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MEASURING THE LEVEL OF LAND DAMAGE DUE TO SAND AND GRAVEL MINING IN DUSUN SIDOREJO, TALUN VILLAGE, KEMALANG DISTRICT, KLATEN REGENCY OF CENTRAL JAVA

Irfan Dzaky Elma, Johan Danu Prasetya*, Dina Asrifah
Department of Environmental Engineering, Faculty of Mineral Technology,
Universitas Pembangunan Nasional Veteran Yogyakarta
**Corresponding author:* johan.danu@upnyk.ac.id

ABSTRACT

Mining activities are quite a lot carried out by the people of Dusun Sidorejo, the mining is a sand and gravel mine. Sand and gravel mine in the process causes changes in shape of the landscape that have an impact on land damage. This research aims to determine the level of land damage caused by mining activity. The method used in this research is quantitative with observation, mapping, and land damage analysis which refers to Keputusan Menteri Lingkungan Hidup No. 43 Tahun 1996, with the parameters used is the height of the excavated cliffs, the slope of the excavated cliffs, the relief of the excavation base, vegetation cover, and management of top soil and overburden. Based on the measurement results of each parameter used, It was found that the level of damage that occurred at the research site was in the form of heavy damage. Effort to improve the mining site at the research area carried out by making bench terraces and revegetation using sengon tree, adjusted to the applicable regulations, KepMen LH No. 43 Tahun 1996.

Keywords : Level of land damage, Mining, Sand and gravel

INTRODUCTION

Population growth in Indonesia has increased, as the population increases, it causes an increase in the needs of their lives. The needs for life include the need for mineral resources which are the driving force for the sustainability of national development (Nasution et al., 2020). Indonesia is a country that is classified as rich with abundant natural resources. One of the greatest natural resources and a mainstay after agriculture is mining (Mailendra & Buchori, 2019). The mining industry is one of the industries that the Indonesian government relies on to bring in foreign exchange and provide employment as well as a source of Regional Original Income for Regencies and Cities (Yudhistira et al., 2011). Kemalang District is morphologically located on the southern slope of Mount Merapi, which is one of the most active volcanoes in the world, This area has enormous potential in the mining, agriculture, plantation and tourism sectors. Especially in the mining sector, the slopes of Mount Merapi have the potential for sand and gravel mining (Wibowo, 2006). The existence of natural resources, especially mining resources, always interacts and is closely related to their habitat environment, such as soil, water and plants. Mining resource management that is not guided by good mining practice and ecological principles will result in environmental degradation (Zaerin et al., 2015). Mineral resources are non-renewable mineral resources so that environmental damage is found in mining areas (Ariyanto & Dibyosaputro, 2012).

The research was conducted in Dusun Sidorejo, Talun Village, Kemalang District, Klaten Regency, Central Java. The results of this mining activity have a good impact on the community because it is used by some of the surrounding community as a source of their livelihood, as well as development for the region. Besides being able to increase the income of the surrounding community, mining activities can also have a negative impact on the physical environment. This mining activity has been going on since 2014, with a long enough time in the process has changed the landscape at the research site so that it causes damage to the environment of the mining area under study, excavated cliffs arise with a fairly high height with a steep slope that can endanger workers around the mining site and basins which if it rains will cause puddles. This study aims to analyze the level of damage caused by sand and gravel mining activities in Dusun Sidorejo, Talun Village, Kemalang District, Klaten Regency, Central Java..

METHODS

The research method is carried out using quantitative methods in several ways, namely observation at the research site, mapping and measurement and analysis of land damage. Quantitative research methods are research conducted using data in the form of numbers as a tool to analyze information about what you want to know (Syahrum & Salim, 2014).

Observation and mapping methods are carried out to obtain primary data needs in the field by measuring the physical parameters used, as well as to do *cross check* secondary data used in this study. The method of analyzing the level of land damage is used to determine the level of land damage that occurs at the research site using primary data obtained directly in the field, the analysis of the level of land damage is calculated mathematically and analyzed descriptively which refers to Keputusan Menteri Lingkungan Hidup No. 43 Tahun 1996. The criteria for each parameter can be seen in **Table 1** and to find out the level of land damage can be seen in **Table 2**.

