The Effect of Natural Disasters on the Environmental Resilience of Rural Areas

Abstract

Disasters have detrimental effects on environmental aspects. This research investigates the negative impacts of earthquakes, volcanic eruptions, and land drought on the environment. The data used in this research was obtained from Podes 2021 and the Environmental Resilience Index (IKL) 2022 and 2023. The method applied in this research is multiple linear regression. The results of this research show that natural disasters harm the environment. Of the three independent variables in this research, it is known that volcanic eruptions have the most significant adverse effects one year and two years after the event occurs. Therefore, an extra role is needed from the government to carry out evacuations when a disaster occurs and implement mitigation measures early on to reduce negative impacts.MENTION THE REMARKABLE RESULT

I. Introduction

Natural disasters are natural events that cannot be avoided and often have a destructive environmental impact(Caraka et al., 2020; Kelman, 2020; Panwar & Sen, 2019). All natural disasters, from earthquakes, floods, landslides, and forest fires to tropical storms, cause extensive and varied damage. Its negative impact on the environment is evident in various aspects. One of the most visible impacts is ecosystem damage. Natural disasters often destroy the natural habitats of different plant and animal species (Gunderson, 2010; Kiss, 2022; Kumari et al., 2023). For example, overflowing floods can destroy riparian forests and disrupt river ecosystems, while forest fires can destroy various types of flora and fauna that live in them. Natural disasters can also pollute the environment with hazardous waste and materials, such as oil spills or industrial waste, which can poison the land, water, and air.

Natural disasters also impact the social and economic sectors(Jovel, 1989; Salvato et al., 2020). Many people have lost their homes, sources of livelihood, and even families due to natural disasters. Natural disasters often result in significant economic losses due to destroyed infrastructure, damaged crops, and loss of human resources. Recovery after a disaster usually takes a long time and costs a lot of money, putting additional pressure on a region's economy(Finucane et al., 2020; Gatti et al., 2023; Quartieri et al., 2010).

Natural disasters often leave traces of waste, which can be a source of ecosystem problems and impact the health of living creatures(Akhtar et al., 2021; Dehghani et al., 2021; Uralovich et al., 2023). When a disaster occurs, many materials, such as building debris, household waste, or even hazardous materials, are scattered in the surrounding environment. This rubbish can come from collapsed buildings, used materials, or chemical waste from affected industrial facilities. The impact of waste after natural disasters is enormous. Building debris and used materials can obstruct the flow of rivers or water channels, cause flooding, and damage water ecosystems. Waste originating from industry or leaking chemicals can pollute soil, groundwater, or rivers, negatively impacting plants, animals, and humans who depend on these environments.

It threatens the ecosystem, and post-disaster waste also has serious potential for human health(Habib et al., 2022; Kasabdji et al., 2020; Pradhananga et al., 2021). This rubbish can become a nest for disease because it invites the spread of bacteria, viruses, or sharp objects, which can cause wounds and infections in those exposed to it. In addition, the dangerous chemicals that are distributed can cause poisoning or other health problems in humans exposed directly or indirectly. With its abundant natural wealth, Indonesia also has a high risk of natural disasters. Apart from earthquakes, volcanic eruptions, and land drought, this country is also vulnerable to flood disasters. Increased rainfall, the confluence of large rivers in inland areas, and changes in water management patterns often trigger destructive floods.

Floods are natural disasters that occur periodically in various regions of Indonesia(Hakim & Lee, 2020; Kusumasari, 2019). Every rainy season, especially between October and March, many areas are vulnerable to flooding due to overflowing rivers, excessive waterlogging, and poor drainage. Floods can cause significant losses, including damage to houses, infrastructure transportation disruption, and health impacts from contaminated water.

Efforts to handle and mitigate flood disasters in Indonesia involve various parties, including the government, community, and aid organizations. Building flood control systems, maintaining water channels, and river rehabilitation are the main focuses for reducing flood risk. Apart from that, awareness campaigns on the importance of protecting the environment, greening, and proper waste management are also preventive steps that minimize the impact of flooding.

Awareness of the risk of natural disasters and joint efforts to deal with them is essential for Indonesian society. Disaster preparedness, emergency response plans, and the availability of tools and safe evacuation routes are crucial in minimizing the losses incurred. Through collaborative efforts and a planned approach, the hope is to reduce the negative impacts of flood disasters and maintain the security and welfare of the Indonesian people.

Environmental conservation is a crucial principle in maintaining the sustainability of ecosystems on Earth(Chen et al., 2020; Hosen et al., 2020). This refers to actions to protect, preserve, and maintain the balance of nature and existing natural resources. A healthy and balanced environment is the foundation for the survival of humans and all life forms on this planet. Environmental conservation covers various aspects, from conserving natural resources such as water, air, land, and biodiversity. These conservation efforts also include reducing waste, using renewable energy, protecting natural habitats, and controlling pollution to minimize adverse environmental impacts.

