Determination of Climate Factors in Flood and Drought Disaster in Indonesia Using Variable Instrumental Methods

by Faradiba 1

Submission date: 29-Jan-2021 02:17PM (UTC+0700)
Submission ID: 1496879194
File name: EN_Tulis_2901.docx (802.96K)
Word count: 2034
Character count: 10537

Determination of Climate Factors in Flood and Drought Disaster in Indonesia Using Variable Instrumental Methods

Faradiba

Abstact

Located in the Southeast Asia region, Indonesia has rainy and dry seasons. The peak of the rainy and dry seasons often creates a number of problems in the community, including floods and droughts. It is known that the disaster will have an impact on material and non-material losses. This study uses climate data and disaster data at the village level, to determine the effect of rainfall on disasters that occur. This study uses the instrumental variable method, because the model has endogeneity problems. The results of the study concluded that increased rainfall had a positive impact on flood disasters with a coefficient of 0.003038; and simultaneously rainfall also has an impact on drought with a coefficient of -0.000377. Government and community efforts are required to anticipate similar disasters.

Key words: climate; Natural disasters; Instrumental variable

1. Introduction

Flanked by two oceans, namely the Pacific Ocean and the Indian Ocean, Indonesia has two climates every year. The rainy season ranges from October to March, and the dry season from April to September (Mau, 2018). Indonesia's geographical conditions greatly affect the climate conditions that occur, especially with the issue of global warming (Faradiba, 2018; Laksmana, 2011; Marfai & King, 2008).

Extreme climatic conditions in Indonesia often disrupt community activities, thus impacting government programs. Disasters that occur due to extreme weather during the rainy season include floods. Meanwhile, the disaster that often occurs during the dry season is drought (McSweeney & Coomes, 2011; Mitchell et al., 2010; Rahman, 2013). The two disasters were basically greatly affected by the rain that occurred, and were opposites.

In a flood disaster, it can be triggered by several natural factors, including prolonged heavy rains, silting rivers, and high tides. (Chatterjee, 2010; Manawi et al., 2020; Trysnyuk et al., 2018). In addition, flood disasters can also be triggered by human actions, such as littering into waterways. In a short time this may not cause significant harm, but the behavior of littering that is carried out by many people and carried out continuously will cause disaster.

In contrast to floods, during the dry season Indonesia is often hit by drought. Drought is caused by a lack of rain intensity that flushes an area (Potts, 2003; Rouault & Richard, 2003). In addition, drought disasters can also be prevented through "loving the environment" behavior, by creating greenery around the house (Ryan, 2011). When this behavior is carried out by the whole community, the natural ecosystem will tend to be better preserved.

Flood and drought disasters are frequent disasters in Indonesia, which are directly caused by the intensity of rainfall (Asy'ari, 2018; Pratiwi & Nugraha, 2016). Disasters that occur will cause material and non-material losses, such as damage to houses, casualties, wounded victims, even a few disasters will cause poverty and disrupt regional development (Cherniack, 2008; Panwar & Sen, 2019; Toya & Skidmore, 2007).

Based on previous research, it is known that climate affects natural disasters (Banholzer et al., 2014; Benevolenza & DeRigne, 2019; Van Aalst, 2006). Previous research has used data at both the state and provincial levels. In this study, using data at the village level, the effect of rainfall on floods and drought in Indonesia will be known.

2. Methodology and Data

The data used in this study is the raw data from the 2018 PODES data collection, which describes the conditions of flood and drought disasters at the village level in the 2015 to 2017. The PODES data collection is organized by BPS and is specifically designed to collect data that can describe conditions in rural areas and urban villages, as well as preparing the upcoming census through the collected data and information.

The unit of analysis in this research is definitive villages and sub-districts according to the following provisions: (i) there is a village / kelurahan area with clear boundaries, (ii) there are residents who live in the village / kelurahan area, (iii) There is a village / kelurahan government (BPS, 2018). The number of observations used in the study was 83,931 villages.

This study uses rainfall data as a variable of interest. The instrument variables in this study were wind speed, humidity, and temperature. This study also uses several control variables, namely villages bordering the sea, villages in forest areas, water pollution, soil pollution, and air pollution.

