

Implementation Of The Urban Forest Canopy Concept In Urban Forest Park Design, As An Effort To Rehabilitate Post-Mining Land Of Pt. Bukit Asam, Muara Enim, South Sumatera

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Abstract. Mining industry activity has a positive and negative impacts on life. The positive impacts of the mine are to meet the needs of industry, energy and other things that are important to life. However, on the other hand, mining activities will lead to land degradation. The mining site needs major attention due to environmental damage caused. In addition to causing erosion and sedimentation, mining activities can lead to increase of heavy metal content in soils potentially entering the aquatic environment, decreasing the quantity and quality of water. Therefore, a repair or rehabilitation effort on post mining land is needed so as not to cause sustained damage.

PT Bukit Asam in Muara Enim regency is one of the largest mining and mineral resource company in Indonesia. Recovery of land in PTBA is done by utilizing ex-mining land as urban forest as well as to increase recreation facilities in Muara Enim community.

This study uses a data collection technique including field observations, interviews, documents review, narratives and questionnaires. The analysis used in the study include the analysis of natural physical conditions, users, activities and space requirements, site analysis, infrastructure analysis and Urban Forest Canopy Concepts. The results of this study are Urban Forest Park designs by applying Urban Forest Canopy Concepts.

Keywords: Rehabilitation; Post Mining; Urban Forest Canopy; Urban Forest Design

1 Introduction

Mining activity bring both good and bad impacts for a region. One of the impacts of change on mining activity is a challenge on land function shift. The impact towards land quantity shown from the number of function-shifted land so that the contribution of reforestation land function to keep the environment quality of an area will be declined.

The decline of both land quantity and environment quality will trigger the escalation of air pollution, soil movement, water and top soil quality, and other environmental impacts exploitation of mineral resources [1]. Muara Enim regency is one of the largest mining regency in Indonesia . One of their mining activity promoter companies is Bukit Asam Corp. Inc. Coal mine is the main commodity on Muara Enim Regency [2] . As a coal mining regency it will bring a significant impact towards the physical aspects of environmental and physical condition. One of the significant changes post mining activity is shown on the environmental change. Chemical changes post mining will impact on the ground surface water and will physically change the soil morphology and topography [3].

One of those efforts can be implemented through ecosystem rehabilitation activity. Bukit Asam Corp. has been working in the process of repairing the environment ecosystem post mining activity. The company cooperated with Agricultural Faculty of Bengkulu University on the research related to the development of urban forest on 2012. The research cooperation is related to the local plants and laboratory-scale greenhouse has been made as one of the conceptual reference for urban forest development [4].

As coal mining regency, many green open spaces are needed to balance the environment quality of the area. But Muara Enim regency has only 27 parks with total area of only 6,38 Ha [2] . These conditions have not met the needs of green open space to maintain environmental stability as well as social interaction space. So in the effort of repair physical and environmental conditions, the post mining land is re-utilized through urban forest development efforts.

Rehabilitation on the region implements a revegetation process before utilizing the post mining land. In the process the revegetation and post mining land utilization program have some obstacles and challenges. The success of revegetation relies on the landscape arrangement, cultivation media, plant cultivation and treatment [5]. To maintain the revegetation sustainability and supporting the urban

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forest realization, proper conceptual approach is needed, which is implementing Urban Forest Canopy concept.

2 Research Method

This research method used Quantitative method. This method collecting numerical data for explain a phenomenon and answered of percentage of preception of public for urban forest.[6] So, quantitative research focused on measuring of social reality which is what user want from the urban forest [6]. The technicque of Collective data for this research used survey, questionnaire, interviews, and observation for collected data needed and compilation secondary and primary data[7].

Answered of problem based on deductive process with several stages, they are decision of main issue, decision of planning study area, survey and management of data, analysis, and decision of concept[7]. Analysis technique of data, the result of analysis support for designing urban forest process. Analysis in the design of urban forest area consists of analysis of activity and user characteristics, space requirements, site analysis of the area, infrastructure analysis. So from the analysis, it will produce an output product in the form of new landscape for urban forest especially focus on vegetation arrangement.

