Does Environmental Conservation, Economic Activities, and the Role of Government Affect Natural Disaster Risk in East Java, Indonesia?

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ARTICLE INFORMATION

ABSTRACT

Natural disaster risks are things that need to be prioritized in relation to economic activities. The intensity of disasters is getting higher and it is necessary to know what the impact will be. Therefore, this study wants to see how much influence economic activity, population development, and the government's role have on the level of disaster risk. The panel regression model is used on secondary data from 38 districts/cities from 2015 to 2021 as a database. Based on the estimation results, there are several findings in this study: (i) increased environmental preservation and the role of the government can reduce the level of disaster risk (ii) economic activity and population density leads to an increase in disaster risk. As a result, areas with a high level of disaster risk have economic activities that need to improve prospects for a sustainable green economy and population density that causes land use change. Nevertheless, the government's role in spending is felt to be able to reduce the level of disaster risk. Of course, by increasing nature conservation to reduce environmental damage.

Keywords: Disaster Risk, Economic Activity, Environmental Conservation, Government's Role.

INTRODUCTION

Unsustainable economic activity can lead to high rates of poverty and inequality. As an indicator of welfare, the problem of poverty is very complex and should be a development priority. The beginning of the emergence of the problem of poverty led to inequality of economic growth in each region. Not evenly distributed, it proves that there is still a high-income disparity between regions. This is a major problem in efforts to improve welfare indicators (Apriyanti and Mulyo, 2011). This is in line with Samiun (2021), the growth of cities and economic activities are caused by increase in the number of local and foreign residents. Hence, this condition of course have an impact on increasing land use sporadically and causing degradation.

East Java, which is part of the island of Java, has a high contribution to the national economy. Being one of the dominant provinces as a source of dynamics of the Indonesian economy. However, based on statistical data, East Java is one of the provinces with a high poverty rate. So, the issues of poverty, inequality, and inequality are critical issues to be studied in more depth for a more inclusive economy. Economic indicators can be observed from the level of economic growth in a region. Where economic growth is a measuring tool that assesses how well the economic indicators are running as represented by the value of increase in total production of services and goods. One of the factors that has not strengthened economic growth in a region is the shocks caused by the intensity of natural disasters. In line with the research of Jha, Jennifer, Priscilla, Daniel, and Stephen, (2010), natural disasters are one of the factors that disrupt the economy. Losses caused by natural disasters are not only related to life, of course, natural disasters also have an impact on economic and non-economic activities. Likewise with the high level of poverty in East Java. Empirical evidence from all regions of the world suggests that natural disasters cause measurable declines in indicators of consumption, income, and human development, and consequently focus on poor households and communities disproportionately.

The impact of natural disasters is especially evident in some of the most important human development indicators for poverty alleviation, namely productivity, health, and education. Poor communities have limited ability to protect themselves from the damage caused by natural disasters, both high-risk and widespread ones. Weak public action in natural disaster recovery in most developing countries also limits social protection for the poor. This demonstrates the importance of investing in natural disaster risk prevention and precautionary measures. In the event of a natural disaster, it may be too late to include the risk of negative feedback between the mission and the natural disaster. Thus, ensuring that financial support to improve housing and communities for the poor and incentives for natural disaster risk mitigation investments in rebuilding housing, infrastructure, and other community assets can reduce the impact of natural disasters (Ngoran, Yvette, Ngoran, & Xue, 2015).

Figure 1. Disasters Incident
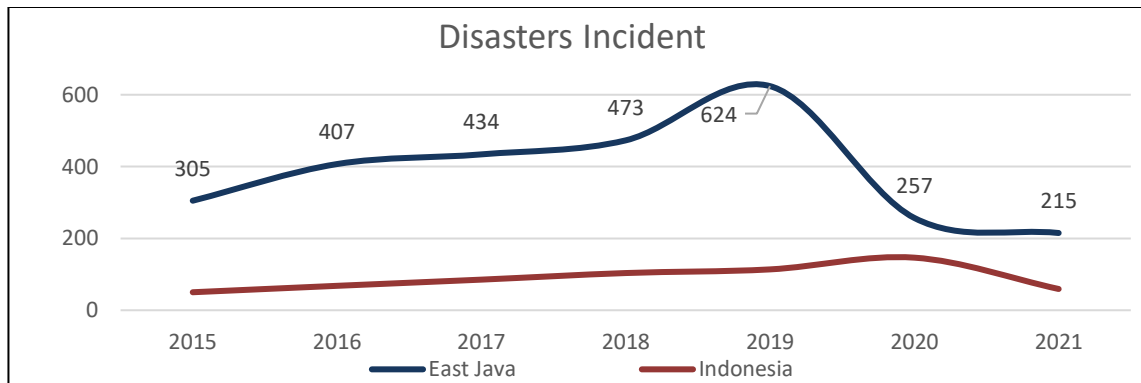
Source: BNPB (2022)