This study uses the instrumental variable method, because the model that is built has an endogeneity problem. Wooldridge (2016) states that instrumental variable analysis is used to overcome the problem of endogeneity. The OLS estimator will be biased and inconsistent if an important variable is not included in the model. Suppose there is a simple regression equation like the following:

$$y = \beta_0 + \beta_i x + u \quad (1)$$

with x and u correlated or $Cov\ (x, u) \neq 0$, hence the OLS method cannot be used. This is known as endogeneity. Order an estimator β_0 and β_1 consistent when x and u correlated, then additional information is needed by adding new variables that fulfill certain properties. The new variable (say z) must meet two assumptions, namely: (i) Variable z uncorrelated with u or $Cov\ (z,u) = 0$. This assumption is called the exogeneity instrument; and (ii) Variable z correlated with x or Cov $(z,x) \neq 0$. This assumption is called the relevance instrument.

In this case, the variable z is called the instrumental variable for the variable x or the instrument for the variable x. Furthermore, the variable x which is said to be an endogenous variable raises the following regression equation:

$$x = \pi_0 + \pi_i x + z + v \quad (2)$$

Gujarati dan Porter (2009) said that the IV method is carried out in two stages. The first stage is to regress equation 2 and predict the value of the variable x which is denoted by

$\hat{x}$. The second stage is to enter the variable value $\hat{x}$ into equation 1 and perform regression using OLS. This second stage estimate is an estimator from method IV which is consistent and unbiased.

3. Results and Discussion

There are differences in position, causing differences in climate in Indonesia. From Figure 1, it is known that the rainfall on Kalimantan Island is the highest, while Java Island has the highest wind speed. In addition, Kalimantan Island is an island that has high humidity, and Java Island has a high temperature. Apart from different geographical positions, regional characteristics (such as population density, regional economy, and the main source of income for the community) can also influence climatic conditions that occur in an area.

From the results of regression calculations using the instrumental variable method, in Table 1 it is known that rainfall has a positive effect on flood disasters as well as a negative effect on drought disasters. These results are in line with previous determinations (Ralph et al., 2003; Verschuren et al., 2000). This indicates that the variable of rainfall, such as two blades. In the dry season, high rainfall is needed for the source of life for the community. The existence of a prolonged dry season causes people to have to try to get clean water. This business can take the form of fetching water that is located further away, or having to pay for water. This condition must be done because water is a basic need for households.

The overall result of the calculation using the instrumental variable method is greater than the calculation using the ordinary least square method. This is in accordance with the theory presented, that the instrumental variable method will solve the endogeneity problem and if traced the coefficient formed will be greater than the ordinary least square method (Wooldridge, 2016).

