in Semarang City is smaller than that in coastal areas. From field observations, land subsidence in former swamps and ponds shows the largest decline, for example in the Tanah Mas housing complex, Tanjung Mas Beach, with a decrease of between 5.5 - 7.23 cm per year (Ikhwanudin, Wahyudi and Soedarsono, 2020).

2. Fire

Structural mitigation is related to the form of physical mitigation, namely the provision and construction of facilities and infrastructure. Meanwhile, non-structural mitigation is

related to the formulation of fire disaster management policies such as public commitment and implementation of methods and operations, including participatory mechanisms and information dissemination and knowledge development, which are carried out to reduce disaster risk. Mitigation scenarios through prevention, mitigation, preparedness, early warning system, recovery, and development (Nurwulandari, 2017). The influence of this community capacity variable is very important in determining the risk of fire disaster. Losses and casualties can be minimized by increasing community capacity (Januandari, Rachmawati and Sufianto, 2017). Fire mitigation can be done by: fire education and training; analysis of active fire protection systems: light fire extinguishers, hydrants, sprinklers, fire alarms; analysis of life-saving means: emergency stairs, exit signs (Karimah, Kurniawan and Suroto, 2019).

3. Fallen trees

Carry out tree planting designs according to locations that pay attention to places that match the dimensions of tree growth, choose the right tree species that will ensure their suitability at the planting location / choose tree species that are native to the area, plant appropriately that pays attention to the cultivation aspect, protect trees from possible damage by humans, take good care of trees (Sulistyantara, 2014), monitoring of trees at risk of breaking/falling, risk management of trees at risk of breaking/falling (Ningrum, 2020), planning and placing tree planting points through state analysis, pruning and cutting trees on a regular basis (Aritama and Dharmadhiatmika, 2019).

3. Using Information Technology

Using Algorithm: Markov Chains Algorithm: Markov Chains Algorithm is a method for generating the probability value of something with probability calculations. Markov chains here make predictions with matrix values for 7 natural disasters that occurred in the city of Semarang with prediction results in 2020 being 35% flood, 0% flood rob, 22% landslide, 3% tornado, 2% house collapse, 30 fire % and fallen trees 8%. Meanwhile, in 2021 the percentage of flood predictions is 22%, rob floods are 3%, landslides are 22%, tornadoes are 2%, houses collapsed 8%, fires were 33% and trees fell 9% (Hidayati, Pungkasanti and Wakhidah, 2021). Using GIS: Flood modeling uses a combination of geographic information systems and fuzzy logic methods (Nugraha, 2018), using GIS for disaster management in Taiwan (Hsu, Wu and Lin, 2005), the role of GIS in a natural disaster, prediction, mitigation, laws and government policies, impact on biogeochemistry of earth crust, role in earthquake in India (Singh, Pandey and Mina, 2019). Using Garbage Sorting Games, DIFMOL, and ILMIZI for environmental learning of disaster mitigation

(Rahmayanti *et al.*, 2020), using google earth pro to learning media for mitigation and adaptation of landslide disaster (Suharini, Ariyadi and Kurniawan, 2020).

[CONCLUSIONS]

The disasters that occurred in the city of Semarang in 2012-2021 were fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. The most common disasters are landslides. Disaster mitigation is needed in general and specifically using information technology to predict future disasters, this is needed so that people can know how to prevent and prepare for disasters

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Mitigation Strategy of Disaster in Semarang City based Information Technology

[**Abstract**] - Semarang is a city located on the coast of the Java Sea. This makes Semarang one of the cities threatened by tidal flooding. Apart from tidal flood inundation, several other disasters that occurred in Semarang were: fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. This study identifies disaster events that occurred in the city of Semarang from 2012-2021, as well as strategies for coping with them in general and specifically using information technology, namely using GIS (Geographic Information System) maps. Research data was obtained from Bappeda, Bappeda, Public Works Office, Central Bureau of Statistics (Semarang in Figures 2022), Semarang City Social Service, and several related stakeholders. The data was then visualized on a GIS map. The results of the study show that the mitigation that can be used is by using GIS maps of floods and landslides, disaster mitigation through the economy and government policies of the City of Semarang.
[Keywords] GIS, disater, mitigation

[INTRODUCTION]

Background

Indonesia is a disaster-prone country. According to the National Disaster Management Agency (BNPB), 1,205 disaster incidents occurred, from January 1 to April 30, 2021. Disasters were dominated by hydrometeorological incidents, for example, floods, hurricanes, and erosions. Floods occur most frequently, with 501 incidents, tornadoes 339 incidents, landslides 233 incidents, forest and land fires 97 incidents, earthquakes 18 incidents, tidal waves and abrasion 16 incidents, and drought. The number of natural disasters increased by 1% from the previous year (Ichsan, 2022). Semarang is a coastal area located on the island of Java. The population of Semarang City, in 2021 is 1,656,564 people (BPS Semarang, 2022). Tidal floods often occur, because Semarang is a coastal area. In 2022, there will be tidal flooding in the coastal area of Semarang. This happened because the embankment broke in the industrial area in the coastal area. As a result, the water level overflowed from 1.25 meters to 1.5 meters. Tidal flooding is a frequent problem in coastal areas of Indonesia because the coast has complex dynamics and processes that make coastal areas vulnerable to disasters. The city of Semarang has tidal flood pressures that last for a long time. The causes of tidal flooding are sea level rise, global warming, and land subsidence (especially in North Semarang). The areas in Semarang that experienced the highest land subsidence were Tanjung Mas, Terboyo Kulon, Purwodinatan, and Central Semarang, with as much as 12-15 cm/year (Nugroho, 2015).

Several previous studies have explained tidal flooding: research on prediction analysis of the largest tidal flood inundation occurred in the center of Semarang city which is flanked by the Banjir Kanal Barat and Banjir Kanal Timur rivers. The area is dominated by settlements, trade areas, industry, and strategic objects for the government and economy of Semarang (Nugroho, 2015), some coastal areas of Semarang City have an adaptive capacity to tidal flooding that ranges between medium and low which is 58 urban villages (58 villages). ,(62%) of the total coastal sub-districts in Semarang City (Suhelmi, 2013), the occurrence of bacterial contamination due to poor water quality contaminated from water affected by tidal flooding, both provider and distribution levels have a very high risk of contamination, while the level of customers has a high risk (Budiyono *et al.*, 2015). This tidal flood becomes chronic stress because this disaster causes the structure of the city to weaken (Egaputra, Ismunarti and Pranowo, 2022). In addition to tidal flooding, several disaster incidents occurred in Semarang City, namely: flood, landslide, tornado, collapsed house, fire, and fallen tree (BPS Semarang, 2022). This study describes several disaster incidents that occurred in the city of Semarang and their mitigation is based on community empowerment, especially in communities.

Geological Information in Semarang

In the Geomorphological Map of Indonesia: Semarang area is generally occupied by alluvial plains with several embankments and swamps. Deposits which are stuffed in inter-mountain basins and hilly fold complexes are found in parts of southern and eastern Semarang. The other area is a complex morphology of volcanic deposits to the east of Semarang cutting through the sedimentary quarter Merbabu dan Merapi volcano to the bottom of the Java Sea to the north of Semarang. The stratigraphy of the Semarang area is mostly covered by the Pleistocene Damar Formation and along the north coast by alluvium deposits. According to Van Bemmelen (1970a), the Damar Formation is composed of tuffaceous sandstone, conglomerate, and volcanic breccia. Sandstone is composed of dark minerals, feldspar, and quartz, as well as vertebrate remains, faults in the south of Semarang as a result of the collapse of Mount Ungaran in the Late Pleistocene (Poedjoprajitno, Wahyudiono and Cita, 2008). The stratigraphic structure of Semarang City is as follows: Alluvium (Qa): is an alluvial deposit of beaches, rivers and lakes, Gajah Mungkur Volcanic Rock (Qhg) The rocks are: andesite lava, blackish gray in color, fine grained, holocrystalline, the composition consists of feldspar, hornblende and augite, hard and compact; Kali Gesik Volcano Rock (Qpk): the rock is basalt lava, blackish gray in color, smooth, mineral composition consists of feldspar, olivine and augite, very hard; Jongkong Formation (Qpj):

Commented [A1]: Gajah mungkur volcanic rock

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Commented [A3]: Olivine

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augite hornblende andesite breccia and lava flows, formerly known as Ungaran Lama volcanic rocks. Andesite breccia is blackish brown, components measuring 1 - 50 cm, angular – slightly rounded with tuffaceous groundmass, medium porosity, compact and hard; Damar Formation (Qtd): the rock consists of tuffaceous sandstone, conglomerate, and volcanic breccia. The tuffaceous sandstone is brownish yellow in color with fine-coarse grain, the composition consists of mafic minerals, feldspar, and quartz with a tuffaceous groundmass, moderately hard porosity; Kali Getas Formation (Qpkg): the rock consists of breccia and lahars with intercalation of lava and fine tuff to coarse, local at the bottom found claystone containing mollusks and tuffaceous sandstone; Kalibening Formation (Tmkl): the rock consists of marl, tuffaceous sandstone and limestone. The marl is greenish gray to blackish in color. The composition consists of clay minerals and carbonate cement, low porosity to impermeable, somewhat hard in the dry state and easily crushed in the wet condition; Kerek Formation (Tmk): alternating claystone, marl, tuffaceous sandstone, conglomerate, volcanic breccia and limestone. Light-dark gray claystone, calcareous, partly interlaced with siltstone or sandstone, containing foram fossils, molluscs, and coral colonies (Soedarsono, 2012).

Commented [A5]: Massa dasar....groundmass

Commented [A6R5]: Sudah dibetulkan

Commented [A7]: porosity

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[METHODS AND MATERIALS]

Methods

The research was conducted in Semarang City, Central Java Province, Indonesia. The city of Semarang is located on the northern coastline of the island of Java and is directly adjacent to the Java Sea. The area around the coast of the Java Sea is prone to tidal flooding, as well as other coastal disasters. Disaster mitigation measures need to be taken so that the affected community is reduced. Several studies use strategic analysis in coastal disasters, especially coastal erosion (Sugianto *et al.*, 2022), contributed ICZM to mitigation coastal erosion (Cantasano *et al.*, 2021), climate change mitigation based economy (Gouldson *et al.*, 2016), community planning, and public participation (Pearce, 2003), landslide (Puri and Khaerani, 2018), dan flood (Budiarti, Gravitiani and Mujiyo, 2018). The mitigation described in this study identifies mitigation in general and specifically using information technology visualized on a GIS map.

Materials

Collecting data in this study using literature study, interviews, field observations, and documentation (Hidajat, Anggoro and Najib, 2021). Data to support the results of this study were obtained from the Regional Development Planning Agency, the Regional Planning Agency, the Public Works Agency, the Central Statistics Agency (Semarang in Figures 2022) and the Semarang City Social Service. The data is then visualized on a GIS map.

[RESULT (AND ANALYSIS)]

Population and Social Vulnerability

The number of population by age in Semarang City is more female than male population, which in 2021, namely: 819,785 male residents and 836,779 female residents, with a sex ratio of 98.01%. The total population in 2021 is 1,656,564 people. (BPS Semarang, 2022). The graph of the population by age group and sex in Semarang municipality is presented in Figure 2.

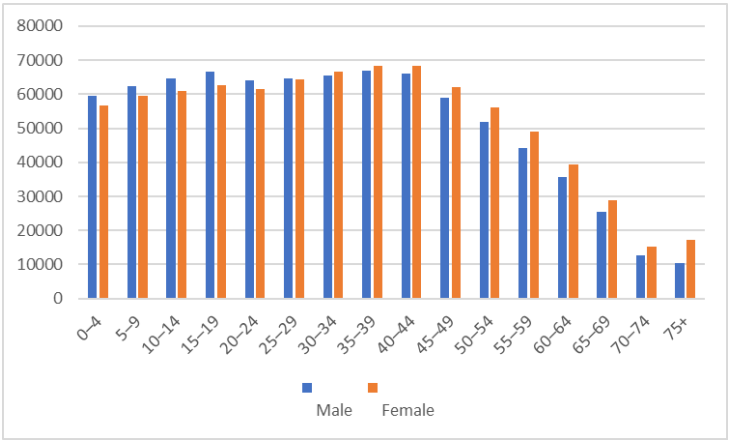

Figure 2. Population by Age Group and Sex in Semarang City

The GIS map Area of Population by Age Group and Sex in Semarang City is visualized on the GIS Web https://sigtahanpangan.info/semarang/penduduk.html which can be seen in Figure ...

Figure …. The GIS map Area of Population by Age Group and Sex in Semarang City

The high population density affects the social vulnerability of the community in potentially disaster-prone areas. Areas with a dense population represent a higher chance of loss of life and loss of property. The elderly population (60 years and over) is 184,798 people, the population of children aged 0-14 years is 363,757 people. The elderly population and the age of children (0-14 years), is one of the variables of social vulnerability. When the disaster process occurs, the elderly population and children have a low capacity, so they depend on the productive age. The productive age population (15-60 years) is 1,108,0009 people. The female population aged over 20 years (mother) is 596,814 people, of the total female population of 836,779 people. The high ratio of the number of women in the composition of the population by sex illustrates the relatively low ability in the evacuation process. This is based on the condition of women who are generally considered lower than the physical condition of men. With this condition, the female population will be more vulnerable than the male population (Hapsoro and Buchori, 2015).

Climate Condition

Climatic conditions in an area affect the potential of the area, both the potential for disasters and the potential for natural resources. The city of Semarang has a tropical climate, and 2 seasons, namely the dry and rainy seasons. The air temperature in Semarang City ranges from 26.50°C to 28.90°C, with an average monthly rainfall in 2021 ranging from 206.58 mm (BPS Semarang, 2022). High rainfall has the potential to cause floods and landslides. Observation of Climate Elements by Months at Semarang Station is presented in Figure 3.

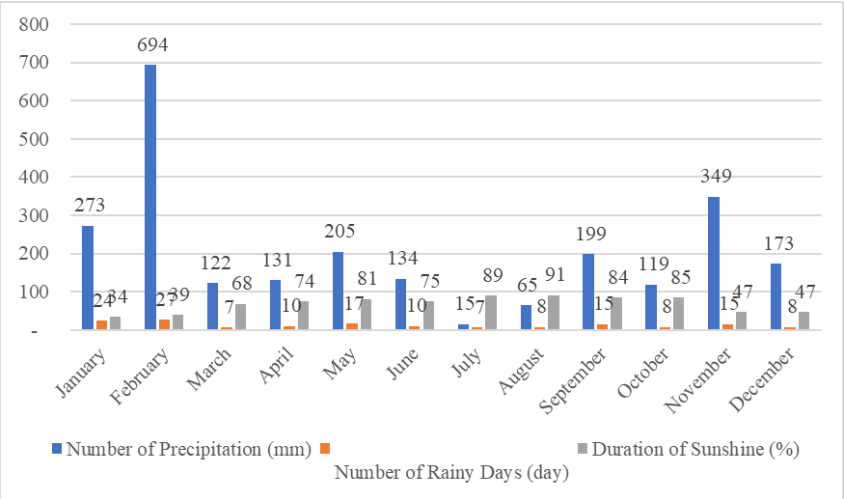

Figure 3. Observation of Climate Elements by Months at Semarang Station

Land Use

Land use (2012-1016) in Semarang City consists of 9 categories, namely: ricefield, garden, farm, plantation, planted trees, grassland, temporary land, pond road/residential/office/river, etc. The largest land use is road/residential/office/river covering an area of 17,768.23 Ha, and the smallest land use is temporary land covering an area of 105.3 Ha. The Graph of Use of Semarang City in 2012-2016 is presented in Figure 4.

