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The Influence of Flood Disasters on Economic Growth and Poverty in Indonesia

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Abstract

This research examines and analyzes the influence of flood disasters on economic growth and poverty in Indonesia. The study has compiled flood data from government agencies for the period of 2014-2022, especially from the Indonesian National Statistics Authority and the National Agency for Disaster Management. Using the quantitative method, this study has employed Full Generalized Least Square to analyze the flood data further and studied their impact on economic growth. Natural disasters have disrupted critical economic activities, including investment and tourism, and certainly affect employment opportunities. This study underscored the importance of strategic disaster managements that deal with social and economic issues, namely supervision and control, socio-economic strengthening, hydrological and preparedness information systems, disaster resilience infrastructure, spatial planning, and risk mapping, as well as forest and land rehabilitation. It is expected that such government interventions could enhance the reciprocal synchronization of data and the information needed, which is crucial to equalizing the components of Hazard, Capacity, and Vulnerability, especially between Ministries and institutional partners. Moreover, optimizing the analysis of regional development projections and spatial planning is necessary. It includes the use of more comprehensive data and information regarding existing disaster management programs and their implementation. By this, a comprehensive analysis can be carried out and investment needs can be identified. This also includes consideration of climate change aspects in disaster hazard analysis. There is still a need to synchronize flash flood disaster hazard data into analysis, as well as synchronize and share data between both parties for capacity and vulnerability components.

Keywords: Floods Economic Effects; Investment Disruption; Government Intervention; Comprehensive Data; Information

Introduction

Natural disasters such as floods often occur in various countries, including Indonesia. This is due to changes in climate conditions and rapid development and urbanization in many areas of Indonesia (Handayani et al., 2020). Rainfall in Indonesia is also relatively high, ranging between 2000-3000 mm per year. As a consequence, floods often occur in Indonesia during the rainy season. Among many areas in Indonesia, West Java is among the most affected provinces due to the flood. Several factors have frequently triggered considerable flooding in the province, including high rainfall, the phenomenon of high tides, forest degradation, and environmental degradation surrounding the Ciliwung River (Rahayu et al., 2023).

Therefore, all parties must work together and increase preparedness to reduce the risk of flooding. The floods that occurred in Indonesia also disrupted economic activity. Floods have a long-term impact on economic activity which is shown in economic growth (Mediodia et al., 2013). This is because floods cause loss of life and destruction of

physical capital, whereas humans and physical capital in economic growth theory have an important role in accelerating economic growth. The damage caused by floods reduces the level of fixed capital accumulation, as it limits people's capacity and willingness to invest (Bangalore, 2019). On the other hand, humans as labor input are affected by death. This condition causes a decrease in productivity and hampers economic growth.

Modeling the impact of natural disasters on economic growth can be done in various ways because disasters can impact society through various channels (Ceesay, 2020). The determinants of economic growth that are widely discussed in the literature on natural disasters include the accumulation of physical capital and human resources, technology, and infrastructure. Economic growth models such as the Solow and Romer model predict the impact of natural disasters on economic growth (Mediodia et al., 2013). Damage to human and physical resources is felt after the flood disaster. In turn, this may impact productivity, and slow down the economy. Schumpeterian economic growth theory could also imply the destruction of creativity due to natural disasters occurring and thus hurting innovation, thus slowing economic growth (Pan & Qiu, 2022).

Flooding has an impact on Indonesia's GDP performance. In 2019, the massive floods caused a loss of GDP formation of 0.037 percent, while in 2020, it was even higher about 0.088 percent, and then 0.004 percent in 2021. It encouraged greater coordination among public stakeholders, the Central Government and Regional Administration to enhance disaster management and anticipate further consequences of floods. It could be exemplified by the economic downturn due to the flood disaster in several Indonesian regencies and cities, such as Tanah Datar, in West Sumatera, and Semarang, in Central Java. In Tanah Datar, floods frequently occurred and pressured the Regional Administration to shift their budget allocation towards recovering from natural catastrophes (Utomo & Marta, 2022).