Likewise, what happened in East Java, the intensity of natural disasters in recent times has increased. Based on geographical and geological location based on the 2020 Indonesian Disaster Risk Index Calculation (IRBI), East Java Province is a moderate disaster risk province with an IRBI score of 126.42 (IRBI, 2021). BNPB data attached in Figure 1 shows the frequency of natural disasters is relatively high when compared to the national average with more than 250,000 fatalities, even though the number of natural disasters in 2019 was 624 events. In 2021, natural disasters in East Java will be dominated by tornadoes and landslides, and floods. However, apart from geographical and geological location, the high risk of disaster is also influenced by environmental degradation. The cause of environmental degradation is the low concern for nature conservation in economic activity. The high environmental degradation causes high disaster risk.

The choice of East Java Province as the location for the research center was due to the high incidence of natural disasters and economic activity, especially in regencies and cities. The first stage of this research is to assist the factors that influence the risk of natural disasters on economic activity and assist the impact of natural disasters on economic activity through several model estimates. So, it is necessary to accelerate economic recovery and poverty alleviation in terms of the impact of natural disasters. This research is expected to be a guarantee for the government to formulate disaster management policies that are parallel with improving economic activity, especially in poverty alleviation. As previously explained, there are potentially different patterns of relationship between disaster risk and economic activity in East Java. Therefore, this study wants to analyze more deeply the relationship between disaster risk and economic activity. To answer the research focus, it is necessary to test the estimation using the regression panel to answer the problem formulation in this study.

LITERATURE REVIEW

Disasters are generally described as a consequence of harm. These natural hazards then affect individuals, communities, and the environment. While natural hazards are defined as natural events that threaten the life of the property, for example, volcanic eruptions, hurricanes, earthquakes, and droughts (Dartanto, Moeis, & Otsubo 2020). Natural disasters are caused by various natural phenomena that cause environmental damage, material losses, and even death. Disaster is one of the important issues considering the potential losses that arise as a result of the disaster itself. In general, the visible impacts of natural disasters are loss of life, massive lockdowns, destruction of houses and public facilities, contaminated water and sanitation, shortage of food supplies, and disrupted road access. The indirect impacts of the disaster were increased

disease patterns and stress symptoms, loss of sources of income, increased anger, and increased poverty rates.

Natural disasters not only threaten lives or damage property, disasters can also affect people's social behavior. Salim (2002) defines social as an arrangement of social relations that place certain parties (individuals, families, groups, classes) in certain social positions based on a system of values and norms that are generally accepted. affect society. Natural disasters affect social change. Natural disasters also have social impacts, both physical and psychological. According to Rusmiyati & Hikmawati (2012), disaster victims face very complex situations and circumstances. The most common problems are physical problems.

Physical problems such as disturbances in fulfilling basic needs such as food, drink, shelter, health, and education. This is opposed to the limited availability or even the absence of public, social, and environmental sanitation facilities that are poor, causing inconvenience and can even become a source of new problems such as deteriorating health from sources of disease. Loss of property causes disaster victims to fall into poverty, especially if the source of currency in the form of agricultural land, ponds, plantations, and plantations is damaged. The loss of a family member, especially the loss of a family breadwinner often causes feelings of worry and even prolonged trauma. Assistance from various sources in the form of materials may be able to relieve and meet the physical needs of the disaster victims, but it may not necessarily be able to solve the problems that will be faced later. Losing family members, property, livelihoods, and declining health can cause mental shock to severe trauma.