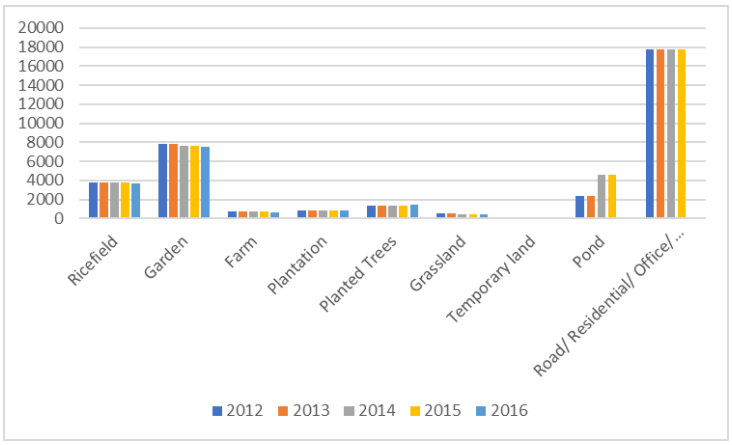

Figure 4. Land Use at Semarang

Land use, especially rice fields is useful for food security management, accurate land evaluation helps decision makers in planning appropriate area management (Kumar *et al.*, 2021). Area of Rice Field Use (Ha) presented in figure 5.

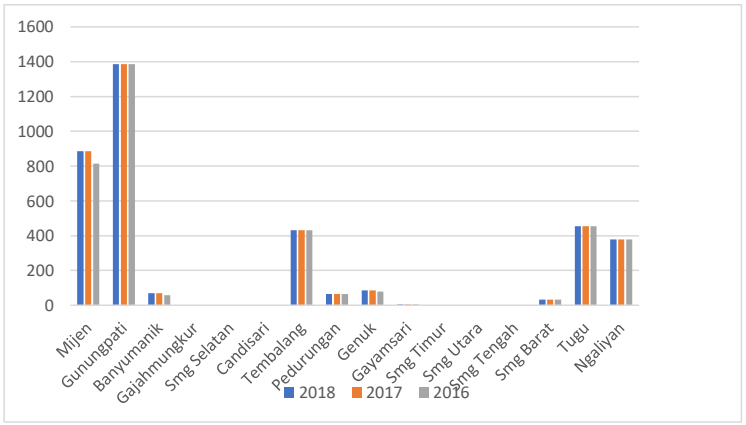

Figure 5. Area of Rice Field Use (Ha)

The GIS map Area of Rice Field Use (Ha) in Semarang City 2016-2018 is visualized on the GIS Web https://sigtahanpangan.info/semarang/luas_sawah.html which can be seen in Figure ...

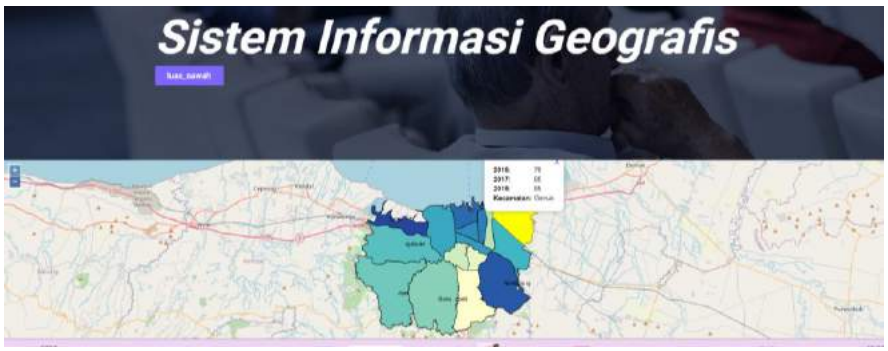

Figure …. GIS map Area of Rice Field Use (Ha) in Semarang City 2016-2018

Disasters in Semarang City

The most common disasters that occurred in the period 2012-2021 were landslides. In 2020, there were 175 landslides. The average disaster with the least frequency is tidal flooding, because this tidal flood only affects the Java Sea coastal area (Semarang which is

close to the coast), while the upper Semarang area is not affected by this disaster. Disaster that occurred in Semarang During the years 2012-2021 are presented in Figure 6.

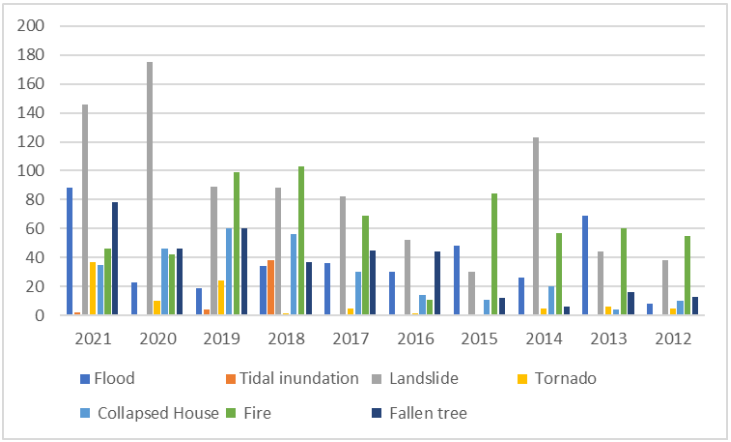

Figure 6. Disaster that Occurred in Semarang During the years 2012-2021

In the period 2012-2021, there were 381 flood incidents (BPBD Semarang, 2022). A flood is a condition in which an area is inundated by large amounts of water. The cause of the flooding is heavy rainfall; rainwater that is not absorbed in the upstream area (because of deforestation); rivers that experience narrowing or siltation (due to the garbage and uncontrolled development in the vicinity), or topographical conditions in the form of basins that tend to become water collection areas (Aritama and Dharmadhiatmika, 2019).

There were 44 tidal floods, the worst of which was in 2022 which attacked the industrial area of Semarang which is close to the coast (BPBD Semarang, 2022). The existing condition of land elevation which is lower than sea level causes greater land subsidence. The tidal flood in Semarang caused damage to infrastructure and residential areas while simultaneously affecting the lives of people, households, and individuals. Problems caused by tidal flooding are productive land no longer functioning properly, damage to public infrastructure, and increasing conditions in slum settlements (Ikhwanudin, Wahyudi and Soedarsono, 2020). The GIS map of the flood disaster in Semarang City 2019-2021 is visualized on the GIS Web https://sigtahanpangan.info/semarang/banjir.html which can be seen in Figure ...

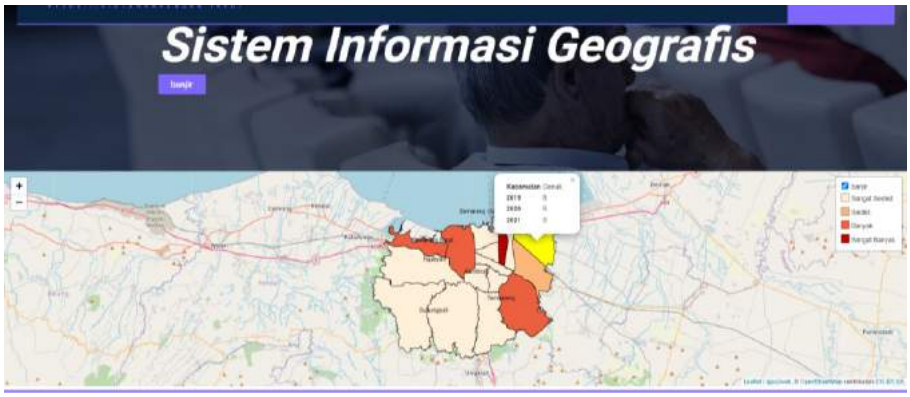

Figure …. The GIS map of the flood disaster in Semarang City 2019-2021

A landslide is a disaster incident with the highest frequency, which is 867 incidents (BPBD Semarang, 2022). Landslides are natural disasters that can cause casualties, loss of homes, and environmental damage. Landslides are not only natural phenomena, but also caused by human activities (Sudaryatno, Widayani, Wibowo, Wiratmoko, *et al.*, 2019). Heavy rainfall and earthquakes can trigger landslides (Hadi *et al.*, 2021). Several parameters that can be used in the analysis of landslide disasters are: slope, aspect, elevation, distance from fault, distance from hydrology feature, distance from road, rainfall, and NDVI (Sudaryatno, Widayani, Wibowo, Pramono, *et al.*, 2019). Indonesia has a tropical climate which always gets rain every year. Indonesia is crossed by a plate subduction path, namely the cross of the Eurasian, Pacific and Australian plates which often cause earthquakes (Karnawati, 2005) (Widiastutik and Buchori, 2018). The GIS map of the landslide disaster in Semarang City 2019-2021 is visualized on the GIS Web https://sigtahanpangan.info/semarang/longsor.html which can be seen in Figure ...

Figure … The GIS map of the landslide disaster in Semarang City 2019-2021

There were 626 fire disasters (BPBD Semarang, 2022). Fire is a disaster based on the cause of its occurrence classified as natural disasters: lightning, earthquakes, volcanic eruptions, droughts, and others, as well as non-natural disasters caused by human negligence: gas leaks, electrical short circuits, cigarette butts, sabotage, the low level of the building construction safety system against fires (Nurwulandari, 2017).

Another disaster that occurred was 357 fallen trees (BPBD Semarang, 2022). Triggers for the occurrence of fallen trees: the load force received by the trunk/top of the tree exceeds its resistance capacity, and the presence of sudden strong winds and/or rainwater falling on and stored in the tree canopy will increase the load capacity.

[DISCUSSION]

Disasters Mitigation

1. Flood

Floods are the most frequent disasters in Indonesia and have quite a detrimental impact on many parties (Pratiwi, 2019). It is very important for policy makers to know the characteristics of flood hazards in order to choose mitigation measures in the future (Purwitaningsih *et al.*, 2022). The rapid development of cities and changes in the characteristics of rain due to climate change cause flooding and inundation in the rainy season (Sedyowati *et al.*, 2020). Communities benefit economically from drainage channels used for fish and vegetable cultivation. The current flood control project not only reduces the flood risk level by 30% but also provides the resulting economic efficiency of the flood risk management system by up to 90% over the project's 6-year effective life (Sedyowati *et al.*, 2020). To overcome these problems, the Semarang City Government chose the Banger Polder drainage system. Indications of land subsidence in Semarang can be known from several data sources. Based on measurements and data, land subsidence in hilly areas in Semarang City is smaller than that in coastal areas. From field observations, land subsidence in former swamps and ponds shows the largest decline, for example in the Tanah Mas housing complex, Tanjung Mas Beach, with a decrease of between 5.5 - 7.23 cm per year (Ikhwanudin, Wahyudi and Soedarsono, 2020).

2. Fire

Structural mitigation is related to the form of physical mitigation, namely the provision and construction of facilities and infrastructure. Meanwhile, non-structural mitigation is related to the formulation of fire disaster management policies such as public commitment and implementation of methods and operations, including participatory mechanisms and information dissemination and knowledge development, which are carried out to reduce

disaster risk. Mitigation scenarios through prevention, mitigation, preparedness, early warning system, recovery, and development (Nurwulandari, 2017). The influence of this community capacity variable is very important in determining the risk of fire disaster. Losses and casualties can be minimized by increasing community capacity (Januandari, Rachmawati and Sufianto, 2017). Fire mitigation can be done by: fire education and training; analysis of active fire protection systems: light fire extinguishers, hydrants, sprinklers, fire alarms; analysis of life-saving means: emergency stairs, exit signs (Karimah, Kurniawan and Suroto, 2019).

3. Fallen trees

Carry out tree planting designs according to locations that pay attention to places that match the dimensions of tree growth, choose the right tree species that will ensure their suitability at the planting location / choose tree species that are native to the area, plant appropriately that pays attention to the cultivation aspect, protect trees from possible damage by humans, take good care of trees (Sulistyantara, 2014), monitoring of trees at risk of breaking/falling, risk management of trees at risk of breaking/falling (Ningrum, 2020), planning and placing tree planting points through state analysis, pruning and cutting trees on a regular basis (Aritama and Dharmadhiatmika, 2019).

2. Using Economics and Policy Systems

Several mitigations that can be done in earthquake are: allocating a specified pre-earthquake budget, minimizing the expected value of total cost, and minimizing the risk of a large loss (Dodo *et al.*, 2004). In addition to engineering methods, other mitigation actions that can be taken are: monitoring capacity, early warning by building more observation stations (Fang *et al.*, 2017). Institutional strengthening indicators and emergency response capability indicators according to Permendagri No. 33 of 2006 with 6 indicators are: infrastructure and utilities, strategic and important buildings, area housing and public facilities, buildings and industrial areas, school buildings, and norms flood resistant buildings. Preparation prepare a disaster management plan called Contingency Plan before the disaster and used as guide when a disaster occurs (Permanahadi and Widowati, 2022).

4. Using Information Technology

Using Algorithm: Markov Chains Algorithm: Markov Chains Algorithm is a method for generating the probability value of something with probability calculations. Markov chains here make predictions with matrix values for 7 natural disasters that occurred in the city of Semarang with prediction results in 2020 being 35% flood, 0% flood rob, 22% landslide, 3% tornado, 2% house collapse, 30 fire % and fallen trees 8%. Meanwhile, in 2021 the percentage of flood predictions is 22%, rob floods are 3%, landslides are 22%, tornadoes are 2%, houses collapsed 8%, fires were 33% and trees fell 9% (Hidayati, Pungkasanti and Wakhidah, 2021). Using GIS: Flood modeling uses a combination of geographic information systems and fuzzy logic methods (Nugraha, 2018), using GIS for disaster management in Taiwan (Hsu, Wu and Lin, 2005), the role of GIS in a natural disaster, prediction, mitigation, laws and government policies, impact on biogeochemistry of earth crust, role in earthquake in India (Singh, Pandey and Mina, 2019). Using Garbage Sorting Games, DIFMOL, and ILMIZI for environmental learning of disaster mitigation (Rahmayanti *et al.*, 2020), using google earth pro to learning media for mitigation and adaptation of landslide disaster (Suharini, Ariyadi and Kurniawan, 2020). In this study, information technology was used: GIS maps that visualize the number of disaster events in various sub-districts in the city of Semarang, which are presented in Fig....

[CONCLUSIONS]

The disasters that occurred in the city of Semarang in 2012-2021 were fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. The most common disasters are landslides. Disaster mitigation is needed in general and specifically using information technology to predict future disasters, this is needed so that people can know how to prevent and prepare for disasters

[ACKNOWLEDGMENTS]

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Pernyataan Penulis dan Rekomendasi Reviewer

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Kepada: IJOG GEOLOGI <ijog.geologi@gmail.com>

Yth Editor IJOG GEOLOGI,

Berikut kami lampirkan surat pernyataan dan rekomendasi reviewer.

