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Assessments Toward Social and Environmental Vulnerability of Landslide Threats in Cimanggung District Sumedang Regency West Java Province

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Abstract

Disasters are closely related to the social and environment vulnerability. The level of vulnerability is an important factor to asses to know the community and government capacity to deal with disaster. For example, the high vulnerability of the community, infrastructure, and elements in disaster prone areas are also the factors in the occurrence of floods and landslide. This research will study the assessments toward social and environmental vulnerability of landslide threats in Cimanggung District Sumedang Regency West Java Province using qualitative methods. Data obtained in this research was from observation, interview, and study literature. The result in this research shows that social vulnerability in Sumedang Regency was affected by the number of people who do not have an understanding of the potential for landslides. This condition is exacerbated by the high level of poverty in Sumedang Regency which is increasing due to the Covid-19 pandemic. Meanwhile, the environmental vulnerability of Sumedang Regency itself is a horseshoe-shaped area with steeper slopes than other places, hillsides are open land with a lack of strong rooted vegetation and slope reinforcement, and poor drainage so that surface water flows accumulate in the upstream channel. In addition, about 67% of the total area of Cimanggung District, Sumedang Regency is prone to floods and landslides.

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Introduction

Natural disasters occur due to the influence of climate change which has an impact on increasing vulnerability in the community [1]. The level of vulnerability is an important thing to know as one of the factors that have an influence on disaster risk, because a new disaster will occur if a hazard is in a vulnerable condition [2]. According to UN-ISDR, vulnerability is a condition determined by physical, social, economic and environmental factors or processes that can increase the vulnerability of a community to the impact of hazards [3]. In addition to these factors, UN-ISDR also mentions the lack of information and public awareness as well as the neglect of the community and government towards the environment as one of the vulnerability factors of a community [4].

For example, the high vulnerability of the community, infrastructure, and elements in disaster prone areas are also the factors in the occurrence of floods and landslide. The low capacity of various components within the community, such as the community itself and the local government, is a contributing factor to the potential for disasters in the area. Landslide is one type of natural disaster that causes loss of life and property of the population. Several factors that cause landslide naturally include the morphology of the earth's surface, lithology, soil, slopes, and rainfall [5]. The frequency of landslide in Indonesia recently, although it has decreased, is still the most frequent natural disaster and takes a large number of victims. In 2017 there were 846 incidents, in 2018 there were 473 incidents, and in 2019 there were 340 incidents [6].

On January 9, 2021, floods and landslide occurred in several areas in Sumedang Regency. At 14.00 local time, there was a flood in Cisempur Village and Cikeruh Village, Jatinangor District and in Cimanggung District. At 15.30 WIB, a landslide occurred in Cihanjuang Village, Cimanggung District and another landslide occurred at night at 19.00 WIB. The worst disaster conditions occurred in the Cimanggung District, especially in Cihanjuang Village. The victims of this disaster amounted to 65 people, of which 3 people were seriously injured, 22 people were slightly injured, and 40 people died [7]. While the total damage that occurred included 26 heavily damaged houses and 3 moderately damaged houses. Data on the number of refugees obtained were 1,126 people (314 families) which were divided into 3 zones, namely Zone 1 as many as 465 people, Zone 2 as many as 513 people, and Zone 3 as many as 148 people [8].

Based on the analysis of the Meteorology, Climatology and Geophysics Agency, the landslide occurs when conditions are quite heavy in the area [9]. In addition, the Head of Central Land Movement Mitigation, Volcanology and Geological Hazard Mitigation, Agus Budiarto explained, landslide events are also inseparable from the geological conditions of the area. The results of the study conducted by his team, the Cimanggung area is a vulnerability zone for soil movement in the medium to high category [10]. National Disaster Management Agency (Badan Nasional Penanggulangan Bencana – BNPB) also stated that the area affected by the landslide in Cimanggung was included in the Citarum Watershed. The results of monitoring by the National Aeronautics and Space Agency show that until 2020 there have been changes to various lands from dry fields, wetlands to settlements. Other than that, based on the National Aeronautics and Space Agency report, in 2003 the area that experienced the landslide was still a dry field and tended to be green.

