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Does Natural Disasters Have an Impact on Poverty in East Java, Indonesia?*

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Abstract

There is a strong association between poverty levels and the probability of natural disasters. East Java, however, exhibits a distinct pattern. While the rate of poverty is declining, natural disasters are becoming more severe. Considering that East Java is an area with a high risk of natural disasters and a high poverty rate, this study aims to estimate the effect of environmental preservation and the magnitude of the impact of disasters as measured by the Disaster Risk Index (IRBI) on poverty. The 3SLS model is used on secondary data from 38 districts/cities from 2015 to 2021 as an analytical database. Based on the estimation results, there are 3 findings in this study: (i) the role of government, population development, and economic activity have a strong influence on nature conservation; (ii) nature conservation has a strong influence on disaster risk; and (iii) the disaster risk index has a strong effect on poverty. As a result, areas with a high level of disaster risk have a slower rate of poverty reduction. The role of this research is to show the need for the government's role in improving the quality of natural disaster mitigation anticipation, economic activity, and the role of the population in a sustainable manner.

Keywords: Disaster Risk Index, Poverty, Simultaneous, Indonesia

JEL Classification Code: P25, P28, Q54

1. Introduction

Communities around the world face risks from natural disasters. Based on the Emergency Database (EM-DAT), the number of natural disasters and victims affected appears to be increasing worldwide. According to the National Disaster Management Agency (BNPB), the number of deaths and the intensity of disaster events have increased significantly in recent times, making it the main contributor to the increase in the number of fatalities due to disasters. Natural hazard severity is influenced by hydro-meteorological hazards such as floods, landslides, wildfires, droughts, and tornadoes. The high incidence of disasters is caused by natural and non-natural factors. One of the natural factors that influence is the environmental level of coral reefs which tends to be ignored. Environmental conservation exacerbates environmental degradation. This is of course, inseparable from economic activity, population density, and the government's role in controlling the environment.

Much interest has been paid to analyze at the effect of failures on poverty, specifically the usage of macroeconomic data. Natural hazards are defined as natural phenomena (earthquakes, hurricanes, floods, volcanic eruptions, droughts, etc.) that threaten life and property. Natural disasters are one of the causes of regional economic shocks. Natural disasters make areas with low-income communities very vulnerable, especially given that the community's welfare level is below the poverty line (Kurosaki et al., 2012).

Natural disasters have an impact on communities' declining income and capacity for saving. This is what

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triggers deeper poverty in an area. Therefore, there has been an increasing need to incorporate disaster-related issues into poverty and development planning due to the enormity of the economic and social damages caused by natural disasters, particularly in East Java. According to several research findings, poverty and the probability of natural disasters are closely associated. Lee (2018) found that natural disasters increase poverty rates in low-income neighborhoods. Meanwhile, on a smaller scale, households that experience natural disasters tend to be poorer than other households (Putra, 2017). There are direct and indirect impacts due to natural disasters, especially on poverty. Disasters can affect the income distribution of people and affected communities (Karim & Noy, 2016).

Interesting facts in East Java show a slightly different pattern (Figure 1). When compared to the national average, the intensity of natural disaster events in East Java is quite high. Since 2015 the number of disaster events has been quite high. In fact, in 2019 there were 624 recorded natural disasters. However, as the intensity of disasters increased in 2019, poverty decreased. However, it should be noted that East Java's poverty rate is still high compared to the national level. It can be seen from year to year that poverty is above the national figure.

This study uses 3SLS to quantitatively analyze the impact of natural disasters on poverty in East Java. Using data for 2015–2021 and covering 38 districts/cities. This study is consistent with previous studies. Several studies have used different approaches and methodologies to conclude that there is a strong link between natural disasters and poverty.

