Green city Banda Aceh: city planning approach and environmental aspects

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Abstract. Banda Aceh as the capital of Aceh Province is the region with the tsunami disaster that occurred on December 26, 2004 the most severe of which over 60% of the city area were destroyed mainly coastal region and settlements. One product plan for rehabilitation and reconstruction of Banda Aceh is made of Banda Aceh as Green City. To realize the Green City Banda Aceh, urban development process should be conducted in a planned and integrated way with attention to spatial and environmental aspects to ensure an efficient urban management and to create a healthy, beautiful and comfortable environment. There is a weakness of the process in urban planning and development that occurred at present where cities tend to minimize the development of green open space and land conversion into a commercial district, residential areas, industrial areas, transport networks and infrastructure and facilities for other cities. Another tendency that occurs is urban environment only developed economically but not ecologically, whereas ecological balance is as important as the development of the economic value of urban areas. Such conditions have caused unbalance of urban ecosystems including increased air temperature, air pollution, declining water table, flooding, salt water intrusion and increased content of heavy metals in the soil. From an ecological perspective, unfavorable microclimate, high-temperature increase due to the lack of trees as a sieve / filter against heavy rain, can cause flooding. These conditions result in inconvenient, arid and less beautiful urban areas. The author identifies the elements contained in the Green City Banda Aceh and how the efforts and approaches must be made toward Green City Banda Aceh.

1. Introduction

As an archipelago with a coastline of about 81,000 km, Indonesia coastal areas have a strategic significance because it is a region of interaction and transition between terrestrial and marine ecosystems that have unique properties and characteristics. The coastal region is very significant for human life on earth. As a transitional area of land and sea that has a unique ecosystem, especially in the field of environment in the context of sustainable development (sustainable development).

One of the natural resources that directly or indirectly holds an important role in human life is the land where the land is a complex environment and have the characteristics such as; climate, relief, soils, hydrology, vegetation and all living creatures that play a role in its use. Land suitability evaluation is the process of land use planning that is essential to compare the requirements demanded by different types of land use, with the nature or quality of land. The use of land is not up to his potential will lead to degradation of land and unsustainable. To avoid this, it is necessary to evaluate the characteristics of the land to support the planning area of the city better.

The tsunami that occurred on December 26, 2004 resulted in damage and great loss for the city of Banda Aceh. Largely very heavy damage occurred in coastal areas resulting in loss of life and
economic centers of marine fishermen and changing vegetation patterns and open green spaces in coastal areas. Learning from the tsunami, effectively limiting factor that minimizes runoff tsunami is their protective natural shoreline vegetation (buffer zone) by considering the character of coastal geomorphology.

Therefore, the central government and the Aceh provincial government has agreed to set the Spatial Plan of Banda Aceh which in essence is the establishment of a buffer zone (Buffer Zone) in the form of green belt width of 300-400 m from the shoreline as well as social forestry and fishing settlement with a width of 600-700 m re-planting mangrove trees (mangrove). The mangrove forest is the habitat for many wildlife species, as the economic function of mangrove forests serve as a source of timber, pulpwood, firewood, char materials, fishing equipment. Buffer Zone serves to protect the shoreline of the changes are not desirable as: erosion beach, or sedimentation dialur or harbor cruise, naturally effective coastal protection.

From the above it can be concluded that the coastal areas of Banda Aceh is an area that has the vulnerability and also the strategic potential in terms of aspects of the layout, which is an area that is geographically very important, but there has been little effort to organize the land uses in integrated / unified.

Writing this study aims to evaluate the characteristics of the land Buffer Zone Banda Aceh appropriate or not in accordance with the current land use, evaluating the green open land Banda Aceh coastal areas which have been planted or that there is damage or not. Spatially and gives an overview of the areas experiencing the rehabilitation of mangrove forests in the city of Banda Aceh.

