

The Role Of Vegetation In Avalanche Control Around Balikpapan Shaft Road - Samarinda In Soeharto Hill Forest Park Area (Taman Hutan Raya Bukit Soeharto)

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Abstract: This study aims to determine the causes of landslide disaster and to find out how to cope with triggered landslide around along the axis of Balikpapan Samarinda road in Soeharto Hill Forest Park. Based on the analysis at the location of the research of land texture in Soeharto Hill Forest Park area is yellow Podzolic soil type, Latosol and Litosol (15%) and Alluvial soil (10%) with parent material in the form of folds of hill and. The structure of the soil is clumped and its consistency is flat. The topographic state of the field is bottom to bumpy to the slope of 10-45%. Referring to the general nature of soil chemical physics, most soil types in the Bukit Soeharto Forest Park area have a high degree of erosion sensitivity with very low land productivity, so it is appropriate to be designated as a conservation area. One of the geological processes that become the main cause of soil movement is rock weathering, rock characteristics in the research location of weathering occurs because of the weather is in tropical climate with high intensity. The location of the study is a hilly area that forms a slope of land with an average slope of 25 to 75 degrees and is composed by a pile of soil formed by physical and chemical weathering on rocks or more compact soil has the potential to move or landslides. The cause of a landslide disaster along the Balikpapan-Samarinda axle road in Soeharto Hill Forest Park is due to high rainfall and deforested land cover deforestation.

1 INTRODUCTION

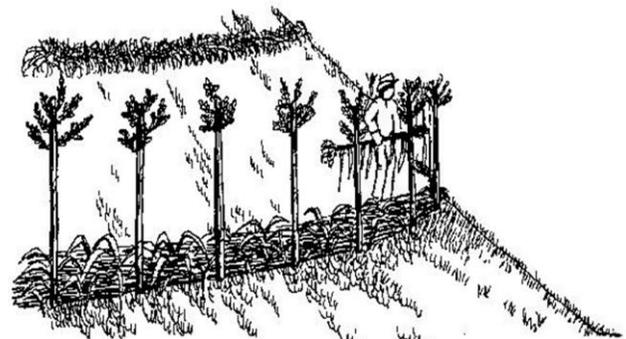
THE existence of a Balikpapan-Samarinda axis stretch of road through Soeharto Hill Forest Park Area, at this time has been a deterioration of road conditions, this is due to the occurrence of landslides at certain points of road segment so that inconvenience for the road users which in turn can occur violation events and accidents in traffic. Therefore it is necessary to rebuild at certain points of road that are damaged, so that the recovered road condition can be used for the road users in traffic with full comfort and can position itself on the track correctly. It is realized that the current condition in the vicinity of the axis stretch of the area of the area has been a lot of disturbance that is in the form of critical land, big trees have disappeared, landslide and based on the observation in the field shows that there has been a surge of motorcycle users, cars, or truck, all this has an impact on increasing the compressive force of the road which resulted in the decrease of the road or the occurrence of landslides, especially during the rainy season where the rift is easily entered by rain water which of course rain water will bring grains of sand soil that cause erositannah process and cause landslide body road.

The research activities aim to:

- Identify potential landslides along the axis of Balikpapan Samarinda Km. 28 Sungai Merdeka Samboja Sub-district up to Km. 69 BatuahLoa Janan
 - Know the factors of landslide
 - Knowing the potential landslide hazard associated with the condition of vegetation or shrubs
 - Analyze the role of vegetation in avalanche control
- Determine the avalanche control measures

2 RESEARCH AND ANALYSIS OF THE ROLE OF VEGETATION IN THE FRAMEWORK OF AVALANCHE CONTROL FOLLOWING ITS CAUSES AND ITS MITIGATION

Loss of cover plants can cause grooves in certain areas. The erosion of the land will increase and eventually there will be a landslide (Pangular 1985). Under these conditions also contributes to the erosion factor. The location or position of the cover of perennials and their density affect the safety factor of the hillside. The planting of hardwood vegetation on the foot of the hillside makes the stability of the hillside, on the contrary, planting hard crops at the top of the slope will actually lower the safety factor of the hillside, thus weakening the stability of the hillside itself (Hirawan 1993), thus the planting of certain types of clump vegetation is very appropriate in an effort to minimize the landslide, according to the degree of land slope associated with the role of Soeharto Hill Forest Park Area (Taman Hutan Raya Bukit Soeharto). Another cause of landslide events is internal disturbance coming from within the body of the hillside soil itself especially the water factor in the hillside soil itself