There are several contributions to this paper. Previous studies have only looked at how disasters affect poverty. However, what needs to be highlighted is that there are factors that influence disasters and increase the poverty rate. This has not been discussed in previous studies. Second, this study provides recommendations to policymakers to evaluate whether environmental conservation efforts and sustainable economic activities have been carried out adequately in reducing disaster risk. Discovering the variables that affect the model's estimation will allow you to evaluate those variables more effectively. By using some influential control variables, this study aims to address the issues of whether the findings of earlier studies apply to East Java and whether there is a connection between the incidence of natural disasters and poverty rates in East Java.

2. Literature Review

Research from Sarac and Yaglikara (2017) found a relationship between income levels and pollution at different stages of the development of the economy. The Kuznets environment hypothesis curve shows that pollution increases early in economic growth. But above a certain level of income, economic growth can improve the environment. This shows a U-shaped relationship between income levels and pollution. Economies of scale mean that as production increases, the use of natural resources increases, the environment worsens, and the economic structure changes. Moving from manufacturing to services and using fewer natural resources is the positive part of the relationship because the quality of the environment is reduced due to environmental pollution. The technological effect is an increase in technology investment that accompanies an increase in a country's national income. Greater use of green technology leads to more investment in research and development and less pollution (Erataş & Uysal, 2014).

Economic development initially leads to environmental degradation. The Kuznets environmental curve, however, demonstrates that after a certain level of economic development, people's environmental awareness improves, which lowers the pace of environmental degradation. Nevertheless, several previous studies argued that there is no guarantee that environmental improvements can occur in tandem with increased economic growth. There is empirical evidence that pollution levels decrease with economic growth based on the environmental Kuznets curve. Studies show that rapid growth leads to increased use of vehicles, and the expansion of factories increases air pollution. Examining government spending based on environmental functions can help us understand how the government plays a role in economic development and growth. By enacting this legislation, the government is attempting to counteract the negative effects of the outside environment on people's health and level of living. Some of these effects of environmental deterioration raise the probability of disaster risk.

One of the risks associated with natural disasters is vulnerability. This can be demonstrated in the community's capacity to prepare for and recover from a disaster. Of course, the community's physical and sociological traits contribute to this level of vulnerability (Yoon et al., 2006). Economic status and demographic patterns are factors associated with social vulnerability (Cutter et al., 2003). Not only individuals, but vulnerability also occurs due to geography, and the intrinsic causes of physical vulnerability vary in different geographic areas (McEntire & Boateng, 2012). Areas with large numbers of children, the elderly, the uneducated, and ethnic minorities also tend to be vulnerable to natural disasters. To be able to overcome natural disaster shocks, physical and mental abilities are needed (McEntire & Boateng, 2012).

The level of community vulnerability is also influenced by economic conditions. Limited access to the resources needed for recovery from natural disaster losses will have an impact on vulnerability to natural disasters (McEntire &

Boateng, 2012). In areas with low demand, people live in disaster-prone areas because it is difficult to find housing in safe areas (McEntire & Boateng, 2012). In relation to the physical environment, determinants of vulnerability due to natural disasters are also determined by the characteristics of the building (McEntire & Boateng, 2012), open space, forest conditions, buffer zones, and slopes (Schipper & Pelling, 2006). Meanwhile, vulnerability to natural disasters can be measured from the natural disaster risk index.

According to Arouri et al. (2015), natural hazards like tsunamis, earthquakes, and tornadoes can have a variety of negative effects depending on the intensity and degree of the hazard, duration of exposure, and the likelihood of occurrence. Natural disasters are defined as natural phenomena that pose a threat to life and property. The physical effects of natural disasters include human fatalities, injuries, and destruction of infrastructure and property at the local and regional levels. Natural disasters' socio-economic effects also depend on sociodemographic and economic elements like family size, home ownership, and marital status.

Natural disasters cause shocks resulting in loss of human, physical and social capital which can temporarily or permanently limit access to future income opportunities (Dercon, 2008). Risks and shocks can contribute to poverty in two ways: making households succumb to fate (after-effects of shocks) and fear (behavioral effects of shocks). Natural disasters create feelings of anxiety that people leave their jobs and leave potential business opportunities in disaster-affected areas. Communities may also surrender to their fate or surrender, leaving casualties and physical buildings, including damaged residents' houses.

