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Tropical Ecological City Concept for Banda Aceh to Become Sustainable After Tsunami Disaster

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ABSTRACT

After being rehabilited and recovered from worst damage caused by earthquake and tsunami which happened on 26th December 2004, the future development of Banda Aceh have to be planned as sustainable ecological city. As an element in sustainable ecological city concept, urban green space become important to support Banda Aceh as ecological city. But in reality, post disaster development that goes on short period in most part of city area of Banda Aceh, have lessened the wide of urban green space which can weaken its ecological function. This research will analyse the role of urban green space in ecological city concept and its adjustment to tropical climate. It applies methods of exploratory research of urban green space in Banda Aceh. Result expected is a strategic concept of tropical ecological city based on urban green space for Banda Aceh.

Keywords: Banda Aceh, ecological city, post disaster, sustainable, tropical, urban green space

INTRODUCTION

City planning approach which pay more attention to environment or which more knowledgeable in the planning term as environment friendly or environment sustainability has become the global trend issue [1]. This approach in general often related to the concept of sustainable development which then become the concept of sustainable city. It goes more specific to become the concept of ecological city. Ecological city represent the concept of healthy city, green and in harmony with nature [2]. The future development of Banda Aceh have to be planned as sustainable ecological city, after being rehabilited and recovered from worst damage caused by earthquake and tsunami.

The concept of ecological city defined as greener, safer and healthier city, more efficient, more people friendly and more socially equitable [3]; the principles in ecological city are efficient using natural resources, energy efficiency and appropriate to climate, while ecological city's components are landuse, transportation, building, green space, infrastructure and natural system of energy, water, air, sunlight [4]; city as sustainable ecosystem [5]; models of the ecological city variously stress energy, traffic, and the development of healthy communities [6]; ecological approach to urban design, management and towards a new way of lifestyle in harmony with the natural environment [7].

Although there is no universally accepted definition of an ecological city, there is some consensus on the basic feature of an ecological city amongst the available definitions. From an environmental sustainability perspective, an ecological city should be in balance with nature, dedicated to minimise the required inputs of energy, water and food, its waste output of heat, gases such as carbon dioxide and methane that cause atmospheric pollution and water pollution. However, in order to ensure sustainable development, which requires a balance between environmental, social and economic sustainability, the environmental features referred to above should be acceptable to the people and should be in harmony with their economic development aspirations [8].

Urban green space is an important part of complex urban ecosystems and provides significant ecosystem services. Some research shows, urban green space benefits urban communities environmentally, esthetically, recreationally and economically [9]; urban green space existence as counterpart of urban built area represent the important element in city with vision of environment, peaceful, compatible, well balanced and sustainable [10]; in tropical climate's cities, the function of tree planted in the urban green space is to decrease the contamination and air heating. Plant has the ability to lessen the use of energy in the building by degrading the air temperature around the plant [11].

As important component in ecological city concept, the existance of green open space and its natural richness have to be enough in wide and spread in the city. Unfortunely, post disaster development that goes on short period to rehabilited and recovered the damage in most part of city area of Banda Aceh have resulted in

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decreasing the wide of urban green space when constructing various new infrastructure for the city. And so when Banda Aceh return to its normal condition, startedly various socio economic activities arise. These various activity claim the needs to develop new housings, shops, offices and others. With the land limitation in the city, hence new development activity will progressively lessen the wide of urban green space.

Based on various problems mentioned above, research formulation is decreasing wide area of urban green space can weaken the ecological function of the urban green space. This research will analyse the role of urban green space in ecological city concept and its adjustment to tropical climate. Result expected is a strategic concept of tropical ecological city for Banda Aceh based on urban green space.

The benefit from this research practically can be used as consideration for decision or policy maker in planning ecological city based on urban green space, specially for Banda Aceh and also can enrich the understanding of ecological city planning in tropical area.

MATERIALS AND METHODS

The analyse in this research was based on information collected from related local goverment agencies in Banda Aceh. Report document on urban green space [12], city's yearly statistic record [13] and Banda Aceh Masterplan 2009-2029 [14] are the documents used as data source. These documents were used extensively during the analysis. The other secondary data from literature review and desk research also have been gathered.

This research applies methods of exploratory research of urban green space in Banda Aceh. Site visit to Banda Aceh was done at early September 2011. Photographic of the study area was carried out. The preliminary choice of parts of urban green space were studied.

For the purpose of this paper, the analysis will be limited to the following issue: first, the existing condition of urban green space: how wide is the existing area of urban green space to match with ecological city concept; second, the role of urban green space: what is the role of urban green space in ecological city concept and how urban green space overcome the problem of tropical climate.