Sample image of vegetation planted on the slope of the soil

2.1 Management of the environment

Environmental management is intended to reduce, prevent and mitigate negative impacts and increase positive impact. The study is also based on a feasibility study of engineering or geological studies covering engineering geology, soil mechanics and hydrogeology. Thus the approach

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in dealing with landslide hillsides prone to landslides other than based on the recommendations of feasibility studies of engineering or geological studies, also based on the management of the environment. Thus, it is expected that the existence of axis road in Bukit Soeharto Forest Park area along 31 kilometers between Km. 38 Sungai Merdeka Samboja Sub-district up to Km. 69 Batuah Loa Janan Sub-district crossing slopes of hill-prone landslide can be identified furthermore so as to anticipate the strength and racket of a hillside. The relationship between factors affecting the deterioration of physical and mechanical conditions needs to be known. Effect of increase in aft rate, placement of load, vegetation planting and vibration conditions to the hillside soil. In general, the prevention of landslide slopes is to try to control the factors causing and the trigger. However, not all of these factors can be controlled unless they reduce the trigger factor. Several ways to prevent or stabilize the hillside in order to save the pavement stretch of Soeharto Hill Forest Park Area They are :

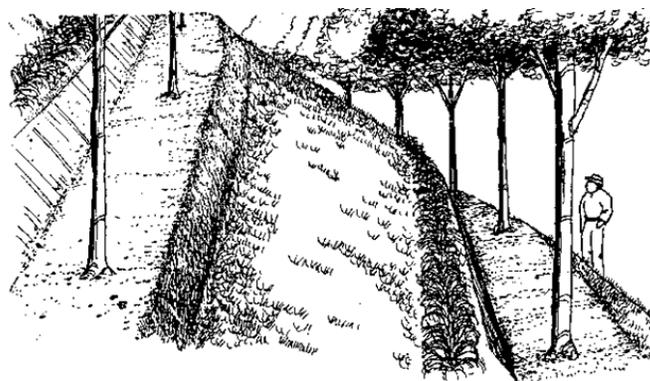
- Reduce the load at the top of the hillside by means of trimming the hillside, slope cuts are usually combined with filling or fill at the foot of the mountain slope, the making of the steps- steps and so on.
- Adding weights at the foot of the hillside by :
 - planting perennials
 - planting a certain type of vegetation at the top of the hillside so that evapotranspiration increases. Falling rainwater will enter the hillside, then infiltration can be done that way.
 - The coverage of the grass. the same way to reduce infiltration of rainwater into the hillside and with the coverage of grasses accompanied by drainage will also control run-off.
- Controlling surface water in the following manner :

Planting vegetation and grass coverage also reduces run-off runoff water so that surface erosion can be reduced.



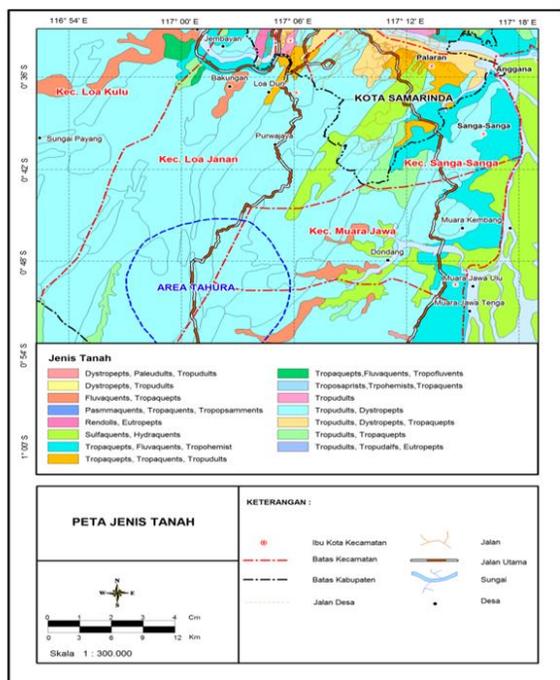
Sample image of vegetation planting in erosion control

- In agricultural areas that have a high slope of soil, it is better to create terraces to reduce the drift of soil particles by the speed of water flow (supported by fertilization to increase fertility for plants).