The resulting damage can drastically lower household happiness and poverty. For instance, the income of farmers who don't harvest is one of the factors that contribute to malnutrition in more extreme situations. Disasters can directly harm household well-being and force households into poverty by causing damage to property (homes, goods, utilities, etc.), loss of crops, family injury or death, and disability. It will result in significant economic loss, such as decreased economic liquidity (Dartanto & Nurkholis, 2010, 2013; Dartanto et al., 2020). The early marriage of females is also intimately tied to natural disasters. Women may suffer from this, which may result in everything from financial losses to deteriorating health problems (Dewi & Dartanto, 2019). There is a poverty exposure bias because poor people are often disproportionately exposed to droughts and urban floods for the same natural hazards (Winsemius et al., 2015).

The relationship between natural disasters and poverty can be a reciprocal process. Natural disasters not only cause an increase in the poverty rate, but poverty also increases the exposure of poor households to the risk of facing natural disasters. Household vulnerability to natural disasters depends on several factors (Lopez-Calva & Ortiz-Juarez, 2009), such as the level of development of economic structures, social and economic conditions, availability of coping mechanisms, exposure to risks, and frequency and intensity of natural disasters. According to Kurosaki et al. (2012), households that were originally less wealthy and flood-affected had a harder time recovering from natural disasters, while those that got aid were more likely to do so than households that did not. The recovery rate was found to be neither high nor low. Elsewhere, significant increases in poverty in disaster-hit communities have been noted in Mexico (Rodrigues-Oreggia et al., 2013) and Nicaragua (Van den Berg, 2010). Not all households have recovered equally.

More broadly, disaster is defined as the impact of the natural environment on the socio-economic system. Therefore, natural disasters in economic models are often translated into exogenous factors that affect the economic system. This is inseparable from the character of the natural disaster itself which cannot be predicted with certainty and often occurs suddenly, and cannot be fully controlled. When considering exogenous variables in economic models, it is important to understand the economic impact after natural disasters. Rose and White (2004) considered the following four key consequences of natural disasters on the economy, namely: (i) lack of production of goods and services in affected areas due to damage to buildings and infrastructure (ii) due to decreased industrial production, there will be less supply and less demand in other (non-affected) areas; (iii) there will be greater demand for imports from the disaster area to other regions to satisfy product needs that cannot be satisfied locally; and (iv) there will be an increase in the need for reconstruction in the disaster area. Even disasters themselves may result in lower income. Then the decline in income affects people's interest in saving and low capital costs. This affects productivity and income and keeps people in a vicious cycle of poverty.

3. Research Methods and Materials

From an econometric point of view, OLS can have serious econometric problems. Heteroscedasticity or standard error of bias has a severe impact on OLS estimators (Vuko & Čular, 2014). Therefore, robust heteroscedasticity can overcome this problem (Thompson, 2011). Since our panel data contains many companies from year to year, we can control for the effect of time with a general approach that includes a time dummy variable. Therefore, enterprise dummy variables can triumph over this problem (Chen et al., 2017) by overcoming this and minimizing the risk of using concurrent regressions in 3SLS (Shaddady & Alnori, 2020).

Three Stage Least Square (3SLS) is a method to estimate over-identified structural equations simultaneously. 3SLS is a development of 2SLS, where the first and second stages are the same as the 2SLS technique, while the third stage uses general least squares (Syafa'at, 1996). Assuming that the equations of the system of equations model are identified (exactly or more accurately), there are several ways to estimate them. Therefore, the methods fall into two main categories: single-equation methods and system methods. The single equation method is most widely used for reasons such as economy and specification error. A unique feature of this method is the ability to estimate a single equation of a multi-equation model without worrying too much about other equations in the system. There are currently three single-equation methods in common use. OLS, ILS, and 3SLS In general, OLS is not appropriate in the context of simultaneous equation models, but it can be applied to so-called iterative models where there is a clear but one-way causal relationship between endogenous variables.