RESULTS AND DISCUSSION

The existing condition of study area

Banda Aceh is located within Aceh Province, in the north of Sumatra Island, Indonesia, at latitude 05°30′ – 05°35′ N, longitude 95°30′ – 99°16′ E (Figure 1). Banda Aceh has tropical climate and it rains throughout the year. The mean annual temperature is 26,4 °C, and the average mean precipitation 1008–1200 mm. The natural vegetation is rain forest tree. Today the dominant species in the urban green spaces are Tamarindus indica, Pterocarpus indicus, Samanea saman and Swietenia mahagoni.

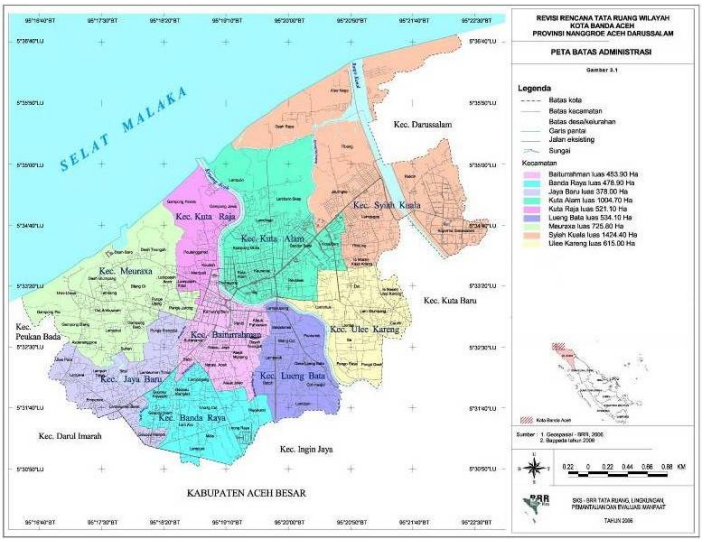

Figure 1. Map of Banda Aceh [14]

Banda Aceh City is the capital of Aceh Province. At present, the administration of Banda Aceh City consists of nine districts: Meuraxa, Baiturrahman, Kuta Alam, Syiah Kuala, Ulee Kareng, Banda Raya, Kuta Raja, Lueng Bata and Jaya Baru. While Banda Aceh total area remain 6.135,9 ha, the total population has grown, increasing from 177.881 in 2005 to 224.209 in 2010 (Table 1).

Table 1. Banda Aceh's Population and Density 2005-2010 [13]

Year	Population	City area (ha)	Density (pop./ha)
2005	177.881	6.135,9	29
2010	230.774	6.135,9	38

Since population and density increase in 2010 while wide of city area unchange, therefore the new development will take the wide of open space area. In Banda Aceh Master Plan 2009-2029, it show prediction of population, density and built area which will increase in 2029, while open space will decrease from 4.010,95 ha (65,37%) to 1.258,80 ha (20,52%) (Table 2).

Table 2. Prediction of Land Use Change between 2005 - 2029 [14]

Year	Population	Density (pop./ha)	Built area (ha)	%	Open space (ha)	%
2005	177.881	29	2.124,95	34,63	4.010,95	65,37
2029	482.131	79	4.877,10	79,48	1.258,80	20,52

The trend in city's growth in the last five years between 2005-2010 show the new developments have consumed a lot of city's open space, including urban green space. Banda Aceh's urban green space has been decrease from 2.132,61 ha (34,76%) in 2005 to 612,105 ha (9,98%) in 2010. The wide of urban forest, park, green ways and agriculture/riparian area become less, while funeral area unchange (Table 3).

Table 3. Banda Aceh's urban green space in 2005 - 2010 [14]

Year	Urban forest	Park	Green ways	Funeral	Agriculture/ Riparian	Total (ha)	City Land Use Percentage
2005	285,92	44,65	1.138,37	11,89	651,78	2.132,61	34,76%
2010	25,39	20,95	551,45	11,89	2,42	612,105	9,98%

This condition show attention to the natural components and the green spaces of the urban structure is still poor, city's strategies mainly focus on man made and built components of the urban environment. The impact of population growth on urban green space is illustrated in this case, where the proportion of the city's area of urban green space is falling annually. If this condition keep going on, it will affect negatively to the city's livability because urban forests, parks and open green spaces are importance for the quality of life of increasingly urbanized society.

Empirical evidence indicates that the presence of natural assets such as urban forests, parks and green belts and its components such as trees and water in urban contexts contributes to the quality of life in many ways. Besides important environmental services such as air and water purification, wind and noise filtering, or microclimate stabilization, natural areas provide social and psychological services, which are of crucial significance for the livability of modern cities and the well being of urban dwellers [15].

