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THE IMPACT OF CLIMATE DISASTERS ON POVERTY VULNERABILITY OF RURAL HOUSEHOLDS IN EAST JAVA PROVINCE 2016

Dian Priastiwi
Universitas Diponegoro

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E-mail:
dianpriastiwi@gmai.com

ABSTRACT

The study aims to analyze the effect of climate disasters on the vulnerability rural households to poverty in East Java. Vulnerability is defined as probability of a household becoming poor on the future by using the per capita expenditure function of the household. This approach will produce a household vulnerability to poverty score that is used to analyze the effect of climate disasters on vulnerability to poverty. The results, it is known that East Java province has a very low average score of poor vulnerability (vulnerability to poverty score of VEP < 0,5). Sidoarjo regency and Surabaya city are the regions with the lowest poor vulnerability rate in East Java province, while the highest poor vulnerability rate is in Bangkalan Regency. The variable of flood disaster has an impact on the vulnerability of poor households, while landslide and tornado events have not been proven to affect the vulnerability of poor households in East Java province.

1. INTRODUCTION

Climate Change has become a global issue that receives serious attention from countries worldwide, as reflected in their commitments to minimize the impacts of climate change through the Paris Agreement. The primary agenda agreed upon is to prevent global temperatures from rising more than 2 degrees Celsius. The average annual air temperature trends and average air temperature anomalies during the period 1981-2020 indicate a tendency towards an increase, with the warmest year recorded in 2016.

The World Meteorological Organization (WMO) has stated that the average temperature in 2016 was the hottest on record, with an anomaly of 1.2°C above the normal temperature (average for the period 1981-2020). Observations by the Indonesian Agency for Meteorology, Climatology, and Geophysics (BMKG), using data from 89 stations, indicate that the normal air temperature in Indonesia for the observation period of 1981-2020 was 26.6°C, and in 2016, it reached 27.4°C. The increase in average temperatures in the atmosphere, oceans, and land leads to changes in climate variability and an increase in the intensity of extreme weather events.

Disasters are associated with climate variability because they cause unpredictable and volatile fluctuations in rainfall, often resulting in both droughts and floods (Purboningtyas et al., 2018). The National Disaster Management Agency (BNPB) stated that in the year 2016, nearly 92 percent of disasters were climate and weather-related, with floods, landslides, and tornadoes being the most dominant. There were 766 flood incidents, 612 landslide disasters, 669 tornado events, as well as 178 forest and land fires in 2016. Additionally, there were 7 volcanic eruptions, 13 earthquakes, and 23 instances of high tides and coastal erosion. BNPB further noted the absence of a clear dry season, with only a wet dry season that led to increased occurrences of floods, landslides, and tornadoes, even during the peak of the dry season.

According to BNPB data, at least 47,798 houses were damaged, 1,484 educational facilities were damaged, 232 health facilities were damaged, and over three million people suffered and were displaced. Findings from the Intergovernmental Panel on Climate Change (2014) illustrate that changes occurring in the climate over time can pose a serious threat to human health, global food security, and economic development. The increased frequency and severity of extreme weather events due to global warming result in property and infrastructure losses. According to the WMO Atlas of Mortality and Economic Losses from Weather, Climate, and Water Extremes (1970-2019), economic losses due to climate disasters reached $3.64 trillion, with the most impactful events being storms ($521 billion) and floods ($115 billion).

In 2016, East Java province became the second province with the highest temperature anomaly after North Sulawesi, with a temperature anomaly of 2.2°C above the long-term average. It also experienced the second-highest number of disaster occurrences after Central Java province, with a total of 419 events, the majority of which were climate-related. Among these events, there were 146 flood incidents, 135 tornado

incidents, 103 landslide incidents, and 11 drought disasters (2016 Disaster Data, BNPB). As a result, approximately 10,960 hectares of agricultural land were affected by floods, while 11 hectares of land were affected by drought in East Java province. These impacts can lead to vulnerability, particularly for rural households that rely on agriculture.

Pritchett et al. (2000) and Chaudhuri et al. (2002) presented measurements of poverty vulnerability and poverty using an expected poverty approach. The publication "Keadaan Angkatan Kerja" by the Central Bureau of Statistics (BPS) mentions that the agricultural, forestry, hunting, and fishing sectors still serve as the main employment fields in East Java province, with approximately 6.98 million people or 36.49% of the population working in this sector. Natural disasters directly impact crop production and the livelihoods of farmers, posing a threat to their sources of income and living conditions. This easily pushes non-poor farmers into poverty and those who have escaped poverty back into poverty (Lu et al., 2022).

