EVALUATION OF THE LEVEL OF SUCCESS OF PLANTING IN THE REHABILITATION OF WATERSHED AREA PT BERAU COAL IN SEI LESAN PROTECTED FOREST

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ABSTRACT

The high level of community activity in using river watershed land has resulted in the exploitation of land around the watershed which has resulted in a decline in soil quality and caused land degradation along the river flow, therefore areas along the river flow require land reclamation so that the natural balance around the watershed is maintained. Reclamation is an activity that aims to repair or organize the use of land that has been disturbed as a result of inappropriate environmental processing business activities so that it can function and be efficient according to its intended purpose. This research aims to determine the level of success in implementing PT Berau Coal watershed rehabilitation in the Sei Lesan Protected Forest. The research was carried out in the Sei Lesan Protected Forest Area in the Segah Watershed, Kelay Sub Watershed in Kelay District, Berau Regency, East Kalimantan Province, Indonesia from July to August 2022. This research used systematic sampling with the random start method, namely plot measurement, The first measuring plot is created randomly and subsequent measuring plots are created systematically with a sampling intensity of at least 5%. The results of the research show that the level of plant growth in watershed rehabilitation activities at PT Berau Coal Watershed Rehabilitation was declared successful with a plant growth percentage value of 78.24%, and the results of planting in the watershed rehabilitation area were very good with the success rate of healthy plants reaching 76.08%.

Keywords: Level of Success of Planting, Rehabilitation of River Flow Area

1. INTRODUCTION

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A River watershed is a land area that is a unit of rivers and their tributaries, which functions to accommodate, store, and channel water from rainfall to lakes or the sea naturally, where the land boundary is a topographic separation and sea boundaries to water areas that are still affected by land activities (Law No. 7 of 2004).

Human activities in utilizing watershed land often exceed limits, such as excessive felling of trees or deforestation, construction of settlements, and conversion of forest land into plantation land and agricultural land, which can disrupt the function of the watershed.

Planting activities in the context of watershed rehabilitation are carried out inside and outside forest areas, which is one of the obligations of Forest Area Use Approval Holders (PPKH) and holders of Ministerial Decrees regarding the release of forest areas due to the exchange of forest areas as an effort to restore, maintain and improve watershed functions. Watershed rehabilitation is expected to provide direct benefits for the community, namely providing employment opportunities for local communities, and long-term benefits include enjoying plants resulting from watershed rehabilitation in the form of multi-purpose tree species (Ministry of Environment and Forests, 2021).

Planting activities in the context of rehabilitation of River Watersheds is one of the obligations that must be carried out by holders of Forest Area Borrow-to-Use Permits (IPPKH) as regulated in Minister of Forestry Regulation Number P.87/MENHUT-II/2014 concerning Planting Guidelines for Holders Borrow-to-Use Forest Area Permit for the Rehabilitation of River Watersheds; Regulation of the Minister of Environment and Forestry Number P.89/MENLHK/SETJEN/KUM.1/11/2016 concerning Planting Guidelines for Holders of Borrow-to-Use Forest Area Permits in the Context of Watershed Rehabilitation as amended by Regulation of the Minister of Environment and Forestry Number P .59/MENLHK/SETJEN/ KUM.1/10/2019 concerning Planting for the Rehabilitation of River Watersheds.

PT Berau Coal is a coal mining company that has a Forest Area Use Approval (PPKH) for coal operations in Berau Regency, East Kalimantan Province. Concerning its obligations as an IPPKH holder,

PT Berau Coal has carried out planting in the context of watershed rehabilitation at locations determined based on the Decree of the Minister of Environment and Forestry Number SK.2596/MENLHK-V/RHL/2015 concerning Determination of Planting Locations for the Context of Watershed Rehabilitation River in the name of PT Berau Coal. The ~~location for~~ watershed rehabilitation planting is located in the Sei Lesan Protected Forest Area in the Segah Watershed area, Kelay Sub Watershed in Kelay District, Berau Regency, East Kalimantan Province with an area of 4,893 hectares.