However, in 2017 it appears that land clearing for new housing has begun not only at the landslide location, but also around the affected area. The Gadjah Mada University Landslide Expert, Teuku Faisal Fathani, said the same thing. He highlighted the horseshoe-shaped cliff structure which is actually very easy to absorb water and then landslide hit the settlements downstream [11]. Moreover, on top of the cliff there is housing, and downstream there is also a village, with a very steep slope, then gentler below. With the housing on the cliff, it is necessary to review the flow of water or the drainage system from the top of the cliff. Therefore, there are several factors that can cause landslide to occur, not only caused by natural environmental factors but can also be influenced by the cultural environment, such as changes in land use and social conditions of the community which are alleged to be factors causing landslide. Inappropriate land use can increase the vulnerability to landslide. In addition, the triggering factor for landslide in Sumedang Regency is also because business actors often do not make reports and pay less attention to recommendations for environmental studies at the construction and post-construction stages.

Natural disasters are closely related to the social and environmental vulnerability of the community in a disaster-prone area. Social vulnerability is the ability of community to protect themselves and cope with the effects of natural hazards/disasters without outside help. Social vulnerability can be seen using indicators such as population composition, livelihoods, security level, and social system. Meanwhile, environmental vulnerability is the decreasing quality of natural resources and increasing damage to natural resources. Thus, if an area has a high vulnerability to disasters, the impact caused by the disaster itself is also large.

Hence, this research will discuss in great details the assessments toward social and environmental vulnerability of landslide threats in Cimanggung District Sumedang Regency West Java Province. The novelty aspect of this study in this regard is the discussion of the said assessments toward social and environmental vulnerability of landslide threats in Cimanggung District, which has never been conducted previously.

Research Methodology

In order to satisfy the objectives of the research, qualitative research in descriptive manner was held. This method offers a complete description and analysis of the research subject. According to Creswell [12] qualitative research is defined as methods to explore, understand the meaning ascribed to social or humanitarian problems. The process of qualitative research involves important efforts, including asking questions, procedures, collecting specific data from participants, analysing data inductively from specific themes to general themes, and interpreting the data. The hypothesis in this paper was then evaluated by using the data collected from observation, interview, and literature study. Moreover, the problem presented in this paper was further analysed with Social Vulnerability Theory, Environmental Vulnerability Theory, and Landslide Theory.

Social Vulnerability Theory

The magnitude of the risk and impact of a disaster is not only influenced by the magnitude of the hazard (including associated hazards due to physical vulnerability), it is also influenced by human resilience in minimizing risk before a disaster, in managing risk during a disaster, and managing risk after a disaster occurs [13]. In social vulnerability, the aspects that affect it are the level of life, groups and communities. This includes links to reading and writing skills, education, security factors, access to basic community rights, good governance systems, social justice, traditional positive values, customs, beliefs and community collective systems

[14]. If the social conditions are in a great position, then vulnerability can be reduced, but if in a bad position it will increase the vulnerability of an area to disasters. Social vulnerability consists of parameters of population density and vulnerable groups. Vulnerable groups consist of the ratio of sex, vulnerable age groups, poor people and people with disabilities. The social vulnerability index [15] is obtained from the average weighted population density (60%), vulnerable groups (40%) consisting of sex ratio (10%), poverty ratio (10%), disabled people ratio (10%) and age group (10%).