In order to understand and plan to set strategy for future improvements of urban green spaces, it need to compare the existing urban green space in 2010 to minimum green space standard from United Nations World Health Organization (UN-WHO) and goverment regulation. The UN-WHO recommends at least 9m2 of urban green space per capita to mitigate a number of undesirable environmental effects and provide other benefits [16]. Indonesia goverment regulation arrange minimum 20% portion of urban green space as public green space in the city has to be strived to provide benefits in improving the quality of life in the city [17].

The result is wide of existing urban green space (612,105 ha) is above UN WHO standard (207,70 ha) but below goverment standard (1.227,18 ha) (Table 4).

Table 4. Banda Aceh's green space comparison : existing and standard

City area (ha)	Existing green space (DKK, 2011)	UN WHO standard	Goverment Standard on
6.135,9	9,98%	9 m2/capita	20%
	612,105 ha	207,70 ha	1.227,18 ha

The role of urban green space

Urban green spaces can be defined as outdoor places with significant amounts of vegetation, and exist mainly as semi natural areas [18]. Urban green space in city may have numbers of different forms : limited public green space that enriches urban ecological quality of life; open public space such as urban parks that serve the recreational needs of visitors through walking, relaxing or sports activities; private gardens attached to the citizen's property meant for private use; private green space belonging to corporate organizations such in

schools, hospitals, industrial parks that serve to strengthen the image of openness, nature and health within the city limits.

Besides important environmental services such as air and water purification, wind and noise filtering, or microclimate stabilization, natural areas provide social and psychological services, which are of crucial significance for the livability of modern cities and the well being of urban dwellers [15]. Urban green spaces provide a range of benefits in various forms and offer a variety of opportunities to people. They reinforce the identity of city, which can enhance their attractiveness for living, working, investment and tourism, and therefore these spaces can contribute positively to both the quality of life and the competitiveness of cities. In addition, urban green spaces moderate the impact of the negative consequences of human activities by, for example, absorbing pollutants and releasing oxygen [19]. Furthermore, they maintain a certain degree of humidity in the atmosphere; regulate rainfall; moderate changes in temperature; curb soil erosion; form the basis for the conservation of fauna and flora; contribute to the maintenance of a healthy urban environment by providing clean air, water and soil; improve the urban climate; and maintain the balance of the city's natural urban environment.

Urban green space also preserve the local natural and cultural heritage by providing habitats for a diversity of urban wildlife and conserve a diversity of urban ecosystems. Green space as agricultural functions might deliver products such as wood or fruits and also compost and energy as a result of urban green production. The presence of these spaces can create an increase in the economic value of an area and may provide new jobs. Green areas, water bodies, open space and attractive landscape types are all aspects of an attractive urban setting. In particular, attractive landscape types can lead to a considerable increase in real estate values.

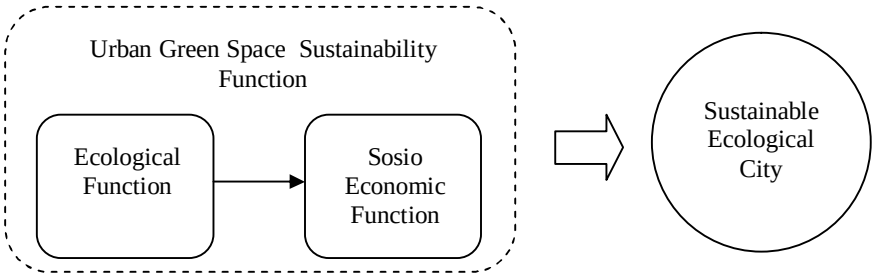

Figure 2. Urban green space function support Sustainable Ecological City

In sustainability perspective urban green space has basic ecological function to support sosio economic activities. Both ecological and sosio economic functions of urban green space will support the city to become sustainable ecological city (Figure 2). In the context of this study, the role of urban green space as provider of ecological and socio economic services and their importance for city sustainability has been addressed. Some results have been presented from preliminary survey aimed at exploring the existing of urban green space. Due to the small size of the sample analysed and the limited statistics performed, no universal conclusions can be consistently made about the role of urban green space in general. However, some conclusive remarks can be made.

Urban nature fulfill many ecological and socio enconomic functions and psychological needs of citizens, which make urban nature a valuable city resource, and a key ingredient for city sustainability. Urban green space's planning and management, therefore, should take into account functional requirements of all aspects.

Valuation and assessment of these intangible services and benefits is of crucial importance in order to justify and legitimise strategies for urban sustainability. It is argued that valuation of their worth to society must start from the appraisal of the needs, wants and beliefs of the individuals composing that very society. Public involvement, citizens' participation and a qualitative appraisal of their needs and interests are believed to help urban communities to articulate commonly shared values which, in turn, can serve as reference criteria for local planners to envision more sustainable city strategies.

