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# Green open space plan for coal mine reclamation area PT Angsana Jaya Energi, Angsana, Tanah Bumbu, South Kalimantan

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## ABSTRACT

Mining activities can have a significant negative impact on the environment, leading to degradation. Converting land into a mining area requires mandatory post-mining reclamation activities. PT Angsana Jaya Energi, one of the coal mining companies in South Kalimantan, especially in Tanah Bumbu Regency, is participating in the implementation of reclamation activities. These activities will develop urban forests on mining land sold, covering an area of 29.75 hectares based on field surveys and data synthesis. To prepare a zoning plan foran urban forest area, several analyses are necessary, including spatial requirements, activities, user characteristics, forest organization, and regional footprint. The development of an urban forest will serve different functions in each area.

**KEYWORDS:** post mining area; reclamation; urban forest

## 1. Introduction

Global warming and the urban heat island effect have led to a decline in the quality of urban open spaces(Wang & Gou, 2024). Reclamation can be categorized as Green Open Space, part of open spaces (open space) an area filled with plants, crops, and vegetation (endemic or introduced) to support ecological, social, cultural, and architectural benefits that can provide economic benefits (welfare) for the community after the completion of mining activities (Saleh, 2021). Degradation of land use in an area will result in a lack of space to meet public open space needs. Especially in green open spaces, if there is a decline in quality or quantity, it will hurt the environment and society. One of the activities that Mining activities are quite significant in having an impact on changes in land cover. Mining is carried out using an open system (surface mining) will result in changes in land cover patterns, both on ex-mining land and on ex-filling land (Republika: Former Mining Area Renovated to Become a Forest Park, 2008).

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Tanah Bumbu Regency is one of the districts whose main commodity is coal mining with one of the companies, namely, PT Angsana Jaya Energi. There is a lack of green open space in Tanah Bumbu Regency and it is a mining city that needs green open space which can function to maintain environmental stability and to support economic, social, and cultural activities. Based on the author's observations, the location does not have green open space. The absence of green open space in Angsana District does not meet the need to maintain the ecological environment. Several incidents as a negative impact of mining activities can be seen from the threat to the physical, biological, social, cultural, economic, and national heritage environment, to threats to ecology and sustainable development (Makurwoto, 1995). Historic mine wastes generally contain higher amounts of metal(loid)s than modern wastes due to the lower processing efficiency and mining of higher grade ores in the past (Bevandić et al., 2022). The demand for the provision of green open space to maintain environmental quality is carried out by the existence of activities post-mining. Ex-mining land that cannot be reused requires reclamation and revegetation to restore the function of the land and use it as public open space. In general, the success of revegetation on ex-mining land depends on landscaping, fertility of the planting medium, and planting and caring for plants (Zulkifli, 2014). One of the implementations of post-mining activities from PT Angsana Jaya Energi is environmental management (reclamation) so that ex-mining land can function normally again.

As a mining company, PT Angsana Jaya Energi is committed to developing areas that have been mined to be managed responsibly, through reclamation, revegetation, and post-mining activities. PT Angsana Jaya Energi a mining company in Tanah Bumbu Regency has made efforts to restore environmental improvements, one of which is in developing urban forests to restore land function and improve the ecological environment after mining activities. Administratively, the design location is in Angsana Village, Angsana District, Tanah Bumbu Regency. The research location is a former landfill mine owned by PT Angsana Jaya Energi. The ex-mining land that will be used for urban forest is located at the PT IUP location. Angsana Jaya Energy. And it borders directly on the Sungai Loban District area.

The urban forest is located administratively along the border between the urban area and the coal mining area of PT Angsana Jaya Energi. It is strategically situated noGreen open space of Sungai Loban District, west of PT AJE Mining Area, south of TIA Street, and east of Tri Martani Street. The urban forest planning, which was prepared in collaboration with PT Angsana Jaya Energi, is divided into several areas, including forest planting areas located in OPD AN (Out Pit Disposal AJE NoGreen open space).