Table 1. Land Damage Assessment Criteria

Land Damage Parameters		Score (N)	Weight (B)	N x B
Excavation Wall Height	< 3 meters	1 (Well)	0,25	
	3 – 6 meters	2 (Moderate)		
	> 6 meters	3 (Damaged)		
Excavation Base Relief	< 0,5 meters	1 (Well)	0,125	
	0,5 – 1 meters	2 (Moderate)		
	> 1 meters	3 (Damaged)		
Excavation Cliff Slope	Flat (0' – 15')	1 (Well)	0,25	
	Crooked (16' – 40')	2 (Moderate)		
	Steep (41' – 90')	3 (Damaged)		
Vegetation Cover	> 75% land covered with vegetation	1 (Well)	0,125	
	25% - 75% land covered with vegetation	2 (Moderate)		
	< 25% land covered with vegetation	3 (Damaged)		
Top Soil and Overburden Management	Saved	1 (Well)	0,25	
	Partially used	2 (Moderate)		
	Discarded/not used	3 (Damaged)		
Mining Land Damage Index $\sum(Ni.Bi)$				
Level of Land Damage				

Source :Keputusan Menteri Lingkungan Hidup No. 43 Tahun 1996, Najib, 2011

Table 2. Land Damage Rate Value

Damage Rate Range	Damage Level
1,00 – 1,66	Light Damage
1,67 – 2,33	Moderate Damage
2,34 – 3,00	Heavy Damage

Source : Najib, 2011

RESULTS AND DISCUSSION

Research activities are focused on analyzing the level of land damage in sand and gravel mining areas, by measuring each physical parameter based on Keputusan Menteri Lingkugan Hidup No. 43 Tahun 1996, i.e. excavation wall height, excavation base relief, excavation cliff slope, vegetation cover, and top soil and overburden management.

a. Excavation Wall Height

The excavation wall is the edge of the bottom of the excavation to the initial surface of the excavation. Based on KepMen LH No. 43 Tahun 1996, the height of the excavation wall is limited to a maximum of 3 meters so that the tolerance limit is maintained for the safety of the surrounding environment, while the minimum width of the terrace base is 6 meters. Measurement of the height of the excavation wall is carried out using a meter and the help of a drone, the results of the measurement activities obtained 31 points with heights ranging from 6 meters to 43 meters, with an average excavation wall height at the research site of about 17,29 meters. Mining activities carried out by these miners led to the appearance of these dug cliffs, which if left unchecked will be dangerous for workers and have the potential for erosion and landslides, these cliffs need to be made terraces with a maximum height of 3 meters with a width of 6 meters to maintain the safety tolerance limit of the surrounding environment. The results of measuring the height of the excavation wall in more detail can be seen in **Table 3** below.

Table 3. Excavation Wall Height Measurement Data

No.	Measuring Point	Results	Score	Information	Weight
1.	X : 444433 Y : 9155200	16 m	3	Damaged	0,25
2.	X : 444405 Y : 9155176	23 m	3	Damaged	
3.	X : 444466 Y : 9155169	29 m	3	Damaged	
4.	X : 444513 Y : 9155185	25 m	3	Damaged	
5.	X : 444552 Y : 9155185	16 m	3	Damaged	
6.	X : 444424 Y : 9155128	11 m	3	Damaged	
7.	X : 444450 Y : 9155127	16 m	3	Damaged	
8.	X : 444480 Y : 9155123	12 m	3	Damaged	
9.	X : 444513 Y : 9155129	15 m	3	Damaged	
10.	X : 444558 Y : 9155139	21 m	3	Damaged	
11.	X : 444541 Y : 9155138	11 m	3	Damaged	
12.	X : 444431 Y : 9155105	11 m	3	Damaged	
13.	X : 444450 Y : 9155093	15 m	3	Damaged	
14.	X : 444485 Y : 9155093	11 m	3	Damaged	
15.	X : 444499 Y : 9155077	7 m	3	Damaged	