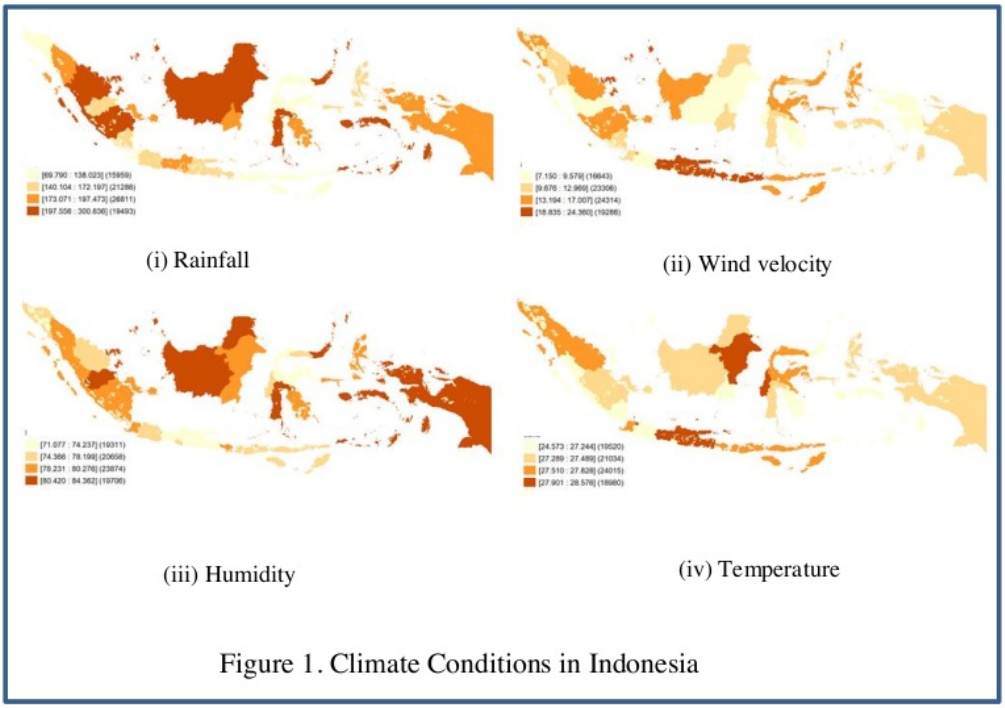


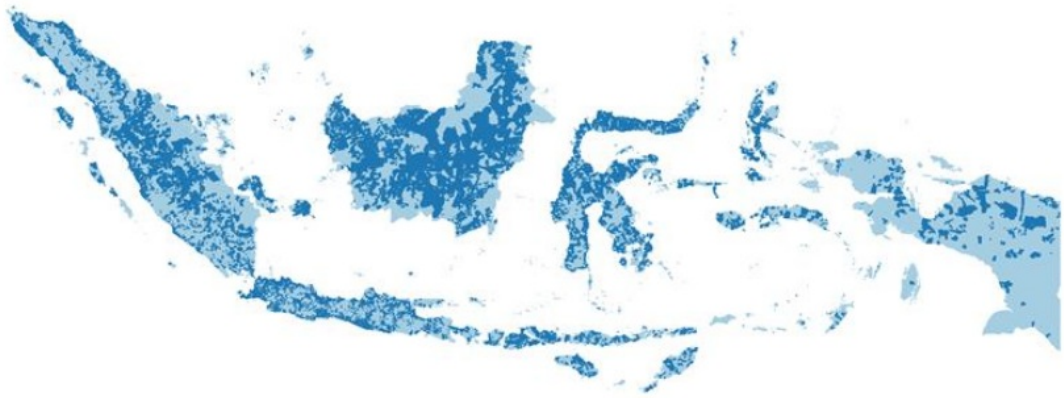
Figure 1. Climate Conditions in Indonesia

Table 1. Overall OLS and IV estimation results on the number of floods and droughts during the 2015-2017 period

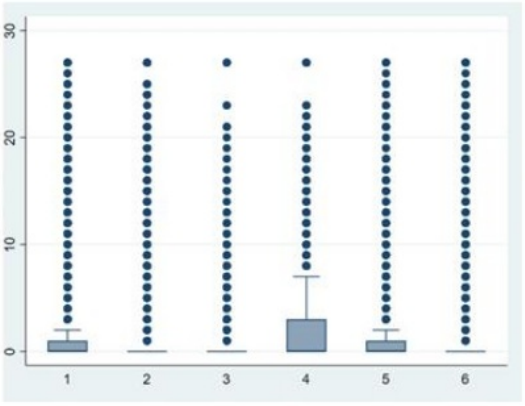
Description	Floods		Droughts	
	OLS	IV	OLS	IV
Rainfall	-0.000084	0.003038***	-0.000369***	-0.000377***
Control Variabele	Yes			
Instrument Variable	No	Yes	No	Yes
R^2	0.0205	0.0174	0.0059	0.0059
Observation	83,931			

Note: Notation level of significance *** p <1%.

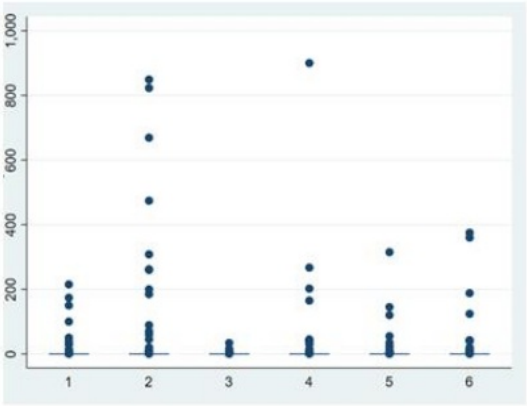
From Table 1 it can be interpreted that the variables in the regression model that are formed can explain 1.74 percent of the flood disaster and 0.59 percent of the drought disaster. These results indicate that there are most other variables that can influence the occurrence of floods and droughts. Other things that can affect these disasters include the role of local governments in controlling extreme weather and community behavior in protecting the environment (Porter et al., 2015).