PT Berau Coal Block C planting activities were carried out in March 2019, to assess the level of success of watershed rehabilitation planting referring to and guided by the Minister of Environment and Forestry Regulation Number P.59/MENLHK/SETJEN/KUM.1/10/2019 concerning Deep Planting River Basin Rehabilitation Framework. B~~b~~ased on Article 33 paragraph 2, it is stated that further provisions regarding procedures for assessing the success of Watershed Rehabilitation Planting are implemented by the provisions of the Legislative Regulations regarding assessing the success of Forest and Land Rehabilitation. What is meant is Regulation of the Minister of Environment and Forestry Number 23 of 2021 concerning the Implementation of Forest and Land Rehabilitation. Based on Article 22 paragraph 3, it is stated that the success of plant growth is at least 75% ~~-~~of the initial plant at the time of planting.

This research aims to determine the level of success in implementing PT Berau Coal Watershed rehabilitation in the Sei Lesan Protected Forest.

2. LITERATURE REVIEW

2.1 Rehabilitation of Watersheds

A river basin is a land area that is a unit with a river and its tributaries that functions to accommodate, store, and channel water originating from rainfall to a lake or to the sea naturally, where the land boundary is a topographic divider and the sea boundary up to with water areas that are still affected by land activities (Regulation of the Minister of Forestry of the Republic of Indonesia Number: P.28/MENHUT-II/2009). One of the main functions of a watershed is as a supplier of water with good quantity and quality, especially for people in downstream areas. The conversion of forest land to agricultural land will affect the quantity and quality of water systems in the watershed which will be felt by people in downstream areas (Republic of Indonesia Government Regulations. Number 37 of 2012).

River watersheds have specific characteristics that are characterized by parameters related to morphometric conditions, morphology, soil, geology, vegetation, land use, hydrology, and those related to humans. This watershed characteristic is one of the main elements in watershed management such as planning, monitoring, and evaluation. How to prepare technical plans for forest and river watershed land rehabilitation, w~~W~~atershed characteristic parameters as determinants of the level of land criticality, namely including land cover level, slope ~~s~~slope, erosion level, productivity level, and land management (Regulation of the Minister of Forestry of the Republic of Indonesia Number: P.28/MENHUT-II/2009).

Watershed management is a human effort to regulate the reciprocal relationship between natural resources and humans in the watershed and all its activities, to realize sustainability and harmony of the ecosystem and increase the benefits of natural resources for humans in a sustainable manner (Republic of Indonesia Government Regulations. Number 37 of 2012).

Watershed rehabilitation is an effort to restore, maintain, and improve watershed functions so that their supporting capacity for forest area functions is maintained. Watershed rehabilitation and management activities aim to achieve optimal rehabilitation of critical land and increase forest productivity and forest/land utilization. So far, the forest and land rehabilitation process in watersheds has been carried out using a reference level of land criticality based on the weight of watershed characteristic parameters, where watersheds with land criticality levels of very critical and critical are the watersheds with the main priority to be rehabilitated. The critical land assessment method refers to the definition of critical land, namely land that has experienced damage (Regulation of the Minister of Forestry of the Republic of Indonesia Number: P.28/MENHUT-II/2009).

2.2 Evaluation

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Evaluation is an integrated assessment activity that is used as an effort for reflection, introspection, performance improvement, coaching, and as a medium for joint learning and not as a repressive tool. Evaluation of Watershed Rehabilitation is a participatory control effort, involving related parties, towards the implementation of Watershed Rehabilitation to determine increased progress, development, achievements, and management obstacles from work plans that have been made and as a medium for joint learning (Cahyaningsih, 2006).

Evaluation is an assessment carried out systematically to determine the results that have been achieved and to what extent the success of a program can be accounted for. Besides that, to determine training needs appropriately, provide appropriate responsibilities to employees so that they can carry out better work in the future and as a basis for determining policies in terms of determination (Budiantoro, 2000).

One of the strategic activities in the planting evaluation program is knowing the success rate of plant growth and the performance level of field implementers in the field (Awang, 2008). Evaluation or assessment activities are intended to analyze the extent of physical and non-physical activities in the implementation of Watershed Rehabilitation in the short, medium, and long term. If there are differences and the work targets that should have been achieved are not achieved, then the evaluation activity must find out the reasons why the activity is not appropriate or by the plan and what the next solution is.