The importance of environmental preservation is also reflected in climate change mitigation efforts. By maintaining the sustainability of ecosystems, we can reduce greenhouse gas emissions and slow the rate of climate change, which can seriously impact life on this planet(Mikhaylov et al., 2020; Prakash, 2021; Shen et al., 2020). Through sustainable environmental conservation, we can realize harmony between humans and nature and improve the quality of life now and for future generations. This long-term investment is vital for the survival of humans and all living things on Earth.NO RESEARCH OBJECTIVES?

II. Data and Methodology

WHO ARE THE PARTICIPANTS? MENTION ALSO THE DESIGN AND PROCEDURE COMPREHENSIVELY

This research uses natural disaster data from Village Potential (Podes2021) sourced from the Central Statistics Agency and Environmental Resilience Index (IKL) from the Ministry of Villages, Development of Disadvantaged Regions and Transmigration. The Environmental Resilience Index (IKL)

used in this research includes IKL for 2022 and 2023. The indicators used in calculating IKL are as follows:

List 1 : Environmental Resilience Indicators	
1.	Environmental Quality
2.	Disaster-prone
3.	Disaster Response

This research uses multiple regression analysis to see the influence of disaster events in 2020 and 2021 on IKL in 2022 and 2023. Through this method, it is hoped that it can show past natural disasters' impact on current environmental conditions. The natural disasters discussed in this research include earthquakes, volcanic eruptions, and droughts (Land). The dependent variable in this research is the Environmental Resilience Index (IKL), while the independent variable is the number of earthquakes, volcanic eruptions, and droughts (land).

III. Results and Discussion

The regression analysis results show that earthquakes, volcanic eruptions, and land drought negatively and significantly impact environmental resilience (IKL), illustrating the ecological vulnerability to natural disasters in various regions. These findings demonstrate that natural disasters, such as destructive earthquakes, threatening volcanic eruptions, and productivity-reducing land droughts, significantly affect the environment's ability to maintain natural balance.

The existence of a significant relationship between natural disasters and environmental resilience provides a deeper understanding of the link between natural events and ecological sustainability. Earthquakes, as one of the often-unpredictable natural disasters, can affect the ecological structure of the affected areas. Likewise, volcanic eruptions can cause extensive environmental damage and land drought, threatening the productivity and sustainability of natural resources.

Natural disasters can cause severe environmental damage that is difficult to repair quickly. When disasters such as earthquakes, volcanic eruptions, floods, or forest fires occur, the environmental impact can be extensive and severe. For example, earthquakes can change the topography of an area by collapsing soil structures and creating cracks that affect drainage and water flow patterns. Volcanic eruptions produce lava, volcanic ash, and pyroclastic material, which can bury and damage natural habitats and surrounding agricultural land.

Environmental damage due to natural disasters also affects biodiversity. Natural disasters such as forest fires or major floods often destroy the natural habitats of animals and plants. Loss of this habitat can cause species extinction and disrupt the food chain in the ecosystem. Complete environmental recovery can take years, even decades, even after a disaster.

The difficulty of repairing environmental conditions damaged by natural disasters highlights the importance of prevention and mitigation. Preventive efforts such as wise spatial planning, effective early warning systems, and investment in disaster-resistant infrastructure are significant. In addition, mitigation strategies involving post-disaster environmental restoration, sustainable management of natural resources, and public education about the importance of environmental sustainability can help minimize the negative impact of natural disasters on the environment. With awareness of the environment's vulnerability to natural disasters, efforts to protect and preserve ecosystems become increasingly crucial in maintaining environmental sustainability for future generations.

The natural sustainability we enjoy today results from the accumulation of ecosystems that have developed over many years. Nature carries within itself a long history of complex interactions between elements, ranging from various species to physical environments formed from natural processes that last thousands or even millions of years.

Each ecosystem has a unique pattern of balance, where every organism, from microorganisms to large animals, has an essential role in maintaining the continuity of the ecosystem itself. Natural processes such as water circulation, nutrient cycles, and interconnected food chains have formed and adapted over the years, creating a fragile but essential balance.

However, natural sustainability accumulated over the years cannot be considered permanent and eternal. Current environmental changes, such as deforestation, pollution, climate change, and other human activities, have disrupted this natural balance. This disturbance has threatened the survival and balance of ecosystems, affecting the biodiversity and ecological functions of various habitats.