Sample image of making terracing to keep the soil is not easy to slide

- Reforestation on critical land with annual crops of economic value, the availability of foodstuffs, medicines and sap so that the roots of trees can play a role to keep the soil is not easy to landslide and maintain the availability of ground water.
- Rehabilitation in order to improve the land
- The closure of vegetation in a region of hilly, plains, and valleys in the Soeharto Hill Forest Park Area is closely related to soil and water conservation issues. In this case forest as one of the main buffer system of water valley area. Therefore, good forest management is also a conservation effort of land and water conservation. Destruction of forests and other vegetation, the occurrence of soil erosion, the emergence of degraded land, reduced groundwater supplies, and decreased land productivity are natural problems that are interconnected with one another. Generally it happens scientifically because of human activities in the exploitation of forest resources and agricultural resources regardless of its sustainability.
- It is important to realize that the population growth in Soeharto Hill Forest Park Area and the rising standard of human life has also increased the need pattern. Automatically human activities in the exploitation of natural resources including forest resources and agricultural resources are also increasing. Such human activities if not accompanied by rehabilitation of forest land and agricultural land, then the existence of these resources will not be sustainable which arteli that the damage will always occur. Facing the problem as above will only be resolved by maintaining the balance of nature that is still intact. Without the effort of land rehabilitation and awareness of maintaining the balance of land, the damage will continue to occur both on a large and small scale.
- Any form of damage to the vegetation of soil protection within the watershed area of Soeharto Hill Forest Park Area must be improved through reforestation activities must be done seriously to overcome and improve the forest leading to depletion of alias deforestation species, as well as avoiding threats to the stretch of road axis in the area.



Land type map image

14.	Pinusmerkusii	19,9-22,4	15-25
15.	Pinuscaribaea	24	7
16.	Swieteniamacrophylla	15-20	40-50
17.	Sesbaniagrandiflora	25	3
18.	Araucaria hunsteinii	16,9	19,5
19.	Tectonagrandis	12,7	40-60
20.	Shorea javanica	6-8	JO
21.	Acacia leucophloea	8,6	20
22.	Adenanthera microsperma	16,5	20
23.	Altingia excels	11,4-9,7	20-40
24.	Paraserianthes falcataria	37,4	15

(Source :Kadriand friend (1992), Suharlanand friend , (1975), and Manan (1978))

The types of native trees that have grown livestock area are the safest option. However, sometimes there are better types of exotic species than the original tree species, but the reactions to the body are only visible after the aging of the forest. Thus, if it is forced to plant a strange tree species, it must originate from a place of growing with climatic and soil conditions similar to or near to the area in the planting area. For example, if you are going to be planting a different new tree species then the species to be planted will come from outside the area of Bulkit Soeharto's tropical forest park and not from outside the tropics. Climatic conditions that need to be considered related to it :

- Average temperature and extreme temperatures.
- Distribution and intensity of rain.
- Altitude of place from sea level (altitude).

Types of trees as an alternative choice to be planted in reforestation activities rehabilitation of land, should meet the various requirements or criteria as follows (Kadri et al 1992):

- Able to grow in the open under full sunlight conditions. So this includes the type of intolerant and pioneer tree, which means it does not require many conditions of the growth factor, even has the ability to improve soil conditions.
- Be able to compete with weeds and other weeds, so we have to choose the type of tree that has fast growth properties so it can cover the soil and reduce the erosion hazard.
- Easily sprout or sprout again when pruned or burned
- Able to grow on the condition of skinny soil and drought soil.
- Seeds or vegetative parts as a breeding material are easily obtained.

2.2 The Election of Vegetation Types In Countermeasures Avalanche

The selection of tree species for rehabilitation in avalanche mitigation is not a simple issue as many factors need to be considered, such as ecological factors, tree species, economic, social, and time factors to achieve desired results. Thus, the selection of suitable tree species with growing places is the key to success. From a number of tree species suitable to the condition of the place of growth, there should be selected species of trees that can provide protection for the location or the avalanche points around the pavement road in Soeharto Hill Forest Park Area. In relation to the results to be obtained from the forest development, the factors that need to be considered, and they are :

- The cost of plant construction and its management.
- Losses that may arise due to pests, diseases or fire.
- Tree density or tree growth rate
- The benefits and value of wood and quality produced, in anticipation of landslide disaster.