Environmental Theory

The environmental vulnerability of an area is also strongly related to local socio-economic factors because human activities can greatly influence various environmental evolutions [16]. Environmental vulnerability consists of parameters of protected forest, natural forest, mangrove/mangrove forest, shrubs, and swamp. Environmental vulnerability is the decreasing quality of natural resources and increasing damage to natural resources. In addition, the lack of resilience in ecological systems and exposure to toxic materials and harmful pollutants are important elements that sharpen environmental vulnerability [17]. Each parameter can be identified using land cover data and was analysed using the scoring method according to Regulation of the Head of the National Disaster Management Agency Number 2 of 2012 to obtain an environmental vulnerability score. The indicators used for environmental vulnerability are land cover including protected forest, natural forest, mangrove forest, swamp and shrubs.

Landslide Theory

In addition to climate and geological factors, humans are one of the factors causing landslide where human activities on land that burden the slopes also contribute to the occurrence of landslide [18]. Population density in a sloping area will also affect the level of vulnerability to landslide, because the more population there will be an increase in the load received by the land, thereby increasing the potential for landslide. Disruption of slope stability due to various human activities on it can increase the potential for landslide [19].

Results and Discussion

The 2021 Landslide in Cimanggung District Sumedang Regency

In the 2021 Rehabilitation and Reconstruction Document for Sumedang Regency, it is stated that the topography of the land slope of the Sumedang Regency area is classified into 5 (five) classes, namely:

1. 0–8%, is a flat to wavy area with a total area of 12.24%. The slope of the dominant area is in the northeast, northwest, southwest and district areas;
2. 8–15%, is a wavy area with a total area of 5.37%. The slope of the dominant area in the middle to the north, northwest, and southwest;
3. 15–25%, is a wavy to hilly area with an area composition covering 51.68%. The slope of this type is the most dominant in the Sumedang Regency area. The distribution is in the middle to the southeast, the south to the southwest and the west;
4. 25-40%, is a hilly to mountainous area with an area of about 31.58%. The slope of this type is dominant in the central, southern and eastern parts of Sumedang Regency; and
5. More than 40% slope, is a mountainous area with an area covering about 11.36%. The slope of this type is dominant in the southern, eastern and southwest parts of Sumedang Regency.

On January 9, 2021, Sumedang Regency was hit by floods and landslides after a high-intensity rain. This area is submerged in water as high as 1 meter so that the Cileunyi – Rancaekek-Cimanggung National Road could not be passed by vehicles, and industrial and community activities were disrupted. At around 15.30 local time, a landslide occurred in the hamlet of Bojongkondang, Cimanggung District, which was estimated to have killed 8 people. Soil material piling up settlements worsened the flood conditions, while rescue evacuations were being carried out at 19.30 local time, a subsequent landslide occurred this caused the death toll to increase, recorded 40 people died, 25 people were injured and 1,020 people or 267 families evacuated, and 26 houses were buried. Moreover, residential environmental facilities, infrastructure, mosque buildings, school buildings and Islamic boarding schools were damaged.

Assessments Toward Social Vulnerability of Landslide Threats in Cimanggung District Sumedang Regency

Based on the report from Sumedang Regency Government, the population of Sumedang Regency in 2019 was 1,154,458 people. Meanwhile, the population density level reaches an average of 741 people/km2. The population of Sumedang Regency based on the 2020 population census is 1,152,507 people, consisting of 581,991 male residents and 570,516 female residents [20]. Compared to the official cencus in 2019 recorded, the population of Sumedang grew by 0.51%. Of this number, the population of Cimanggung District is 87,516 people and is one of the districts with a high population level. In addition, the education level of the people of Sumedang Regency is still relatively low. Until now, the average length of school for the people of Sumedang Regency is only up to the second grade of junior high school.

Meanwhile, the number of sex ratios in 2020 for the male population to the female population is 1.02 with a growth rate of 0.83%. The percentage of poor people in Sumedang Regency has decreased significantly, namely 0.71% from 9.76% in 2018, now to 9.05% in 2019. However, due to the Covid-19 pandemic, national and regional poverty has increased, so that these conditions also affect the social conditions in Sumedang Regency. In 2020, the percentage of poor people has increased from 2019 to 10.26% or an increase of 1.21% from 2019. The ratio of disabled people in Sumedang Regency itself is 0%, where there are no people with disabilities in the area.