2. Research Methods

Location of this research carried out in the coastal region of Banda Aceh which functioned as the Buffer Zone Area Kota Banda Aceh. The research was conducted between October 2010 until December 2010, involving a graduate student Degree in Chemical Engineering, students of Department of Architecture Faculty of Engineering and the Faculty of Agriculture, University of Syiah Kuala. Secondary data were used in this study, which include the administrative map of Banda Aceh, map of Municipality Spatial Planning of Banda Aceh (RTRW) in 2009-2029, and the existing landuse map of Banda Aceh produced in 2010. The primary data were taken by conducting fieldwork utilizing GPS and camera to capture city landscape perspective. Data collected during the survey were analysed using ArcGIS 9.3. This research uses descriptive method with survey to observe of physical condition and making the point coordinates in the field, as well as observations by Buffer Zone physical environmental conditions at the sites.

2.1 National legislation

National legislation which is used in the management of coastal areas and urban areas are as follows:

- UU no. 5/1990 on the Conservation of Natural Resources and Ecosystems
- UU no. 26/2007 on Spatial Planning (UUPR)
- The Decree of the Environment No. 45/11/1996 on Sustainable Coastal Program

2.3 Implementation Research
In general, the research carried out in four phases: preparation, data collection, map overlay techniques and ground checks, sampling technique of point coordinates in the field.

3. Results and Discussion (Banda Aceh Green City)

By studying product development scenarios green open space area of Banda Aceh produced by the Government of Banda Aceh in cooperation with JICA institutions, development strategy Banda Aceh Green City can be described as follows:

- Maintaining open space and vegetation through conservation, rehabilitation and revitalization, to preserve the environment (environment).
- Changing attitudes and behavior for more care and respect for nature and the environment.
- Provide facilities and urban infrastructure that supports environmentally friendly city.
- Adjusting the density of buildings so as to guarantee a water catchment area and green environment.

Development Plan for Banda Aceh Green City produced is as follows:

- Conserve / protect the coastal zone by synergizing land use in the area around the beach, which supports the economic, social, cultural and nature conservation / environment.
- Develop a pool of water / retention pond in the city (there) which is part of the drainage system of the city, which also functioned as a green area of the city, recreation area, the area of socio-economic community and the aesthetics of the city.
- The development of city greening in the main structure of the city (roads, rivers) and the open spaces of the city, which became elements of disaster mitigation (track rescue (escape route) and gathering areas for evacuation (escape area), and protect the city from the effects of climate change micro and create an aesthetic city.
- The implementation of building regulations regarding building density (Coefficient Building Basics / KDB, Coefficient of Land Building / KLB, Building Equivalent Line / GSB and Line Border Rivers / GSS)
- The provision of waste management facilities and waste (by the City Sanitation Department / DKP).
- At the level of spatial planning, as far as possible avoid the allotment of land for industrial heavy / pollutive in the city of Banda Aceh
Figure 2. Banda Aceh *Green City* development scenario, JICA, 2006

Regions Research *Green City* in the Coastal city of Banda Aceh can be seen in the map below:

![Map of the study area green coastal area of Banda Aceh](image)

Figure 3. Map of the study area green coastal area of Banda Aceh

Figure 4. RTRW Kota Banda Aceh

Description of Research Areas of green open space of Banda Aceh in 2006-2008 (during the rehabilitation and reconstruction of Banda Aceh)
Dike River Flood Canal

River Flood Canal levee are in the District of Syiah Kuala exactly starting from Alue Naga village to village Rukoh and Lamnyong. Currently along these canals are flooded vegetation distribution in the form of pine trees. However still linearly with the number still very limited so it can not characterize a green area of the city. The problem today is along the canal flooding has placed temporary shelter for displaced victims of the tsunami that, without supervision will have an impact for the sustainability of the region.

Tibang village, village ponds and dikes Fisherman Seafood

This area is an area of the former pond area and an open area that is relatively hot, because the concept of development in this area is the creation of an urban forest in the area of fishing villages that can help improve the condition of the air due to climatic influences. So, fishing settlement later a settlement located in the forest area of the city. Besides, today in some parts of the village Tibang has started planting mangrove especially around ponds. And in this area there are also marshes (wet land)

Krueng Aceh

The existence of Krueng Aceh that divides the city of Banda Aceh a strong impression on the identity of the city, but the potential is still underutilized and distribution of vegetation along streams and rivers still in groups where some places quite lush but on the other hand even with no vegetation at all.