Likewise, Semarang City experienced recurrent tidal floods that affected negatively not only the environment but also its economic performance (Kusumaningsih et al., 2023). Flood disasters not only disrupt economic growth activities but cause poverty to increase. Floods which damage people's homes and cause death or injury worsen household economic conditions, so poor people experience an increase (Dube et al., 2018). The process of recovering from damage caused by flood disasters is more difficult from a position of financial difficulty, so low-income households affected by floods are also worse off, and have a greater risk of falling into poverty (Winsemius et al., 2018).

If a disaster such as a flood occurs, the gap between the rich and the poor is likely to widen, so that more people fall below the poverty line (Thye et al., 2021). Floods that occur can disrupt the performance of production equipment, resulting in a decrease in the income generated. If this happens continuously, poverty will increase (Sung et al., 2022). Shaari et al., (2016) conducted research on flood disasters in Malaysia for the period 1960-2013 which showed that floods had a significant negative effect on the manufacturing and agricultural sectors (Pan & Qiu, 2022). conducted research related to the influence of floods on economic growth in China.

The estimation results show that flooding has a significant negative effect on economic growth. Krichene et al., (2021) found different research results, because floods do not hurt economic growth, as long as policymakers accelerate handling, and macroeconomic fundamentals are not disturbed. Amarasinghe et al., (2020) conducted research with a Sub-National Level sample in India and found that floods did not have a significant effect on economic growth, in fact drought had a more significant effect on economic growth. Kawasaki et al., (2020) conducted research related to flood disasters and poverty in Myanmar. The estimation results show that flooding pushes people into

poverty. Khayyam, (2020) researched the influence of flood disasters on poverty in Pakistan. The estimation results show that flooding has a significant positive effect on poverty, and gives rise to poverty syndrome, a situation where savings and borrowing of funds are lost, which further worsens the economic situation. Bangalore, (2019) found different estimation results, namely that floods did not worsen poverty in Vietnam. Vietnam has carried out early flood mitigation and mapping of flood-prone areas, especially in slum areas. Research in Nigeria and found that floods increased poverty in rural areas, but not in urban areas (Lawanson et al., 2023). These findings are also in line with the results of research by Junior et al., (2023) which explains that the increase in poverty in Brazil is due to flooding in slum areas, not in urban areas. Based on the background and previous research that has been explained, research gaps were found which lie in differences in views regarding the transmission of natural disasters to economic growth, and the results of research estimates from previous studies.

Solow's economic growth theory explains that natural disasters will damage physical capital and the quality of human resources will decrease, but from the view of Schumpeterian growth theory, natural disasters will reduce the level of creativity, so that innovation is hampered. Furthermore, there are differences in research results from previous studies, Shaari et al., (2017), and Pan and Qiu (2022) found that floods have a negative and significant influence on economic growth, while Krichene (2021) and Amarasinghe et al., (2020) found that floods do not have a significant effect on economic growth. Furthermore, Kawasaki et al., (2020) and Khayyam (2020) found that floods had a significant positive effect on poverty, while Bangalore et al., (2019), Lawanson et al., (2023), and Junior et al., (2023) found that flooding did not increase poverty. Another research gap lies in the research sample and research period. Previous studies used different samples and periods.

Method

This study uses data from 34 provinces in Indonesia from 2014 to 2022. During this period, each province's data on flood catastrophes was relatively complete. Overall, the study used quantitative approaches to generate analysis. The study defined economic growth and poverty as the dependent variable illustrated by the Gross Regional Domestic Products (GRDP) and poverty data issued by the Indonesian Central Board of Statistics (BPS). From the same source, flood data was taken and used in this study as the independent variable. Moreover, our research also considered other controlling variables, such as labor, foreign direct investment, domestic investment, human development index, ICT, and unemployment rate. In the first stage, we employed descriptive statistics to depict some general illustrations of flood catastrophes and their economic consequences. Subsequently, we continued quantification with Full Generalized Least Squares (FGLS) to affirm the correlation among variables, especially between flood frequencies and economic performance. Furthermore, to validate the estimation results, we conducted a robustness check involving different control variables to examine their consistencies and appropriateness.