Landslide that occurred are not only caused by social vulnerability, but also have an impact on increasing social vulnerability in Sumedang Regency. The calculation of damage and losses in the social sector due to landslide in Sumedang Regency includes the health sub-sector, in health service facilities 1 ambulance unit at the Sawah Dadap Health Center was damaged by the landslide of Rp. 210,000,000. The education sub-sector of school and elementary school buildings suffered minor damage due to the eroded buildings due to evacuation activities that were used as shelters or main posts. Kindergarten buildings and study groups were slightly damaged due to being crushed or eroded by landslides and the affected religious sub-sector consisting of mosques was lightly damaged due to some buildings being hit by landslides and Islamic boarding schools buildings were heavily damaged due to landslides.

The calculation results obtained that the value of damage and losses to the social sector reached Rp1,420,560,000.00 with the composition of the damage value of Rp 1,007,560,000 and a loss of Rp 413,000,000. The value of damage to the education sub-sector was Rp 595,060,000 and the value of the loss was Rp 311,750,000 including costs for cleaning buildings, debris and garbage carried by water and mud and heaps of landslide as well as

temporary places for teaching and learning in schools, so that the value of damage and losses from schools reached Rp906.810,000. Meanwhile, for the religious sub-sector that hit Mosques and Islamic boarding schools, the damage was light and heavy, the estimated value of the damage was Rp202,500,000. While the losses include the costs required for cleaning buildings, lumps of material and piles of soil due to floods and landslides, the value of the loss reached Rp101,250,000, so the total value of damage and loss in the religious sub-sector is Rp303,750,000.

The population of Sumedang Regency in 2020 was 1,152,507 with a population density level reaching an average of 741 people/km2. Referring to the classification of the area and population density according to the Public Works Settlement Service, the population density level of 741 people/km2 is included in the classification of the area as "Very Dense." With this level of population density, it will affect the level of landslide vulnerability because the more population it will increase the load received by the land thereby increasing the potential for landslides. The number of people who do not have an understanding of the potential for landslides also has an impact on the number of residential developments carried out around the landslide area. This condition is exacerbated by the high level of poverty in Sumedang Regency which is increasing due to the Covid-19 pandemic. The landslide disaster that occurred in Sumedang Regency also had an impact on increasing vulnerability in the community. The livelihoods of the majority of the people of Sumedang Regency are farmers and industrial workers, so that the landslide disaster that occurred in early 2020 had a huge impact on the economic aspects of the community.

The social vulnerability of Sumedang Regency is also caused by a lack of information from the local government and public awareness of Sumedang Regency. In addition, the neglect of society and the government to the environment, both in terms of geography and social, is one of the factors of social vulnerability. This is in accordance with the vulnerability theory proposed by UN-ISDR (2009). With the existence of social vulnerabilities, it is not surprising why the landslide that occurred in Sumedang Regency took many lives and many people were affected by the disaster. The social vulnerability of Sumedang Regency has an impact on the absence of the local community's ability to minimize risk before a disaster occurs and manage risk during a disaster. Even after the disaster, disaster risk management has not been carried out. In the context of the landslide disaster in Sumedang Regency, social conditions that often occur are intensive agriculture, forest destruction, or the area of critical land becomes the vulnerability of the region.

Social vulnerability in Sumedang Regency is in a fairly bad position because this region is faced with several problems such as high poverty rates, lack of information, and public awareness about disasters, low levels of education, and a government system that does not pay attention to potential disasters. As mentioned above, the poverty rate in Sumedang Regency has increased to 10.26% in 2019. Vulnerability caused by poverty will easily cause the people of Sumedang Regency to become even poorer than before the disaster occurred. Deaths caused by landslides, especially those that hit the head of the family in Sumedang Regency, threaten the welfare of other family members who depend on the head of the deceased family as a source of income. This includes the threat of loss of physical assets and property in an instant where these assets are usually a buffer for households in the face of shocks.