Density of some trees and age

Number	Tree Species	Density	Age (annual)
1.	Acacia auriculiformis	12-23	8-17
2.	Acacia mangium	46-50	9
3.	Agathisloranthifolia	27, 7-29, 9	30-50
4.	Paraserianthesfalcataria	37,4	15
5.	Anthocephaluscadamba	20-24	5-10
6.	Araucaria cunninghamii	17-18,5	9,5
7.	Cassia siamea	15	17
8.	Casuarinaequisetifolia	10-20	7-10
9.	Dalbergialatifolia	23,7	40
10.	Eucalyptus deglupta	24,5-34	9
11.	Gmelinaarborea	35-40	7-11
12.	Maesopsiseminii	13-34	10
13.	Musangasmithii	14-19	9,5

These are the examples of tree species that can be selected as reforestation plants for rehabilitation of land include tusam (PinusMerkusii), teak (Tectonagrandis) large leaf mahogany (Swieteniamacrophylla), small leaf mahogany (Swieteniamahgoni), resin (Agathisloranthifolia), rasamala (altingia Excelsa), Sangon (Paraserianthes falcataria), Acacia (Acacia auriculiformis), mangium (Acacia mangium), leda (Eucalyptus deglupta), eucalyptus (melaleucaleucadendron) African wood (Maesopsiseminii), small acacia decurens (Acacia auriculiformis), acacia auriculiformis (Acacia auriculiformis), candlenut (Aleuritesmoluccana), kelampayan (Anthocephaluscadamba), jabon (Anthocephaluschinensis), sonokeling (Dalbergialatifolia), sonosiso (Delbergiasisso), pupsa (Schimanoronhae), sungkai (Peronemacanesens), wareng (Gmelinaarborea), macadamia (Macadamia hildebrandia), kaliandra red flower (Caliandracalothirus), Kaliandra white flowers (Calliandratetragona), lamtorogung

(*Leucaenaleucephala*), weru (*Albiziaprocera*). andkemlanding (*Leucaenaglauca*). As for the types of trees for greening, such as turi flower (*Sesbaniagrandiflora*), white flower turi (*Sesbaniabispinosa*), gamal (*Gliricidiamaculata*), rosidi (*Gliricidiasepium*), cloves (*Eugenia aromatica*), cashew (*Anacardiumoccidentale*), cotton (*Ceiba petandra*), rubber (*Hevea brasiliensis*), jackfruit (*Artocarpusintegra*), kluwih (*Artocarpussinensis*), breadfruit (*Artocarpuscommunis*), sawokecik (*Manikalkarakauki*), Cinnamon (*Cinnamomumsp*), petai (*ParkiaSpeciosa*) durian (*Duriozibethinus*), rambutan (*Nepheliumlappaceum*), avocado (*PerseaAmericana*) and Tamarind (*Tamarindusindica*). Types of trees as an alternative choice to be planted around the hillside with the following criteria:

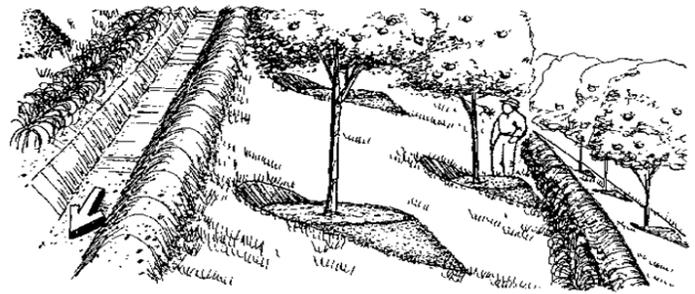
- Deep rooting, roots of long and tight branches, so as to establish incentive root system.
- The nature of rapid growth, so it can quickly cover the soil and reduce the danger of erosion.
- The selected tree must be a pioneer, a tree species that does not require the requirements of a specific growing site, so it has the ability to grow well in various conditions where it grows.
- Trees should be able to increase soil fertility directly or indirectly.
- To the area with high rainfall is selected species of trees that have a large evapotranspirasintature. While for areas with smaller rainfall selected species of trees that quickly adapt to the area, preferably the type of tree that quickly adapt to the area.