3 Muara Enim District as one of Coal Producing District

Administratively the research area is located on Karang Raja Village in Muara Enim Sub-district, Muara Enim Regency, South Sumatera.

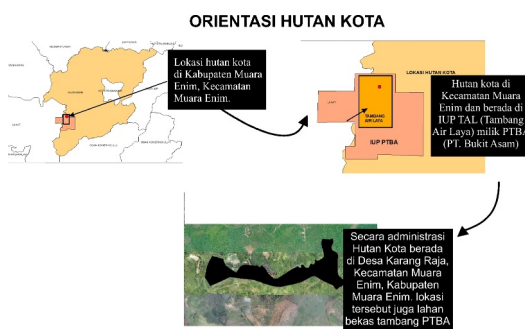


Fig. 1.Constellation Study Site

The location is a mining site of Bukit Asam Corp. Inc. By the mining permit of Bukit Asam Corp. Inc. it's located on the spreader area on the mining permit of Air Laya Mine. The mining permit of Air Laya Mine covers an area of 50 Ha.

Urban forest borders determined by considering the physical condition of the area, such as topography, accessibility and the revegetated areas. Those zonings divided into plantation areas, Water Park, forest and campgrounds and decision by Bukit Asam Corp and

State Department of Environment of Muara Enim Regency.

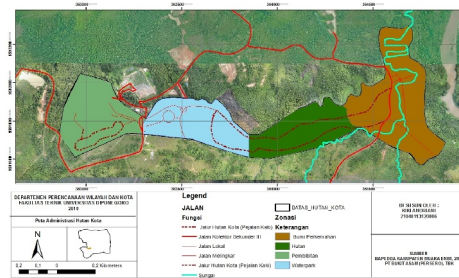


Fig.2. Zoning of Muara Enim Urban Forest

3 Theories

3.1. Urban Forest Canopy

Urban Forest Canopy concept is a concept adopted from Tulsa Urban Forest Master Plan. This concept refers to urban forest development and establishment plan focused on the resources management, improvement and development, especially long term vegetation on urban forest, for 20 years [8]. This concept mainly has some goal in its implementation, they are Conserve and improve life quality and being sustainable, Repair the environment on the region, and Preserve the local biodiversity.

The concept accomplishment supported by several indicators to achieve the goal of urban forest development that will implement the concept [8]. Here are the five indicators of the concept implementation, such as resilient, safe, connect, park and recreation, walkability, and stakeholder.

3.1 Post Mining Activity (Reclamation, Rehabilitation and Revegetation)

Refers to the regulation related to post mining reclamation, UU No 4 of 2009 about Mineral and Coal Mining mention that reclamation is an activity done through the mining business stages to organize, restore and repair environment and ecosystem quality to be able to functioning again according to its designation[9]. The rehabilitation focused on the ecosystem history or ecosystem prior to mining activities as a reference on the rehabilitation process [10]. Refers to Muara Enim Regency Local Regulation No. 4 on 2004 about the utilization of post mining land of Bukit Asam Corp. on Muara Enim Regency as Forest Park (TAHURA Enim).

The success of revegetation relies on the vegetation choice that is adaptive, grow correspondingly with soil characteristics, climate and post mining activities. The success mainly refers to the landscape arrangement, the fertility of planting media also the planting and plant treatment [5].

4 Pt Bukit Asam Post Mining Area As Case Study

4.1 Muara Enim Urban Forest New Landscape in Post Mining Land.

4.1.1 User Characteristic Analysis and Spatial Proportion

User characteristics can be seen from the number of area that will be provided for the user. The land area on urban forest is 50 Ha with the proportion of built and non-built region of 40% (20 Ha) and 60% (30 Ha). The built region area is 20 Ha and the non-built area is 30 Ha. The area division is an agreement between Bukit Asam Corp. and State Department of Environment of Muara Enim Regency. As for the circulation area is 30% of the built region area. So the 140.000 m² are used as building space and 60.000 m² are used as circulation.