This poverty rate is directly proportional to the low level of public understanding of the dangers of landslides in Sumedang Regency. The inability of the community to build settlements in disaster-safe zones has forced the community to live in zones with high landslide vulnerability. The absence of non-structural mitigation capabilities in the form of education

and disaster socialization has an impact on the inability of the people of Sumedang Regency to protect themselves and their families so that they are vulnerable to landslide disaster.

Sumedang Regency's social vulnerabilities will then be analyzed using the scoring method according to Regulation of the Head of the National Disaster Management Agency Number 2 of 2012 to obtain a social vulnerability score. The social vulnerability index is obtained from the average weighted population density (60%), vulnerable groups (40%) consisting of sex ratio (10%), poverty ratio (10%), disabled people ratio (10%) and age group (10%). The social vulnerability assessment of Sumedang Regency can be seen in Table 1 below.

Table 1. *Assessments Toward Social Vulnerability of Landslide Threats in Cimanggung District Sumedang Regency West Java Province*

Parameter	Score (%)	Grade			Total
		Low	Medium	High	
Population Density	60%		741 people/km^2		Medium
Sex Ratio		0,83%			
Poverty Ratio		10,26%			
Disabled People Ratio	40%	0%			Low
Age Group Ratio		1%			

Based on the results of the analysis above, moderate and low risk levels dominate social vulnerability in Sumedang Regency. Thus, it can be concluded that the social vulnerability in Sumedang Regency is at the "Medium" level. The most striking parameter on social vulnerability in Sumedang Regency is the level of population density which is at the “Medium” level and is included in the “Very Dense” category according to the Ministry For Public Works and Human Settlements of the Republic of Indonesia. Thus, when viewed from the parameters of social vulnerability, Sumedang Regency does not have a high social vulnerability. However, this must be supported by public understanding of the risk of landslides they face. The vulnerability of the people of Sumedang Regency has an impact on the emergence of new social vulnerabilities such as poverty.

The social vulnerability of Sumedang Regency determines its vulnerability to landslides. In the context of landslides, social conditions that often occur are intensive agriculture, forest destruction, or the area of critical land. In Sumedang Regency, the existing social conditions show that land degradation and the dense population living in disaster-prone areas are factors in their vulnerability. The disaster risk can actually be reduced if Sumedang Regency has the capacity, whether it is individual, group or managerial (leadership). However, in reality, the people of Sumedang Regency have not considered landslides as a threat even after the disaster. This has an impact on the lack of individual community capacity in dealing with landslide disasters.

Assessments Toward Environmental Vulnerability of Landslide Threats in Cimanggung District Sumedang Regency

Sumedang Regency has geological characteristics with a series of tertiary marine sedimentary rocks consisting mostly of clay, marl, tuffaceous clay, and sandstone with volcanic deposits. Based on the Geological Map of Indonesia, the study area is composed of rock types consisting of alluvial, young volcanic products, and old volcanic products. Weathering of volcanic rocks produces weathered rock and residual soil that compose the slopes in the study area. This residual soil is loose and vulnerable to erosion and landslides [21]. The potential

natural disasters that are often found in Sumedang Regency are generally in the form of soil movements, erosion, floods, hurricanes, and earthquakes. The occurrence of ground movements in addition to earthquakes, often occurs due to continuous and quite large rains. Meanwhile, floods often occur due to inadequate drainage and large land cover, such as around Rancaekek Street around Cimanggung District and Jatinangor District.

The environmental vulnerability of Sumedang Regency itself is a horseshoe-shaped area with steeper slopes than other places, hillsides are open land with a lack of strong rooted vegetation and slope reinforcement, and poor drainage so that surface water flows accumulate in the upstream channel. Water that has a steep slope moves to flow into the valley of the waterway below it [22]. Floods and landslides that occurred in Sumedang Regency, among others, were in the form of land damage at the disaster site which was actually a human activity where the land that should be used as a green area was converted by the community into settlements and agricultural land.