Based on these criteria, then can be selected several types of forest trees that can be planted as a path of securing a slope, such asbungur (*lagerstroemia specio*, johar (*cassia siamea*), mindi (*meliaazedarach*), laban (*vitexpubeseens*), sangon (*paraserianthesfalcataria*), large leaf mahogany (*S marophylla*), lamtorogung (*L. leucocephala*), sonokeling (*D latifolia*) walnut (*A mollucana*), mentru (*Schimawallichii*), rengas (*Glutarengas*),asamjawa (*tamarindusindica*), angšana/Burmese rosewood (*Pterocarpusindicus*), breadfruit (*Artocarpuscommunis*), bamboo (*Bambussaspp*,*Gigantocloaspp*), kluwih (*Artocarpussinensis*) kihujan (*Samaneasaman*) and banyan (*Ficusbanjamina*). The types of trees to be planted to strengthen the embungs or ponds, preferably from tree species that qualify as hardwoods.Criteria of this type of plant, among others have a deep root system, many roots and strong, and mmapu improve the physical and chemical properties of the soil.Based on these criteria, the tree species that can be selected are Lamtorong (*L. leucocephala*), gamal (*Gliricidiamaculata*), rosidi (*G sepium*), red flower Kaliandra (*Calliandracalothyrsus*), Kaliandra flower (*C.teragona*), and acacia *villosa*).

2.3 Determine the vegetative aversion control measures

The Anticipation of landslides To prevent slopes saturated with ground water or reduce soil moisture levels in the slope itself, groundwater and groundwater levels will usually appear during the rainy season, then prevention by way of making some water distributor from bamboo or paralon pipe at the slope near the foot of the slope.This means that the rising groundwater level in the slope will flow out so that the ground water level down. There are several ways to control surface water: Create adequate drainage design so that surface water

from the top of the slope can flow smoothly and infiltration decreases.



Sample image of terracing drainage design

- On the shoulder of the road as well as on the slope of the road resulting from increased road construction by doing land work ie by cutting the hill to be made so the land is more sloping and land accumulation.
- Reduce the intensification of land treatment in landslide prone areas

The above three things are of course adapted to the conditions and problems of the land at certain points along the stretch of the axle road in the area of Bukit Soeharto Forest Park Area. The existence of a pivot road that stretches into the Bukit Soeharto Forest Park Area by crossing the slopes and swamplands against landslide erosion can be clearly identified at certain points so that the handling is more specific, by looking at the characteristics of the area of the points primarily in its handling involves engineering vegetation that has various roles and can be combined with civil engineering engineering. Reduce logging of uncontrolled and unplanned tree species, clear-cuts and looting. The planting of vegetation with the type of perennials with intensive roots and can grip the soil and have tap the roots and fiber root is intended to prevent the rate of erosion.

Root structure

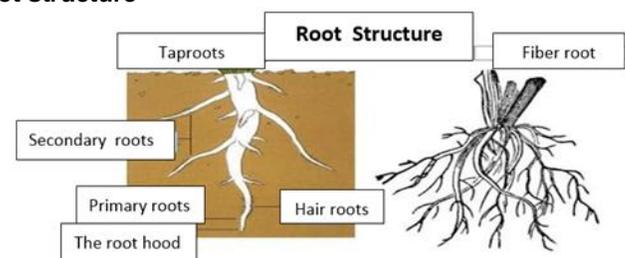


Image of taproots and fiber roots

3 CONCLUSION

- Identified landslide location and known factors that influence the occurrence of landslide.
- Analysis of avalanche control with follow-up treatment by means of vegetative planting and can be integrated by constructing an avalanche retaining (infra structure)
- Provide input or recommend to the authorities, to take concrete policy steps based on the accuracy of data in the field, so as to create road conditions that meet the requirements and safe for road users and environmentally friendly.

5 SUGGESTIONS

- Required more complete and accurate field investigation data in order to describe the actual and real conditions.
- To improve the stability of the slope is done penbulangan with Bioengineering or Bio Technical Stabilization, these two ways can be done by planting vegetation that has a root tap or fiber roots.
- The prevention of landslide disaster can be done by civil engineering.
- Efforts to reduce the vulnerability of communities in the activities of land use in areas prone to landslides by providing multiple activities as well as socialization of the impact of landslides.

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