Result and Discussion

The results of these descriptive statistics draw the data used in this study, and then the results were obtained using STATA 17 software. Table 4.1. shows descriptive statistics in this study. The descriptive statistics displayed are the amount of data, average, standard deviation, minimum and maximum values. Overall, the amount of data in this study was 306. First, the GRDP variable has an average of 302,770.5 trillion, then a standard deviation of 429,420.1 trillion, with a minimum value of 19,208.8 trillion, and a

maximum value of 1,953,489 trillion. Second, the poverty variable has an average of 789 thousand people, then has a standard deviation of 1,117 thousand people, a minimum value of 40 thousand people, and a maximum value of 4,776 thousand people. Third, the flood disaster variable has an average of 31 incidents, a standard deviation of 40 incidents, a minimum of 2 incidents, and a maximum of 256 incidents. Fourth, the labor variable has an average of 3,657 thousand people, then a standard deviation value of 5,188 thousand people, a minimum value of 226 thousand people, and a maximum value of 23,453 thousand people.

Table 1. Descriptive Statistic

No	Variable	N	Mean	Deviation Stdr.	Min	Max
1	PDRB	306	302.770,5	429.420,1	19.208,8	1.953.489
2	Pov	306	789	1.117	40	4.776
3	BJR	306	31	40	2	256
4	TK	306	3.657	5.188	226	23.453
5	PMA	306	921,2	1.315,77	2	7.486
6	PMDN	306	9.622,3	14.177	3,6	89.223,6
7	HDI	306	0,714	0,417	0,5675	0,8165
8	ICT 1	306	60,38	10,46	42,75	82,37
9	ICT 2	306	38,48	18,80	40,34	85,55
10	UN	306	5,25	1,90	5,32	10,95

Information
PDRB : Gross Regional Domestic Product
POV : Poverty
BJR : Flood natural disaster
TK : Labor
PMA : Foreign Investment
PMDN : Domestic Investment
HDI : Human Development Index
ICT1 : Information & Communication Technology (Cell Phone)
ICT2 : Information & Communication Technology (Internet)
UN : Open Unemployment Rate

Fifth, the PMA variable had an average of 921.2 million dollars, a standard deviation of 1,315.77 million dollars, a minimum of 2 million dollars, and a maximum of 7,486 million dollars. Sixth, the PMDN variable had an average of 9,622.3 billion Rupiah, then a standard deviation value of 14,177 billion Rupiah, a minimum value of 3.6 billion Rupiah, and a maximum value of 89,223.6 billion Rupiah. Seventh, the HDI variable averages 0.714 points, then a standard deviation value of 0.417 points, a minimum value of 0.5675 points, and a maximum value of 0.8165 points. Eighth, the ICT 1 variable has an average of 60.38 percent, then a standard deviation value of 10.46 percent, a minimum value of 42.75 percent, and a maximum value of 82.37 percent. Ninth, the ICT 2 variable has an average of 38.48 percent, then a standard deviation value of 18.80 percent, a minimum value of 40.34 percent, and a maximum value of 85.55 percent. The ten open unemployment rate variables have an average of 5.25 percent, then a standard deviation value of 1.90 percent, a minimum value of 5.32 percent, and a maximum value of 10.95 percent.

Table 2. Result FEM-FGLS with River Flood

Variabel	ln(PDRB)	ln(POV)	ln(PDRB)	ln(POV)
	1	2	3	4
	b/se	b/se	b/se	b/se

ln(BJR)	-0.068**	0.419***	-	-
	0.028	0.05	-	-
ln(BJRS)	-	-	-0.061**	0.431***
	-	-	0.029	0.052
ln(TK)	0.760***	-	0.754***	-
	0.039	-	0.039	-
ln(PMA)	0.169***	0.100***	0.169***	0.096***
	0.017	0.033	0.017	0.033
ln(PMDN)	0.074***	0.147***	0.073***	0.150***
	0.021	0.039	0.021	0.039
TIK1	1.900**	-7.669***	1.969**	-7.629***
	0.934	1.312	0.936	1.311
TIK2	0.022***	-	0.022***	-
	0.004	-	0.004	-
IPM	-0.004**	-	-0.005**	-
	0.002	-	0.002	-
UN	-	0.04	-	0.039
	-	0.026	-	0.026
N	306	306	306	306
***,**,* signifikan pada 1%, 5%, 10%				