Urban green space overcome the problem of tropical climate

According to its position nearby with the equator line, hence Banda Aceh region stay in the tropical climate. The characteristic of tropical climate is daily mean temperature height compared to other climate. Problem generated by this climate to the city as a place of human being live and work, are hot air generated by sun radiation, heavy rain and wind speed. To overcome the problem of tropical climate, trees in urban green space can provide shade to reduce heat cause by sun radiation. Tress can also absorb rain water and control wind which can overcome humidity problem (Figure 3).

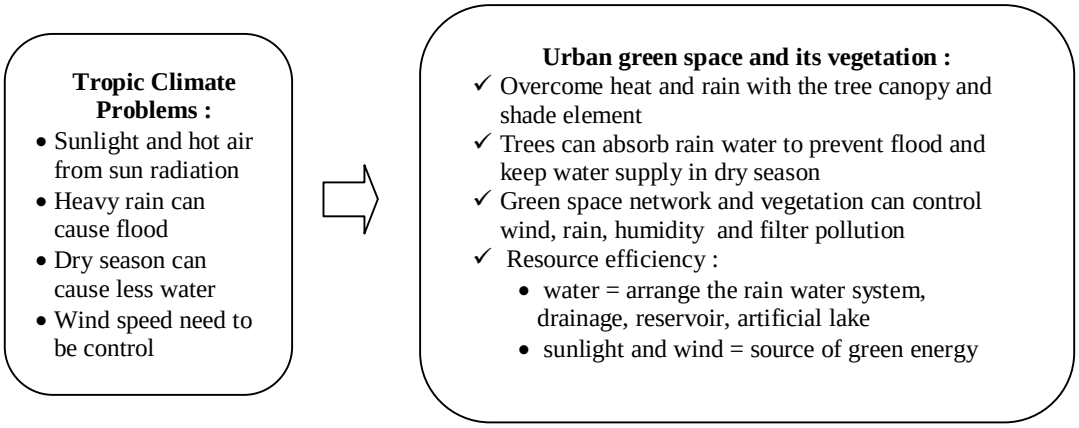

Figure 3. Urban green space and its vegetation solve tropic climate problem

Because the native vegetation in Banda Aceh like other in the tropics is forest, tropical forest tree selection is key to successfully improving its urban green infrastructure. Information collected from the existing street tree and heritage park tree regarding species performance and native habitat can suggest general guidelines for appropriate species selection and management practices when put in the context of how the tropical climate affects native forest habitats.

Tree species and habitat type selection criteria for the proposed semi naturalized tree parks will be particularly important, but should generally be similar to that for street trees. Aesthetic and utility factors will likely drive a balance between an evergreen canopy, particularly for shade during the dry season, with enough colorful, flowering deciduous. Evergreen versus deciduous foliage will affect some management issues, as drought deciduous species may require a more rigorous fertilization program to a void mining soil for nitrogen and other nutrients due to leaf loss and removal. A significantly challenging management issue regarding species selection for both semi naturalized parks and street trees is the potential for water stress during the dry period.

Strategic concept of tropical ecological city based on urban green space

In formulating a strategic concept, the following issue could be discussed: values, differences and common ground to be identified, particularly on what people value regarding future development and what would constitute progress to meet human needs is a critical dimension of sustainability.

The tropical ecological city based on urban green space has to fulfill the following list of the qualities of a healthy city, which could form part of a vision statement as strategies to reach city's sustainability: first, create an ecosystem that is stable now and sustainable in the long term to meet basic needs such as clean air, water, food, shelter for all the city's people; second, create a safe and clean physical environment which increase quality of city's lives, health and well being; third, create new partnerships at the regional level. These partnerships should include not only local goverment of Banda Aceh and Aceh Besar Regency, but also the goverment of Aceh Province, which must realign its policies to support urban redevelopment and open space protection.

CONCLUSION

Developing Banda Aceh as sustainable city, can be approach with the ecological city concept. Ecological city concept related in resolving the problem of using natural resource, energy and waste inside the city by its component namely building sector, urban green space, settlement or housing area, transportation, and infrastucture. Urban green space existence and trees play important role in tropical ecological city concept by decresing the use of energy and air contamination in the city. Therefore by incorporating the climate responsive concept, it can help achieve the city's vision to be the sustainable, liveable, attractive and prosperous for residents, business and visitors. No papers about Banda Aceh's urban green space concept have been published in international journals. This study is in progress and will contributes to fill this gap.

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