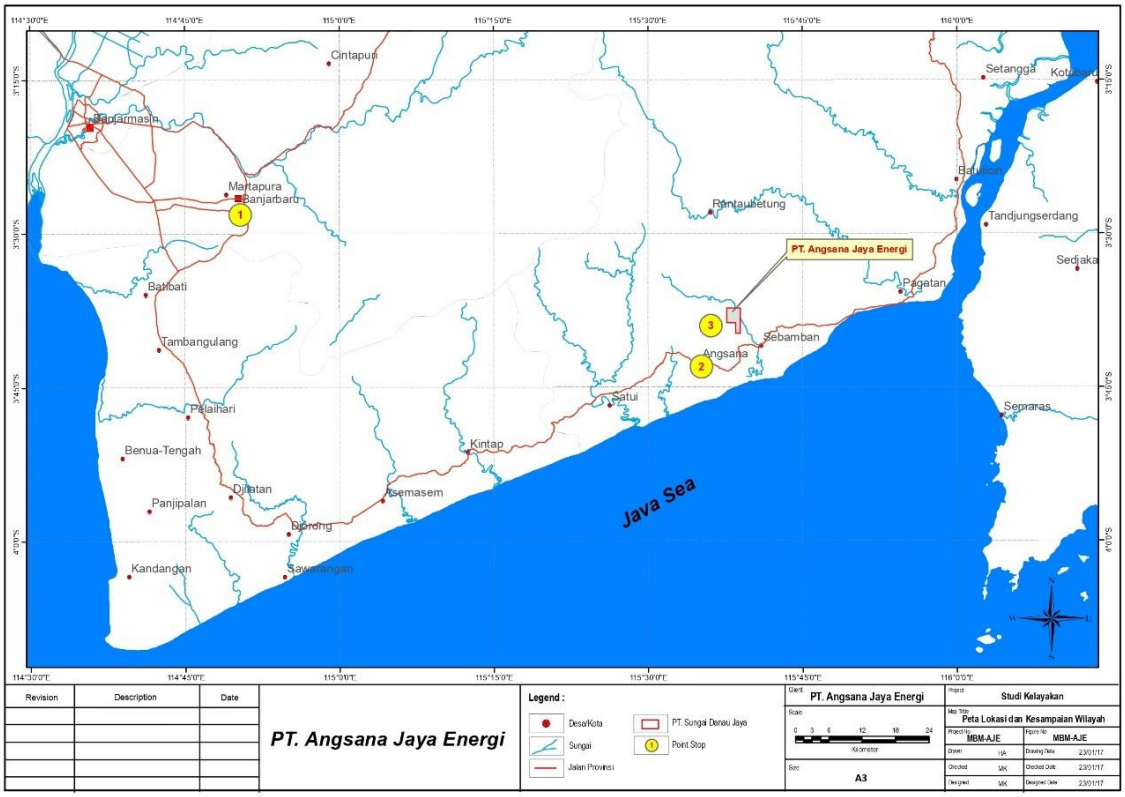


Fig1. Location map (PT. Angsana Jaya Energi, 2023)

## 2. Methods

The technique for determining data sampling uses sampling techniquesProbality Sampling which provide an equal opportunity for every element of the population to be selected as a member of the sample (Retnawati 2017). TypeProbality Sampling used is proportional Stratified Random Sampling where the population has a stratified or layered structure and the population members are not homogeneous (Sugiyono 2001). Research respondents are the people of Angsana District based on age group (Hidayanti and Pahlevi, 2023). The research method uses a quantitative or deductive approach. The stages in the research are:

1. Literature Study
   Clarify the literature review related to the title, directly or indirectly related to the final result based on the discussion.

2. Observation
   The survey was conducted through field observations, interviews, and questionnaires. Supporting data obtained from the survey was used in the analysis and design of the area.

3. Data Analysis
   The main issue in Angsana District is determined by the problems arising from mining activities, which have turned the area into a mining city. To focus on the design and development studies, it is important to identify the potential and problems of the study area. By doing so, the study area can be developed into a new and improved area. Data management is essential to analyze and design concepts. Additionally, a literature review of urban forest design onex-mining land will be conducted to support this study.