Table 2 shows the results of this study. The estimation results using FEM-FGLS show that the flood disaster variable has a considerable negative effect on the economic growth variable. Labor has a significant positive effect on the economic growth variable. PMA, PMDN, HDI, and ICT1 significantly positively affect the economic growth variable. ICT2 has a significant negative effect on economic growth variables. Flood disaster variables, PMA, and PMDN positively affect the poverty variable in a significant way. The HDI variable has a significant negative effect on the poverty variable. The unemployment rate variable has no significant effect on the poverty variable. Model 3 and model 4 show the results of FEM-FGLS estimation using flood variables due to river overflows.

The overall estimation results show that the signs of the coefficients in models 1 to 4 are consistent. This means that the model used in this study is robust. This study uses the flood disaster as an example. Several studies explained that large-scale flood disasters hurt economic growth in the short term. In Japan, for example, the study Ashizawa et al. (2022) revealed that floods had a robust negative effect on the manufacturing, wholesale, and retail sectors. These sectors are widely known for their contribution to the employment creation in many countries. In the United States, The Great Flood of 2019, which occurred along the Missouri River, caused significant economic losses of about US$6.3 billion, mostly in the damage to property and agriculture (Sun et al., 2022).

It was also estimated that climate change would worsen the risk of river floods. It has extensively been acknowledged that fluvial floods could have a major impact on economic losses. There remained limitations in a large-scale structural adaptation that would significantly increase economic losses globally by 17% (Willner et al., 2018). Moreover, Mediodia et al., (2013), explained that floods cause loss of life and destruction of physical capital, while humans and physical capital in economic growth theory have an important role in accelerating economic growth. The damage caused by floods reduces the accumulation rate of fixed capital because it limits people's capacity and willingness to invest.

Not limited to physical and infrastructure damages, natural catastrophes have generated negative consequences, including those related to employment. Many empirical studies have considered natural disasters a negative factor affecting employment performance. This occurs especially with businesses and industries that are prone to natural catastrophes, such as agriculture and livestock. Besides, it has also threatened many informal jobs in which poor people work. They do not have sufficient financial backup, including soft loans and credits, to overcome financial losses due to the disaster (Garzón, 2017). On the other hand, humans as labor input are affected by death. This condition causes a decrease in productivity and hampers economic growth.

Economic growth models such as the Solow and Romer model predict the impact of natural disasters on economic growth. Damage to human and physical resources occurs after a disaster occurs. In turn, this may impact productivity, and slow down the economy. Schumpeterian economic growth theory could also imply the destruction of creativity due to natural disasters occurring and thus hurting innovation, thus slowing economic growth. Endogenous growth models, which exploit increasing returns to scale in production, predict negative impacts as damage and destruction caused by natural disasters can result in low economic growth and lead to permanent deviations from normal economic growth trajectories.

Most research conducted at the national level currently reports the negative impact of flood disasters on economic growth, especially in the short term (Grames et al., 2015). Frequent disasters can create an atmosphere of uncertainty and hinder investment, thereby disrupting long-term growth prospects as well (Chhibber and Laajaj, 2008). Investment is one of the core business interests of every country in the world. Natural catastrophes could have a pessimistic psychological effect on potential investor by deciding not to invest or postponing their investment plan in the affected district (Feng et al., 2022). Thus, at the same time, investment in disaster risk reduction and management is essential for many developing countries to anticipate further potential risks due to natural disasters (Ishiwatari and Surjan, 2019).