3. RESEARCH METHODOLOGY

3.1 Place and Time of Research

The research was carried out in the Sei Lesan Protected Forest Area in the Segah Watershed, Kelay Sub-Watershed in Kelay District, Berau Regency, East Kalimantan Province, Indonesia from July to August 2022.

3.2 Materials and Tools

The materials and tools used are stationery, paper, computerized materials, Global Positioning System (GPS), compass, rope and tree measuring equipment, blanks/checklists/tally sheets, digital cameras, laptops, and printers.

3.3 Research Objects

The objects in the research are plants that have been planted in Block C plots C1-C45 in the PT Berau Coal watershed rehabilitation area in the Sei Lesan Protected Forest Area (Figure 1).

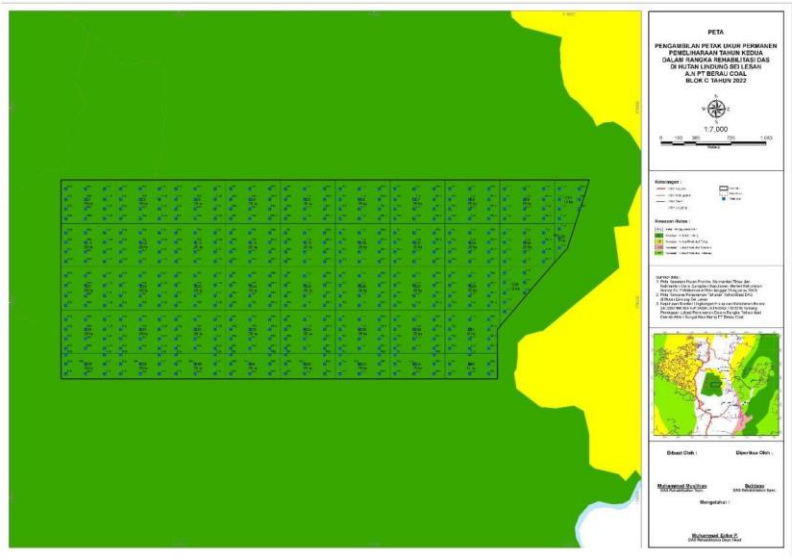

Figure 1. Map of Research Locations

3.4 Research Methods

Plant assessment is carried out using a sampling technique using systematic sampling with the random start method, namely Measuring Plots (PU), the first measuring plot is made randomly and the next measuring plot is made systematically with a Sampling Intensity of at least 5% (five percent). The number of measuring plots can be calculated using the formula:

$$\sum PU = (\text{IS} \times \text{N}) : (\text{n})$$

Information : $\sum PU$ = Number of measuring plots; IS = Sampling intensity
N = Plot area (hectare); and n = Area of measuring plot (hectare).

3.5 Research Procedures

In making measuring plots for plant assessment, it is necessary to make a schematic diagram for drawing plant measuring plots mapped to a scale of 1:10,000 or adapt it as a guide in making measuring plots for carrying out plant assessment, with a schematic diagram that includes the geographical coordinates of tie points that are easy to find in the field. Making a schematic diagram for drawing rectangular plant measuring plots as follows:

(1) Prepare a map of plant assessment results with a scale of 1:10,000 or adjust.
(2) Determine the first measuring plot point randomly on the map.
(3) Make a transect line through the measuring plot point, namely a vertical line and a horizontal line that intersect at the first measuring plot point. Vertical lines are cut perpendicular to the plant line and horizontal lines are parallel to the plant line.
(4) Make the next transect line systematically against the first transect line with a distance between vertical lines of 2 cm (200 m in the field) and a distance between horizontal lines of 1 cm (100 m in the field).
(5) Make measuring plots covering an area of 0.1 ha or measuring 4 mm x 2.5 mm (40 m x 25 m in the field) on the transect lines with the intersection point of the transect lines as the center point, so that the distribution of the measuring plots can represent the entire area the plants being assessed.

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(6) If during the assessment there is a location that has been affected by a natural disaster and has experienced damage, the area, type of plant, and cause of plant damage will be measured.

3.6. Data collection

Plant plot data and information collected include:

(1) Administrative area (province, district/city, sub-district, village), watershed/sub-watershed, area, function of forest area, name of block register and plant plots.