Ministry of Public Work Regulation No. 05 05/PRT/M/2008 on Guidelines for the Provision and Utilization of Green Open Space in Urban Areas, the maximum capacity of urban forest coverage is 35.000 inhabitants with minimum per capita area of 4 m².

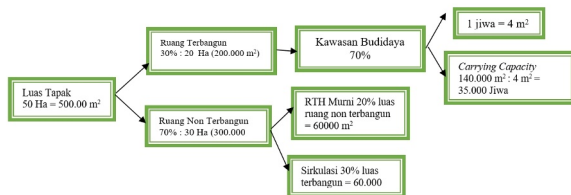


Fig. 3. Analysis of Carrying Capacity on Urban Forest

4.1.2 Site Activity Analysis

Urban forest area of 50 Ha is used as a new tourist location and as an environment quality control. Thus, for the division of activity groups is based on the function of the built and non-built regions. The design of urban forests will be divided into several new activities. Here's the explanation of the activity in the built area, in example:

- Recipient Aktiviti, as a receiving space for visitors before entering the area.
- Management Activity, as a space for Urban Forest managers consisting of an office manager, operational and maintenance space area.
- Main Aktiviti
Main activity as its new activity as a tourism area. The main activity consists of waterpark zones (water tourism), campsites, and forests.
- Supporting Activity
This activity as a support of the main activity. Supporting activities include a group of waterpark facilities consisting of toilets, shower rooms, changing rooms, children's pool, main pool, gazebo, some water rides games, and information boards. Also for campground zones the facilities that support the main activities will be provided such as gazebo,

verandah, toilet, rinse room, outbound rides, public kitchen, bonfire area, information boards, manager guesthouses, and cooking and baking tool room. In addition, it will be supported by trade and service groups and religious facilities.

- Service Activity.

Services in urban forests consist of clean water services, solid waste services, and security services.

4.1.3 Topography and Soil Condition

Topography is used as a determinant of the built and non-built space usage development which is determined from the contour and slope condition of the region

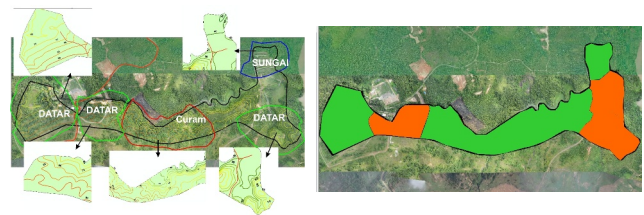


Fig. 4. Slope and Topography Condition of the Region and Analysis of Topography

The existing condition of contour lines of urban forest varies, ranging from 30 to 95 meters elevation. So the building placement is on the flat or slope area while steep areas will be used as a non-built area. Planned built area marked with orange blocks while for non-built blocks are green.

4.1.4 Landscape Vegetation

Vegetation at the urban forest design site correspond with the process of revegetation on post mining land. Types of plants for pioneer vegetation (original plants) namely gegenjuran grass (*Phaspalum* sp), Cottonwood (*Hibiscus tiliaceus*), Senggani (*Melastoma*) and Putri Malu (*Mimosa invisa*). As for the reclamation plant in the urban forest is a leguminocae or legume family. Existing types of vegetation are Cormis (*Acacia auriculaeformis*), Silk (*Albizia falcata*), Forest Mangrove (*Acacia mangium*), Angsana (*Pterocarpus indicus*), Cassias (*Cassia multijuga*), and White Leadtree (*leucauna glauca*).

The vegetation selection based on the vegetation function divided into as a shade, giving the neat view impression from side to side, directing a path, reducing pollutants, and giving aesthetics to the region. while the vegetation for water absorption consists of vegetation with root system and fiber can enlarge the soil porosity and can absorb rainwater and a bit of runoff water well [7]. Based on the shape of the tree canopy consists of different forms of canopy with different vegetation types. The shape classification of tree canopy consists of [8]:

- The cone shape is a Merkus pine tree, the pine trees that scattered in the plaza's main park
- Cylindrical shape of Eucalyptus, Ashoka, Medlar, Fern, Mango trees, etc.