Another illustration of negative consequences in critical economic sectors could be exemplified in the tourism sector, which has grown to become one of the strategic business sectors in the developing world. Tourism has been extensively acknowledged as an engine of economic growth that could contribute to other related and supporting industries (Rasool et al., 2021). It considerably impacts several business sectors, including hotels, travel agencies, restaurants, the handicraft industry, and art shops. Certainly, it creates more employment opportunities and other added value, especially in tourism-surrounded areas (Ernawati, 2019). In many countries, disaster has a long-run effect and disrupted tourism growth for five consecutive years.

This causes economic activity to slow down in Dominica (a small island in the Caribbean), because tourism contributes around 35% to economic performance (Chen et al., 2020). The estimation results in this study show that flood disasters have a negative and significant impact on economic growth in Indonesia. These results mean that the floods that occurred in Indonesia hampered economic growth performance. The flood coefficient is -0.068, meaning that an increase in flood events in Indonesia by 1% will cause economic growth to decrease by 0.068 percent. Ceteris paribus assumption. The results of this study are in line with research by Pan and Qiu (2021) who conducted research in China in 2003-2019.

The estimation results show that flooding has a significant negative effect on company performance in China. Panwar and Sen (2019) conducted in India with 24 regions from 1990-2015. The estimation results show that floods hurt growth in the short term in all economic sectors except the agricultural sector, where the impact is considered

positive. Parida et al., (2021) conducted research in India. Shaari et al., (2017) conducted research on flood disasters in Malaysia for the period 1960-2013 which showed that floods had a significant negative effect on the manufacturing and agricultural sectors. Floods that occur due to extreme rainfall in several areas have become an obstacle to Indonesia's economic growth. For provinces whose main sector is the agricultural sector, the flooding phenomenon that has occurred in these areas has disrupted the productivity of the agricultural sector, because many areas have failed to harvest. During the flood season, agricultural land will be submerged in water for quite a long period. This condition can damage plants, causing crop failure. This crop failure could reduce the supply of food in Indonesia. If the supply of food decreases, while demand and people's needs remain high, this will result in an increase in food prices in the market and a threat to food security. Apart from that, farmers also have to deal with diseases and pests that live in swamp areas or rice fields.

This forces farmers to postpone planting time until the floods recede. This disaster also resulted in a reduction in the amount of agricultural land in Indonesia. Tidal floods have inundated agricultural land, especially in the northern coastal areas of Java, so that the land can no longer be used. According to World Bank data (2022), approximately 34% of Indonesia's population is classified as poor and vulnerable. When there is an increase in food prices, people with low incomes will find it difficult to get food commensurate with their income, so that people's welfare decreases and they even have the potential to experience hunger and malnutrition. Rising food prices will also be detrimental to farmers producers and traders. If food prices continue to rise, people's purchasing power will also decrease. As a result, farmers and traders will suffer losses. This condition is hampering the slowdown in economic growth. Floods also have an impact on the trade sector. The flood paralyzed trade in various types of goods such as electronics, clothing and food and drinks because several trade centers were affected by the flood, causing traders to complain. As a result of the flooding, many stall traders complained that the flood had closed their shops, so they could not sell, and some of their equipment had even been damaged by being submerged in water. This condition has an impact on decreasing the contribution of the trade sector.

Floods also have an impact on the industrial sector, especially small and medium industries which suffer the most losses due to the floods. Due to flooding, many are not operating. Products that are damaged due to being submerged in water, disrupted distribution or delivery, and hampered consumer access. Workers are asked to stay at home for the time being. If this happens continuously, it will hurt economic growth in Indonesia. People as consumers also have difficulty getting various needs and disrupt business activities. This condition hampers economic growth. Therefore, there needs to be serious and integrated planning so that flooding problems do not disrupt the industrial climate. Floods are one of the disasters that can cause poverty to increase.

This study aims to analyze whether flooding in areas of Indonesia causes more poverty. Floods cause losses in the form of loss of livelihood and reduced income due to submergence of productive land (Felbermayr and Gröschl, 2014). Various studies show a link between disasters and increased poverty. These studies found that poverty in Indonesia is a dynamic phenomenon because a person or household can enter or exit poverty at certain times due to certain conditions. Floods which hurt damage to people's homes and cause death or injury worsen household economic conditions, so poor people experience an increase (Dube et al., 2018). Winsemius et al., (2018) added that the recovery process from the damage caused by flood disasters is more difficult from a position of financial difficulty, so that low-income households affected by floods are also worse off, and have a greater risk of falling into poverty.