Rural areas have a higher proportion of the population working in the agricultural sector compared to urban areas. About 5.53 million people, or approximately 77.1% of the total workforce in the agricultural sector, are located in rural areas. However, there is still a significant disparity in poverty levels. The poverty rate in urban areas of East Java province was recorded at 7.91%, while the poverty rate in rural areas reached 11.85% in 2016. This indicates that the average expenditure gap between the poor population and the poverty line in rural areas is relatively larger than in urban areas. A study by Skoufias et al. (2000) found that in Indonesia between 1997 and 1998, 16% of rural households moved from non-poor to poor, but four percent of households managed to escape poverty. The proportion of the population that is poor and vulnerable to poverty remains much higher in rural areas than in urban areas (Suryahadi and Sumarto, 2001). One contributing factor is that the majority of rural workers rely on the agricultural sector as their primary source of livelihood.

The study by Purboningtyas et al. (2018) states that flood disasters result in agricultural land being inundated, while the adverse impacts of climate variability, such as the occurrence of droughts, damage agricultural land, leading to failed harvests and reduced agricultural production. This situation creates vulnerability for farming households. In line with the study by Maganga et al. (2021), which mentions that drought, floods, and erratic rainfall worsen poverty, drought has the greatest impact on the loss of well-being for farmers.

In support of the above, the study by Patankar and Patwardhan (2016) explains that the floods in 2005 not only resulted in the direct loss of household assets but also led to income loss and significant expenditures for house repairs or reconstruction. Additionally, the findings of the study by Lu et al. (2022) indicate that poverty vulnerability can shift from positive to negative when disaster resilience capacity is enhanced. This can be achieved by improving the farmers' coping capacity to address the negative impacts of disasters.

Svetlana et al. (2015) state in their study that regular annual floods provide a water resource for household supplies, irrigation, and industrial purposes. Some of the most important benefits of floods are related to the maintenance of biodiversity in floodplain ecosystems (Smith and Ward, 1998). Additionally, many river overflows carry minerals and nutrients that support agricultural production in floodplains (Svetlana et al., 2015).

Vulnerability arises due to a combination of factors, including physical, social, and politico-economic processes and events (Ribot et al., 2005). To determine the impacts of climate (Skoufias et al., 2020) in their study used estimates of wind speed combined with the Household Income and Expenditure Survey at the barangay level (the smallest administrative unit in the Philippines). Household consumption expenditures were then regressed against wind speed (or a related damage index) and the socio-economic characteristics of the households.

The results of the study by Skoufias et al. (2020) indicate that compared to chronically poor households, those vulnerable to poverty are slightly older, have a higher proportion of female-headed households, and generally have higher levels of education (mostly secondary school graduates) and access to electricity. Similar findings from the study by Rahman and Wulansari (2018) show that approximately 68.75 percent of vulnerable households have low-educated heads of households, with education levels below elementary school. In fact, around 60 percent of households classified as vulnerable to poverty still rely on the primary sector, particularly agriculture, as certain skills are not required for this type of work (Rahman and Wulansari, 2018).

Based on this background, the research aims to analyze the impact of climate disasters on the vulnerability of rural poverty in East Java Province. Rural areas are more susceptible to the effects of climate variability, considering that the majority of primary livelihoods are in the agricultural sector. According to the World Bank report (2016), agriculture is one of the sectors with high sensitivity to climate change, given

its dependence on weather conditions, both directly and through climate-related stressors (such as pests, epidemics, and sea-level rise). The study also takes into account the determination of poverty vulnerability not only based on monetary factors, such as per capita expenditure, but also considers household characteristics.

2. METHOD

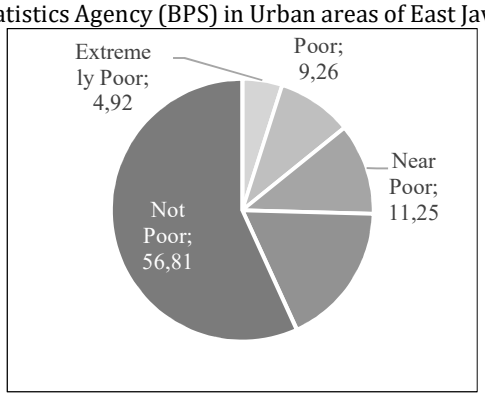
The research utilizes household data from the East Java Province obtained from the National Socioeconomic Survey (Susenas) in 2016. The total number of households in East Java in 2016 was 10,797,300, while this study uses a sample of 29,477 household data without weighting. The Vulnerability as Expected Poverty (VEP) method is employed to determine the poverty vulnerability indicators, and the analysis is conducted using Stata 14 software. This method considers vulnerability as the expected poverty, which means estimating the likelihood of individuals falling into poverty within a certain time frame, given the current conditions (Fujii, 2016). The VEP method is employed to determine the poverty vulnerability indicators by incorporating non-monetary factors (in contrast to the Central Statistics Agency's approach that uses per capita expenditure data compared to the poverty line).