The 3SLS method is specifically designed for over-specified equations but can also be applied to exactly-specified equations. The basic idea behind 3SLS is to replace the endogenous (probabilistic) explanatory variables with linear combinations of predefined variables in the model and use these combinations as explanatory variables in place of the original endogenous variables. Therefore, the 3SLS method resembles an instrumental variable estimation method in which a linear combination of the given variables acts as an average or proxy for endogenous regressors. A key feature of the resulting estimates is consistency. In other words, the estimates converge to the true population value as the sample size increases indefinitely. Small sample properties such as fairness and minimum variance can be overlooked in the estimation. Therefore, the results obtained by applying this method to small samples and the conclusions drawn therefrom should be interpreted with caution.

To determine these three equations, this model requires a simultaneous regression panel using 3SLS. In the absence of systems of equations or problems, the OLS estimator produces consistent and efficient estimators. On the other hand, the OLS estimator is inconsistent under simultaneity. At the same time, the three-step least squares method (3SLS) and instrumental variables provide a consistent and efficient estimator. Surprisingly, applying this alternative method when there are almost no concurrency results in a consistent but inefficient estimator (that is, with lower variance). All these discussions suggest that we should consider the issues together before abandoning OLS in favor of alternatives.

As mentioned earlier, the problem of simultaneity arises because some of the regressors are endogenous and thus tend to correlate with the disorder or error term. Therefore, the simultaneous test is a test of whether (endogenous) regression correlates with the error term. If so, this is a simultaneous problem, where alternatives to OLS must be found. Otherwise, we can use OLS. To find out what happens in a given situation, we can use the Hausman Custom Error test and Chow test (Gujarati, 2004)

This model requires panel data with time series data from 2015 to 2021 and cross-section data from 38 regencies/cities in East Java. Hence, this equation model needs to go through panel data procedures, such as the Hausman test and Chow test to prove the fixed effect, random effect, or pool effect data with the three equations as follows.

In general, the equations used in this study can be written as follows:

$$\text{IKLH: } \beta_0 + \beta_1 \text{ Growth} + \beta_2 \text{ Density} + \beta_3 \text{ GovSpending\_Env} + \varepsilon \quad (1)$$

where IKLH is a proxy for the level of environmental conservation calculated based on several components such as water quality (IKA), air quality (IKU), and land cover quality (IKTL), with the following formula:

$$\text{IKLH: } (30\% \times \text{IKA}) + (30\% \times \text{IKU}) + (40\% \times \text{IKTL})$$

The first equation (1) shows IKLH is influenced by economic activity which is proxied by economic growth, population density, and the role of government which is reflected by government spending based on environmental functions.

$$\text{IRB: } \beta_0 + \beta_1 \text{ IKLH} + \varepsilon \quad (2)$$

Meanwhile, estimation (2) shows the similarity of natural disasters proxied by the disaster risk index (IRBI) which is calculated based on the equation below.

$$\text{Risk: Hazard} \times \text{Vulnerability/Capacity}$$

The frequency, spatial distribution, and magnitude probabilities of natural occurrences like earthquakes, floods, and volcanic eruptions are used to determine where the hazard will occur. Meanwhile, vulnerability is calculated based on socio-cultural, economic, physical, and environmental parameters. The capacity is assessed using the regional resilience level approach.

Equation (3) shows poverty as seen from the depth of poverty in an area. This equation is influenced by IRB variables, economic growth, government spending based on social functions, and the health index.

$$\text{Poverty: } \beta_0 + \beta_1 \text{ IRt} + \beta_2 \text{ Growth} + \beta_3 \text{ GovSpending\_Social} + \beta_4 \text{ Health\_Index} + \varepsilon \quad (3)$$

The government's role, which is measured by government spending on social functions, and the health index, which measures the quality of society, are both used to define economic activity in this equation. The disaster variable represented by the IRB is very important in determining how big the effect of a natural disaster is on poverty.

The data used in this research is data from 38 districts/cities in East Java. This study uses the 3SLS simultaneous regression model through several database sources such as BPS, BNPB, the Ministry of Environment, and the World Bank. The years 2015 to 2021 were chosen to see how big the impact would be on 38 regencies/cities in East Java.