However, several previous studies argue that there is no guarantee that environmental improvements will occur in tandem with improved economic growth. Studies show that rapid growth will lead to increased use of vehicles and expansion of factories will increase air pollution. The role of government through economic growth and development by looking at government spending based on environmental functions. This government regulation is an effort to overcome the influence of the external environment which is detrimental to health and standard of living. Some of these environmental degradation impacts increase vulnerability to disaster risk.

Scientists and policy makers have been trying to improve people's lives along with protecting biodiversity in the face of population growth. At one end of the puzzle lie strategies aimed at promoting development but neglecting ecological considerations, leading to loss of biodiversity, changes to landscapes, degradation of wildlife habitats, and natural disasters, leading to the destruction of global ecosystems (Sala et al 2000; Foley et al 2005). Environmental damage can disrupt the ecological balance. This naturally affects human existence. Ecological disturbances can weaken the productive capacity of nature, while human needs increase with population growth. Environmental damage is the cause of natural disasters, which have an impact on the emergence of casualties, material and psychological accidents. For example, floods, landslides, and forest fires are signs of human negligence in managing nature (Fransis, 2009). Environmental conditions change sooner or later due to various factors and their different influences. changing environmental components will affect other parts of the environment with varying degrees of intensity (Rosyidie, 2013).

In general, there is a lot of literature that examines the economic impact of natural disasters in two ways, namely by observing direct losses and indirect losses. (Okuyama, 2003; Rose, 2004; Okuyama and Santos, 2014). However, in its development, a methodology designed to make disaster impact assessments based on a three-part assessment was proposed. These components are direct damage, indirect damage, and secondary effects. The existence of a direct effect includes all fixed assets, capital, and

inventories of finished and semi-finished goods, raw materials and spare parts that simultaneously arise as a result of this direct influence, including emergency financing.

Natural disasters also cause indirect damage, the effects tend to be related to the flow of unproduced goods and services that are not available after the disaster. This indirect damage can increase operational costs due to infrastructure damage. The increase in costs is due to the provision of alternative services (alternatives in the production, distribution and delivery of goods and services). The third effect of a disaster, the secondary effect, includes the effect on aggregate economic efficiency as measured by the main macroeconomic variables (Artiani, 2011).
Natural disasters can cause very significant and intense damage to capital and labor stocks. While the damage is getting worse and more widespread, it has a damaging impact on long-term economic growth in developed regions which is still very limited (Okuyama et al, 1999). This damage becomes quite serious in the context of developing areas, even in areas with a majority of low-income people. A simple growth theory can provide useful information about the allocation of resources for disaster recovery activities. Although the effects of disasters on growth theory are able to be analyzed to offer some insight regarding the effects of disasters on growth transitions in the long run (Okuyama, 2003).

Represented by this classical economic view is actually the study of disasters that actually impede the growth and development of a country's economy. Remember that natural disasters are unpredictable, but they are events that have a real impact on the economy. Local disasters result in economic losses, including damage to local infrastructure (Hidalgo & Baez, 2019)

RESEARCH METHOD

This survey employs a quantitative survey method using panel data. Combining time series and cross-sectional data increases the number of observations. There are at least three methods available for panel data. These are common effects models, fixed effects models, and random effects models. The simplest technique for estimating panel data regression models is to perform estimation (pooling) by combining time series and cross-sectional data. This is commonly referred to as the common effects model approach. The data were combined without regard to differences between time and between individuals. In this approach, the OLS method is used to estimate the model (Sukendar & Zainal, 2007 in Caraka, 2019).

The next model is the Fixed Effect Model (FEM). This model is used to take into account the possibility of encountering a variable-eliminated problem. Then it is possible to bring about a change in the time series intercept or cross-section, by adding a dummy variable to reveal any change in this intercept. In addition, the random effects approach or Random Effect Model (REM) improves the efficiency of the least squares process by taking into account the errors of the cross-section and time series (Verbeek, 2000).