## 3. Result and Discussions

3.1 Factors for urban forest design on the former coal mining land of PT Angsana Jaya Energi include:

*a. Reclamation Area*

Reclamation is an activity carried out throughout the stages of a mining business to organize, restore, and improve the quality of the environment and ecosystem so that it can function again according to its intended purpose (Widawati 2023). The concept of reclamation is creating new land by backfilling. This reclamation is regulated in the Mineral and Coal Mining Law (UU Minerba) No.3 of 2020. The rules make mine reclamation much stricter, from supervision to punishment. This means that these post-mining activities are mandatory things that mining companies must carry out. Therefore, there are several important things in reclamation efforts so that mining companies do not commit violations. There are many ways to carry out mine reclamation.
Reforestation and revegetation could be several options. However, this requires a long-term process so that theecosystem can re-form.

1. Mining Area Cleaning
   To carry out reforestation or revegetation, it is necessary to clean the mining area. Cleaning must be hold in its safety and cleanliness, the location and construction of mining area should be calculated comprehensively. It is necessary to consider possible wastes and pollutants in the mining area(Dong et al., 2020).

2. Vegetation Selection
   Vegetation cover is one of potential ecological barometer to gauge the level of environmental damage and restoration in mining area (*Haoxuan Yu 2023*, n.d.) There are three stages in selecting vegetation, namely choosing *cover crops plant*, plant *fast growing plant*s, as well as replanting *indigenousspecies*.

3. Collaboration with Local Communities
   Companies cannot carry out revegetation without involving local communities. Local communities have an important role because they can supervise mining areas and their community settlements.

4. Carrying out Long Term Supervision and Control
   This process cannot run without supervision and control. Forest reforestation takes a long time and keeping the process running without failure is important.

*b. Green Open Space*

Green open space build method determines the location that could potentially be the new additional green open space based on vegetation density, temperature humidity index, population density and land prices (Humaida et al., 2016). Green open space planning is prepared as an effort to anticipate the growth and development of city development activities, as an effort to maintain balance, harmony, and harmony between built space and green open space. Green open space planning is a noble effort to maintain continuity between generations, so it is hoped that the direction, form, function, and role of green open space can be obtained in each area, as a whole, both in its position as a natural green open space: in the form of natural wild habitat, protected areas, and national parks, as well as non-natural or built green open spaces, as a result of the work of spatial planners to allocate non-natural green open spaces (Samsudi 2010). The Green open space arrangement aims to:

1. Maintaining the harmony and balance of the urban environmental ecosystem
2. Creating a balance between the natural environment and the artificial/built environment in urban areas
3. Improving the quality of an urban environment that is healthy, beautiful, clean, and comfortable.

*c. City Forest*

Urban forests are part of a form of green open space. According to Fakuara (1987) in Dahlan (1992) City Forests are plants or woody vegetation in urban areas that provide maximum environmental benefits in terms of protection, aesthetics, recreation, and other special uses. Dahlan (1992) divides the urban forest development approach into two approaches. The first approach, urban forest development is built in certain locations with the area determined based on the percentage of urban forest area, per capita calculation of population, and based on the existing main issue. Meanwhile, for the second approach, all areas in a city are areas for urban forests. City forests have several roles based on the use of city activities, such as conservation city forests, industrial city forests, residential area city forests, tourist city forests, and animal breeding city forests. Referring to the Regulation of the Minister of Forestry of the Republic of Indonesia Number P.71/Menhut-II/2009 concerning Guidelines for the Implementation of City Forests, it also explains the forms of urban forests, namely, green belts, city parks, gardens, botanical gardens, grand forests, zoos, grand forests, and protected forests.

*d. Vegetation Determination*

Vegetation or community is one of the biotic components that occupy certain habitats such as forests, grasslands, shrubs, and others (Arrijani, Setiadi, Guhardja, Qayim, 2006). Consideration of vegetation selection based on canopy density, top surface height, bottom surface height, area height, and average minimum temperature in the area. Selecting based on the canopy can be seen from the shape of the canopy and canopy density (Mahendra, 2009).