No.	Measuring Point	Results	Score	Information	Weight
16.	X : 444531 Y : 9155105	13 m	3	Damaged	
17.	X : 444540 Y : 9155088	7 m	3	Damaged	
18.	X : 444540 Y : 9155088	14 m	3	Damaged	
19.	X : 444582 Y : 9155106	14 m	3	Damaged	
20.	X : 444589 Y : 9155065	21 m	3	Damaged	
21.	X : 444593 Y : 9155098	11 m	3	Damaged	
22.	X : 444463 Y : 9155024	15 m	3	Damaged	
23.	X : 444476 Y : 9155052	16 m	3	Damaged	
24.	X : 444506 Y : 9155050	43 m	3	Damaged	
25.	X : 444556 Y : 9155025	28 m	3	Damaged	
26.	X : 444578 Y : 9155048	6 m	3	Damaged	
27.	X : 444592 Y : 9155038	26 m	3	Damaged	
28.	X : 444471 Y : 9155013	9 m	3	Damaged	
29.	X : 444496 Y : 9155006	8 m	3	Damaged	
30.	X : 444560 Y : 9154991	35 m	3	Damaged	
31.	X : 444589 Y : 9155013	31 m	3	Damaged	
Amount		536 m	3	Damaged	0,75
Average		17,29 m			

Source: Author's observations and measurements, 2021

b. Excavation Base Relief

The bottom surface of the dug hole is generally never flat, because there are always piles or piles of excavated material. The difference in the relief of the excavation base is the difference in the height of the surface of the pile/pile with the base surface of the surrounding excavation. Measurements are made by measuring the two surfaces with the help of a meter. Piles of less than 1 m are relatively easy to level/prepare so that it is not difficult to prepare for further land use. The measurement results obtained 6 measurement locations with an average difference in the bottom relief of excavations exceeding 1 meter with the highest base relief of 1,8 m and the lowest

0,9 m. The results of the excavation bottom relief measurements can be seen in **Table 4** below.

Table 4. Measurement Result Data Excavation Base Relief

No.	Measuring Point	Results	Score	Information	Weight
1.	X : 444486 Y : 9155117	1,8 m	3	Damaged	0,125
2.	X : 444509 Y : 9155111	0,9 m	2	Moderate	
3.	X : 444524 Y : 9155095	1,7 m	3	Damaged	
4.	X : 444518 Y : 9155078	1 m	2	Moderate	
5.	X : 444502 Y : 9155058	1,2 m	3	Damaged	
6.	X : 444560 Y : 9155033	1 m	2	Moderate	
Amount		7,6 m	3	Damaged	0,375
Average		1,2 m			

Source: Author's observations and measurements, 2021

c. Excavation Cliff Slope

The slope of the excavated cliff is the slope of the cliff surface as a whole and is one of the factors that determine the carrying capacity of the land for a designation, The greater the slope, the greater the erosion rate (Sitepu et al., 2017). In general, the slope is limited to 50% and a terrace must be made in order to maintain the stability of the slope, In measuring the excavated cliffs, the slope of the slope is measured using the help of a geological compass, GPS and drones. The results of the measurement of the slope of the excavated cliffs obtained 31 points with the largest slope of the excavated cliff being 81^{o} and the smallest being 31^{o}, based on KepMen LH No. 43 Tahun 1996 the slope of the excavated cliffs at the research site is almost entirely classified as damaged and only a few are categorized as moderate, the slope of the slope at the study site has an impact on the area so that many erosion paths are found which if left unchecked will have the potential for landslides, the slope of the slope needs to be adjusted not to exceed 50% in order to maintain slope stability and reduce the impact of erosion. The detailed measurement results of the excavated cliff slope parameters can be seen in **Table 5** below.