Equation of the model specification of the disaster index:

$$IRB = \beta_0 + \beta_1\ IKLH + \beta_2\ Growth + \beta_3\ Density + \beta_4\ GovSpending + \varepsilon\ldots\ldots\ldots\ldots(1)$$

Where,
IRB   : Disaster Index
IKLH   : Environmental Quality Index
Growth   : Economics Growth

Density   : Density
GovSpending   : Government spending
E   : error

To be able to answer these three equations, this model requires panel regression. This model requires panel data with time series data from 2015 to 2021 and cross-section data from 38 regencies/cities in East Java. So that 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.

RESULTS

Based on the estimation results using panel data regression, it is known that disaster risk is influenced by several factors such as environmental quality, economic growth, density, and government spending based on social functions. While the disaster 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. As for how the effect will be explained below.

Table 1. Result of Disaster Risk Quality Index estimation

Variable	Coef.	Z value	P>|z|
Environmental Quality	- .3579434	-3.54	0.000
Density	.5825412	4.44	0.000
Growth	2.068193	3.84	0.000
GovSpending	-1.27e-10	-2.05	0.041
_cons	151.4142	19.75	0.000

R^2 : 0.1635, Chi^2 : 13.95, Prob: 0.0000
Source: Estimation using STATA, 2022

The risk of natural disasters is influenced by several factors. The equation shown in Table 1 explains that disaster risk is influenced by an environmental quality which is proxied by the environmental quality index, and economic growth which reflects economic activity, population development, and the role of government based on expenditure.

First, the growth variable which is a proxy for the level of environmental conservation has a negative effect on environmental quality. The environmental quality index has a significance level of less than 1%. The coefficient value of the environmental quality index is -0.53 which means that the higher the environmental quality index is one unit, the disaster risk will decrease by 53%.

Second, the economic growth variable that reflects East Java's economic activity has a positive effect on increasing disaster risk. The significance level of the economic growth variable is less than 1%. This shows that the coefficient value of economic growth is 2.068193 which means that the higher the economic growth by one unit, the disaster risk will increase by 206.8%.

Third, the density variable as a proxy for population development shows an effect on disaster risk. The significance level of the population density variable is less than 1%.

The coefficient value of population density is 0.5825412 which means that the higher the population density of one unit, the disaster risk level will increase by 58.2%.

Fourth, the government's role is proxied by the variable government spending by function. With a significance level of less than 5%. The expenditure variable has a coefficient value of -1.27e-10 which indicates that if there is an increase in the government's role by one unit, disaster risk will decrease by 127%. The results of this study indicate the quality of the environment and government spending based on the significant risk function for reducing natural disasters. while the variables of economic growth and population density have an influence on increasing the risk of natural disasters.

DISCUSSION

The results of this study show that the better the quality of the environment, the higher the disaster risk. According to UNDRR (2004), the environment and disasters go hand in hand. Environmental degradation affects natural processes, transforms the workforce, and increases vulnerability. This will have devastating effects, reduce overall resilience and make the strategic response more difficult. Furthermore, effective and economical risk mitigation solutions should not be neglected.

Environmental protection policies have improved in response to the human-induced degradation of natural ecosystems, but little is known about their relationship to natural disasters. Seen in Viña et al. (2011) state that there is a risk that environmental quality will decline if there is degradation that can lead to natural disasters. correlating this research yields suggestions for reducing environmental impacts and ecosystem degradation and increasing incentives to participate in conservation programs that can reduce hazards.

Figure 3. The Impact of Enivonmental to Disasters
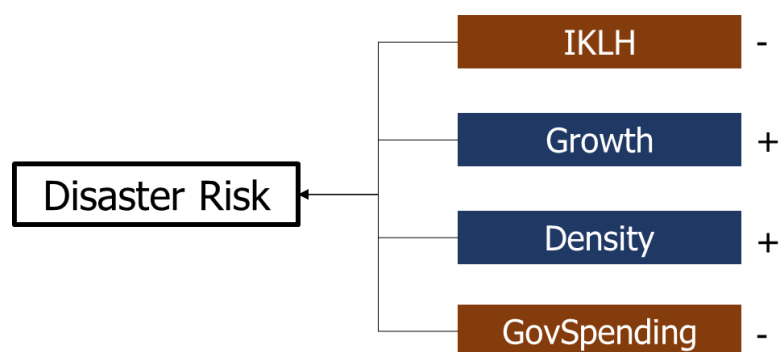
Source: Interpretation from result estimation, 2022

The results of the model estimation show that environmental protection has a negative impact on natural disasters. In other words, a high environmental quality index as an indicator of the quality of good nature conservation has an impact on reducing the risk of natural disasters. Environmental changes can affect the frequency and intensity, as well as exposure and susceptibility to hazards. Land degradation is both a cause and a consequence of poverty and vulnerability. Low-income households in developing areas suffer disproportionately from land degradation. The direct impact is loss of soil organic

matter, nutrients, and water storage and regulation, which results in loss of productivity and wildlife habitat.