*e. Site Plan*

According to Lynch & Hack (1983)Site Planning or site design is a work of art that arranges structures on land and forms the space between them, art related to architecture, engineering, landscape architecture, and urban planning (Lynch & Hack, 1983). According to Lynch and Hack (1983), the site design stage includes programming and analysis ofthe site and users. According to (Rubenstein, 1996), the site analysis stages are divided into natural factors, namely, environment, topography, noise, accessibility, path of sun and wind, drainage, view, and vegetation. Analysis of site design and its environment consists of natural conditions, culture, and aesthetic factors that influence it. These features influence location selection and provide clues to the nature and character of the site which will help establish guidelines for fuGreen open spaceer development (Rubenstein, 1996). Apart from being based on natural factors and cultural factors, site analysis is also influenced by aesthetic factors consisting of natural features and spatial patterns. The character of the site is distinguished from natural feature elements and spatial patterns (Rubenstein, 1996). So the results of the site analysis produce regional zoning planning. Site analysis in research consists of several related physical analyses such as regional constellation, topography, accessibility, view, vegetation, the path of the sun and wind, noise, the environment, and the final results in the form of an overlay of all site analyzes in the form of urban forest area zoning. Site design is not only based on land use and circulation, the visual design of contextual factors and natural elements, but planning is also seen from the form of spatial organization (Tapak 2010). The form of spatial organization with buildings, nature, rocks, water, and plant materials must be structured.

*3.2 Analysis Of Urban Forest Design*

Designing an urban forest on former coal mining land refers to several analyses namely user analysis, activity analysis, and site analysis. Each analysis produces output that will influence the design of the urban forest area, where these components can be subjected to fuGreen open spaceer design analysis.

*a. User, Activity, and Space Requirement Analysis*

This analysis is used to study activity groups in urban forests and also to determine the characteristics of planned space requirements to support the design of the physical space

of the area (Tahir 2005). Areas in urban forests will be directed into planting areas and can be used to maintain the ecological balance of environmental activities. This analysis consists of user analysis and activity characteristics, analysis of carrying capacity, analysis of space requirements, analysis of relationships between spaces, and analysis of space organization. Overall, the urban forest area planned by PT Angsana Jaya Energi is 29.75 hectares.

*b.Site and Area Analysis*

The use of site analysis in planning planting in urban forests that will function as planting locations is intended to determine the basis for site planning (Beddu 2015). The analysis was carried out based on implementing public green open spaces as tourist locations which can also improve environmental quality. Site planning uses several analyses namely, regional constellation, topography, accessibility, view, and vegetation. So that all the analyses will produce a land use function area.

1. *Topographic Analysis*

The elevation value in the area starts from elevation 58 to elevation -2 so there are areas that are quite steep and sloping. In those areas are areas with loose or sloping contours and close or steep areas. So that the close or steep area will be developed as a non-developed area while the loose or sloping area will be developed as a developed area.

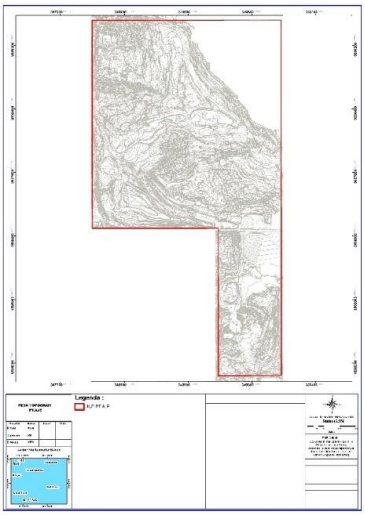

**Figure 2.** Image of topographic conditions in the area (PT Angsana Jaya Energi, 2023)

2. *Accessibility Analysis*

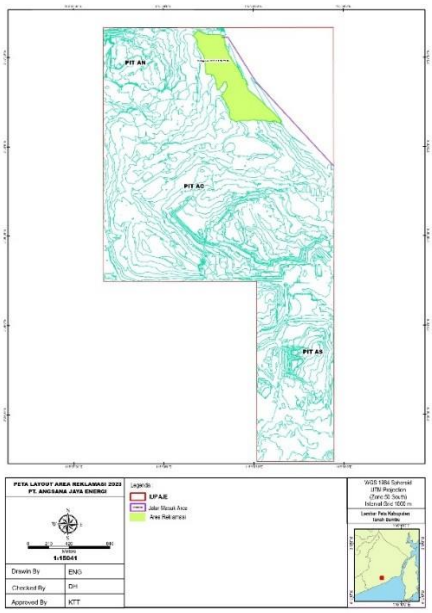


Figure 3. Image of accessibility conditions available for reclamation entry access routes (PT Angsana Jaya Energi, 2023