(2) Data recorded and measured in each measuring plot includes plant data (type of plant, number of living plants, and plant growing conditions) as well as supporting data (condition of undergrowth, soil conditions, plant disturbance, and land physiography).

3.7. Processing and Analysis of Data

Data processing and analysis are as follows:

(1) Data processing of assessment results from sampling results in measuring plots is carried out in stages using the smallest assessment/evaluation unit, namely the plant plot.

(2) The results of the plant assessment are recapitulated and classified in each plant plot in each planting block based on the tabulation results on the sampling measuring plots (PU) that have been created.

(3) Next, for the final results of the assessment of planting success, data processing is carried out to calculate the area of successful or unsuccessful planting using the smallest unit, namely the plot. Data on the area of successful planting is obtained from the minimum requirement for the number of plants in each plant plot, namely at least 75% of the initial number of plants planted at the time of planting (P0).

(4) Implementation of planting activities in the context of PT Berau Coal watershed rehabilitation was carried out in March 2019, for Block C it was carried out before the issuance of Regulation of the Minister of Environment and Forestry Number P.59/MENLHK/SETJEN/KUM.1/10/2019 concerning Planting in the Context of Rehabilitation Watershed. However, with the Letter of the Director General of PDASHL Number S.120/PDASHL/KTA/DAS.1/8/2020 dated 31 August 2020 regarding the Assessment of the Success of Watershed Rehabilitation Planting, the assessment of the success of plants in the context of PT Berau Coal's Watershed Rehabilitation refers to:

a. Regulation of the Minister of Environment and Forestry Number P.59/MENLHK/SETJEN/KUM.1/10/2019 concerning Planting in the Context of Watershed Rehabilitation, article 33 paragraph 2 which states that further provisions regarding procedures for assessing the success of watershed rehabilitation planting are implemented by the provisions of laws and regulations regarding assessing the success of RHL.

b. Minister of Environment and Forestry Regulation Number 23 of 2021 concerning Implementation of Forest and Land Rehabilitation, article 22 paragraph 3 states that the success of plant growth is determined to be at least 75% of the initial plant at the time of planting.

c. Letter from the Director General of PDASHL Number S.120/PDASHL/KTA/ DAS.1/8/2020 dated 31 August 2020 regarding Assessment of the Success of Watershed Rehabilitation Planting, point 7 states that plants resulting from watershed rehabilitation are declared successful if the number of plants in the third year is at least 75 % in good health.

(5) Taking into account the provisions of point 4 above, the evaluation of plants at the end of the third year resulting from planting activities in the context of watershed rehabilitation can be declared successful if the number of plants at the end of the third year, the number of plants per hectare is at least 75% of the initial number of plants ~~obtained.~~ planted.

(6) The percentage of plant growth is calculated by comparing the number of plants that grow with the planned number of plants that should be in the measuring plot. The percentage of plant growth and the percentage of healthy plants can be calculated in the following way:

$$T = [(\sum ti) : (\sum ni)] \times 100\%$$

Information: T = percentage of plant growth; ti = number of living plants in the measurement plot; and ni = number of plants that should be in the measuring plot.

4. RESULTS AND DISCUSSION

4.1. General Conditions of the Research Location

Location of plants carried out by assessment activities in the context of PT Berau Coal Watershed Rehabilitation in Block C (C1-C45) in the Sei Lesan Protected Forest Area in the Segah Watershed/Kelay Sub Watershed area in Kelay District, Berau Regency, East Kalimantan Province covering an area of 1,000 hectares. ~~-~~Based on the results of observations in the field, data was obtained as presented in Table 1.