The approach begins by regressing the natural logarithm of household per capita expenditure with household characteristics. The three-step Feasible Generalized Least Squares (FGLS) mechanism is then applied, resulting in estimated values that are used to calculate the probability of a household falling into poverty (Rahman and Wulansari, 2018). The poverty vulnerability indicators for each household are subsequently utilized to analyze the impact of climate disasters, specifically flood events, landslides, and tornadoes, on household poverty vulnerability. The poverty vulnerability indicators for each household are subsequently utilized to analyze the impact of climate disasters, specifically flood events, landslides, and tornadoes, on household poverty vulnerability.

3. RESULT AND DISCUSSION

Central Bureau of Statistics (BPS) determines the categorized population as poor based on monetary factors only, specifically if individuals have an average per capita monthly expenditure below the poverty line. BPS data shows that in 2016, East Java Province had a poverty rate of 11.85%, which is higher than the national average of 10.70%. East Java Province also contributed the highest number of categorized poor population compared to other provinces. As a comparison, in 2016, the number of poor people in East Java was 4,638,530 individuals, while North Kalimantan had the lowest number of poor people, which was 47,030 individuals.

The poverty categories based on the Central Statistics Agency (BPS) in Urban areas of East Java.



The poverty categories based on the Central Statistics Agency (BPS) in Rural areas of East Java.

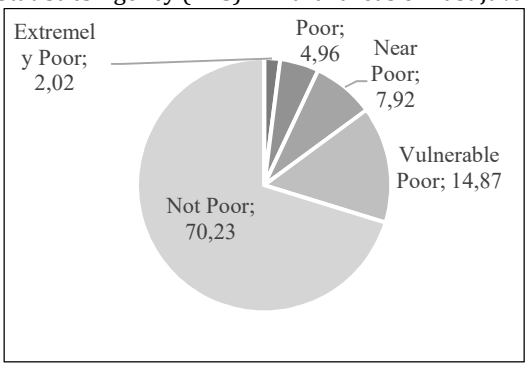


Figure 1. Comparison of Household Poverty Categories in East Java Province According to the Central Statistics Agency (in percentage), 2016.

Surabaya City is the district/city with the lowest percentage of population categorized as vulnerable poor, which is 4.13%, while the highest percentage of population categorized as vulnerable poor is found in Sampang Regency, which is 24.27%. This also indicates that districts/cities with a predominantly rural population have a higher proportion of vulnerable poor population compared to urban areas.

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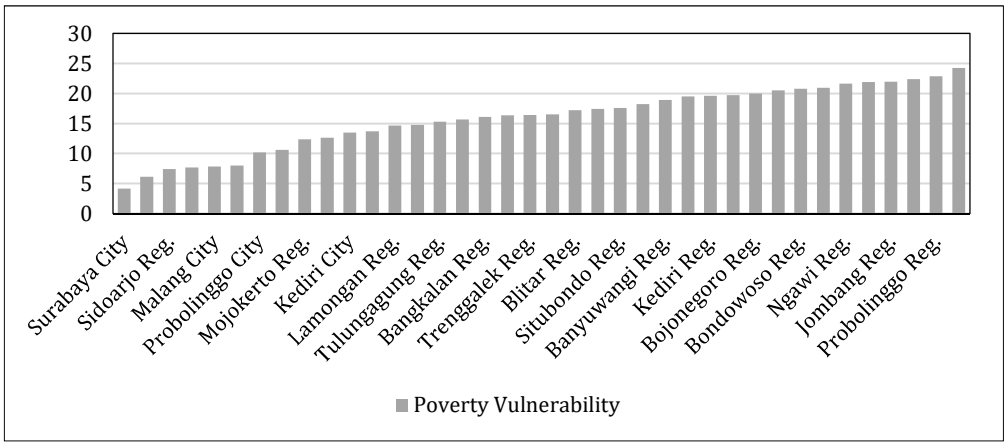

Figure 2. Percentage of Vulnerable Poor Categories by District/City in East Java Province According to the Central Statistics Agency (in percentage), 2016.