Table 5. Excavated Cliff Slope Measurement Result Data

No.	Measuring Point	Results		Score	Information	Weight
		o	%			
1.	X : 444433 Y : 9155200	53 o	132,704 %	3	Damaged	0.25
2.	X : 444405 Y : 9155176	62 o	188,072 %	3	Damaged	
3.	X : 444466 Y : 9155169	66 o	224,603 %	3	Damaged	
4.	X : 444513 Y : 9155185	70 o	274,747 %	3	Damaged	
5.	X : 444552 Y : 9155185	58 o	160,033 %	3	Damaged	
6.	X : 444424 Y : 9155128	59 o	166,427 %	3	Damaged	
7.	X : 444450 Y : 9155127	77 o	433,147 %	3	Damaged	
8.	X : 444480 Y : 9155123	33 o	64,940 %	2	Moderate	
9.	X : 444513 Y : 9155129	34 o	67,450 %	2	Moderate	
10.	X : 444558 Y : 9155139	62 o	188,072 %	3	Damaged	
11.	X : 444541 Y : 9155138	39 o	80,978 %	2	Moderate	
12.	X : 444431 Y : 9155105	55 o	142,814 %	3	Damaged	
13.	X : 444450 Y : 9155093	69 o	260,508 %	3	Damaged	
14.	X : 444485 Y : 9155093	32 o	62,486 %	2	Moderate	
15.	X : 444499 Y : 9155077	31 o	60,086 %	2	Moderate	
16.	X : 444531 Y : 9155105	64 o	205,030 %	3	Damaged	
17.	X : 444540 Y : 9155088	35 o	70,020 %	2	Moderate	
18.	X : 444578 Y : 9155084	48 o	111,061 %	3	Damaged	
19.	X : 444582 Y : 9155106	81 o	631,375 %	3	Damaged	
20.	X : 444589 Y : 9155065	65 o	214,450 %	3	Damaged	
21.	X : 444593 Y : 9155098	59 o	166,427 %	3	Damaged	
22.	X : 444463 Y : 9155024	59 o	166,427 %	3	Damaged	

No.	Measuring Point	Results		Score	Information	Weight
		o	%			
23.	X : 444476 Y : 9155052	58 o	160,033 %	3	Damaged	
24.	X : 444506 Y : 9155050	53 o	132,704 %	3	Damaged	
25.	X : 444556 Y : 9155025	61 o	180,404 %	3	Damaged	
26.	X : 444578 Y : 9155048	49 o	115,036 %	3	Damaged	
27.	X : 444592 Y : 9155038	62 o	188,072 %	3	Damaged	
28.	X : 444471 Y : 9155013	45 o	100 %	3	Damaged	
29.	X : 444496 Y : 9155006	39 o	80,978 %	2	Moderate	
30.	X : 444560 Y : 9154991	62 o	188,072 %	3	Damaged	
31.	X : 444589 Y : 9155013	59 o	166,427 %	3	Damaged	
Amount		1699 o	5323,317 %	3	Damaged	0,75
Average		54,806 o	171,719 %			

Source: Author's observations and measurements, 2021

d. Vegetation Cover

Vegetation cover is useful in restoring the function of land that has been degraded by mining activities. The wider the vegetation cover, the better, for land that is undergoing changes due to mining activities, without vegetation, the land becomes open and will cause potential erosion and sedimentation during the rainy season (Herman et al., 2017). The minimum growth requirement of 50% is an indicator that ensures that the soil returned as cover is suitable for plant growth according to its designation. Measurements are made by observing in the field, and using aerial maps to determine the area of vegetated land and non-vegetated land. Vegetation cover in the study area is only about 21% so it is categorized as damaged for this parameter, the lack of vegetation in this area causes a large erosion potential and can be seen at the location of the grooves that appear due to erosion. The results of data processing for the measurement of vegetation cover can be seen in **Table 6** below.

Table 6. Vegetation Cover Measurement Results Data

Mining Area	Vegetation		Non-Vegetation		Score	Information	Weight
36.876,8 m^2	7.793,33 m^2	21,13 %	29.083,438 m^2	78,86 %	3	Damaged	0,375

Source: Author's observations and measurements, 2021

e. Top Soil and Overburden Management

Land that is returned as cover to the ex-mining area is land that was previously in the area SIPD (Surat Izin Penambangan Daerah) which are peeled off and secured before the area is mined. The characteristics of this soil must be adjusted in such a way as to be able to support plant growth according to its land use, either by adding organic matter or artificial fertilizers. The management of top soil and overburden at the research site is only partially utilized, because the topsoil is used directly for sale as mining material.