In terms of existing conditions, high accessibility is in areas where access to the area is available. So that the accessibility plan becomes public and private in the area (Budisetyorini et al. 2021). The public areas are light green areas that will be developed into built-up areas as well as several green open spaces that will be used by users as interaction spaces.

3. *Analysis view*

View analysis in the area where there is an analysis view from the site found at the entrance to the city forest on the secondary collector road. On planned view of the area will be made from the site in the form of an entrance gate to the area and a view of a road with shady vegetation. Meanwhile, the view that can be seen in the city forest is the name of the city forest area's main entrance as a marker for the urban forest. The name of the city forest's main entrance is "AJE City Forest". In addition, it is also in the form of skyline from buildings and vegetation in the urban forest. In urban forest areas, for skyline, The tallest are the trees.

Figure 4. Image of vegetation conditions in the area (PT Angsana Jaya Energi, 2023)

4. *Vegetation analysis*

Reclamation vegetation in urban forests is of the legume family nuts. The types of vegetation that exist are nuts (*Pueraria Javanica*), legumes (*Centrosema Pubescens*), and green plants or vines (*Calopogonium mucunoides*). Types of plants for Eucalyptus pioneer vegetation (*Melaleuca leucadendra*), Clove (*Aromatic Syzygium*), Jackfruit (*Artocarpus Heterophyllus*), Pete (*A Beautiful Park*), Guava (*Western Cashew*), Jengkol (*Archidendron pauciflorum*), Mahogany (*Swietenia Mahagoni*) and White Jabon (*Neolamarckia Cadamba*). The vegetation plan that will be implemented in the area consists of various types of vegetation. Vegetation on barrier The area functions as an area marker. The vegetation is in the form of Eucalyptus trees as a barrier on the Green open space side.

Figure 5. Image of Vegetation (PT Angsana Jaya Energi, 2023)

*c. Function Analysis of Green Open Space*

Green open space has a special function and role in each area in each spatial plan, which is planned in the form of arrangement of plants, plants, and vegetation so that it can play a role in supporting ecological, socio-cultural, and architectural functions so that it can provide optimal benefits for the economy and welfare of society, as follows:

1. Ecological function; Green open space is expected to contribute to improving groundwater quality, preventing flooding, reducing air pollution, and supporting microclimate regulation
2. Socio-cultural function; Green open space is expected to play a role in creating space for social interaction, recreation facilities, and as a marker (landmark) area.
3. Architectural/aesthetic function; Green open space is expected to increase the beauty and comfort value of the area, through the presence of parks and green belts
4. Economic function; Green open space is expected to play a role in developing urban green tourism facilities, thereby attracting the interest of the public/tourists to visit an area, so that it can indirectly increase economic activity.

Benefit what is expected from green open space planning in urban areas is:

1. A means to reflect regional identity (image).
2. Research, education, and extension facilities
3. Facilities for active recreation and passive recreation, as well as social interaction
4. Increasing the economic value of urban land
5. Foster a sense of pride and increase regional prestige
6. Facilities for social activities for children, teenagers, adults, and seniors
7. Evacuation room facilities for emergencies
8. Improving the microclimate, and
9. Increasing oxygen reserves in cities.

## 4. Conclusion

### *4.1Conclusion*

Overall, the site analysis shows that ex-mining land has been converted into urban forest based on physical, and non- physical conditions and surrounding environmental conditions. So the main activity is as a space for forest planting areas which can develop the area both aesthetically and develop the area design. So that this area is the initial stage in allocating urban forest land use.

### *4.2Recommendation*

The overall urban forest design is 29.75 Ha, but only limited to the urban forest. So there is a need for developments such as playgrounds to increase public interest in community entertainment venues.

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