Table 1. Realization of Planting for Watershed Rehabilitation

No	Block	Planting				Information
		Plan (Ha)	Realization (Ha)	Rating Result		
				Area (Ha)	Percentage (%)	
1	Block C	1.000	978,66	978,66	97,86	Rocky Location
Amount		1.000	978,66	978,66	97,86	

Source: Data of PT Berau Coal

The climate of the Sei Lesan Protected Forest area is strongly influenced by a wet tropical climate which is characterized by fairly high rainfall evenly distributed throughout the year so that there are no clear changes in seasons. Rainfall in the Sei Lesan Protected Forest experiences varying changes every year. The total annual rainfall intensity is between 1,800 mm to 4,100 mm/year with an average number of rainy days of 130-150 days/year. The average annual rainfall obtained over the last 12 years, namely 2005-2016, was 3,052 mm. Meanwhile, the monthly rainfall intensity in the Sei Lesan Protected Forest ranges from 163 mm/month to 362 mm/month with the average monthly rainfall intensity being 254.4 mm/month. This area has a slope class of more than 40%, with very extreme land slopes.

4.2. Land Cover and Vegetation Types

The biophysical survey that has been carried out shows that Block C is a primary forest type due to the higher species diversity and more complex forest structure with vegetation types from ~~the Dipterocarpaceaae~~Dipterocarpaceae family such as the *Shorea smithiana* and *Shorea leavis* types, with a tree density of 193 trees~~.~~ /hectare (PT Berau Coal Tahun 2014).

The results of observations in the Block C area in the context of rehabilitation of the PT Berau Coal watershed show that it has been planted with woody plants and multi-purpose trees species, such as *Shorea sp., Shorea balangeran, Dryobalanops lanceolata, Pterospermum javanicum, Artocarpus integer, Litsea spp., Durio zibethinus, Palaquium spp.*, and *Baccaurea motleyana*. As stated by Marpaung, et al. (2015) these advantages include, among others, originating from their natural habitat, having been tested and able to adapt to their environment, having the value of preserving biodiversity, and financially having high economic value and being liked by the community. So these tree species will be more prospective in providing opportunities for the success of critical land rehabilitation activities if they are offered as tree species used for rehabilitation. For this reason, it is necessary to carry out an inventory of the wealth of multiple-purpose tree species.

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4.3. Plant Growth Percentage

The results of the assessment of the success of PT Berau Coal's River Watershed rehabilitation in the Sei Lesan Protected Forest (HLSL) which has been carried out in the Block C (C1-C45) planting plots with an area of 1000 ha and 500 measuring plots, can be seen in the overall Table. 2.

Table 2. Recapitulation of Number and Percentage of Growing and Healthy Plants

No. Plots	**Area (ha)**	Number of Plots	Measure the Target of Plant	Number of Plants There is	Number of Plants Healthy	Plant Growth (%)	Healthy Plants (%)
C1	25	13	812	643	624	79,19	76,85
C2	25	13	812	629	616	77,46	75,86
C3	25	13	812	631	618	77,71	76,11
C4	25	13	812	636	615	78,33	75,74
C5	25	13	812	641	619	78,94	76,23
C6	25	13	812	630	611	77,59	75,25
C7	25	13	812	633	610	77,96	75,12
C8	25	13	812	630	612	77,59	75,37
C9	25	13	812	630	610	77,59	75,12
C10	13	7	437	340	328	77,80	75,06
C11	25	12	750	584	571	77,87	76,13
C12	25	12	750	590	578	78,67	77,07
C13	25	12	750	590	574	78,67	76,53
C14	25	12	750	582	570	77,60	76,00
C15	25	12	750	591	573	78,80	76,40
C16	25	12	750	584	573	77,87	76,40
C17	25	12	750	586	570	78,13	76,00
C18	25	12	750	586	564	78,13	75,20
C19	25	12	750	592	577	78,93	76,93
C20	5	3	187	144	143	77,01	76,47
C21	25	13	812	632	619	77,83	76,23
C22	25	13	812	634	618	78,08	76,11
C23	25	13	812	636	618	78,33	76,11
C24	25	13	812	637	616	78,45	75,86
C25	25	13	812	644	623	79,31	76,72
C26	25	13	812	625	610	76,97	75,12
C27	25	13	812	639	620	78,69	76,35
C28	25	13	812	632	610	77,83	75,12
C29	16	8	500	393	383	78,60	76,60
C30	25	12	750	595	577	79,33	76,93
C31	25	12	750	586	574	78,13	76,53
C32	25	12	750	581	569	77,47	75,87
C33	25	12	750	581	567	77,47	75,60
C34	25	12	750	594	577	79,20	76,93
C35	25	12	750	589	570	78,53	76,00
C36	25	12	750	592	571	78,93	76,13
C37	24	12	750	589	573	78,53	76,40
C38	15	8	500	390	384	78,00	76,80
C39	15	7	437	344	331	78,72	75,74