Terimakasih banyak.
Salam,
Author
[Kutipan teks disembunyikan]

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Reviewer 1

1. Is this topic	A. Suitable for the journal?	**yes**	This manuscript is suitable to be published in journals.	-
	B. Of broad national interest?	**yes**	Following the national interest, due to Indonesia, especially in Central Java/Semarang, they are a lot of disasters in this place, example: Flood occurred in Semarang City at the end of this year, furthermore the manuscript is interest to the disaster science	-
	C. Significant?	**yes**	The manuscript is significant to be published in this journal.	-
2. Clarity of objectives:		**B**	Why the research was conducted in Semarang city? What are the special characteristics of Semarang city on the geological and disaster science?	In paragraph 1 and 2 In paragraph 3
3. Quality of methods:		**B**	according to the title based on information technology, it has not been reflected in what kind of information technology method	has been added to the method using GIS
4. Quality of data:		**B**	more complete data related to the Semarang city disaster	presented in sections Disasters in Semarang City
5. Validity of assumptions and analyses		**B**	use a more detailed analysis	analysis using the GIS map presented in the Figure 3,7, 9,10
6. Is this paper	A. Properly organized?	**yes**	The paper is properly organized.	-
	B. To the point and concise	**yes**	The paper is to the point and concise.	-
	C. Written clearly using correct grammar?	**no**	The grammar isn't correct and many geological terms are wrong, please revise according to the comments	corrected in colored text
7. Are the approach, results and conclusions		**no**	The abstract is incomplete so that the results and research	revision has been added

intelligible from the abstract?			methods must be completed, describe information technology according to the title	
8. Is the title informative and a reflection of the content?		**yes**	The title is informative and presents a reflection of the paper content.	-
9. Are the illustrations/tables	A. Useful and all necessary?	**yes**	The illustrations and tables are useful and all necessary with the content, but adjust it to the illustration template and table in the IJOG journal	-
	B. Of good quality?	**yes**	The illustrations/tables are of good quality. but adjust it to the illustration template and table in the IJOG journal	Tables and figures have been digitized and converted in (*.jpg) with a minimum of 300 dpi in resolution
10. Is the referencing relevant, up to date and accessible?		**yes**	Additional recent references about disaster should be added to your manuscript	references has been added
11. Overall quality of the work		**B**	The overall quality of the manuscript is good, but revise it according to my comment	revision has been added
12. Can you suggest any improvements to the paper or any parts that could be shortened or removed? [use separate sheet of paper if necessary to answer this]			Please correct the comments and add the suggestions that I have written on this review page.	revision has been added
13. Reviewer's decision			Minor revision.	Thank you reviewer

Reviewer 2

1. Is this topic	a. suitable for the journal?	**yes**	The manuscript is suitable to be published in this journal.	-
	b. of broad national interest?	**yes**	As Indonesia is prone to the natural disasters, I think the topic can draw the interest for the national and international readers.	-
	c. significant?	**yes**	The manuscript is quite significant to bepublished in this journal	-
2. Clarity of objectives:		**B**	The authors need to emphasize the position of the Information Technology in the research objectives	has been added to the abstract using GIS
3. Quality of methods:		**B**	It is suggested to provide more detailed information on the research method. As the Information Technology is not much mentioned in the method section`.	has been added to the method using GIS
4. Quality of data:		**B**	The disaster data in Semarang City needto be described in detail.	presented in sections Disasters in Semarang City
5. Validity of assumptions and analyses		**B**	The authors need to make the detailed assumptions and analyses.	added webgis map to visualize results
6. Is this paper	a. properly organized?	**yes**	The manuscript is properly organized.	-
	b. to the point and concise	**yes**	The manuscript is to the point andconcise enough to read.	-
	c. written clearly using correct grammar?	**no**	The authors need to meticulously read again the manuscript. Please check for completeness of sentences, grammar, and typos. It is suggested to kindly examine the English structure of the professional proofreading service.	revision has been added
7. Are the approach, results and conclusions intelligible from the		**no**	The abstract can be expanded into notmore than 200 words to provide more detailed information of the methods,results, and conclusions.	methods, results, and conclusions have been added.

abstract?				
8. Is the title informative and a reflection of the content?		**yes**	The title is quite informative and providea reflection to the content of the manuscript.	-
9. Are the illustrations/tables	a. useful and all necessary?	**yes**	The figures and tables are useful and necessary. However, it would help a figure with the details of the map of Semarang City with the natural disastersmostly found.	GIS maps are added in Figure 3,7, 9,10
	b. of good quality?	**no**	Please provide more clear and detailed figures and tables to describe the phenomena. It should be revised to become more informative to the readers.	Tables and figures have been digitized and converted in (*.jpg) with a minimum of 300 dpi in resolution
10. Is the referencing relevant, up to date and		**no**	Please kindly provide more referenceswith English.	

accessible?			I think here it is important to underline those researchers which have investigated the disaster mitigation in the coastal area. Some useful references are: a. Dodo, A., Ningxiong X.U., Davidson, R.A., and Nozick, L.K., 2004. Optimizing the Selection of Regional Earthquake Mitigation Strategies. Proceedings, 13th World Conference on Earthquake Engineering, Vancouver b. Fang, J., Liu, W., Yang, S., Brown, S., Nicholls, R.J.., Hinkel, J., Shi, X., and Shi, P., 2017. Spatial-temporal changes of coastal and marine disaster risks and impacts in Mainland China. Ocean and Coastal Management, 139, p.125-140. c. Wahju Krisna Hidajat, Sutrisno Anggoro, Najib. Coastal Area Management Based on Disaster Mitigation: A Case Study in Purworejo Regency, Indonesia. Indonesian Journal on Geoscience Vol. 8 No. 2 August 2021: 147-156. d. Sudaryatno, Widayani, P., Wibowo, T.W., Pramono, B.A.S., Afifah, Z.N., Meikasari, A.D., and Firdaus, M.R., 2019. Visualized Information Value Model Result of Landslide Vulnerability in Purworejo. Proceedings, 6th Geoinformation Science Symposium, Yogyakarta. references has been added
11. Overall quality of the work		**B**	This is a pleasant paper to read, with clear logic, organization, and arguments. However, there are still some problems worth in-depth discussion, which can be shown on the review page. Thank you reviewer, revision has been added

12. Can you suggest any improvements to the paper or any parts that could be shortened or removed?			The manuscript does not need to be shortened or removed. The length of the manuscript is appropriate enough to read. Thank you reviewer
13. Reviewer's decision			**Moderate revision** Thank you reviewer

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Komentar 2 Reviewer

IJOG GEOLOGI <ijog.geologi@gmail.com> 12 Januari 2023 pukul 10.19
Kepada: rizkymuliani upgris <rizkymuliani@upgris.ac.id>
Cc: Rian Koswara <rian_koswara@yahoo.co.id>, Rian Koswara <riankoswaraijog@gmail.com>

Yth. Penulis,

Berikut kami lampirkan komentar dari 2 reviewer untuk makalah berjudul : "Mitigation Strategi of Disaster in Semarang City based Information Technology".

Kami tunggu perbaikannya.

Salam,
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Geological Agency
Ministry of Energy and Mineral Resources

Journal homepage: http://ijog.geologi.esdm.go.id
ISSN 2355-9314. eISSN 2355-9306

The second review parameters:

1. The authors need to double-check the sentence completion, grammar, and errors. As it stands, there are a few sentences that do not conform to the English structure.
2. The words “Bappeda” is redundant in the abstract.
3. The reference should not be included in the abstract.
4. As the data is plural, it is suitable to use the verb “were”. It is found in the abstract.
5. The keyword “disater” needs to be revised.
6. For the sentence “This menu displays the disaster GIS for 2019–2021, to display GIS on this menu, you can click on the image on each tab of the disaster menu in this web GIS: https://sigtahanpangan.info/semarang/banjir.html.” in page 9. Do we really need to mention this in the manuscript body? If so, please rephrase the sentence to be properly read in the paper.
7. For figures 3, 7, 9, and 10. Is it possible to focus only on the detail of the map? I do not think we need to give the bigger part for the words "Sistem Informasi Geografis".
8. The other revision for the 1st stage of my review have been corrected.

rizkymuliani upgris <rizkymuliani@upgris.ac.id>

Komentar 2 Reviewer

rizkymuliani upgris <rizkymuliani@upgris.ac.id> 27 Januari 2023 pukul 20.40
Kepada: IJOG GEOLOGI <ijog.geologi@gmail.com>

Yth Editor.
Berikut kami lampirkan revisi manuskrip kami yang berjudul "Mitigation Strategi of Disaster in Semarang City based Information Technology",
kami akan merevisinya kembali untuk revisi selanjutnya.
Terimakasih atas kesempatan yang diberikan.

Salam
Author
Rizky MD Ujianti, dkk
Universitas PGRI Semarang
[Kutipan teks disembunyikan]

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Reviewer 1

			Review1 reviewer 1	author	Review-2 reviewer 1
1. Is this topic	A. Suitable for the journal?	**yes**	This manuscript is suitable to be published in journals.	-	-
	B. Of broad national interest?	**yes**	Following the national interest, due to Indonesia, especially in Central Java/Semarang, they are a lot of disasters in this place, example: Flood occurred in Semarang City at the end of this year, furthermore the manuscript is interest to the disaster science	-	-
	C. Significant?	**yes**	The manuscript is significant to be published in this journal.	-	-
2. Clarity of objectives:		**B**	Why the research was conducted in Semarang city? What are the special characteristics of Semarang city on the geological and disaster science?	In paragraph 1 and 2 In paragraph 3	- -
3. Quality of methods:		**B**	according to the title based on information technology, it has not been reflected in what kind of information technology method	has been added to the method using GIS	explain in more detail about the GIS method you are using
4. Quality of data:		**B**	more complete data related to the Semarang city disaster	presented in sections Disasters in Semarang City	add the latest disaster data

			Review1 reviewer 1	author	Review-2 reviewer 1
5. Validity of assumptions and analyses		**B**	use a more detailed analysis	analysis using the GIS map presented in the Figure 3,7, 9,10	-
6. Is this paper	A. Properly organized?	**yes**	The paper is properly organized.	-	-
	B. To the point and concise	**yes**	The paper is to the point and concise.	-	-
	C. Written clearly using correct grammar?	**no**	The grammar isn't correct and many geological terms are wrong, please revise according to the comments	corrected in colored text	revision of the comments on the color
7. Are the approach, results and conclusions intelligible from the abstract?		**no**	The abstract is incomplete so that the results and research methods must be completed, describe information technology according to the title	revision has been added	-
8. Is the title informative and a reflection of the content?		**yes**	The title is informative and presents a reflection of the paper content.	-	-
9. Are the illustrations/tables	A. Useful and all necessary?	**yes**	The illustrations and tables are useful and all necessary with the content, but adjust it to the illustration template and table in the IJOG journal	-	-
	B. Of good quality?	**yes**	The illustrations/tables are of good quality. but adjust it to the illustration template and table in the IJOG journal	Tables and figures have been digitized and converted in (*.jpg) with a	please editor check the figure and table according to the journal template

			Review1 reviewer 1	author	Review-2 reviewer 1
				minimum of 300 dpi in resolution	
10. Is the referencing relevant, up to date and accessible?		**yes**	Additional recent references about disaster should be added to your manuscript	references has been added	-
11. Overall quality of the work		**B**	The overall quality of the manuscript is good, but revise it according to my comment	revision has been added	-
12. Can you suggest any improvements to the paper or any parts that could be shortened or removed? [use separate sheet of paper if necessary to answer this]			Please correct the comments and add the suggestions that I have written on this review page.	revision has been added	-
13. Reviewer's decision			Minor revision.	Thank you reviewer	Thank you

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Komentar 2 Reviewer

IJOG GEOLOGI <ijog.geologi@gmail.com> 6 Maret 2023 pukul 10.16
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Cc: Rian Koswara <riankoswaraijog@gmail.com>, Rian Koswara <rian_koswara@yahoo.co.id>

Yth. Penulis,

Berikut kami lampirkan komentar dari 2 reviewer untuk makalah berjudul : "Mitigation Strategi of Disaster in Semarang City based Information Technology".

Kami tunggu perbaikannya.

Salam,
IJOG

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Mitigation Strategy of Disaster in Semarang City based Information Technology

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[**Abstract**] - Semarang is a city located on the coast of the Java Sea. This makes Semarang one of the cities threatened by tidal flooding. Apart from tidal flood inundation, several other disasters occurred in Semarang, including fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. This study identifies disaster events that occurred in the city of Semarang from 2012–2021, as well as strategies for coping with them in general and specifically using information technology, namely GIS (Geographic Information System) maps. Research data was obtained from Bappeda, Bappeda, the Public Works Office, the Central Bureau of Statistics (Semarang in Figures 2022), the Semarang City Social Service, and several related stakeholders. The data was then visualized on a GIS map. The study's findings indicate that one method of mitigation that can be used is the use of GIS maps of floods and landslides, as well as disaster mitigation through the City of Semarang's economy and government policies.
[Keywords] GIS, disater, mitigation

[INTRODUCTION]

Background

Indonesia is a disaster-prone country. According to the National Disaster Management Agency (BNPB), 1,205 disaster incidents occurred from January 1 to April 30, 2021. Disasters were dominated by hydrometeorological incidents, for example, floods, hurricanes, and erosions. Floods are the most common type of natural disaster: 501 incidents, followed by tornadoes (339), landslides (233), forest and land fires (97), earthquakes (18), tidal waves and abrasions (16), and drought (16). The number of natural disasters increased by 1% from the previous year (Ichsan, 2022). Semarang is a coastal area located on the island of Java. The population of Semarang City in 2021 will be 1,656,564 people (BPS Semarang, 2022).

Tidal floods often occur because Semarang is a coastal area. In 2022, there will be tidal flooding in the coastal area of Semarang. This happened because the embankment broke in the industrial area in the coastal area. As a result, the water level overflowed from 1.25 meters to 1.5 meters. Tidal flooding is a frequent problem in coastal areas of Indonesia because the coast has complex dynamics and processes that make coastal areas vulnerable to disasters. The city of Semarang has tidal flood pressures that last for a long time. The causes of tidal flooding are sea level rise, global warming, and land subsidence (especially in North Semarang). The areas in Semarang that experienced the highest land subsidence were Tanjung Mas, Terboyo Kulon, Purwodinatan, and Central Semarang, with as much as 12–15 cm/year. Several previous studies have explained tidal flooding. Research on prediction

analysis of the largest tidal flood inundation occurred in the center of Semarang city, which is flanked by the Banjir Kanal Barat and Banjir Kanal Timur rivers. The area is dominated by settlements, trade areas, industry, and strategic objects for the government and economy of Semarang (Nugroho, 2013), some coastal areas of Semarang City have a medium to low adaptive capacity to tidal flooding, totaling 58 urban villages (58 villages). 62% of the total coastal sub-districts in Semarang City (Suhelmi, 2013), the occurrence of bacterial contamination due to poor water quality contaminated by water affected by tidal flooding, both provider and distribution levels have a very high risk of contamination, while the level of customers has a high risk (Budiyono *et al.*, 2015). This tidal flood causes chronic stress because it causes the structure of the city to weaken (Egaputra, Ismunarti and Pranowo, 2022). In addition to tidal flooding, several disaster incidents occurred in Semarang City, namely: flood, landslide, tornado, collapsed house, fire, and fallen tree (BPS Semarang, 2022). This study describes several disaster incidents that occurred in the city of Semarang and their mitigation, which is based on community empowerment, especially in communities.