4. Results

Based on the estimation results using 3SLS it is known that natural sustainability is influenced by several factors such as economic growth, density, and government spending based on environmental functions. At the same time, the natural disasters index estimation results are influenced by environmental quality. Meanwhile, the poverty equation is influenced by the disaster index, economic growth, government spending based on the social protection function, and the health index. How it impacts is explained in Table 1.

Environmental quality is influenced by several factors. Table 1 shows the results of environmental quality estimation. First, the growth variable, which is a proxy for environmental activities, has a negative effect on the environmental quality (–0.53). The density variable as a proxy for population development shows the effect on environmental quality—the higher the density, the lower the quality of the environment. Meanwhile, government spending based on environmental functions does not affect the current environmental quality.

The results of the study, as predicted in the second equation, show a negative impact on environmental quality in the disaster index. Table 2 demonstrates that the likelihood of a more severe disaster might increase if environmental quality declines. This is in accordance with the hypothesis of this study.

Table 3 displays the relationship between the function of the social protection and health indices and the impact of the disaster, growth, and government spending indices. The disaster index has a positive effect on increasing poverty. Meanwhile, increased economic growth can reduce poverty. Both a health index and government spending based on the social protection function have the potential to alleviate poverty.

Table 1: Summary Statistics Result of Environmental Quality Index Estimation

Variables	Coef.	*Z* value	*P* > |*z*|
Growth	−0.5382467	−4.15	0.000
Density	−0.0967029	−3.65	0.000
Government spending on the environment	−6.21e-13	−0.36	0.715
_cons	70.73387	74.99	0.000

R^2 : 0.0251; Chi^2 : 27.04; Prob: 0.00.

5. Discussion

Several studies to date have shown a relationship between economic growth and environmental conditions, highlighting the need to prioritize environmental considerations in the planning process to ensure sustainable development. In this study, the first estimation model concludes that nature conservation has a negative impact on natural hazards.

This means that the environmental quality index, as an indicator of good conservation quality, contributes to the decline in the natural disaster index. Environmental changes can affect the frequency and intensity of hazards, as well as exposure and vulnerability to these hazards. Land degradation is both a cause and a consequence of rural poverty and vulnerability. Poor rural households in developing countries suffer disproportionately from land degradation. The direct impact is loss of soil organic matter, nutrients, water storage and regulation,

Table 2: Summary Statistics Result of Disasters Index Estimation

Variables	Coef.	*Z* value	*P* > |*z*|
Environmental Quality Index	−3.071036	−2.09	0.036
_cons	352.5824	3.61	0.000

R^2 : –0.3103, Chi^2 : 4.39, Prob: 0.036.

Table 3: Summary Statistics Result of Poverty Estimation

Variables	Coef.	*Z* value	*P* > |*z*|
Disasters Risk Index	−0.0951719	3.26	0.001
Growth	−0.3695073	−3.86	0.000
Government spending on social protection	−2.87e-11	−3.68	0.000
Health Index	−59.29054	−4.91	0.000
_cons	46.04034	3.60	0.000

R^2 : 0.1415; Chi^2 : 126.55; Prob: 0.000.

loss of productivity, and wildlife habitat. Low-input agricultural systems are common in poor rural areas. Environmental quality is affected by government spending on economic growth, density, and environmental performance (Figure 1).

Economic growth has a negative effect on the environmental quality index. Economic activities that have occurred so far have not fully implemented a sustainable economy. This is consistent with the study by Damayanti and Chamid (2016), who found a negative link between the environmental quality index and economic growth. This is due to various supporting economic activities, which include industrial activities, air pollution, factory, and household waste, while the lack of attention to environmental aspects causes a decrease in environmental quality. Research by Ong and Sek (2013) and Lee and Oh (2015) concluded that economic growth in the research area shows an unsustainable trend. Global warming and extreme climate change show that the relationship between economic growth and development and environmental change tends to get worse.