Another factor that can affect the high risk of disaster is population density. Density has a negative impact on the risk of natural disasters. The denser the population of an area, the worse the quality of the environment. This is supported by Zuhri (2014), previous studies have shown that higher population density in an area has a negative impact on environmental quality. This study shows that there is a negative relationship between population density and environmental quality. This is in accordance with Zuhri's research (2014) which found that population density causes an increase in air emissions which is an indicator of environmental quality. Also, research by Das and Paul (2014); Damayanti (2016) supports similar findings that population density increases pollution. The decline in environmental quality causes environmental degradation, increases the risk of natural disasters, and also affects economic activities related to economic growth

This is because they support various economic activities such as industrial activities, air pollution, industrial and household waste, etc. Lack of consideration for the environment leads to the deterioration of environmental quality. Studies by Ong & Sek (2013); Lee & Oh (2015) concluded that research on economic growth shows unsustainable trends. Global warming and extreme climate change indicate that the relationship between economic growth and development and environmental change tends to deteriorate. According to Kuznets' environmental curve, the economy is divided into three stages: pre-industrial, industrial, and post-industrial. Damage can occur early in the branch, as observed in some previous studies. However, the reduction in pollution indicates that the economy has entered a phase of post-industrialization. The entry of technology into the economy is to make national economic activity greener by prioritizing a green economy.

Klomp & Valckx's (2014) study found a negative impact of natural disasters on short-term economic growth. The negative impact of disasters on economic growth is concentrated in developing areas and is related to disasters caused by hydrometeorological and climatic events. Several studies show that natural disasters have a negative impact on economic growth. The facts show that natural disasters can have devastating impacts at the local level. Regions have many obstacles to face economically (Bertinelli & Strobl, 2012).

Economic growth and mission are so closely related that they are one of the major themes in the development literature today. Most of the research to date has found that overall economic growth reduces overall poverty, and policymakers should use public and financial resources 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, Scrimshaw, Fullilove, Fielding, & Task Force on Community Preventive Services 2003). Natural disasters not only affect economic growth but also increase poverty.

On the other hand, the government's role in dealing with disaster risk can be represented by government spending. Government spending influences disaster risk reduction. Government spending has the effect of reducing the risk of natural disasters. This means that the role of government can help effectively reduce vulnerability to disaster impacts with a focus on coping with economic shocks. State regulation in this case is carried out in different ways. Through function-based regulation and government spending. Regarding poverty, government spending is effective in reducing poverty in the region. Similarly, the findings of Fan, Huong, and Long, (2004) argue that government spending is effective in reducing poverty. As a result, regions with high disaster risk experience

slower rates of poverty reduction than regions with low disaster risk. Disaster-prone areas can be helped by the government's effective role in coping with local impacts. This is because the level of disaster risk is influenced by population growth, economic activity, and the nature of conservation, which is closely related to the role of the state.

CONCLUSION

This study shows the relationship between environmental protection, economic activity, demographic trends, and the role of government in natural disaster risk. The more vulnerable a region is to disasters, the greater the vulnerability and economic shocks that hit that region. The study concludes that improving the quality of the environment and the effectiveness of the government's role have implications for reducing the risk of natural disasters. At the same time, unsustainable economic activity and population density increase the risk of natural disasters.

Therefore, in order to reduce disaster risk, it is necessary to consider improving the quality of the environment. Environmental quality can be improved through environmental remediation efforts to minimize degradation. On the other hand, minimizing the impact of disasters that cause economic shocks requires a role for governments in regulation and mitigation efforts. Economic activity and population density are still developing, but a green economy should be considered to reduce environmental damage.