Revealed that if a disaster such as a flood occurs, the gap between the rich and the poor is likely to widen, so that more and more people fall below the poverty line (Thye et al., 2021). Floods that occur can disrupt the performance of production equipment, resulting in a decrease in the income generated. If this happens continuously, poverty will increase (Sung et al., 2022). The results of this estimation mean that the floods that occurred in parts of Indonesia pushed people into poverty. The results of this study are in line with research by Ridzuan et al., (2020) which states that poor people are more affected by floods than rich people, thereby widening the income gap in society. This will have an impact on the 2030 vision of shared prosperity in Malaysia which focuses on reducing income gaps and increasing community welfare.

Lawanson et al., (2020) conducted research in Nigeria and found that floods increased poverty in rural areas, but not in urban areas. These findings are also in line with the results of research by Junior et al., (2023) which explains that the increase in poverty in Brazil is due to flooding in slum areas, not in urban areas. Khayyam (2020) researched the influence of flood disasters on poverty in Pakistan. The estimation results show that flooding has a significant positive effect on poverty, and causes poverty syndrome, loss of savings, and borrowing of funds which further worsens the economic situation. Attempted to measure the impact of flooding in West African countries (Bazhal, 2019). The research notes that floods can harm communities and cause more poverty.

Schilirò (2017) examined the impact of flooding on poverty on rural development in the Northern Province in Zimbabwe using qualitative methods. The empirical results of this research reveal that floods hinder development through four main channels consisting of human population movement, destroying crops, collapsing buildings, and disturbing livestock and subsequently have an impact on increasing poverty. Thye et al., (2021) based on empirical results that disasters such as floods cause the gap between the rich and the poor to likely widen, resulting in increasing poverty. Suyanto (2017) stated that flood disasters that hit disaster-prone areas often cause poor families to experience various things that threaten business continuity and social life.

Therefore, climate change mitigation needs to be directed at the poor and vulnerable to poverty. The World Bank (2022) describes the effects of high rainfall which increasingly threatens poor communities in Indonesia. People who are classified as poor will increasingly fall into poverty if there is an increase in food prices. Apart from that, the majority of Indonesia's population still depends on income from natural products. If a flood disaster occurs, the reduction in agricultural land and crop damage will cause food prices to increase. Farmers' income has also decreased. Under these conditions, poor and vulnerable people have difficulty buying food. Floods make poor people vulnerable to diseases such as malaria and diarrhea.

The emergence of various diseases will also burden family expenses and reduce income due to reduced work days due to illness. Poor people always try to revive their lives. Poor people who are affected by floods take various savings measures, then sell small businesses, work as small craftsmen such as casual laborers, or even migrate, perhaps also asking relatives for help. Therefore, the distribution of various emergency services, in the short term, is indeed needed by poor families who are forced to flee because their homes are no longer suitable and their businesses have collapsed due to flooding. However, in the future, what the state should offer is not enough. distribution of aid that is charitable, simply carrying out emergency response steps (Suyanto, 2017).

Conclusion

Flood disasters have caused many losses over the past few years. The amount of this loss varies in each province depending on the number of flood disasters that occur.

Provinces that have high economic income and high human resources will have the ability to recover more quickly due to large resources to support flood disaster management, but provinces that have low economic income and low human resources will have difficulty in handling disasters. floods faced. To take appropriate policies, empirical studies are needed to analyze the impact of flood disasters on gross regional domestic product and poverty levels. The focus of this research is how flood disasters affect GRDP and poverty levels. This study concludes that the results of research on the influence of changes on GRDP show that flood disasters have a negative influence on GRDP, causing a decline in GRDP in Indonesia. The results of research on the influence on poverty levels show that flood disasters hurt poverty, where every flood disaster event causes an increase in poverty.

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