Geological Information in Semarang

In the Geomorphological Map of Indonesia, the Semarang area is generally occupied by alluvial plains with several embankments and swamps. Deposits that are stuffed in inter-mountain basins and hilly fold complexes are found in parts of southern and eastern Semarang. The other area is a complex morphology of volcanic deposits to the east of Semarang, cutting through the sedimentary quarter of the Merbabu and Merapi volcanoes to the bottom of the Java Sea to the north of Semarang. The stratigraphy of the Semarang area is mostly covered by the Pleistocene Damar Formation and along the north coast by alluvium deposits. According to Van Bemmelen (1970a), the Damar Formation is composed of tuffaceous sandstone, conglomerate, and volcanic breccia. Sandstone is composed of dark minerals, such as feldspar and quartz, as well as vertebrate remains and faults in the south of Semarang as a result of the collapse of Mount Ungaran in the Late Pleistocene.(Poedjoprajitno, Wahyudiono and Cita, 2008). The geological conditions around Semarang are in the form of marine sedimentary rocks, namely the Kerek and Kalibeng Formations, which are Early Miocene–Pliocene. Unggaran Tua clastic volcanic rocks were deposited, namely the Kaligetas and Damar Formations, and then the last volcanic activity was marked by Ungaran Muda deposits, namely the Kaligesik Formation, Gadjah Mungkur Formation, Jongkang Formation, and Kemalon and Sengkuh Formations (Fahrudin and Winarno, 2012). The stratigraphic structure of Semarang City is as follows: Alluvium (Qa):

is an alluvial deposit of beaches, rivers and lakes, Gajah Mungkur Volcanic Rock (Qhg) The rocks are: andesite lava, blackish gray in color, fine grained, holocrystalline, the composition consists of feldspar, hornblende and augite, hard and compact; Kali Gesik Volcano Rock (Qpk): the rock is basalt lava, blackish gray in color, smooth, mineral composition consists of feldspar, olivine and augite, very hard; Jongkong Formation (Qpj): augite hornblende andesite breccia and lava flows, formerly known as Ungaran Lama volcanic rocks. Andesite breccia is blackish brown, components measuring 1 - 50 cm, angular – slightly rounded with tuffaceous groundmass, medium porosity, compact and hard; Damar Formation (Qtd): the rock consists of tuffaceous sandstone, conglomerate, and volcanic breccia. The tuffaceous sandstone is brownish yellow in color with fine-coarse grain, the composition consists of mafic minerals, feldspar, and quartz with a tuffaceous groundmass, moderately hard porosity; Kali Getas Formation (Qpkg): the rock consists of breccia and lahars with intercalation of lava and fine tuff to coarse, local at the bottom found claystone containing mollusks and tuffaceous sandstone; Kalibening Formation (Tmkl): the rock consists of marl, tuffaceous sandstone and limestone. The marl is greenish gray to blackish in color. The composition consists of clay minerals and carbonate cement, low porosity to impermeable, somewhat hard in the dry state and easily crushed in the wet condition; Kerek Formation (Tmk): alternating claystone, marl, tuffaceous sandstone, conglomerate, volcanic breccia and limestone. Light-dark gray claystone, calcareous, partly interlaced with siltstone or sandstone, containing foram fossils, molluscs, and coral colonies (Soedarsono, 2012).

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[METHODS AND MATERIALS]

Methods

The research was conducted in Semarang City, Central Java Province, Indonesia. The city of Semarang is located on the northern coastline of the island of Java and is directly adjacent to the Java Sea. The area around the coast of the Java Sea is prone to tidal flooding as well as other coastal disasters. Disaster mitigation measures must be implemented in order to reduce the impact on the affected community. Several studies use strategic analysis in coastal disasters, especially coastal erosion (Sugianto *et al.*, 2022), contributed ICZM to mitigation coastal erosion (Cantasano *et al.*, 2021), climate change mitigation based economy (Gouldson *et al.*, 2016), community planning, and public participation (Pearce, 2003), landslide (Puri and Khaerani, 2018), dan flood (Budiarti, Gravitiani and Mujiyo, 2018). The mitigation described in this study identifies mitigation in general and specifically using

information technology visualized on a GIS map. The attributes needed in GIS management are elements of points, lines, and polygons. Point elements as cities, line elements as roads, and polygon elements as residential areas; and the number of landslides and floods in the city of Semarang. Processing of GIS attributes using Arc-View software, which has a network analysis extension, can function to determine the service area of a point from a distance determined according to the availability of the road network or accessibility (Purbani *et al.*, 2015). This research uses Web GIS. Web GIS is a system created to work with spatially georeferenced data (Imansyah, 2020). GIS planning diagram is presented in the figure 1

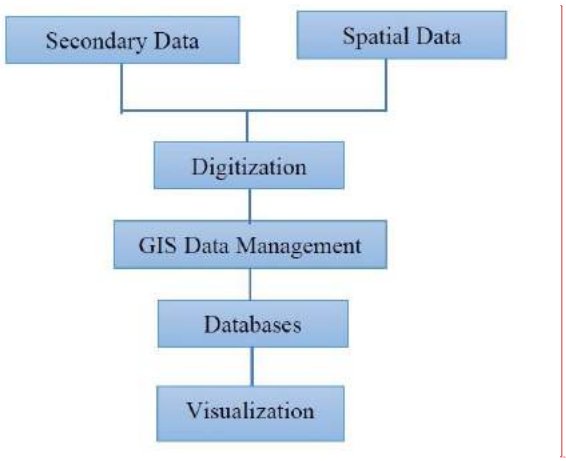

Figure 1. GIS Planning Diagram (Herlambang and Setyawati, 2016)

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Materials

Collecting data in this study uses a literature review, interviews, field observations, and documentation. (Hidajat, Anggoro and Najib, 2021). Data to support the results of this study were obtained from the Regional Development Planning Agency, the Regional Planning Agency, the Public Works Agency, the Central Statistics Agency (Semarang in Figures 2022), and the Semarang City Social Service. The data is then presented on a GIS map.

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[RESULT (AND ANALYSIS)]

Population and Social Vulnerability

The number of population by age in Semarang City is more female than male, namely 819,785 male residents and 836,779 female residents, with a sex ratio of 98.01%. The total population in 2021 will be 1,656,564 people (BPS Semarang, 2022). The

availability of arable land can be threatened by population growth and the urbanization process, furthermore the possibility of this food disaster must be a concern. (Diack *et al.*, 2017). The graph of the population by age group and sex in Semarang city are presented in Figure 2.

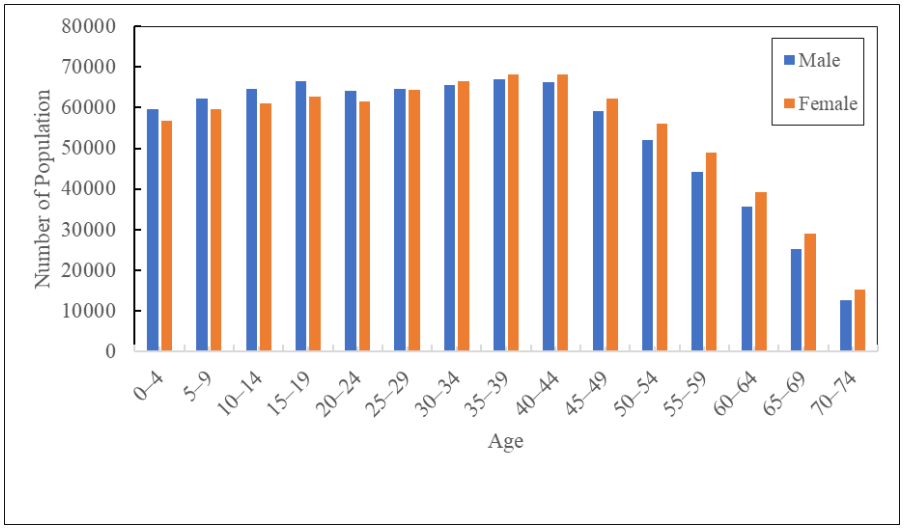

Figure 2. Population by Age Group and Sex in Semarang City

The GIS map Area of Population by Age Group and Sex in Semarang City is visualized on the GIS Web: https://sigtahanpangan.info/semarang/penduduk.html and presented in Figure 3.

Figure 3. The GIS map Area of Population by Age Group and Sex in Semarang City

The high population density affects the social vulnerability of the community in potentially disaster-prone areas. Areas with a dense population represent a higher chance of loss of life and loss of property. The elderly population (60 years and over) is 184,798 people; the population of children aged 0-14 years is 363,757 people. The elderly population and the age of children (0–14 years) are two variables of social vulnerability. When the disaster process occurs, the elderly population and children have a low capacity, furthermore they depend on the productive age. The productive age population (15-60 years) is 1,108,0009 people. The female population aged over 20 years (mothers) is 596,814 people out of the total female population of 836,779 people. The high proportion of women in the population composition by sex demonstrates the evacuation process's relative inability. This is based on women's physical conditions, which are generally thought to be worse than men's. With this condition, the female population will be more vulnerable than the male population (Hapsoro and Buchori, 2015).

Climate Condition

Climatic conditions in an area affect the potential of the area, both the potential for disasters and the potential for natural resources. The city of Semarang has a tropical climate and two seasons, namely the dry and rainy seasons. Semarang City's air temperature ranges from 26.50°C to 28.90°C, with an average monthly rainfall of 206.58 mm in 2021 (BPS Semarang, 2022). High rainfall has the potential to cause floods and landslides. The observation of climate elements by months at Semarang Station is presented in Figure 4.

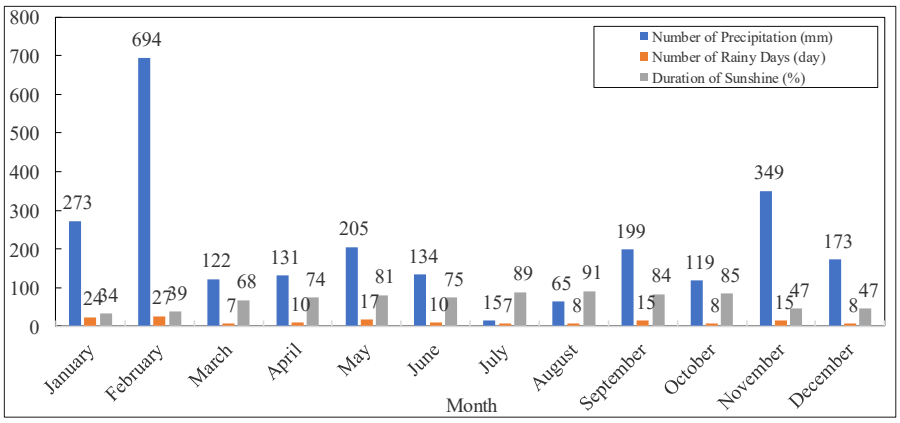

Figure 4. Observation of Climate Elements by Months at Semarang Station

Land Use

Land use (2012–2016) in Semarang City consists of nine categories, namely: ricefield, garden, farm, plantation, planted trees, grassland, temporary land, pond, road, residential, office, river, etc. The largest land use is roads, residential, office, and river, covering an area of 17,768.23 Ha, and the smallest land use is temporary land, covering an area of 105.3 Ha. The Graph of Land Use of Semarang City in 2012-2016 is presented in Figure 5

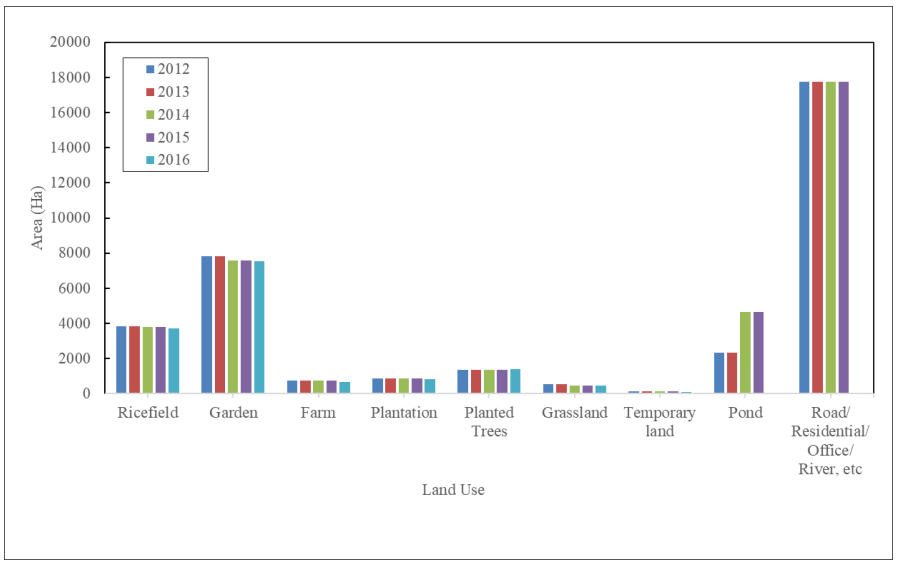

Figure 5. Land Use at Semarang 2012-2016

Land use, especially rice fields, is useful for food security management; accurate land evaluation helps decision makers in planning appropriate area management (Kumar *et al.*, 2021). Area of Wetland (Ha) by Subdistrict in Semarang presented in figure 6.

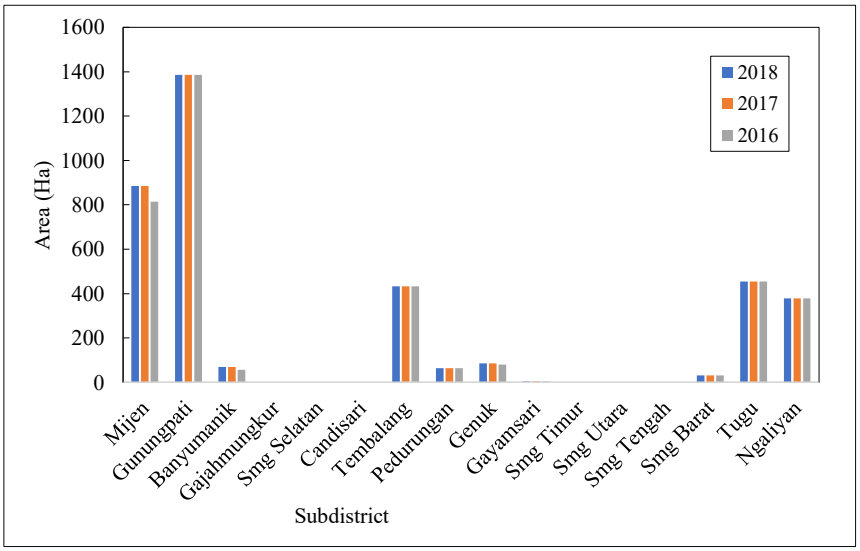

Figure 6. Area of Wetland (Ha) by Subdistrict in Semarang City

The GIS map Area of Wetland (Ha) by Subdistrict in Semarang City 2016-2018 is visualized on the GIS Web at https://sigtahanpangan.info/semarang/luas_sawah.html and presented in Figure 7.