Table 7. Parameter Result Data for Top Soil and Overburden Management

Mining Area	Management Form	Score	Information	Weight
36.876,8 m^2	Partially used	2	Sedang	0,5

Source: Author's observations and measurements, 2021

Based on the results of measurements and calculations of all parameters used to determine the level of land damage that occurred at the research site which is a mining area, obtained a score of 2,75 which is based on the value of the level of land damage in table 2, then the level of damage to the land there is a mining area under study, categorized as the level of damage to heavy damage. Efforts to improve the land are carried out using technical engineering by making bench terraces and revegetation with sengon plants that are adapted to applicable regulations.

CONCLUSION

Based on the results of measurements and analysis of the level of land damage, it is known that each parameter has a level of damage that is dominated by the level of damage. Parameters of excavation wall height, excavation base relief, excavation cliff slope and vegetation cover are classified as damaged and only the top soil and overburden management parameters are classified as moderate level. Based on the results of the measurement of the level of land damage, the mining area studied includes the level of heavy damage. Therefore, it is necessary to improve the mining area at the research site, namely engineering by making bench terraces and revegetation using sengon plants that are adapted to applicable regulations.

REFERENCE

Ariyanto, W., & Dibyosaputro, S. (2012). Tingkat Kerusakan Lahan Akibat Penambangan Batugamping dan Prioritas Reklamasi Lahan Desa Pacarejo Kab Gunung Kidul DIY. *Jurnal Bumi Indonesia*, *1*(3), 1689–1699.

Herman, D. P., Putri, R. E., & Elsa. (2017). *Analisis Kerusakan Lahan Pada Penambangan Emas di Kecamatan IV Nagari Kabupaten Sijunjung*. 1–12.

Mailendra, & Buchori, I. (2019). Kerusakan Lahan Akibat Kegiatan Penambangan Emas Tanpa Izin Disekitar Sungai Singingi Kabupaten Kuantan Singingi. *Jurnal Pembangunan Wilayah & Kota*, *15*(3), 174–188.

Najib. (2011). Studi Kerusakan Lingkungan Akibat Penambangan Bggc Wilayah Sungai Di Kabupaten Pekalongan. *Teknik*, *32*(2), 129–137.

Nasution, R. R., Irawan, A. B., & Yogafanny, E. (2020). Rancangan Teknik Reklamasi Penambangan Pasir dan Batu Di Dusun Banaran, Desa Keningar, Kec. Dukun, Kab. Magelang, Jawa Tengah. *Jurnal Ilmiah Lingkungan Kebumian (JILK)*, *2*(2), 10–17.

Sitepu, F., Selintung, M., & Harianto, T. (2017). Pengaruh Intensitas Curah Hujan dan Kemiringan Lereng Terhadap Erosi Yang Berpotensi Longsor. *Jurnal Penelitian Enjiniring*, *21*(1), 23–27.

Syahrum, & Salim. (2014). *Metodologi Penelitian Kuantitatif*. Citapustaka Media.

Wibowo, M. (2006). Evaluasi Kerusakan Lingkungan Kawasan Penambangan Batupasir Tufaan Di Kec. Prambanan dan Sekitarnya, Kab. Sleman. *Jurnal Teknik Lingkungan*, *Edisi Khus*, 148–155.

Yudhistira, Hidayat, W. K., & Hadiyarto, A. (2011). Kajian Dampak Kerusakan Lingkungan Akibat Kegiatan Penambangan Pasir Di Desa Keningar Daerah Kawasan Gunung Merapi. *Jurnal Ilmu Lingkungan*, *9*(2), 76–84.

Zaerin, M., Sinuhadji, A., & Seo, H. P. (2015). Kajian Rancangan Produk Hukum Daerah Tentang Kriteria Kerusakan Lingkungan. Studi Kasus Penambangan Batuan di Kota Tidore Kepulauan, Provinsi Maluku Utara. *Prosiding Seminar Nasional ReTII Ke-10 2015*, 309–315.