3.1 River dikes and areas of green open space in the Krueng Aceh

Prototype river dikes to prevent flooding and guides Riverbanks with the adoption of green open space (RTH) and Pedestrian paths.
Coastal Region

As a result of the tsunami disaster there is little vegetation in coastal areas, only a fraction are mangroves. However mangrove replanting efforts have been started.

3.2 Scenario Concept Approach Green City Banda Aceh

The concept of urban development of green or Green City Banda Aceh is to create an urban environment that is strong enough to be able to repair the ecosystem itself, able to adapt to the development of the life of the new city as an environmentally friendly city, and be able to defend the city from other natural forces such as floods, waves and tide and can minimize excessive heat and wind. As the concept of the development of city greening listed in the Green City plan scenarios in Banda Aceh, the direction of development of city greening is as follows:

- No major city halls such as rivers and roads that form the linear pattern (Green Linear).
- In the open space of the city (Green Area) as part of the concept of disaster mitigation (escape road and communal areas for evacuation).
- In the conservation area which is the main buffer zone that coastal areas of mangrove forest.
3.2 The concept of Crop Type

For plant species concept is based on the appearance and function, the categories are divided as follows:

**Category A (on the side of the road and the edge of the RTH)**

- **General characteristics**
  High-category plant canopy cover crops are large or medium
- **Appearance**
  For shade, firmly rooted, long-lived, can be as a steering road, trunk strong and big and can reduce noise
- **Plants; Angsana (*Pterocarpus indicus*), Kidamar (*Agathis domara*), Tamarind (*Tamarindus indicus*), Kihujan (*Samanae saman*), mahogany (*Swieteria mahogany*), Nyamplung (*Calophyllum inophyllum*), Bungur (*Langerstroma spesiosa*)

**Category B (on a private area)**

- **General characteristics**
  Modern plants, including the categories of shade trees, canopy size medium
- **Appearance**
  As a shade tree and the trunk is not too large, need small space as a place to grow, are annual tree.
- **Plants; Felicium (*Felicium decipiens*), Damar (*Agathis alba*).

**Category C (As the hedge)**

- **General characteristics**
  Trees small / medium / shrub has a major attraction in the form of flowers, branches and shape plants
• Appearance
Flower color and form high, memorable splendor can be used as an ornamental plant and barrier
• Type of plant; Kasia, Dadap Merah, Flower Butterfly, Peacock Flower, Soka.

Ground cover, flowers or interesting leaf shape

• Appearance
Alternative land cover other than grass
• Type of plant; Taiwan Beauty, Bird of Paradise.

3.3 Category E (on the edge of the area, the median curb street as well as a steering)
• General characteristics
Trees with special characters
• Appearance
As a director, gave the impression and has a distinctive shape and attractive.

![Diagram](image)

**Figure 6.** The concept of structuring vegetation village area Lamnyong

3.4 Countryside Lamnyong around the flood channel

For the region around the village Lamnyong River Embankment Canal, plant placement plan is in two locations placements. The first of course is the river basin area, the placement on the river embankment is at the outer side of the dike to create sufficient visibility.

4. Conclusion

Placement of vegetation on the city's main hall, which is along the main street with the bearing arrangement of vegetation/plants is between pedestrian and private areas or areas awoke. Placement of vegetation or crops on the curbs and pedestrian paths. Placement of vegetation on the median of the road, on the road with sufficient width and a road with two-way flow of circulation.
The choice of location placement on top of the vegetation will be affected by the width of the existing roads, district GSB also the flow of circulation that occur on roads in the planned planting. Placement of vegetation in the area of the open city directed by planting trees for planting stratified lot of vegetation in this area is expected to regulate the microclimate of the area. Besides the preferred shape of a tree with a wide canopy that can be used as a shelter.

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