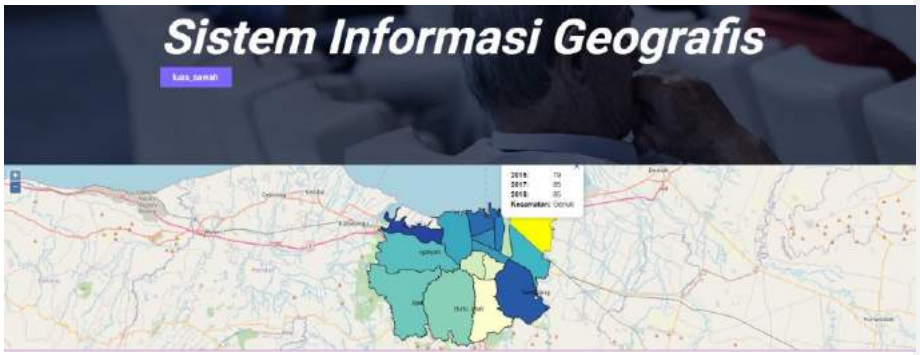

Figure 7. GIS Map Area of Wetland (Ha) by Subdistrict 2016-2018

Disasters in Semarang City

The most common disasters that occurred in the period 2012–2021 were landslides. In 2020, there were 175 landslides. The average disaster with the lowest frequency is tidal flooding, because this tidal flood only affects the Java Sea coastal area (Semarang, which is close to the coast), while the upper Semarang area is not affected by this disaster. Disasters that occurred in Semarang during the years 2012–2021 are presented in Figure 8.

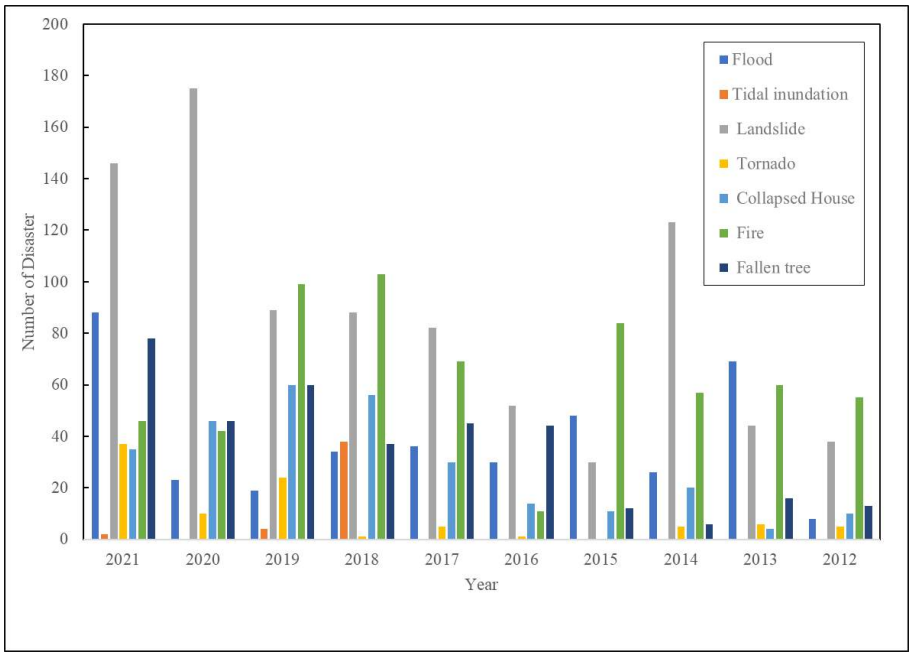

Figure 8. Disaster that Occurred in Semarang During the years 2012-2021

In the period 2012–2021, there were 381 flood incidents (BPBD Semarang, 2022). A flood is a condition in which an area is inundated by large amounts of water. The cause of the flooding is heavy rainfall, rainwater that is not absorbed in the upstream area (because of deforestation), rivers that experience narrowing or siltation (due to garbage and uncontrolled development), or topographical conditions in the form of basins that tend to become water collection areas (Aritama and Dharmadhiatmika, 2019).

There were 44 tidal floods, the worst of which was in 2022 and attacked the industrial area of Semarang, which is close to the coast (BPBD Semarang, 2022). The existing condition of land elevation that is lower than sea level causes greater land subsidence. The tidal flood in Semarang caused damage to infrastructure and residential areas while simultaneously affecting the lives of people, households, and individuals. Problems caused by tidal flooding include productive land no longer functioning properly, damage to public infrastructure, and increasing conditions in slum settlements. (Ikhwanudin, Wahyudi and Soedarsono, 2020). This menu displays the disaster GIS for 2019–2021, to display GIS on this menu, you can click on the image on each tab of the disaster menu in this web GIS: https://sigtahanpangan.info/semarang/banjir.html. For example, when clicking on Disaster GIS Flood, presented in Figure 9.

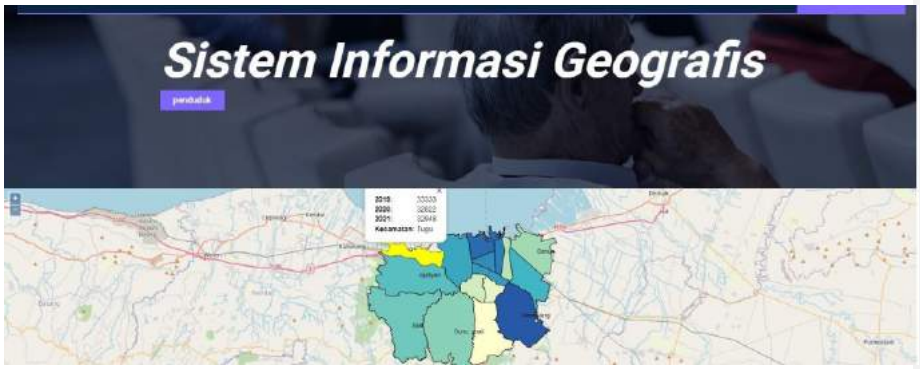

Figure 9. The GIS map of the flood disaster in Semarang City 2019-2021

A landslide is the disaster incident with the highest frequency, which is 867 incidents (BPBD Semarang, 2022). Landslides are natural disasters that can cause casualties, the loss of homes, and environmental damage. Landslides are not only natural phenomena but are also caused by human activities (Sudaryatno, Widayani, Wibowo, Wiratmoko, *et al.*, 2019). Heavy rainfall and earthquakes can trigger landslides (Hadi *et al.*, 2021). Several parameters that can be used in the analysis of landslide disasters are: slope, aspect, elevation, distance from fault, distance from hydrology feature, distance from road, rainfall, and NDVI (Sudaryatno, Widayani, Wibowo, Pramono, *et al.*, 2019). Indonesia has a tropical climate that always gets rain every year. Indonesia is crossed by a plate subduction path, namely the crossing of the Eurasian, Pacific, and Australian plates, which often cause earthquakes (Karnawati, 2005) (Widiastutik and Buchori, 2018). The GIS map of the landslide disaster in Semarang City 2019–2021, is visualized on the GIS Web at https://sigtahanpangan.info/semarang/longsor.html and presented in Figure 10.

Figure 10. The GIS map of the Landslide Disaster in Semarang City 2019-2021

There were 626 fire disasters (BPBD Semarang, 2022). Fire is a disaster based on the cause of its occurrence and is classified as a natural disaster: lightning, earthquakes, volcanic eruptions, droughts, and others, as well as a non-natural disaster caused by human negligence: gas leaks, electrical short circuits, cigarette butts, sabotage, and the low level of the building construction safety system against fires. (Nurwulandari, 2017).

Another disaster was the fall of 357 trees (BPBD Semarang, 2022). Triggers for the occurrence of fallen trees include the load force received by the trunk or top of the tree exceeding its resistance capacity and the presence of sudden strong winds and/or rainwater falling on and storing in the tree canopy, which will increase the load capacity.

[DISCUSSION]

Disasters Mitigation

1. Flood

Floods are the most frequent disasters in Indonesia and have an impact on many parties (Pratiwi, 2019). It is very important for policymakers to know the characteristics of flood hazards in order to choose mitigation measures in the future (Purwitaningsih *et al.*, 2022). The rapid development of cities and changes in the characteristics of rain due to climate change cause flooding and inundation in the rainy season (Sedyowati *et al.*, 2020). Communities benefit economically from drainage channels used for fish and vegetable cultivation. The current flood control project not only reduces the flood risk level by 30% but also increases the resulting economic efficiency of the flood risk management system by up to 90% over the project's 6-year effective life (Sedyowati *et al.*, 2020). To overcome these problems, the Semarang City Government chose the Banger Polder drainage system. Indications of land subsidence in Semarang can be known from several data sources. Based on measurements and data, land subsidence in hilly areas of Semarang City is smaller than that in coastal areas. From field observations, land subsidence in former swamps and ponds shows the largest decline, for example in the Tanah Mas housing complex, Tanjung Mas Beach, with a decrease of between 5.5 and 7.23 cm per year (Ikhwanudin, Wahyudi and Soedarsono, 2020). Another thing to do in disaster mitigation is to procurement an EWS (Early Warning System). Effective and comprehensive management of disaster risk preparedness is necessary to protect lives, livelihoods, and reduce the cost of disaster damage. This can be done by procuring EWS (Seng, 2013). According to the BBPD, there are 14 EWS in Semarang City for flood and landslide mitigation spread across 14 villages, which are presented in Table 1..

Table 1. Disaster Early Warning System in Semarang

No	Village	Subdistrict	Disaster EWS
1	Pudak Payung	Banyumanik	Flood
2	Bendan duwur	Gajahmungkur	Flood
3	Karangroto	Genuk	Flood
4	Jatibarang	Mijen	Flood
5	Wates	Ngaliyan	Flood
6	Wonosari	Ngaliyan	Flood
7	Mayangsari	Ngaliyan	Flood
8	Karangtempel	Semarang Timur	Flood
9	Meteseh	Tembalang	Flood
10	Mangkang Wetan	Tugu	Flood
11	Mangkang Kulon	Tugu	Flood
12	Plumbon	Tugu	Flood
13	Sukorejo	Gunungpati	Landslide
14	Kalipancur	Ngaliyan	Landslide

2. Fire

Structural mitigation is related to the form of physical mitigation, namely the provision and construction of facilities and infrastructure. Meanwhile, non-structural mitigation is related to the formulation of disaster management policies such as public commitment and implementation of methods and operations, including participatory mechanisms, information dissemination, and knowledge development, which are carried out to reduce disaster risk. Mitigation scenarios through prevention, mitigation, preparedness, an early warning system, recovery, and development (Nurwulandari, 2017). The influence of this community capacity variable is very important in determining the risk of a fire disaster. Losses and casualties can be minimized by increasing community capacity (Januandari, Rachmawati and Sufianto, 2017). Fire mitigation can be accomplished through fire education and training, as well as an examination of active fire protection systems such as fire extinguishers, hydrants, sprinklers, and fire alarms. An analysis of life-saving means: emergency stairs, exit signs (Karimah, Kurniawan and Suroto, 2019).

3. Fallen trees

Carry out tree planting designs that pay attention to places that match the dimensions of tree growth; select the right tree species that will ensure their suitability at the planting location; select tree species that are native to the area; plant appropriately that pays attention to the cultivation aspect; protect trees from potential human damage; and take good care of trees (Sulistyantara, 2014), risk management of trees at risk of breaking or falling, monitoring of trees at risk of breaking or falling (Ningrum, 2020), planning and placing tree

planting points through state analysis, pruning, and cutting trees on a regular basis. (Aritama and Dharmadhiatmika, 2019).

2. Using Economics and Policy Systems

Several mitigations that can be done in an earthquake are: allocating a specified pre-earthquake budget; minimizing the expected value of total cost; and minimizing the risk of a large loss (Dodo *et al.*, 2004). In addition to engineering methods, other mitigation actions that can be taken are: increasing monitoring capacity; improving early warning by building more observation stations (Fang *et al.*, 2017). Institutional strengthening indicators and emergency response capability indicators according to Permendagri No. 33 of 2006 have six indicators: infrastructure and utilities; strategic and important buildings; area housing and public facilities; buildings and industrial areas; school buildings; and flood-resistant buildings. Prepare a disaster management plan called a "Contingency Plan" before the disaster and use it as a guide when the disaster occurs. (Permanahadi and Widowati, 2022).

4. Using Information Technology

Using algorithms: markov chains algorithm: the markov chains algorithm is a method for generating the probability value of something with probability calculations. Markov chains here make predictions with matrix values for 7 natural disasters that occurred in the city of Semarang, with prediction results in 2020 being 35% flood, 0% flood rob, 22% landslide, 3% tornado, 2% house collapse, 30% fire, and 8% fallen trees. Meanwhile, in 2021, the percentage of flood predictions was 22%, rob floods were 3%, landslides were 22%, tornadoes were 2%, houses collapsed 8%, fires were 33%, and trees fell 9% (Hidayati, Pungkasanti and Wakhidah, 2021). Using GIS: dimensions of food security (Ujianti, Novita and Muflihati, 2022), flood modeling uses a combination of GIS and fuzzy logic methods (Nugraha, 2018), using GIS for disaster management in Taiwan (Hsu, Wu and Lin, 2005) The role of GIS in a natural disaster: prediction, mitigation, laws and government policies, impact on the biogeochemistry of the earth's crust, and role in the 2004 earthquake in India (Singh, Pandey and Mina, 2019). Using garbage sorting games, DIFMOL, and ILMIZI for disaster mitigation environmental learning (Rahmayanti *et al.*, 2020), using Google Earth Pro to learn media for mitigation and adaptation of a landslide disaster (Suharini, Ariyadi and Kurniawan, 2020). In this research, information technology was used, including GIS maps that visualize the number of disaster events in various sub-districts in the city of Semarang, which are presented in Figures 9 and 10.

[CONCLUSIONS]

The disasters that occurred in the city of Semarang in 2012–2021 were fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. The most common disasters are landslides. Disaster mitigation is needed in general and specifically using information technology to predict future disasters, which is needed furthermore that people can know how to prevent and prepare for disasters.

[ACKNOWLEDGMENTS]

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Yth Editor.

Berikut kami lampirkan revisi manuskrip kami yang berjudul "**Mitigation Strategy of Disaster Based on Information Technology in Semarang City**",
kami akan merevisinya kembali jika ada revisi selanjutnya.
Terimakasih atas kesempatan yang diberikan.

Salam
Author
Rizky MD Ujianti, dkk
Universitas PGRI Semarang
[Kutipan teks disembunyikan]

author rev3 & after proof read-Mitigation Strategy of Disaster Based on Information Technology in Semarang City.doc
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Komentar 2 Reviewer

IJOG GEOLOGI <ijog.geologi@gmail.com> 27 Maret 2023 pukul 10.49
Kepada: rizkymuliani upgris <rizkymuliani@upgris.ac.id>

Yth Penulis,

Mohon untuk melampirkan lembar response to reviewer yang menjelaskan poin-poin apa saja yang sudah diperbaiki sesuai arahan reviewer. Kami tunggu secepatnya.