According to the determination of poverty status by BPS, East Java Province has a relatively high percentage of vulnerable poor population, surpassing the national average. The Vulnerability to Poverty (VEP) method considers not only per capita expenditure but also household characteristics to determine the vulnerability to poverty. As a result, East Java Province has a very low average probability of falling into poverty at the provincial level (VEP vulnerability index < 0.5), which is 0.034.

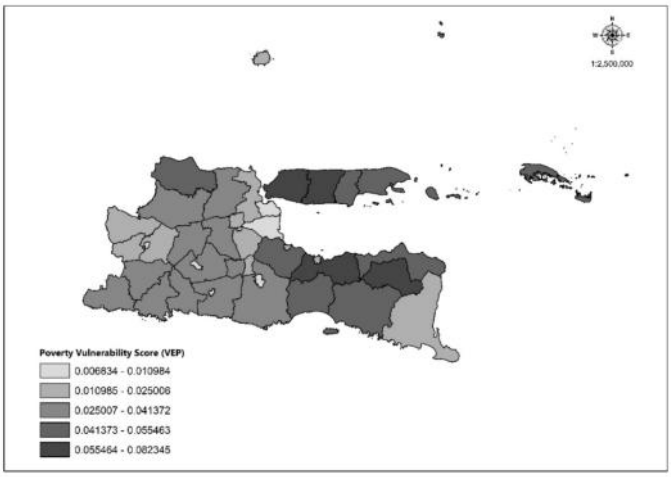

Figure 3. Map of Poverty Vulnerability (Mean) Distribution in East Java Province using the VEP Method, 2016.

Using the VEP calculation, it is found that Sidoarjo Regency is the city with the lowest average vulnerability index in East Java Province, with an average vulnerability index of 0.0068, followed by Surabaya City with 0.0087. The highest poverty vulnerability index in East Java Province is found in Bangkalan Regency, which is 0.082. Approaching the findings of BPS, Surabaya City is an area with a low percentage of vulnerable poor status, indicating a low likelihood of the population falling into poverty in the future.

Analyzing the comparison of household characteristics in Surabaya City and Bangkalan Regency reveals that Surabaya City is predominantly an urban area, while Bangkalan Regency has a significant rural population. Another notable characteristic is the level of education and the main occupation of the household head. Additionally, Surabaya City has a higher proportion of households headed by women and a lower percentage of private home ownership compared to Bangkalan Regency.

Table 1. Comparison of Household Characteristics between Surabaya City and Bangkalan Regency.

Household Characteristics	Surabaya City	Bangkalan Regency
Location Heads of HH		

Urban	100%	25,60%
Rural	0%	74,40%
Woman Gender Heads of HH	18,35%	25,60%
Age Heads of HH in Average (years)	50,28	52,46
Education of Heads of HH		
Elementary School and below	30,84%	85,25%
Secondary School and above	69,16%	15,75%
Size of Household in average (people)	3,6	3,9
Main Sectors		
Agriculture	0,49%	56,69%
Industrial	14,46%	1,89%
Trade	30,28%	15,12%
Service	25,34%	10,55%
Non-private home ownership	31,99%	1,74%
Private home ownership	68,01%	98,26%
Sanitation Access		
No facilities	0,19%	4,02%
Have sanitary facilities	99,81%	95,98%
Main Lighting Source		
Not electricity	0%	0,27%
Electric	100%	99,73%

Sampling individuals or households to examine the characteristics of households with high and low household poverty vulnerability is conducted. One sampled household with a household ID of 351411330 is located in Pasuruan Regency, where it has an extremely high poverty vulnerability index of 0.8847918. The characteristics of this household include residing in a rural area, with a male household head (KRT), the highest level of education completed by the KRT being primary school or equivalent, working in the construction sector, having a large household size of 8 members, lacking access to sanitation but having electricity as a source of lighting.

Another individual/household with the household ID 351411373, located in the same Pasuruan Regency, has an extremely low poverty vulnerability index of 0.000042. The characteristics of this household include residing in an urban area, with a male household head (KRT), a high level of education for the KRT (at least junior high school or equivalent), working in the non-agricultural sector (trade), having a small household size of 4 members, and having access to sanitation and electricity as a source of lighting.

Cross-Sectional Regression - Analysis of The Influence of Climate Disasters

The poverty vulnerability index obtained using the Vulnerability as Expected Poverty (VEP) method is then used to analyze the influence of climate disasters on household poverty vulnerability.