Based on the study of the Meteorology Climatology and Geophysics Agency, almost all areas in Sumedang Regency are prone to disasters, especially landslides. One of the reasons is the conversion of land functions by the community. The results of monitoring by the National Aeronautics and Space Agency showed that until 2020 there have been changes to various lands from dry fields, wetlands to settlements [23].

Based on a study by the Ministry of Energy and Mineral Resources of the Republic of Indonesia, the Cimanggung District landslide was caused by 5 (five) factors, namely:

a. The disaster area was in the form of a horseshoe with a steeper slope than other places, making the disaster location a local water catchment area and a waterway.
b. The thickness of the soil was water permeable and easily saturated with water and at the bottom is a weathering layer of a relatively impermeable lava body that functions as a slip plane.
c. The hillside was open land with a lack of well-rooted vegetation and slope reinforcement.
d. Poor drainage so that surface runoff accumulates in the upstream of the waterway.
e. Rain that falls with high intensity with a long enough duration triggers the occurrence of landslides.

Data on the distribution of disaster risk studies in Sumedang Regency showed that about 67% of the total area of Cimanggung District is prone to floods and landslides. Approximately 74.55% areas are prone to high landslides, 12.2% are prone to moderate landslides, and 13.25% are prone to high floods. Cimanggung District is one of the areas that is flood and landslide prone. In general, disaster-prone areas in Sumedang Regency can be seen in Figure 1 below:

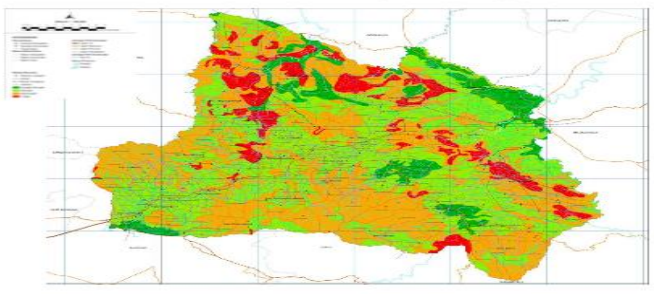

Figure 1. *Sumedang District Disaster Hazard Map*
Source: *Rehabilitation and Reconstruction Document for Sumedang Regency 2021*.

Environmental vulnerabilities that exist among the people of Sumedang Regency are also affected by climate change. The current climate change is causing extreme weather such as very high-intensity rainfall. When the landslide occurred in early 2021, one of the triggering factors was the condition of heavy rain in Sumedang Regency. Based on information from the Meteorology, Climatology and Geophysics Agency, the results of weather monitoring showed that the growth of rain clouds was quite intense one to two hours before the landslide occurred. This weather phenomenon triggers very heavy rain in a short time. Climate change also affects soil degradation, resulting in soil compaction, fractures, acidification and reduced soil organic matter and soil biodiversity, so that plants lack nutrients.

Vegetation is an important factor in maintaining slope stability, because the absence of plants or trees in mountainous areas will greatly affect the landslide process. The effect of vegetation on the ground cover is to protect the soil surface from rainwater collisions, reduce the speed and volume of runoff water, hold soil particles in place through the root system and the resulting litter and maintain the stability of the soil's capacity to absorb water. With good cover vegetation, it should be able to eliminate the influence of topography on erosion. This is because the denser the vegetation, the smaller the potential for landslides and vice versa, the rarer the vegetation, the greater the potential for landslides. In fact, what happened in Sumedang Regency was the high percentage of landslides on the type of hilly land use, on the one hand it proved that the type of land use and the slope of the slope were the controlling factors for the occurrence of landslides.

Influential factors that cause environmental vulnerability are being in hazardous locations, namely in areas of unstable slopes and environmental damage and degradation. Environmental vulnerability consists of parameters of protected forest, natural forest, mangrove/mangrove forest, shrubs, and swamp. Environmental vulnerability is the decreasing quality of natural resources and increasing damage to natural resources. In addition, lack of resilience in ecological systems and exposure to toxic materials and harmful pollutants are important elements that sharpen environmental vulnerability.