Table 1. The Impact of Natural Disasters in 2020 on the Environmental Resilience Index in 2022

INCLUDE HERE EVERY STATEMENT IN THE SURVEY

Natural Disasters (2020)	Coefficient	Significance
Earthquake	-0.0028233	0.070
Erupting volcano	-0.2644590	0.000
Drought (Land)	-0.0175872	0.022
Constant	0.6823114	0.000

Note: Dependent Variable: Environmental Resilience Index
Independent Variable: Earthquake, Volcano Eruption, and Drought (Land)

Based on Table 1, it is informed that earthquakes, volcanic eruptions, and land drought in 2020 have a negative and significant effect on the environmental resilience index in 2022. Volcanic eruptions have the most resounding negative impact compared to other research variables.

Table 2. The Impact of Natural Disasters in 2021 on the Environmental Resilience Index in 2022

INCLUDE HERE EVERY STATEMENT IN THE SURVEY

Natural Disasters (2021)	Coefficient	Significance
Earthquake	-0.0028642	0.106
Erupting volcano	-0.0443517	0.002
Drought (Land)	-0.0066247	0.574
Constant	0.6812539	0.000

Note: Dependent Variable: Environmental Resilience Index
Independent Variable: Earthquake, Volcano Eruption, and Drought (Land)

Table 2 shows that volcanic eruptions and drought (land) in 2020 negatively and significantly affect the environmental resilience index in 2022. Volcanic eruptions have the most resounding negative impact compared to other research variables.

Table 3. Number of Observation Villages According to Development Classification in 2022

Development Village Index Status (2022)	Frequency	Percent
Independent	185	6.40
Proceed	633	21.89
Develop	1,464	50.62
Left behind	444	15.35

Very Left behind	166	5.74
Total	2.892	100.00

Based on Table 3, it is informed that the majority of research observations were in developing villages. This result follows the distribution of village conditions currently in Indonesia. There are 6.40 percent who have an independent status, 21.89 percent who have an advanced level, 50.62 percent who have a developing situation, 15.35 percent who have an underdeveloped status, and 5.74 percent who have a very underdeveloped group.

Table 4 shows that the earthquake in 2020 had a negative and significant effect on the Environmental Resilience Index in 2022. Earthquakes and volcanic eruptions were not substantial in this study.

Table 5 shows that the 2020 earthquake had a negative and significant effect on the Environmental Resilience Index in 2022. Earthquakes and volcanic eruptions were not substantial in this study.

Based on Table 6, it is informed that the majority of research observations were in developing villages. This result follows the distribution of village conditions currently in Indonesia. 13.05 percent have an independent status, 25.92 percent have an advanced level, 45.28 percent have a developing situation, 10.53 percent have an underdeveloped status, and 5.21 percent have a very underdeveloped status.

Table 4. The Impact of Natural Disasters in 2020 on the Environmental Resilience Index in 2023

Natural Disasters (2020)	Coefficient	Significance
Earthquake	-0.0070937	0.000
Erupting volcano	0.0058219	0.650
Drought (Land)	-0.0071925	0.426
Constant	0.7156952	0.000

Note: Dependent Variable: Environmental Resilience Index
Independent Variable: Earthquake, Volcano Eruption, and Drought (Land)

Table 5. The Impact of Natural Disasters in 2021 on the Environmental Resilience Index in 2023

Natural Disasters (2021)	Coefficient	Significance
Earthquake	-0.0061510	0.001
Erupting volcano	0.0365999	0.218
Drought (Land)	-0.0045005	0.716
Constant	0.7146002	0.000

Note: Dependent Variable: Environmental Resilience Index
Independent Variable: Earthquake, Volcano Eruption, and Drought (Land)

Table 6. Number of Observation Villages According to Development Classification in 2023

Development Village Index Status (2023)	Frequency	Percent
Independent	368	13.05
Proceed	731	25.92
Develop	1,277	45.28
Left behind	297	10.53
Very Left behind	147	5.21
Total	2,820	100.00

Based on regression analysis, almost all variables show a significant negative influence on the Environmental Resilience Index. Of the three independent variables in this study, volcanic eruptions

were proven to have the most decisive negative impact within one year and two years after the event. This finding is in line with previous research, which confirms that natural disasters have a detrimental effect on the state of the environment(Benevolenza & DeRigne, 2019; Botzen et al., 2019; Hussain et al., 2020). Therefore, an extra role is needed for the government to evacuate when a disaster occurs and implement mitigation measures to minimize the negative impacts that may arise.

IV. Conclusion

Natural disasters harm various aspects of life, including the environment. The impact of natural disasters can cause damage to environmental elements that have already been formed, requiring the affected areas to be rebuilt so that they can be used again by the community. Reorganizing aspects affected by natural disasters takes quite a long time. This research shows that the adverse effects of natural disasters are still felt two years after the disaster. Therefore, an active role from the government is necessary to accelerate the recovery process from the impacts of natural disasters. Apart from that, disaster mitigation efforts also need to be carried out to reduce the adverse effects that may arise from natural disasters.NO RECOMMENDATIONS?

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