C40	15	7	437	342	335	78,26	76,66
C41	14	7	437	343	328	78,49	75,06
C42	15	7	437	345	333	78,95	76,20
C43	15	7	437	339	332	77,57	75,97
C44	15	7	437	344	335	78,72	76,66
C45	14	7	437	342	336	78,26	76,89
Total* Mean**	**1.000***	**500***	**31.237***	**24.440***	**23.765***	**78,24****	**76,08****

Source: Processed Primary Data.

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The data in Table 2 shows that the target number of plants to be planted in Block C is 31,237 plants, however, the number of plants in the measuring plot is 24,440 plants with the number of healthy plants being 23,765 plants. A comparison of target plants planted and plants growing as well as the number of healthy plants in Block C is presented in Figure 2.

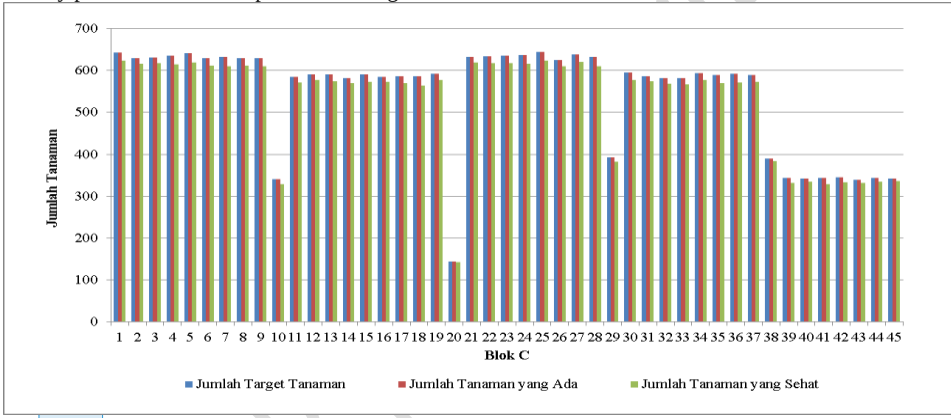

Figure 2. Comparison of Target Plants, Plants Growing, and Number of Healthy Plants in Block C

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The number of target plants and plants that grew was different. Several plants in the measuring plots died because several plants were attacked by pests and plant diseases. In addition, based on field observations, an ineffective planting area of 21.34 ha was found in the form of a rocky area which spread over plot C7, plot C8, plot C9, plot C10, plot C16, plot C17, plot C18, plot C19, plot C20, plot C26, plot C27, plot C28, plot C35 and plot C41. This area cannot be planted because the soil layer is thinner than the existing rock layer.

The percentage of plant growth in Block C reached 78.24% with a percentage of healthy plants of 76.08% (Table 2). The graph of the percentage of plant growth and the percentage of healthy plants can be seen in Graph below.