In addition, other factors may also contribute to the environmental quality of each region. One of the factors affecting environmental quality is population density, which has a negative impact on environmental quality. The more densely populated an area is, the lower the quality of the environment. This is supported by the results of Zuhri (2014) in Indonesia and Ahmad et al. (2005) in Pakistan. Previous studies have shown that higher population density in a region has a negative impact on environmental quality. This study shows that there is a negative relationship between population density and environmental quality. This is consistent with Zuhri (2014), who found that population density leads to increased air emissions in Indonesia. Air emissions are an indicator of local environmental quality. Further, the work of Das and Paul (2014), Gul et al. (2015), and Damayanti and Chamid (2016) also support similar findings that overcrowding increases contamination. On the other hand, government spending based on environmental functions does not affect environmental quality. However, in the long run, it is believed that government spending can minimize the impact of environmental damage, as indicated by the Kuznets curve.

According to the findings of the two studies, the better the quality of the environment, the lower the risk of natural disasters. According to ISDR (2004), the environment and natural disasters are two things that cannot be separated. Environmental degradation affects natural processes, transforms the workforce, and increases vulnerability. This has catastrophic effects, reduces overall resilience, and makes strategic response difficult. In addition, effective and economical risk reduction solutions should not be overlooked.

Several previous studies have found a correlation between natural disaster intensity and poverty. The results of the third agreement are the same as the results of previous studies. Natural disasters had a positive impact on increasing poverty. Research from Lee (2018) found that natural disasters have a negative impact on emission levels in lowland environments. In addition to the disaster index, it is influenced by several variables such as economic growth, health index, and government spending based on the social protection function.

Economic growth and poverty are closely related and one of the main themes in the current development literature.

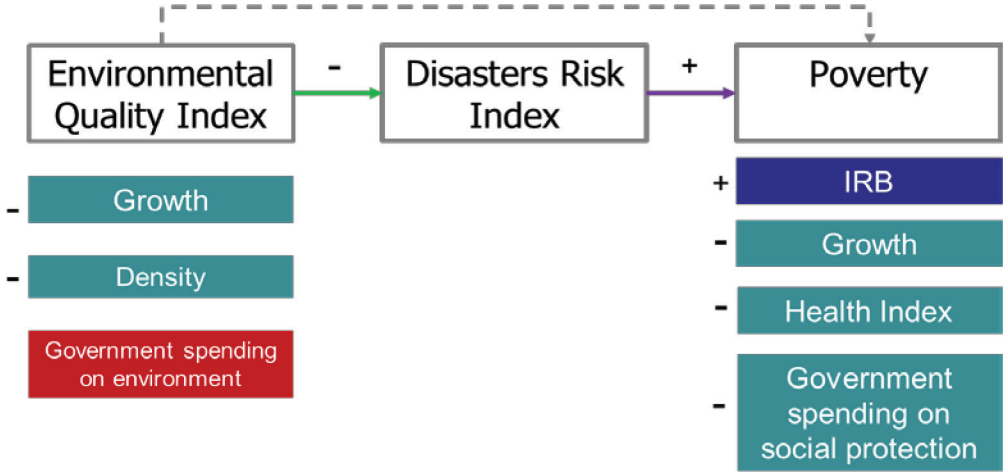

Figure 1: The Impact of Environmental on Disasters

Source: Interpretation from result estimation, 2022.

Most of the research to date has found that overall economic growth reduces overall poverty, and policymakers should consider the use of public resources and funding sources to fund public spending. We need more detailed results to make allocation decisions (Sarris, 2001). Economic prosperity can give individuals access to resources to avoid or withstand health risks (Anderson et al., 2003).

This research shows that people with higher incomes consistently get better health. Likewise, with a good health index, poverty will decrease. Government spending based on the social protection function has a negative effect on poverty. That is, the government's role can effectively help reduce poverty through several ways such as regulation and government spending. In relation to poverty, government spending is effective in reducing poverty in an area. Likewise, the results of research by Fan et al. (2004) found that government spending has an effect on reducing poverty. As a result, areas with a high level of disaster risk have a slower rate of poverty reduction than areas with a lower level of disaster risk. This is because the level of disaster risk is influenced by nature conservation which is inseparable from population development, economic activity, and the role of the government.