LIMITATION

Limitations of this study include several. First, different regions have different geological and geographic structures, so calculations in other regions may lead to different disaster risk measurement results. Second, the effects of natural disasters have both short-term and long-term implications, which were not further explored in this study in terms of future analyses. Third, data limitations are one of the obstacles encountered in this study. In the future, it is hoped that similar research, especially on disaster economics, will be examined in more detail, especially with respect to points that cannot be considered in this study.

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DECLARATION OF CONFLICTING INTERESTS
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

Anderson, L. M., Scrimshaw, S. C., Fullilove, M. T., Fielding, J. E., & Task Force on Community Preventive Services. (2003). The community guide's model for linking the social environment to health. *American journal of preventive medicine*, *24*(3), 12-20. doi: 10.1016/S0749-3797(02)00652-9

Artiani, L. E. (2011). Dampak ekonomi makro bencana: Interaksi bencana dan. pembangunan ekonomi nasional. *Seminar Nasional Informatika, 1*(5), 1-8.

Apriyanti, L. (2011). *Analisis program pemberdayaan masyarakat dalam penanggulangan kemiskinan Kota Semarang (Kasus implementasi program pinjaman bergulir PNPM Mandiri Perkotaan Kelurahan Kemijen Kecamatan Semarang Timur Kota Semarang Tahun 2008-2010* (Bachelor's Thesis). Universitas Diponegoro, Semarang.

Bertinelli, L., & Strobl, E. (2007). Urbanisation, urban concentration and economic development. *Urban Studies, 44*(13), 2499-2510. doi: 10.1080/00420980701558442

BNPB. (2022). Data & informasi bencana Indonesia. Retrieved from Http://Dibi.bnpb.go.id/Desinventar/Main.Jsp

Damayanti, R. (2016). Analisis pola hubungan PDRB dengan faktor pencemaran lingkungan di Indonesia menggunakan pendekatan Geographically Weighted Regression (GWR). *Jurnal Sains dan Seni ITS, 15*(1), 7-12.

Caraka, R.E. (2019). Pemodelan regresi panel pada data Pendapatan Asli Daerah (PAD). *Jurnal Ekonomi Kuantitatif Terapan, 12*(1), 55-61. doi: 10.24843/JEKT.2019.v12.i01.p06

Dartanto, T., Moeis, F. R., & Otsubo, S. (2020). Intragenerational economic mobility in Indonesia: A transition from poverty to middle class during 1993-2014. Bulletin of Indonesian Economic Studies, 56(2), 193–224. doi: 10.1080/00074918.2019.1657795

Das, A., & Paul, S. K. (2014). CO2 emissions from household consumption in India between 1993–94 and 2006–07: A decomposition analysis. *Energy Economics, 41*, 90-105. doi: 10.1016/j.eneco.2013.10.019

Fan, S., Huong, P. L., & Long, T. Q. (2004). Government spending and poverty reduction in Vietnam. No. 103550. Retrieved from http://localhost:4000//entities/publication/98142fee-2535-5a25-912e-12b57e3e4eeb

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., ... & Snyder, P. K. (2005). Global consequences of land use. *Science, 309*(5734), 570-574. doi: 10.1126/science.111177

Fransis. (2009). *Akar krisis ekologi.* Retrieved from https://Fransis.Wordpress.Com/2009/05/04/Akarkrisis-Ekologi/

Hidalgo, J., & Baez, A. A. (2019). Natural disasters. *Critical care clinics, 35*(4), 591-607. doi: 10.1016/j.ccc.2019.05.001

Index Resiko Bencana Indonesia (IRBI). (2021). Pusat data, informasi dan komunikasi kebencanaan Badan Nasional Penanggulangan Bencana. Retrieved from https://inarisk.bnpb.go.id/pdf/BUKU%20IRBI%202021%20(PDF).pdf

UNDRR. (2004) Living with risk – a global review of disaster reduction initiatives. Retrieved from https://www.undrr.org/publication/living-risk-global-review-disaster-reduction-initiatives