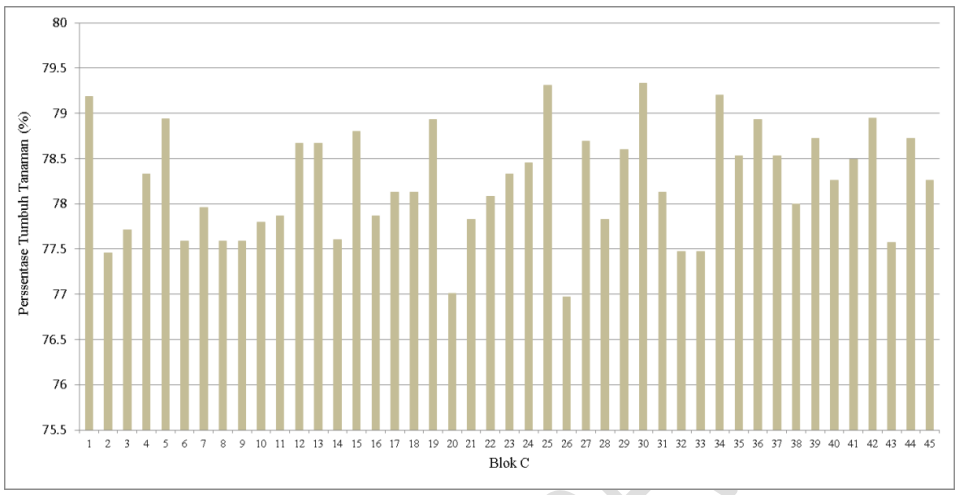

Figure 3. Plant Growth Percentage Graph

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Based on the graph in Figure 3, it is known that the highest percentage of plant growth is in Block C30, namely 79.33% and the lowest is in Block C20, namely 77.01%, with an average growth percentage of 78.24% (Table 2). The difference in the percentage of growth in each block is due to the different number of measuring plots and land productivity factors in each observation plot, thus influencing the number of plants in each planting block.

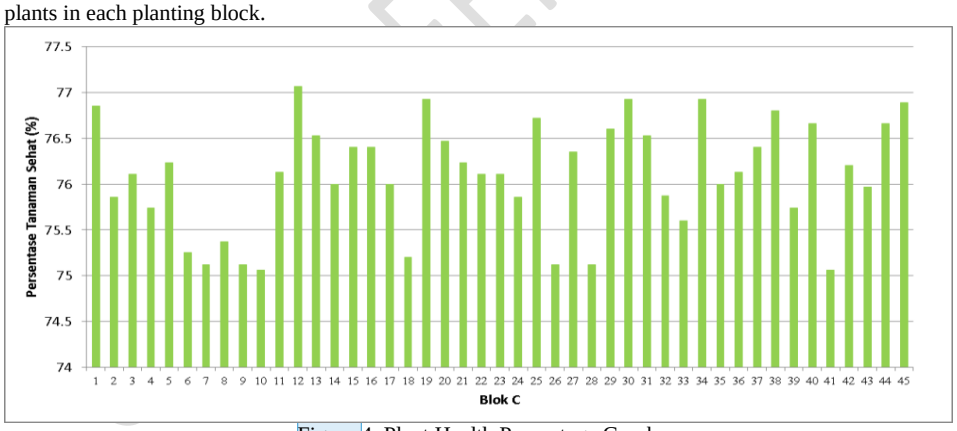

Figure 4. Plant Health Percentage Graph

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Based on the graph in Figure 4, it is known that the highest percentage of healthy plants is in Block C12, namely 77.07%, and the lowest is in Blocks C10 and C41, namely 75.06%, with an average percentage of healthy plants of 76.08% (Table 2). The difference in the percentage of healthy plants in each block, apart from being caused by the number of measuring plots and the number of plants, is also influenced by the number of healthy plants in each observation block.

Taking into account the provisions of the Ministerial Regulation, the evaluation of plants at the end of the third year resulting from planting activities in the context of PT Berau Coal's watershed rehabilitation was declared successful because the measurement results showed that the number of plants planted in the context of Watershed Rehabilitation had an average percentage of plants growing of 78.24% and the percentage of healthy plants was 76.08% of the total number of plants. This means that the PT Berau Coal DAS Rehabilitation planting results were declared successful because they exceeded the percentage of plants (75%) as required in the Minister of Environment and Forestry Regulation Number 23 of 2021 article 22 paragraph 3 and the Letter of the Director General of PDASHL Number S.120/PDASHL /KTA/DAS.1/8/2020 In line with the results reported by Meidisawarman et al (2023) the assessment of the success of watershed rehabilitation in the Riam Kanan Sub-watershed, Banjar Regency was quite successful. It was also reported by Yuliadi, et al (2023) that the success rate of river watershed rehabilitation activities at PT Borneo Indobar located in Artain Village, Aranio District, Banjar Regency was declared less successful with a survival percentage of only around 64.17 – 66.36%.

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5. CONCLUSION

1. The level of plant growth in watershed rehabilitation activities at PT Berau Coal Watershed Rehabilitation was declared successful with a plant growth percentage value of 78.24%.
2. The results of planting in the PT Berau Coal Block C watershed rehabilitation area were very good with a success rate of healthy plants of 76.08%.

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