Salam,
IJOG
[Kutipan teks disembunyikan]

Reviewer 1

no	Kata sebelumnya	coment	revisi	ket
1	Strategi	Dihilangkan blok warnanya	strategy	Sudah dibetulkan
2	flood,	Dihilangkan blok warnanya		Sudah dibetulkan
3	Gajah Mungkur Fire Rock	Dihilangkan blok warnanya	Gajah mungkur volcanic rock	Sudah dibetulkan
4	base mass	Massa dasar….groundmass Dihilangkan blok warnanya	groundmass	Sudah dibetulkan
5	pososity	Porosity Dihilangkan blok warnanya	porosity	Sudah dibetulkan
6	insertions	sisipan….intercalation Dihilangkan blok warnanya	intercalation	Sudah dibetulkan
7	impermeable	kedapair…impermeable Dihilangkan blok warnanya	impermeable	Sudah dibetulkan
8	wet state	wet condition Dihilangkan blok warnanya	wet condition	Sudah dibetulkan
9		Fig 1. Jelaskan kembali dengan lebih rinci mengenai tahapan dalam figure ini		Sudah dibetulkan pada halaman 4 diatas fig 1 “The method in this study was carried out by collecting spatial data, digitizing maps, importing maps in shp format and giving symbols and styles. When there was still an error occurred then editing was occupied. Reversely, when it was done correctly, the style and corresponding symbol were also done, after that, a combination of spatial and non-spatial data was carried out. The next step was inserting them in digital maps and entering

no	Kata sebelumnya	coment	revisi	ket
				them in Web GIS. For non-spatial data collection, the first step was to group the data, make data tabulations, correct the data and do them. When there were still errors, editing action was taken. Reversely, when it was correct, the style and corresponding symbols were done, after that, a combination of spatial and non-spatial data was done"
10		Metode: Sebutkan literatur rujukan yg anda gunakan		Sudah ditambahkan (Sugianto et al., 2022), (Cantasano et al., 2021) (Gouldson et al., 2016) (Puri and Khaerani, 2018) (Budiarti, Gravitiani and Mujiyo, 2018) (Purbani et al., 2015) (Imansyah, 2020) (Ujianti, Novita and Muflihati, 2022) (Hidajat, Anggoro and Najib, 2021) (Setyawati and Herlambang, 2020)
11		Metode: Departemen / stakeholder mana sj yg anda interview dan tentang apa saja, mohon jelaskan dengan lebih rinci		Sdh ditambahkan Regional Development Planning Agency, the Regional Planning Agency, the Public Works Agency and the Semarang City Social Service

The second review parameters:

no	coment	revisi
1	The authors need to double-check the sentence completion, grammar, and errors. As it stands, there are a few sentences that do not conform to the English structure.	Manuskrip sudah dilakukan pengecekan grammar dan proofread oleh ahli Bahasa Inggris
2	The words “Bappeda” is redundant in the abstract.	Sudah dihilangkan
3	The reference should not be included in the abstract.	Sudah dihilangkan
4	As the data is plural, it is suitable to use the verb “were”. It is found in the abstract.	Sudah diberulkan
5	The keyword “disater” needs to be revised.	Sudah dibetulkan menjadi “disaster”
6	For the sentence “This menu displays the disaster GIS for 2019–2021, to display GIS on this menu, you can click on the image on each tab of the disaster menu in this web GIS: https://sigtahanpangan.info/semarang/banjir.html.” in page 9. Do we really need to mention this in the manuscript body? If so, please rephrase the sentence to be properly read in the paper.	Dibetulkan menjadi “This menu displays the disaster GIS for 2019–2021, to display GIS on this menu, you can click on the image on each tab of the disaster menu in this web GIS: https://sigtahanpangan.info/semarang/banjir.html. For example, when clicking on Disaster GIS Flood, presented in Figure 9.”
7	For figures 3, 7, 9, and 10. Is it possible to focus only on the detail of the map? I do not think we need to give the bigger part for the words "Sistem Informasi Geografis".	Kata "Sistem Informasi Geografis" sdh dihilangkan dr peta
8	The other revision for the 1st stage of my review have been corrected.	-

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Komentar 2 Reviewer

rizkymuliani upgris <rizkymuliani@upgris.ac.id> 30 Maret 2023 pukul 09.12
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Yth Editor IJOG GEOLOGI

Berikut kami lampirkan lembar response to reviewer yang menjelaskan poin-poin apa saja yang sudah diperbaiki sesuai arahan reviewer.

[Kutipan teks disembunyikan]

response to reviewer ijog-rev 2.docx
18K

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Makalah diterima (accepted)

IJOG GEOLOGI <ijog.geologi@gmail.com> 10 April 2023 pukul 10.02
Kepada: rizkymuliani upgris <rizkymuliani@upgris.ac.id>
Cc: Rian Koswara <riankoswaraijog@gmail.com>, Rian Koswara <rian_koswara@yahoo.co.id>

Yth Penulis,

Makalah saudara yang berjudul: "Mitigation Strategi of Disaster in Semarang City based Information Technology" telah beres dari dua reviewer dan dinyatakan diterima / accepted.

Untuk keperluan layout, kami meminta file gambar yang asli dengan format Corel atau Photoshop.

Salam,
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Makalah diterima (accepted)

rizkymuliani upgris <rizkymuliani@upgris.ac.id> 27 April 2023 pukul 14.04
Kepada: IJOG GEOLOGI <ijog.geologi@gmail.com>

- **Figure 1. GIS Planning Diagram (Herlambang and ...**
- **Figure 2. Population by Age Group and Sex in Se...**
- **Figure 3. The Map Area of Population by Age Gro...**
- **Figure 4. Observation of Climate Elements by Mo...**
- **Figure 5. Land Utilizing at Semarang in 2012-20...**
- **Figure 6. Area of Wetland (Ha) by Subdistrict i...**
- **Figure 7. Map Area of Wetland (Ha) by Subdistri...**
- **Figure 8. Disaster Occurred in Semarang During ...**
- **Figure 9. The Map of the Flood Disaster in Sema...**
- **Figure 10. The GIS Map of the Landslide Disaste...**

Yth Editor IIJOG

Berikut kami lampirkan gambar dengan format Photoshop, apakah betul seperti ini yang diminta?, jika ada revisi/ada yang kurang, bisa dikirimkan lg comentnya kepada kami, utk kami perbaiki, terimakasih atas kesempatannya.

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Salam
author
[Kutipan teks disembunyikan]

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Author's proofreading

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Kepada: rizkymuliani upgris <rizkymuliani@upgris.ac.id>
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Dear authors,

Herewith, I send you the paper which has been laid-out. Based on the publication rule, the last manuscript must be proofread by the author before publishing. We look forward to your confirmation before publishing.

Thank you very much for your cooperation.

Notes: Please add one Figure for Figure 1 of the Geological Map of Semarang, and clarify or revise the red text.

Regards,

IJOG

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Mitigation Strategy of Disaster ~~in Semarang City~~ ~~B~~based on Information Technology in Semarang City

[**Abstract**] - Semarang is a city located on the coast of the Java Sea which ~~. This~~ makes ~~Semarang~~ it becomes one of the cities threatened by tidal flooding. Apart from tidal flood inundation, several other disasters occurred in Semarang ~~,~~ including fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. This study identifie~~d~~s the disasters ~~events that~~ occurred in ~~the city of~~ Semarang ~~city~~ from 2012 through ~~–~~2021, as well as the strategies for coping ~~with~~ them in general and specifically using information technology, namely Geographic Information System (GIS) maps. The ~~Research~~ data in this study were~~as~~ obtained from Regional Development Planning Board~~Bappeda~~, the Public Works Office, the Central Bureau of Statistics, the Semarang City Social Service, and several related stakeholders. Those data were~~e data was,~~ then visualized on a GIS map. The ~~study's~~ findings indicated that one method of mitigation ~~that can be used~~ is the use of GIS maps of floods and landslides, as well as disaster mitigation through ~~the City of~~ Semarang's economy and government policies.

[~~Keywords] GIS~~Keywords] GIS, disaster, mitigation

[INTRODUCTION]

Background

Indonesia is a disaster-prone country. According to the National Disaster Management Agency (BNPB), 1~~.~~205 disaster incidents occurred from January 1st ~~-~~to April 30th, 2021. The d~~D~~isasters were dominated by hydrometeorological incidents~~;~~ for example, floods, hurricanes, and erosions. Floods are the most common type of natural disaster~~:~~; 501 incidents ~~,~~followed by tornadoes (339), landslides (233), forest and land fires (97), earthquakes (18), tidal waves and abrasions (16), and drought (16). The number of natural disasters increased by 1% from the previous year (Ichsan, 2022). Semarang is a coastal area located on the island of Java. The population of Semarang ~~City~~ in 2021 was~~will be~~ 1~~.~~656~~.~~564 people (Central Bureau of Statistics of~~BPS~~ Semarang, 2022).

Tidal floods often occur because Semarang is a coastal area. In 2022, ~~there will be~~ tidal flooding was occurred in the coastal area of Semarang ~~. This happened~~ because of the embankment broke in the industrial area in the coastal area. As a result, the water level overflowed from 1.25 meters to 1.5 meters. Tidal flooding is a frequent problem in coastal areas of Indonesia because the coast has complex dynamics and processes that make coastal areas vulnerable to disasters. ~~The city of~~ Semarang has tidal flood pressures that last for a long time which ~~. The~~ cause~~d~~s ~~by~~of the rising of ~~tidal flooding are~~ sea level ~~rise~~, global warming, and land subsidence (especially in the North of Semarang). The areas in Semarang

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that experienced the highest land subsidence were Tanjung Mas, Terboyo Kulon, Purwodinatan, and Central Semarang ~~,~~ with as much as 12–15 cm/year. Several previous studies ~~have~~ had discussed~~explained~~ tidal flooding. Research on prediction analysis of the largest tidal flood inundation occurred in the center of Semarang ~~city~~, which is flanked by ~~the~~ Banjir Kanal Barat and Banjir Kanal Timur rivers. The area is dominated by settlements, trade areas, industries~~y~~, and strategic objects for the government and economy of Semarang (Nugroho, 2013), some coastal areas of Semarang ~~City~~ have a medium to low adaptive capacity to tidal flooding, totaling 58 urban villages (58 villages). 62% of the total coastal sub-districts in Semarang ~~City~~ (Suhelmi, 2013), the occurrence of bacterial contamination due to poor water quality contaminated by water affected by tidal flooding, both provider and distribution levels have a very high risk of contamination, while the level of customers has a high risk (Budiyono *et al.*, 2015). This tidal flood causes chronic stress because it causes the structure of the city to weaken (Egaputra, Ismunarti and Pranowo, 2022). In addition to tidal flooding, several disaster incidents occurred in Semarang ~~City~~, namely: flood, landslide, tornado, collapsed house, fire, and fallen tree (Central Bureau of Statistics of ~~BPS~~ Semarang, 2022). This study describe~~d~~s several disaster incidents that occurred in ~~the city of~~ Semarang and their mitigation ~~, which is~~ based on community empowerment, especially in communities.

Geological Information in Semarang

In the Geomorphological Map of Indonesia, ~~the~~ Semarang area ~~area~~ is generally occupied by alluvial plains with several embankments and swamps. Deposits that are stuffed in inter-mountain basins and hilly fold complexes are found in parts of the S~~s~~outhern and the E~~e~~astern of Semarang. The other area is a complex morphology of volcanic deposits to the E~~e~~ast of Semarang, cutting through the sedimentary quarter of ~~the~~ Merbabu and Merapi volcanoes to the bottom of the Java Sea to the N~~n~~orth of Semarang. The stratigraphy of ~~the~~ Semarang area is mostly covered by the Pleistocene Damar Formation and along the N~~n~~orth coast by alluvium deposits. According to Van Bemmelen (1970a), the Damar Formation is composed of tuffaceous sandstone, conglomerate, and volcanic breccia. Sandstone is composed of dark minerals, such as feldspar and quartz, as well as vertebrate remains and faults in the S~~s~~outh of Semarang as a result of the collapse of Mount Ungaran in the Late Pleistocene (Poedjoprajitno, Wahyudiono and Cita, 2008). The geological conditions around Semarang are in the form of marine sedimentary rocks, namely the Kerek and Kalibeng Formations, which are Early Miocene–Pliocene. Unggaran Tua clastic volcanic rocks were deposited, namely the Kaligetas and Damar Formations, and then the last volcanic activity

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was marked by Ungaran Muda deposits, namely the Kaligesik Formation, Gadjah Mungkur Formation, Jongkang Formation, and Kemalon and Sengkuh Formations (Fahrudin and Winarno, 2012). The stratigraphic structure of Semarang City is as follows: Alluvium (Qa)~~:~~ is an alluvial deposit of beaches, rivers and lakes~~:,~~ Gajah Mungkur Volcanic Rock (Qhg): t ~~T~~he rocks are~~:~~ andesite lava, blackish gray in color, fine grained, holocrystalline, the composition consists of feldspar, hornblende and augite, hard and compact; Kali Gesik Volcano Rock (Qpk): the rock is basalt lava, blackish gray in color, smooth, mineral composition consists of feldspar, olivine and augite, very hard; Jongkong Formation (Qpj): augite hornblende andesite breccia and lava flows, formerly known as Ungaran Lama volcanic rocks. Andesite breccia is blackish brown, components measuring 1 - 50 cm, angular – slightly rounded with tuffaceous groundmass, medium porosity, compact and hard; Damar Formation (Qtd): the rock consists of tuffaceous sandstone, conglomerate, and volcanic breccia. The tuffaceous sandstone is brownish yellow in color with fine-coarse grain, the composition consists of mafic minerals, feldspar, and quartz with a tuffaceous groundmass, moderately hard porosity; Kali Getas Formation (Qpkg): the rock consists of breccia and lahars with intercalation of lava and fine tuff to coarse, local at the bottom found claystone containing mollusks and tuffaceous sandstone; Kalibening Formation (Tmkl): the rock consists of marl, tuffaceous sandstone and limestone. The marl is greenish gray to blackish in color. The composition consists of clay minerals and carbonate cement, low porosity to impermeable, somewhat hard in the dry state and easily crushed in the wet condition; Kerek Formation (Tmk): alternating claystone, marl, tuffaceous sandstone, conglomerate, volcanic breccia and limestone. Light-dark gray claystone, calcareous, partly interlaced with siltstone or sandstone, containing foram fossils, molluscs, and coral colonies (Soedarsono, 2012).

[METHODS AND MATERIALS]

Methods

The research was conducted in Semarang City, Central Java Province, Indonesia. The city of Semarang is located on the N~~n~~orthern coastline of the island of Java and is directly adjacent to the Java Sea. The area around the coast of the Java Sea is prone to tidal flooding as well as other coastal disasters. Disaster mitigation measures must be implemented in order to reduce the impact on the affected community. Several studies used strategic analysis in coastal disasters, especially coastal erosion (Sugianto *et al.*, 2022), contributed ICZM to

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mitigation coastal erosion (Cantasano *et al.*, 2021), climate change mitigation based economy (Gouldson *et al.*, 2016), community planning, and public participation (Pearce, 2003), landslide (Puri and Khaerani, 2018), ~~dan~~ and flood (Budiarti, Gravitiani and Mujiyo, 2018). The mitigation described in this study identifie~~d~~ds ~~s~~ mitigation in general and specifically using information technology visualized on a GIS map. The attributes needed in GIS management are elements of points, lines, and polygons. Point elements as cities, line elements as roads, and polygon elements as residential areas; ~~and~~ as well as the number of landslides and floods in ~~the city of~~ Semarang. Processing of GIS attributes using Arc-View software, which has a network analysis extension, can function to determine the service area of a point from a distance determined according to the availability of the road network or accessibility (Purbani *et al.*, 2015). ~~-~~ This research use~~d~~ds Web GIS. Web GIS is a system created to work with spatially georeferenced data (Imansyah, 2020). The method in this study was carried out by collecting spatial data, digitizing maps, importing maps in shp format and giving symbols and styles. When ~~If~~ there wa~~i~~s still an error occurred then ~~do the~~ editing was occupied. Reversely, when ~~If~~ it wa's done correctly, ~~-~~the style and corresponding symbol were also done, ~~,~~ a~~A~~fter that, a combination of spatial and non-spatial data wa~~i~~s carried out. The next step was ~~, entering~~inserting them~~it~~ in digital maps and ~~including~~ entering them~~it~~ in Web GIS. For non-spatial data collection, the first step wa~~i~~s to group the data, make data tabulations, correct the data and do them~~it~~. When~~If~~ there we~~a~~re still errors, editing action wa~~i~~s taken ~~done~~. ~~,~~ Reversely, when~~if~~ it wa~~i~~s correct, the style and corresponding symbols ~~a~~were done, after that, a combination of spatial and non-spatial data wa~~i~~s done. Then, ~~,~~inserting them~~it~~ in digital maps and entering ~~i~~them in Web GIS (Ujianti, Novita and Muflihati, 2022). The s~~S~~patial data ~~i~~were~~s~~ the map of Semarang city, ~~and~~ while the secondary data were~~is~~ disaster. Web GIS planning diagram is presented in ~~the~~ F~~f~~igure 1.