5. Conclusion and Limitation

This study shows the relationship between environmental preservation and disaster risk. The more vulnerable an area is to natural disasters, the higher the poverty rate in that region. To reduce poverty, we need to improve nature conservation. Improving the quality of the environment must also pay attention to efforts related to development which must consider the green economy. To improve the quality of the environment, the government needs to play a role by increasing government spending based on environmental functions, or perhaps through regulations that pay attention to the environment.

The negative impact of natural disasters on society depends on disaster mitigation and preparedness. Hazard mitigation practices are pre-crash measures that protect against casualties and damage during an accident. These include community conservation activities, land use practices, and building practices (Lindell & Perry, 2000).

This is also inherent in the government's role in promoting natural disaster preparedness measures, including pre-impact measures. These measures include setting up early warning systems, evacuation routes, information centers, and emergency shelters. Community recovery resources in the form of community support, family support, and shared feeding can also reduce hardship caused by disasters. Community support and government support can help minimize the socio-economic impact of disasters and help families accelerate the recovery process from natural disasters. This research only represents the East Java region, of course, it will be different if the model used in this study is applied to other regions. However, what can be concluded is the importance of implementing environmental sustainability in economic activities that can reduce disaster risk.

The limitations of this study include several things. first, the proxy used is represented in the variable used. Each region has a different geological and geographical structure. Disasters have short-term and long-term effects which this study has not included in its analysis. Data limitations became one of the obstacles experienced in this study. It is hoped that similar research in the future, especially regarding disaster economics, can be studied more deeply.

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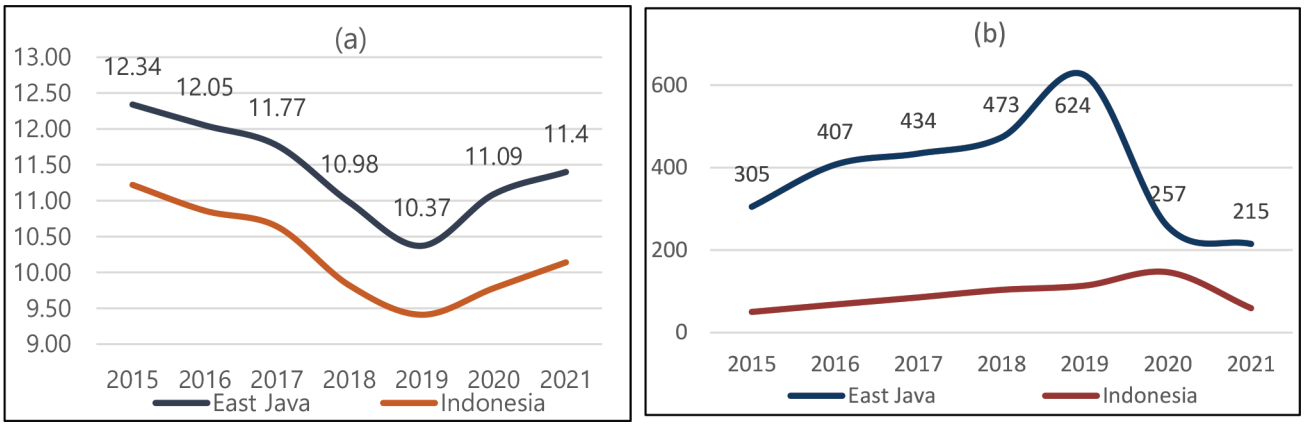
Appendixes

Appendix 1: Poverty Rate* (a) Disasters Incident** (b)