(i) The existence of a flood disaster



(ii) Number of floods



(iii) Number of fatalities due to floods

Note : 1. Sumatera
2. Jawa
3. Bali and Nusa Tenggara
4. Kalimantan
5. Sulawesi
6. Maluku and Papua

Gambar 2. Kondisi Bencana Banjir di Indonesia

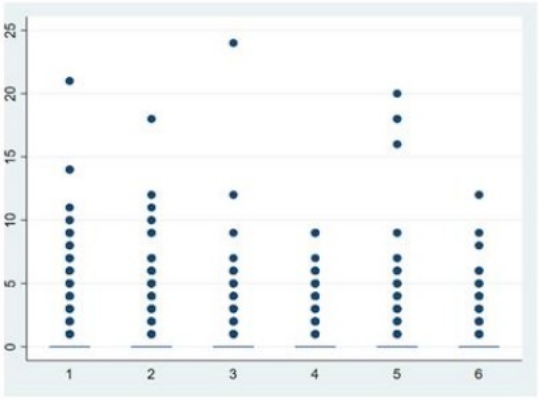
Based on Figure 2, it is known that villages in Papua Island tend to experience a few flood disasters, in contrast to other islands that experience flooding in almost all regions. This is in accordance with the condition of the land on the island of Papua which is still natural, so that water absorption can function optimally (Kurika et al., 2019; Vines, 1970). In addition, the level of population density is still relatively low, resulting in the availability of large water catchment areas. When viewed from the number of casualties, the islands of Java and Kalimantan have a record number of

casualties. This can occur due to the high population density in the area, so that the drought has a big impact. Based on Figure 2 it can also be seen that Kalimantan Island has a history of flood disasters during the last 3 years, mostly in the range below 3 events for each village experienced it. This number is relatively evenly distributed in most of the villages in Kalimantan Island which were hit by the flood.

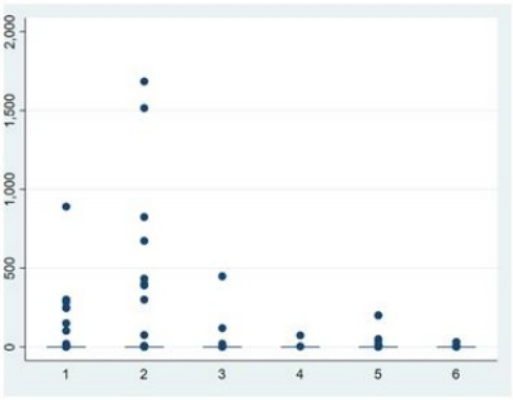
Based on Figure 3, it is known that villages in Maluku and Papua islands tend to experience a few drought disasters, in contrast to other islands that experience drought in almost all regions. This is in accordance with the condition of the land on the island of Papua which is still natural, so that water absorption can function optimally. In addition, the level of population density is relatively low, resulting in the availability of groundwater sources that can meet the needs of local communities. When viewed from the number of casualties, Java Island has a record of many victims. This can occur due to the high population density in the area, so that the drought has a big impact. Based on Figure 3, it can also be seen that the islands of Bali and Nusa Tenggara, Sumatra, and Sulawesi have a history of drought during the last 3 years with more than 20 drought disasters.

Efforts are needed to resolve the annual disasters that often hit villages in Indonesia. The government needs to work with local communities to reduce and even eliminate these disasters. Disasters caused by high or low rainfall cannot be regulated, but mitigation to anticipate disasters needs to be made to minimize material and non-material casualties. Education related to the environment is also needed to increase public insight about the importance of the environment in the source of life. In the short term the disaster may not yet be seen, but the disgraceful behavior of the community will cause a disaster in the long term (Sadiq & Noonan, 2015). Community behavior that can cause climate disruption, among others, is pollution due to business activities, burning fields, use of air conditioner, and the cessation of the culture of planting trees in the yard.

(i) The existence of a drought disaster



(ii) The number of drought disasters



(iii) The number of fatalities due to drought disasters

Note : 1. Sumatera
2. Jawa
3. Bali and Nusa Tenggara
4. Kalimantan
5. Sulawesi
6. Maluku and Papua

Figure 3. Drought Disaster Conditions in Indonesia

In this study, the climate variable is still used at the measurement station level, which is limited in number at the provincial level. It is hoped that future studies can use climate indicators at the village level, so that the analysis can be more representative.

4. Conclusion

Disasters caused by natural factors often cause harm to society. These events usually occur periodically yearly. The results of this study indicate that areas that have high interaction, mobility, and population have a relatively high incidence of disasters. This is caused by disruption of the environmental ecosystem, which results in disasters. From the analysis of rainfall, it is known that an increase in rainfall has a positive impact on flood disasters, and simultaneously rainfall also has an impact on drought. Government and community efforts are required to anticipate similar disasters.

Determination of Climate Factors in Flood and Drought Disaster in Indonesia Using Variable Instrumental Methods

ORIGINALITY REPORT

1%	1%	0%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	bksptnbarat.org Internet Source	1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		