Jha, A.K., Jennifer. D.B., Priscilla, M.P., Daniel, P., Stephen, S. (2010). Safer Homes, Stronger Communities: A Handbook For Reconstructing After Natural Disaster: Safer Homes, Stronger Communities: A Handbook For Reconstructing After Natural Disasters (English). Retrieved from https://documents1.worldbank.org/curated/en/290301468159328458/pdf/528390PUB0safe101Official0Use0Only1.pdf

Klomp, J., & Valckx, K. (2014). Natural disasters and economic growth: A meta-analysis. *Global Environmental Change, 26*, 183-195. doi: 10.1016/j.gloenvcha.2014.02.006

Lee, S., & Oh, D. W. (2015). Economic growth and the environment in China: empirical evidence using prefecture level data. *China Economic Review, 36*, 73-85. doi: 10.1016/j.chieco.2015.08.009

Ngoran, S.D., Yvette, B., Ngoran, S.B., & Xue, X. (2015). Circumscribing the nexus between natural disaster, water resources and poverty in Sub-Saharan Africa. *Journal of Recources Development and Management, 7*, 31-40.

Okuyama, Y., & Santos, J. R. (2014). Disaster impact and input–output analysis. *Economic Systems Research*, *26*(1), 1-12. doi: 10.1080/09535314.2013.871505

Okuyama, Y. (2003). Economics of natural disasters: A critical review. Retrieved from https://researchrepository.wvu.edu/cgi/viewcontent.cgi?article=1123&context=rri_pubs

Okuyama, M. A., Kobayashi, Y., Inouhe, M., Tohoyama, H., & Joho, M. (1999). Effect of some heavy metal ions on copper-induced metallothionein synthesis in the yeast Saccharomyces cerevisiae. *Biometals*, *12*(4), 307-314.

Ong, S. M., & Sek, S. K. (2013). Interactions between economic growth and environmental quality: panel and non-panel analyses. *Applied Mathematical Sciences*, *7*(14), 687-700.

Rusmiyati, C., & Hikmawati, E. (2012). *Penanganan Dampak Sosial Psikologis Korban Bencana Merapi. Sosio Informa: Kajian Permasalahan Sosial Dan Usaha Kesejahteraan Sosial, 17*(2), 97-110. doi: 10.33007/Inf.V17i2.96.

Rose, A. (2004). Economic Principles, Issues, and Research Priorities in Hazard Loss Estimation. In Okuyama, Y., Chang, S.E. (Eds), *Modeling Spatial and Economic Impacts of Disasters. Advances in Spatial Science* (pp. 13-36). Berlin: Springer. doi: 10.1007/978-3-540-24787-6_2

Rosyidie, A. (2013). Banjir: Fakta dan dampaknya, serta pengaruh dari perubahan guna lahan. *Jurnal Perencanaan Wilayah dan Kota*, *24*(3), 241-249

Sala, O. E., Stuart Chapin, F. I. I. I., Armesto, J. J., Berlow, E., Bloomfield, J., Dirzo, R., ... & Wall, D. H. (2000). Global biodiversity scenarios for the year 2100. *Science*, *287*(5459), 1770-1774. doi: 10.1126/science.287.5459.1770

Salim, A. (2002). *Perubahan sosial*. Yogyakarta: PT.Tiara Wacana Yogya.

Samiun, M. Z. M. (2021). Optimal island city capacity: Ternate City case. *International Journal of Applied Business and International Management, 7*(1), 46-58. doi: 10.32535/ijabim.v6i3.1440

Sarris, A. (2001). The role of agriculture in economic development and poverty reduction. Retrieved from https://documents1.worldbank.org/curated/en/649461468766828655/pdf/multi0page.pdf

Verbeek, M. (2000*), A guide to modern econometrics*. Baffins Lane-Chichester: John Wiley & Sons, Ltd.

Viña, A., Chen, X., McConnell, W. J., Liu, W., Xu, W., Ouyang, Z., … Liu, J. (2010). Effects of natural disasters on conservation policies: The case of the 2008 Wenchuan Earthquake, China. *Ambi*o, *40*(3), 274–284. doi:10.1007/s13280-010-0098-0

Zuhri, M. S. (2014). Pengaruh faktor-faktor demografi terhadap emisi udara di Indonesia. *Jurnal Ilmu Ekonomi dan Pembangunan, 14*(2), 13-37. doi: 10.20961/jiep.v14i2.9880