Appendix 2: Classification of Disaster Risk Index (IRBI) of East Java Province

Regency/City	2015	2016	2017	2018	2019	2020	2021	Disaster Risk Class
BANGKALAN	164,4	164,4	158,66	139,01	132,87	118,71	121	Middle Risk
BANYUWANGI	219,2	208,71	206,44	168,29	151,91	137,92	128,03	Middle Risk
BLITAR	210	210	210	198,06	178,27	160,26	154,75	High Risk
BOJONEGORO	150	104,65	101,38	96,93	93,63	90,44	94,19	Middle Risk
BONDOWOSO	166	166	166	166	150,96	128,75	116,61	Middle Risk
GRESIK	175,2	137,79	126,77	101,35	99,29	99,29	115,3	Middle Risk
JEMBER	219,2	219,2	219,07	198,8	182,18	158,19	152,63	High Risk
JOMBANG	154,8	154,8	154,8	154,8	138,4	128,55	137	Middle Risk
KEDIRI	178	178	178	163,09	144,43	131,5	127,63	Middle Risk
KOTA BATU	134,4	134,4	134,4	134,4	116,06	104,09	98,56	Middle Risk
KOTA BLITAR	132	132	132	132	118,79	106,06	108,3	Middle Risk
KOTA KEDIRI	140,8	140,8	140,8	140,8	122,79	109,69	100,84	Middle Risk
KOTA MADIUN	136	136	136	136	121,28	116,73	130,84	Middle Risk
KOTA MALANG	113,6	113,6	113,6	113,6	100,77	91,26	88,29	Middle Risk
KOTA MOJOKERTO	142,8	142,8	142,8	142,8	131,06	120,57	135,88	Middle Risk
KOTA PASURUAN	158,4	158,4	158,4	158,4	123,14	123,69	116,95	Middle Risk

Appendix 2: (Continued)

Regency/City	2015	2016	2017	2018	2019	2020	2021	Disaster Risk Class
KOTA PROBOLINGGO	148,4	140,8	148,4	148,4	129,83	114,16	108,3	Middle Risk
KOTA SURABAYA	166,8	166,8	166,8	166,8	150,34	150,34	150,35	High Risk
LAMONGAN	174	174	167,36	139,55	125,33	115,86	113,9	Middle Risk
LUMAJANG	231,2	213,2	200,76	129,74	123,84	117,76	134,73	Middle Risk
MADIUN	155,2	155,2	155,2	155,2	134,81	130,18	136,02	Middle Risk
MAGETAN	152,8	152,8	152,8	152,8	135,8	131,26	137,39	Middle Risk
MALANG	219,2	208,71	206,44	168,29	137,09	133,2	146,98	High Risk
MOJOKERTO	163,6	163,6	163,6	163,6	136,22	123,74	110,73	Middle Risk
NGANJUK	152,8	152,8	152,8	132,01	129,5	118,22	112,86	Middle Risk
NGAWI	143,2	143,2	143,2	143,2	129,5	119,98	132,3	Middle Risk
PACITAN	215,2	215,2	193,03	126,71	133,95	121,27	131,88	Middle Risk
PAMEKASAN	180,4	180,4	180,4	180,4	172,53	160,19	157,1	High Risk
PASURUAN	214	214	214	214	180,34	158,26	137,01	Middle Risk
PONOROGO	155,2	155,2	155,2	140,77	127,14	115,6	112,48	Middle Risk
PROBOLINGGO	194	194	194	162,29	156,7	141,16	139,18	Middle Risk
SAMPANG	158,4	158,4	158,4	158,4	140,94	127,19	130,59	Middle Risk
SIDOARJO	149,6	149,6	132,02	85,29	81,62	79,15	84,9	Middle Risk
SITUBONDO	168,4	168,4	168,4	168,4	149,35	128,39	114,15	Middle Risk
SUMENEP	204,8	204,8	204,8	204,8	184,62	160,35	155,93	High Risk
TRENGGALEK	198	198	198	190,91	151,25	151,25	130,29	Middle Risk
TUBAN	175,2	175,2	175,2	175,2	160,38	145	150,74	High Risk
TULUNGAGUNG	201,2	201,2	201,2	169,29	151,42	137,68	128,23	Middle Risk