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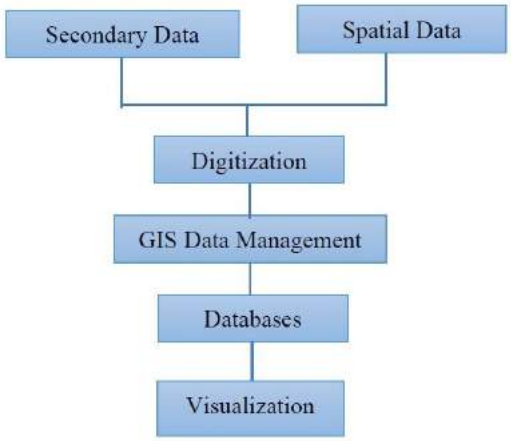

Figure 1. GIS Planning Diagram (Herlambang and Setyawati, 2016)

Materials

The data c~~C~~ollection~~ng data~~ in this study used~~s~~ a literature review, interviews, field observations, and documentation~~.~~ (Hidajat, Anggoro and Najib, 2021). This research is a C~~c~~ross S~~s~~ectional study (Setyawati and Herlambang, 2020) ~~,~~ using secondary data ~~sourced~~obtained from the report~~ing~~ compiled by the Regional Development Planning Agency, the Regional Planning Agency, the Public Works Agency and the Semarang City Social Service which were ~~and~~ published through the official website of BPS of Semarang Municipality within the years 2016~~-~~-2022. Those d~~D~~ata were ~~to~~ used to support the results of this study ~~were~~ obtained from the ~~The~~ data which wa~~i~~s then presented on a Web GIS map.

[RESULT (AND ANALYSIS)]

Population and Social Vulnerability

The ~~number~~ population ~~of population~~ by age in Semarang City revealed that female is~~is~~ ~~more~~ higher than ~~female than~~ male~~;~~ namely 819~~,~~785 male residents and 836~~,~~779 female residents, with a sex ratio of 98.01%. The total population in 2021 was~~will be~~ 1~~,~~656~~,~~564 people (BPS Semarang, 2022). The availability of arable land can be threatened by population growth and the urbanization process, ~~furthermore~~ hence the possibility of this food disaster must be a concern~~.~~ (Diack *et al.*, 2017). The graph of the population by age group and sex in Semarang ~~city~~ is~~are~~ presented in Figure 2.

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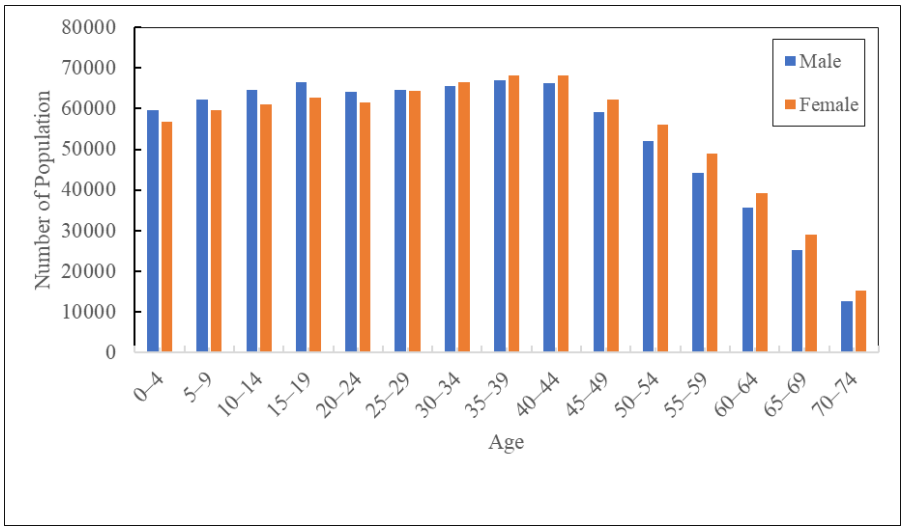

Figure 2. Population by Age Group and Sex in Semarang City

The map Area of Population by Age Group and Sex in Semarang City was visualized on the GIS Web "SIG Ketahanan Pangan" and is presented in Figure 3.

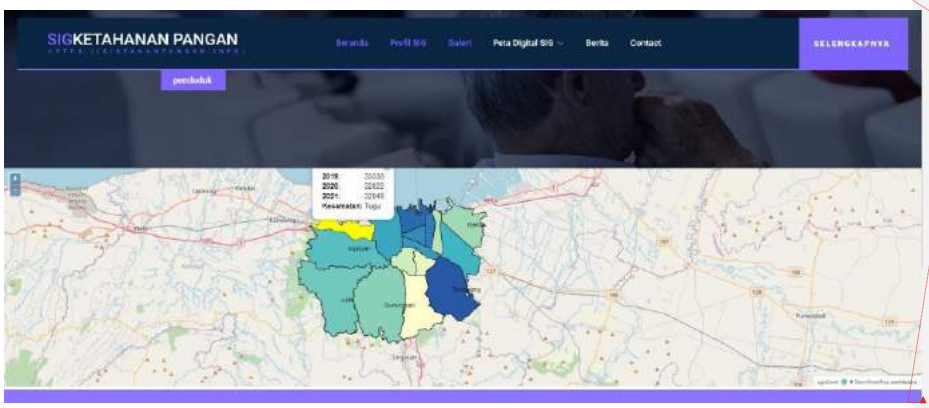

Figure 3. The Map Area of Population by Age Group and Sex in Semarang City

The high population density affects the social vulnerability of the community in potentially disaster-prone areas. Areas with a dense population represent a higher chance of loss of life and loss of property. The elderly population (60 years and over) is 184,798 people; the population of children aged 0-14 years is 363,757 people. The elderly population and the age of children (0–14 years) are two variables of social vulnerability. When the disaster process occurs, the elderly population and children have a low capacity,

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~~furthermore~~ therefore, they depend on the productive age. The productive age population (15-60 years) is 1.~~,~~108.~~,~~0009 people. The female population aged over 20 years (mothers) is 596.~~,~~814 people out of the total female population of 836.~~,~~779 people. The high proportion of women in the population composition by sex demonstrates the evacuation process's relative inability. This is based on women's physical conditions, which are generally thought to be worse than men's. ~~-~~With this condition, the female population will be more vulnerable than ~~the~~ male population (Hapsoro and Buchori, 2015).

Climate Condition

Climatic conditions in an area affect the potential of the area itself, both the potential for disasters and the potential for natural resources. ~~The city of~~ Semarang has a tropical climate and two seasons: ~~, namely the~~ dry and rainy seasons. Semarang's ~~City's~~ air temperature ranges from 26.50°C to 28.90°C, with an average monthly rainfall of 206.58 mm in 2021 (BPS Semarang, 2022). High rainfall has the potential to cause floods and landslides. The observation of climate elements by months at Semarang Station is presented in Figure 4.

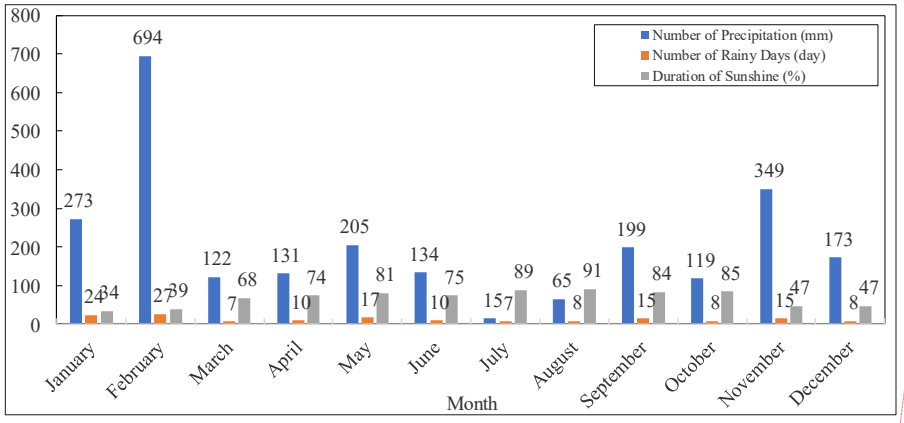

Figure 4. Observation of Climate Elements by Months at Semarang Station

Land Use

Land use (2012–2016) in Semarang City consists of nine categories, namely: ~~ricefield~~rice field, garden, farm, plantation, planted trees, grassland, temporary land, pond, road, residential, office, river, etc. The largest land ~~use~~ utilized by ~~is~~ roads, residential, office, ~~and river~~and river ~~,~~covering an area of 17.~~,~~768.23 Ha, and the smallest land utilized

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by ~~use is~~ temporary land ~~,~~ covering an area of 105.3 Ha. The Graph of Land Utilizing~~se~~ of Semarang City in 2012-~~-~~2016 is presented in Figure 5.

Figure 5. Land Utilizing ~~Use~~ at Semarang in 2012-~~-~~2016

Land ~~use~~utilizing, especially rice fields, is useful for food security management; accurate land evaluation helps decision makers in planning appropriate area management (Kumar *et al.*, 2021). Area of Wetland (Ha) by Subdistrict in Semarang is presented in F~~f~~igure 6.

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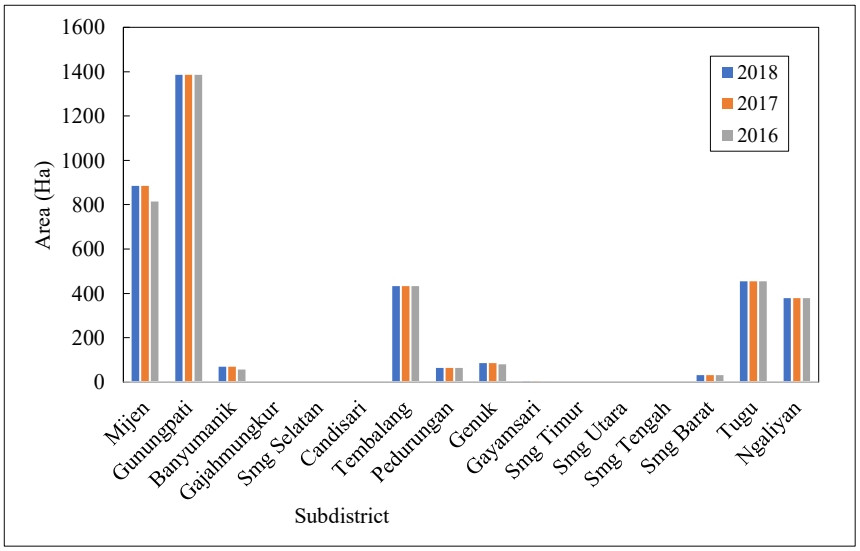

Figure 6. Area of Wetland (Ha) by Subdistrict in Semarang City

The Map Area of Wetland (Ha) by Subdistrict in 2016–2018 was visualized on the GIS Web "SIG Ketahanan Pangan" and is presented in Figure 7.

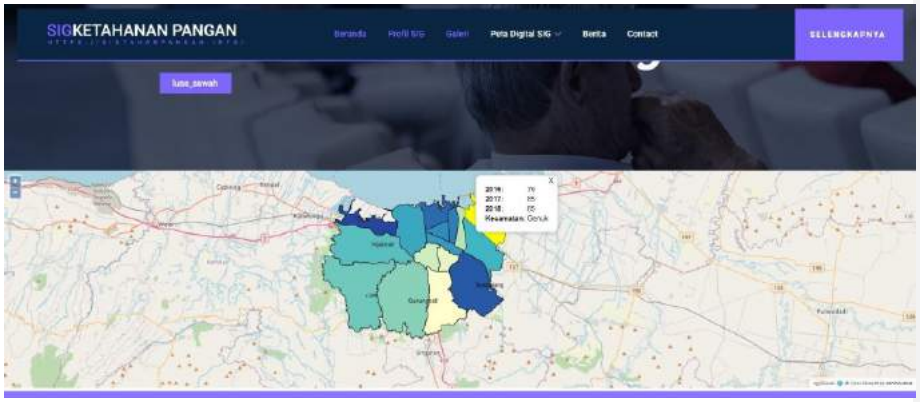

Figure 7. Map Area of Wetland (Ha) by Subdistrict in 2016-2018

Disasters in Semarang City

The most common disasters that occurred in the period of 2012–2021 –were landslides. In 2020, there were 175 landslides happened. The average disaster with the lowest frequency ~~i~~was~~s~~ tidal flooding, because this tidal flood only affecteds~~d~~ the Java Sea coastal area (Semarang, which is close to the coast), while the upper Semarang area wa~~i~~s not

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affected by this disaster. Disasters that occurred in Semarang during the years 2012–2021 are presented in Figure 8.

Figure 8. Disaster ~~that~~ Occurred in Semarang During the years 2012–2021

In the period of 2012–2021, there were 381 flood incidents (BPBD Semarang, 2022). A flood is a condition in which an area is inundated by large amounts of water. The cause of the flooding is heavy rainfall, rainwater that is not absorbed in the upstream area (because of deforestation), rivers that experience narrowing or siltation (due to garbage and uncontrolled development), or topographical conditions in the form of basins that tend to become water collection areas (Aritama and Dharmadhiatmika, 2019).

There were 44 tidal floods, the worst of which was in 2022 and attacked the industrial area of Semarang, which is close to the coast (BPBD Semarang, 2022). The existing condition of land elevation that is lower than sea level causes greater land subsidence. The tidal flood in Semarang caused damage to infrastructure and residential areas while simultaneously affecting the lives of people, households, and individuals. Problems caused by tidal flooding include productive land no longer functioning properly, damage to public infrastructure, and increasing conditions in slum settlements (Ikhwanudin, Wahyudi and Soedarsono, 2020). You can click on the image on each tab of the catastrophe menu in this

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web GIS: https://sigtahanpangan.info/semarang/banjir.html to view the disaster GIS for the years 2019-2021.

~~This menu displays the disaster GIS for 2019–2021, to display GIS on this menu, you can click on the image on each tab of the disaster menu in this web GIS: https://sigtahanpangan.info/semarang/banjir.html.~~ The map of the flood disaster in Semarang City from 2019 through ~~-~~2021 was visualized on the GIS Web "SIG Ketahanan Pangan" and is presented in Figure 9.