Sumedang Regency itself has many settlements on the ridges of the hills. This condition is at risk of landslides because the hills above the housing lack hard trees that function to hold water. According to one of the informants met in the field, the converted hills were once productive agricultural land. In addition, in Sumedang Regency and its surroundings, there are also many Type C excavations on hillsides. Although in the Regional Regulation No. 4 of 2018 regarding the 2018-2038 Sumedang Spatial Plan, it is stated that the Sumedang Regency area is indeed a yellow zone. This means that its designation may be for built-up cultivation such as settlements and housing, industrial areas and other supporting activities.

In addition, in the environmental vulnerability assessment parameters, the geographical condition of an area is also an assessment parameter. Sumedang Regency has a horseshoe-shaped topography with steeper slopes than other places, hillsides are open land with a lack of strong rooted vegetation and slope reinforcement, and poor drainage so that surface water flows accumulate in the upstream waterways which have steep slopes flows into the valley of the waterway below. In addition, about 67% of the total area of Cimanggung District, Sumedang Regency is prone to floods and landslides.

The land use patterns in Sumedang Regency itself include shrubs, dense and sparse forests, mixed gardens, open land, settlements, irrigated and rain-fed rice fields. From the results of spatial data observations, the type of land use most affected by landslides is hilly areas with a percentage of 84.3% of the total area, while rural settlements that are directly

affected by landslides are only around 0.24%. When viewed from the overlay of the contour map and the landslide area map of Sumedang Regency, the landslide area tends to follow a hilly pattern. Landslides occur on hilly slopes and the area of landslides is generally influenced by the steepness of the slopes. Landslides that occur on slopes with almost upright slopes tend to have a wider landslide area than those found around slopes with less steep slopes.

This geographical condition is in line with the theory of landslides, where mass movement landslides are closely related to processes that occur scientifically in a landscape. The landscape is a natural formation on the earth's surface, that is, if it is associated with the geographical conditions of Sumedang Regency, the landscape in question is in the form of hills and basins. Landslides are caused by loads by embankment work, the influence of loads by cutting or excavating cliffs and dynamic loads by earthquake activities, while the hydrometeorological environment involves changes in pore water pressure in soil or rock formations, surface flows and free groundwater. Referring to this definition, the landslide disaster that occurred in Sumedang Regency was caused by loads from excavation work and in pore water pressure after heavy rains.

In addition, the environmental vulnerabilities of Sumedang Regency such as steep slopes, less dense soil, additional burden due to the large number of settlements in landslide areas, exacerbated by rainfall are factors that cause landslides as stated by the Center for Volcanology and Geological Hazard Mitigation (2007). Based on the results of the analysis above, Sumedang Regency has a fairly high environmental vulnerability. In addition, the landslide disaster that occurred in Sumedang Regency will also create new environmental vulnerabilities. The former landslide will potentially become a landslide-prone area if not addressed. Geographical conditions that are prone to landslides are exacerbated by the conversion of land to be a factor causing landslides in Sumedang Regency. Although this area is allowed to be built for settlements, residential developers should see and analyze the geographical conditions in Sumedang Regency itself. The decision to build a residence or shelter in a vulnerable area is a portrait of the community's inability to obtain decent housing as well as a portrait of the government's absence from supervising the implementation of the development plan.