- Umbrella shape is Silk trees, Flamboyant, Amboyna Wood, and Mahogany trees.
- Pagoda shape of Country Almond trees.
- Star shape of palm tree, coconut, bamboo, etc.

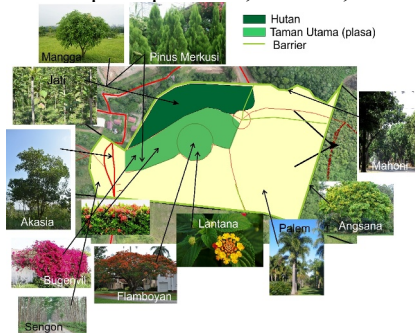


Fig. 6. Vegetation placement illustration in a zone

4.2 Approach to the Urban Forest Canopy Concept

4.2.1 Indicator and Benefit

The indicators on this concept consist of 6 indicators supporting the objectives and application of the concept. So the indicators of the urban forest concept application is:

- Resilient, vegetation distribution by its function into vegetation for pollutant absorbent, for water absorption region, area marker vegetation, aesthetic value enhancer, shade, and for road guide. For open areas or plazas and active green open spaces dominated by ornamental plant, shade, and road guide vegetation such as Cananga, Bugenvil, Lantana, Merkus Pines, Fir, and Ashoka. Vegetation distribution In the waterpark area made of shade and markers vegetation such as Palm and Areca Tree as an area marker and Mahogany, Fern, Country Almond and Cottonwood for shade area. As for the forest area has a variety of species or various vegetation types. Similarly, the vegetation distribution in the camp area has shade vegetation. And to maintain the sustainability of the tree maintenance is done and layout of plants with the same type of vegetation is formed parallel and not mixed with other tree species to be able to optimize the process of photosynthesis in the tree and for the trees with heavy density should not be brought closer to medium or light density. Tree layout arrangement refers to the Regulation of Minister of Public Work No. 05/PRT/2008 about the Guidelines for the Provision and Utilization of Green Open Space in Urban Areas:

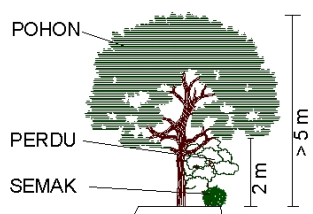


Fig. 2. Plant Path Mapping

- Safe, So in order to maintain the existence and sustainability of vegetation identification, management and maintenance, so that Young plants in the urban forest need intensive supervision to maximize the growth of the plant.
- Connect, Urban forest can directly fulfill the demands of green open space. As for the long term urban forest is capable of reducing air pollution, improving topography, hydrology, creating habitat for wildlife, and biodiversity.
- Park and Recreation, urban forest divided into several zonation create regency area as tourism and recreation which the availability of water park, plaza and camp as the supply to accommodate tourism and recreation activity in the region.
- Walkability, urban forests provide easy access for pedestrian. The road network plan for urban forest provides a safe space for pedestrians.
- Stakeholder, Cooperative coordination between the government agencies, mining companies and the people is required.

4.2.2 Implementation Concept

Implementation in accordance with the strategy applied to Tulsa Urban Forest, namely using Tree Canopy. The function of urban forest as the environmental quality stabilizer is still carried out. The strategy applied from the concept of using tree canopy by utilizing tree trunks and canopies to apply the urban forest canopy concept. So it has a good impact on the temperature reduction of urban areas, reducing heating/cooling costs, reducing air pollution, increasing property values, and providing aesthetics and influencing the life quality of people. Implementation of the concept on various activity groups is as follows:

- Recipient Activity Group.
The recipient activity group use Silk tree vegetation with Silk tree distribution layout following the pattern on the parking line with 10 meters distance between trees and 5 meters minimum height of vegetation.
- Management Activity Group.
Management activity group is similar to the recipient activity group. vegetation in the area as a shade vegetation for visitors in the group and the vegetation combination of trees with one to two species and shrub plants.
- Main Activity Group
Especially for the main activity, shade vegetation with medium and light density and umbrella-shaped canopy is preferred. Visitors do not feel too hot from direct sun exposure although the activity is outdoors due to shade vegetation to provide comfort for the main activity.
- Supporting Activity Group .
Supporting areas use shade vegetation, noise absorbers and aesthetic value enhancers. The vegetation used to absorb pollutants is Amboyna Wood. The shade vegetation around the

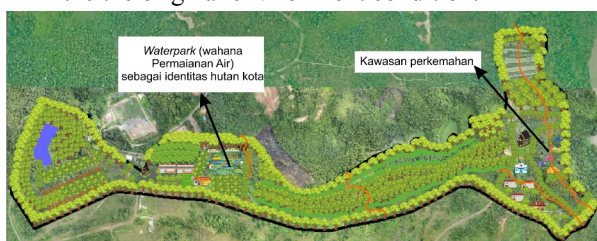
neighborhood and local roads uses Acacia trees as shade vegetas which absorbs pollutants, and gives shade. As for the commercial facilities dominated with vegetation aims to shade and absorb air pollution. Passive Green Open Space

- Passive green open space in urban forests consists of median, forest, and barrier. Median in the region formed as plants arrangement located in the road belonging space (RUMIJA) In the secondary III collector road and the local road vegetation used on the roadside planting path which aims to absorb pollutant i.e. Acacia tree. Maximum vegetation height of 5 meters to the edge of the road with a dense planting layout spacing (3 meters) and solid leaf mass. As for the neighborhood road or a specialized pedestrian path use Merkus Pine tree with 3 meters planting layout and 5 meters maximum height and 4 meters planting spaces. While for passive green open space in the form of forest the various vegetation. Vegetation distribution is evenly distributed in this area, such as vegetation for barrier areas, strong root vegetation in areas with steep topography, local vegetation, and reclamation vegetation. There is pollutants absorber and water absorption areas vegetation in the area, such as Amboyna Wood, Mahogany, Country Almond, Teak, and Fir trees. In addition there are also local tree vegetation and production plants such as Mango.
- Active Green Open Space
 As a park it gives a good aesthetic value, so the vegetation in this area is functioned to provide aesthetic value, road guide and ground cover. Vegetation on the plaza are Cananga, Bougenville and Lantana trees as ornamental plants to increase the aesthetics of the region.

4.3 Muara Enim Urban Forest New Landscape in Post Mining Land

The arrangement of the urban forest landscape on post mining land is seen from the main activity division, such as:

- Waterpark zone although dominated as built area, this zone can be developed as a tourist or recreation site.
- Forest zone is a major activity that is kept as a non-built area to maintain environmental stability and as a water absorption region.
- Campground zone is a camp area it is both tourist and recreation site, but not too much space is being built so this zone condition is almost the same as the the original environment condition.



Skyline

Fig. 3. Landscape planing for Urban Forest

5 Conclusion

The urban forests development on post mining land has some challenges to maintain the land condition post reclamation or rehabilitation. Rehabilitation is done by the initial process of land revegetation and requires efforts in the success of revegetation. The landscape arrangement on the post mining land also provides the opportunity for land to develop into a tourism or recreation area. The Urban Forest Canopy concept approach that focuses on the identification, management, maintenance and regulation of vegetation is able to support the region to restore the initial function and sustainable in the long term. This concept not only help the efforts of the regional function optimalization in maintaining environmental stability, but also can be optimized as an additional tourism or recreational facilities for Muara Enim people. So this strategy can influence the temperature reduction of a region, increasing the groundwater quality whereas trees act as rainwater container, reduce air pollution, improving the property value, provide wildlife habitat and regional aesthetic that form a sense of place .

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