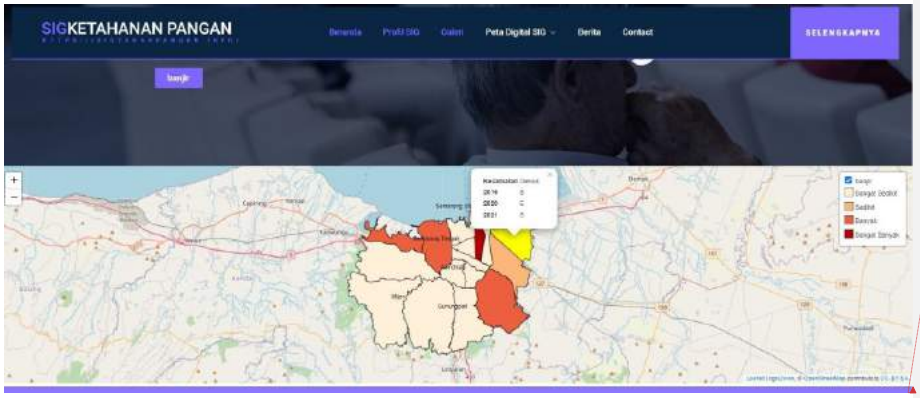

Figure 9. The M~~m~~ap of the F~~f~~lood D~~d~~isaster in Semarang City from 2019 through ~~-~~2021

A landslide is the disaster incident with the highest frequency, which is 867 incidents (BPBD Semarang, 2022). Landslides are natural disasters that can cause casualties, the loss of homes, and environmental damage. Landslides are not only caused by natural phenomena but also ~~are also caused by~~ human activities (Sudaryatno, Widayani, Wibowo, Wiratmoko, *et al.*, 2019). Heavy rainfall and earthquakes can trigger landslides (Hadi *et al.*, 2021). Several parameters that can be used in the analysis of landslide disasters are~~:~~ slope, aspect, elevation, distance from fault, distance from hydrology feature, distance from road, rainfall, and NDVI (Sudaryatno, Widayani, Wibowo, Pramono, *et al.*, 2019). ~~-~~Indonesia has a tropical climate that always ~~gets~~ brings rain every year. Indonesia is crossed by a plate subduction path, namely the crossing of the Eurasian, Pacific, and Australian plates, which often cause earthquakes (Karnawati, 2005~~:~~) ~~(~~Widiastutik and Buchori, 2018). To view GIS on this menu, click on the image on each tab of the disaster menu in this web GIS: https://sigtahanpangan.info/semarang/longsor.html. This menu shows the landslide disaster for 2019–2021. ~~This menu displays the landslide disaster for 2019–2021, to display GIS on this menu, you can click on the image on each tab of the disaster menu in this web GIS: https://sigtahanpangan.info/semarang/longsor.html .~~ The GIS map of the landslide disaster

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in Semarang City from 2019 through ~~–~~2021 was ~~,~~visualized on the GIS Web "SIG Ketahanan Pangan" and is presented in Figure 10.

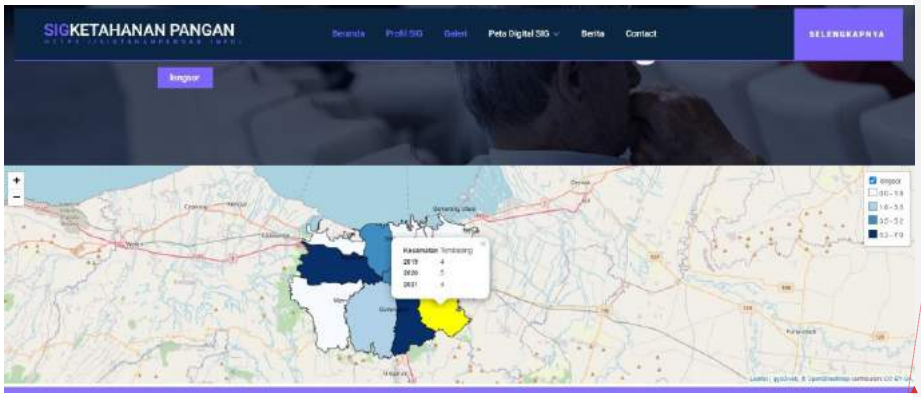

Figure 10. The GIS M~~m~~ap of the Landslide Disaster in Semarang City from 2019 through ~~-~~ 2021

There were 626 fire disasters (BPBD Semarang, 2022). Fire is a disaster based on the cause of its occurrence and is classified as a natural disaster: lightning, earthquakes, volcanic eruptions, droughts, and others, as well as a non-natural disaster caused by human negligence: gas leaks, electrical short circuits, cigarette butts, sabotage, and the low level of the building construction safety system against fires~~.~~ (Nurwulandari, 2017).

Another disaster was the fall of 357 trees (BPBD Semarang, 2022). Triggers for the occurrence of fallen trees include the load force received by the trunk or top of the tree exceeding its resistance capacity and the presence of sudden strong winds and/or rainwater falling on and storing in the tree canopy, which ~~will~~ increase<u>d</u> the load capacity.

[DISCUSSION]

Disasters Mitigation

1. Flood

Floods are the most frequent disasters in Indonesia and have an impact on many parties (Pratiwi, 2019). It is very important for policymakers to know the characteristics of flood hazards in order to choose mitigation measures in the future (Purwitaningsih *et al.*, 2022). The rapid development of cities and changes in the characteristics of rain due to climate change cause flooding and inundation in the rainy season (Sedyowati *et al.*, 2020). Communities benefit economically from drainage channels used for fish and vegetable cultivation. The current flood control project not only reduces the flood risk level by 30%

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but also increases the resulting economic efficiency of the flood risk management system by up to 90% over the project's 6-year effective life (Sedyowati *et al.*, 2020). To overcome these problems, the ~~the Semarang City g~~Government of Semarang chose the Banger Polder drainage system. Indications of land subsidence in Semarang can be known from several data sources. Based on measurements and data, land subsidence in hilly areas of Semarang ~~City~~ is smaller than that in coastal areas. From field observations, land subsidence in former swamps and ponds shows the largest decline, for example in ~~the~~ Tanah Mas housing complex, Tanjung Mas Beach, with a decrease of between 5.5 and 7.23 cm per year (Ikhwanudin, Wahyudi and Soedarsono, 2020). Another thing to do in disaster mitigation is to procurement an EWS (Early Warning System). Effective and comprehensive management of disaster risk preparedness is necessary to protect lives, livelihoods, and reduce the cost of disaster damage. This can be done by procuring EWS (Seng, 2013). According to the BBPD, there we~~a~~re already 14 EWS in Semarang ~~City for~~in attempt to flood and landslide mitigation spread across 14 villages, which are presented in Table 1.~~.~~

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Table 1. Disaster Early Warning System in Semarang

No	Village	Subdistrict	Disaster EWS
1	Pudak Payung	Banyumanik	Flood
2	Bendan duwur	Gajahmungkur	Flood
3	Karangroto	Genuk	Flood
4	Jatibarang	Mijen	Flood
5	Wates	Ngaliyan	Flood
6	Wonosari	Ngaliyan	Flood
7	Mayangsari	Ngaliyan	Flood
8	Karangtempel	Semarang Timur	Flood
9	Meteseh	Tembalang	Flood
10	Mangkang Wetan	Tugu	Flood
11	Mangkang Kulon	Tugu	Flood
12	Plumbon	Tugu	Flood
13	Sukorejo	Gunungpati	Landslide
14	Kalipancur	Ngaliyan	Landslide

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2. Fire

Structural mitigation is related to the form of physical mitigation, namely the provision and construction of facilities and infrastructure. Meanwhile, non-structural mitigation is related to the formulation of disaster management policies such as public commitment and implementation of methods and operations, including participatory mechanisms, information dissemination, and knowledge development, which are carried out to reduce

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disaster risk. Mitigation scenarios through prevention, mitigation, preparedness, an early warning system, recovery, and development (Nurwulandari, 2017). The influence of this community capacity variable is very important in determining the risk of a fire disaster. Losses and casualties can be minimized by increasing community capacity (Januandari, Rachmawati and Sufianto, 2017). Fire mitigation can be accomplished through fire education and training, as well as an examination of active fire protection systems such as fire extinguishers, hydrants, sprinklers, and fire alarms. An analysis of life-saving means: emergency stairs, exit signs (Karimah, Kurniawan and Suroto, 2019).

3. Fallen trees

Carrying out tree planting designs that pay attention to places that match the dimensions of tree growth; select the right tree species that will ensure their suitability at the planting location; select tree species that are native to the area; plant appropriately that pays attention to the cultivation aspect; protect trees from potential human damage; and take good care of trees (Sulistyantara, 2014), risk management of trees at risk of breaking or falling, monitoring of trees at risk of breaking or falling (Ningrum, 2020), planning and placing tree planting points through state analysis, pruning, and cutting trees on a regular basis. (Aritama and Dharmadhiatmika, 2019).

2. Using Economics and Policy Systems

Several mitigations that can be done in an earthquake are~~:~~ allocating a specified pre-earthquake budget; minimizing the expected value of total cost; and minimizing the risk of a large loss (Dodo *et al.*, 2004). In addition to engineering methods, other mitigation actions that can be taken are~~:~~ increasing monitoring capacity and~~;~~ improving early warning by building more observation stations (Fang *et al.*, 2017). Institutional strengthening indicators and emergency response capability indicators according to ~~Permendagri~~ Regulation of Government of The Republic of Indonesia Number ~~No.~~ 33 of 2006 has~~ve~~ six indicators~~:~~ infrastructure and utilities,~~:~~ strategic and important buildings,~~:~~ area housing and public facilities,~~:~~ buildings and industrial areas,~~:~~ school buildings,~~:~~ and flood-resistant buildings. The p~~P~~reparation~~e~~ of a disaster management plan called a "Contingency Plan" before the disaster and ~~use~~ implement it as a guide when the disaster occurs~~.~~ (Permanahadi and Widowati, 2022).

4. Using Information Technology

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Using algorithms,~~:~~ markov chains algorithm,~~: the markov chains algorithm~~which is a method for generating the probability value of something with probability calculations. Markov chains is to ~~here~~ make predictions with matrix values for 7 natural disasters that occurred in the city of Semarang, with prediction results in 2020 being 35% flood, 0% flood rob, 22% landslide, 3% tornado, 2% house collapse, 30% fire, and 8% fallen trees. Meanwhile, in 2021, the percentage of flood predictions was 22%, rob floods was~~ere~~ 3%, landslides was ~~were~~ 22%, tornadoes was ~~were~~ 2%, houses collapsed was 8%, fires was ~~were~~ 33%, and trees fell was 9% (Hidayati, Pungkasanti and Wakhidah, 2021). Using GIS: dimensions of flood security (Ujianti, Novita and Muflihati, 2022), flood modeling used~~s~~ a combination of GIS and fuzzy logic methods (Nugraha, 2018), using GIS for disaster management in Taiwan (Hsu, Wu and Lin, 2005). T~~ T~~he role of GIS in a natural disaster: prediction, mitigation, laws and government policies, impact on the biogeochemistry of the earth's crust, and role in the 2004 earthquake in India (Singh, Pandey and Mina, 2019). Using garbage sorting games, DIFMOL, and ILMIZI for disaster mitigation environmental learning (Rahmayanti *et al.*, 2020) U~~, u~~sing Google Earth Pro to learn media for mitigation and adaptation of a landslide disaster (Suharini, Ariyadi and Kurniawan, 2020). In this research, information technology was used, including GIS maps that visualized the number of disaster events in various sub-districts in the city of Semarang, which have already~~are presented~~ displayed in Figures 9 and 10.

[CONCLUSIONS]

The disasters that occurred in ~~the city of~~ Semarang in 2012–2021 were fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. The most common disasters we~~a~~re landslides. Disaster mitigation is needed in general and specifically using information technology to predict future disasters, which is needed further~~more that~~ so that people can ~~know~~ understand how to prevent and prepare the coming ~~for~~ disasters.

[ACKNOWLEDGMENTS]

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Dear Editor.
We attach our revised manuscript and the map in Figure 1.
We will revise it again if there are further revisions.
Thank you for the opportunity.

Regards,
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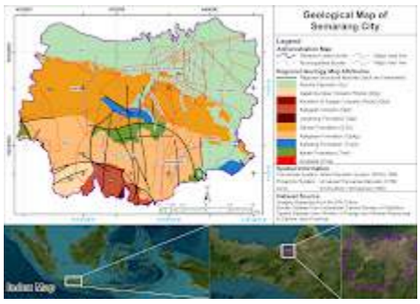

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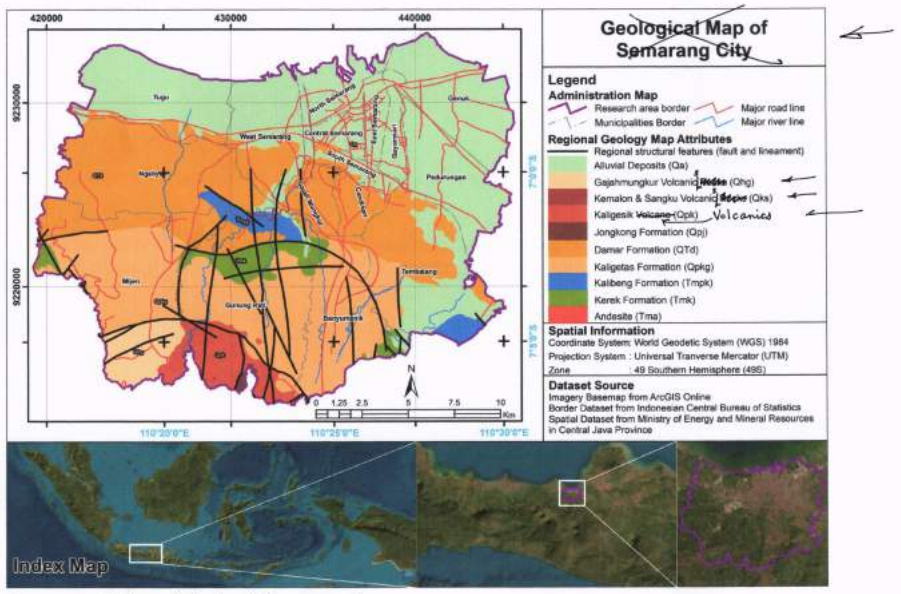

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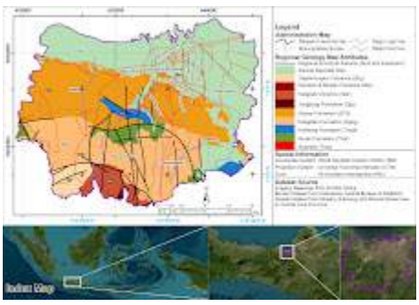

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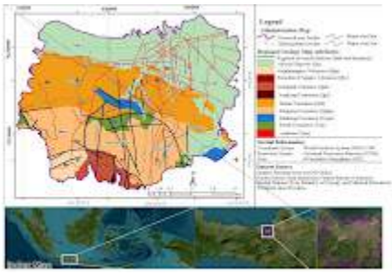

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Mitigation Strategi of Disaster in Semarang City based Information Technology

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Abstract

Semarang is a city located on the coast of the Java Sea. This makes Semarang one of the cities that are threatened by tidal floods. Apart from the tidal flood, several other disasters that occurred in Semarang were: fires, fallen trees, floods, landslides, hurricanes, and collapsed houses. This study identifies disaster events that occurred in Semarang City from 2012-2021, as well as mitigation strategies in general and specifically using information technology. The research data was obtained from the Regional Development Planning Agency, the Regional Planning Agency, the Public Works Agency, the Central Statistics Agency (Semarang in Figures 2022), Semarang City Social Service, and several related stakeholders. The results of the study indicate that mitigation that can be used is using GIS, using algorithms, and combining GIS and fuzzy logic methods.

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