Conclusion

Based on the analysis above, natural disasters are closely related to the social and environmental vulnerability of the community in a disaster-prone area. Social vulnerability in Sumedang Regency was affected by the number of people who do not have an understanding of the potential for landslides. It impacted on the number of residential developments carried out around the landslide area. This condition is exacerbated by the high level of poverty in Sumedang Regency which is increasing due to the Covid-19 pandemic. The landslide disaster that occurred in Sumedang Regency also had an impact on increasing vulnerability in the community. The livelihoods of the majority of the people of Sumedang Regency are farmers and industrial workers, so that the landslide disaster that occurred in early 2020 had a huge impact on the economic aspects of the community. The social vulnerability of Sumedang Regency is also caused by a lack of information from the local government and public awareness of Sumedang Regency. Social vulnerability in Sumedang Regency is at the "Medium" level. The most striking parameter on social vulnerability in Sumedang Regency is the level of population density which is at the “Medium” level and is included in the “Very Dense”.

Meanwhile, the environmental vulnerability of Sumedang Regency itself is a horseshoe-shaped area with steeper slopes than other places, hillsides are open land with a lack

of strong rooted vegetation and slope reinforcement, and poor drainage so that surface water flows accumulate in the upstream channel. In addition, about 67% of the total area of Cimanggung District, Sumedang Regency is prone to floods and landslides. The land use patterns in Sumedang Regency itself include shrubs, dense and sparse forests, mixed gardens, open land, settlements, irrigated and rain-fed rice fields. From the results of spatial data observations, the type of land use most affected by landslides is hilly areas with a percentage of 84.3% of the total area, while rural settlements that are directly affected by landslides are only around 0.24%.

References

Ministry of Environment and Forestry of the Republic of Indonesia 2015 Vulnerability Index Data Information System.

Nurjanah, et al 2013 Manajemen Bencana. Bandung: Alfabeta.

UN-ISDR 2004 Living With Risk: A Global Review Of Disaster Reduction Initiatives. New York: UN-ISDR.

Ibid.

Varnes. D.J. 1984 Landslide Hazard Zonation: A Review of Principle and Practice. Paris: UNESCO

BNPB, "Potensi Ancaman Bencana," bnpb.go.id, 2021.

Sumedang Regency Government "Longsor Cimanggung", sitabah.sumedangkab.go.id, 2021.

Ibid.

BNPB, "Beragam Faktor Pemicu Bencana Longsor Sumedang Awal Januari," bnpb.go.id, 2021.

Ibid.

National Aeronautics and Space Agency, "Peneliti LAPAN Ungkap Penyebab Longsor Cimanggung Sumedang Berdasarkan Data Citra Satelit," lapan.go.id, 2021.

Creswell, John W 2014 Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Los Angeles: SAGE Publication Inc.

Sunarti, E 2009 Analisis Kerentanan Sosial Ekonomi Penduduk dan Wilayah untuk Analisis Risiko Bencana.

United Nations 2004 Living With Risk: A Global Review Of Disaster Reduction Initiatives Volume I. New York and Geneva: United Nations.

Regulation of the Head of the National Disaster Management Agency Number 2 of 2012 concerning General Guidelines for Disaster Risk Assessment.

Wang, X.D et al 2008 "Regional Assessment of Environmental Vulnerability In The Tibetan Plateau: Development and Application of a New Method." Arid Environment 72.

United Nations 2004 Living With Risk: A Global Review Of Disaster Reduction Initiatives Volume I. New York and Geneva: United Nations.

Rahman, A. Zarkasyi 2015 "Kajian Mitigasi Bencana Tanah Longsor di Kabupaten Banjarnegara." Jurnal Manajemen dan Kebijakan Publik 1(1).

Susanti, et al 2017 "Analisis Kerentanan Tanah Longsor Sebagai Dasar Mitigasi di Kabupaten Banjarnegara." Jurnal Penelitian Pengelolaan Daerah Aliran Sungai 1(1).

Central Bureau of Statistics Sumedang Regency 2020.

Wesley, Laurence D 2009 Fundamentals of Soil Mechanics for Sedimentary and Residual Soils. DOI:10.1002/9780470549056.ch8

Post-Disaster Needs Assessment Sumedang Regency 2021.

BNPB, "Beragam Faktor Pemicu Bencana Longsor Sumedang Awal Januari," bnpb.go.id, 2021.