Tabel 2. Regression Result

Variables	Coefficient	P > t
Floods Events	-0.00078	0.000
Lanslides Events	0.00008	0.186
Tornados Events	0.00009	0.558
Dummy Rural	0.0156931	0.000
Dummy HHH Woman	0.0236182	0.000
Age of HHH	0.0005872	0.000
Dummy Education Secondary Scholl and above	-0.0177487	0.000
Dummy Agriculture	0.029308	0.000
Dummy Industrial	-0.0099909	0.000
Dummy Trade	-0.0128366	0.000
Dummy Service	-0.0082971	0.000
Size Household	0.0272068	0.000
Dummy Non-private Home Ownership	0.0102712	0.000
Dummy No Sanitary Facilities	0.0807653	0.000
Dummy Lighting Source Not Electricity	0.1434134	0.000

The occurrence of flood disasters significantly affects household poverty vulnerability in East Java Province with a negative impact. This finding differs from the study conducted by Lu et al. (2022), which found that shocks, intensity, and frequency of natural disasters all showed a significant positive impact on household poverty vulnerability (specifically for farming households in their research). Thus, the likelihood of becoming poor is primarily present in the agricultural sector rather than as a whole. This is also mentioned in the study by Lu et al. (2022), which further explains that poverty vulnerability shifts from positive to negative when adaptive behavior as a capacity for disaster resilience can be implemented.

In the VEP model, the per capita expenditure is regressed with household characteristics to assess adaptive capacity in facing floods. Government assistance or social funds from the community could potentially contribute to resilience in dealing with floods. This can also be considered as one of the factors contributing to the negative impact of flood disasters on household poverty vulnerability in East Java Province On the other hand, landslide and tornado disasters have a positive influence on increasing household poverty vulnerability, but it may not be statistically significant. The occurrences of landslides and tornadoes are accumulated only in specific districts or cities in East Java Province, and their impacts may be felt only by a few in certain areas.

Household characteristics have an influence on household poverty vulnerability in East Java Province. The "Desa" dummy or dummy rural variable indicates that there is a difference in poverty vulnerability, where rural areas have higher vulnerability. One of the reasons is that rural areas have a higher percentage of the population working in the agricultural sector compared to urban areas. A study by Rahman and Wulansari (2018) provides evidence that around 60 percent of household heads classified as vulnerable to poverty still depend on the primary sector, especially agriculture, as certain skills are not required for these types of jobs. Household characteristics that contribute to higher vulnerability include having a female household head, low education level of the household head, large family size, non-private home ownership, lack of access to sanitation, and non-electric lighting. The agricultural sector has a higher poverty vulnerability compared to the industrial, trade, and service sectors, which exhibit lower vulnerability according to the study.

A publication by the Asian Development Bank (ADB) in 2009 states that with its long coastline, high population concentration, and economic activities in coastal areas, there is a high dependency on agriculture as a livelihood source, especially for those living in poverty. Non-vulnerable households mostly have members working outside the agricultural sector (i.e., in formal and service sectors) and fewer members engaged in agriculture compared to vulnerable households (Pham et al., 2021).

4. CONCLUSION

The VEP method, which determines the vulnerability to poverty, takes into account not only per capita expenditure but also household characteristics. As a result, East Java Province has a low average probability of falling into poverty (VEP poverty vulnerability < 0.5), specifically 0.034. Sidoarjo Regency is the city with the lowest average vulnerability in East Java Province, with an average vulnerability value of 0.0068, followed by Surabaya City with 0.0087. The highest poverty vulnerability value in East Java Province is found in Bangkalan Regency, which is 0.082.

The analysis of the impact of climate disasters on poverty vulnerability in East Java Province shows that the flood variable has a significant influence on household poverty vulnerability, while landslide and tornado events are not proven to affect household poverty vulnerability in East Java Province. Adaptive capacity to disasters is particularly important in dealing with flood disasters. The key points that can be focused on are education and the primary employment sector of households, as they are interconnected. Households with higher education tend to be less vulnerable to poverty, indicating the need for improved access to educational facilities and infrastructure. The agricultural sector is particularly vulnerable due to its low requirement for specialized skills, suggesting that the workforce has minimal expertise. The solution lies not only in creating new non-agricultural business opportunities that are less prone to poverty vulnerability but also in enhancing the value of the agricultural sector to increase household well-being, thereby reducing the potential for future poverty.

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