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Analysis of Green Open Space in Krembangan, Surabaya City

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***Abstract*— There are plenty of Green Open Spaces in Surabaya, East Java, Indonesia such as in Krembangan Subdistrict that needed to know its condition. This research aims to identify the type of green open space including its classification. The research method is used by compiling primary and secondary data by field observation and do some spatial analysis using GIS to identify the availability of existing public green open space, public green open space type, public green open space area, and its expansion. Furthermore, interpreting Citra Landsat 8 OLI year 2018 with ArcGIS 10.1. The results showed that in Krembangan Subdistrict has green open space consisting of park 4.0%, vacant land 24.2%, roadsides 26.1%, and riversides 9.4% or else only 5.8% which includes the active park while they remain in the passive park. The active park in Krembangan Subdistrict still has the potential to be expanded by adding a garden in that area or planting along the roadsides. Various types of green open spaces can be created in the densely populated parts of the central, southern and eastern Krembangan sub-districts.**

Keywords—Green Open Space, Park, City

I. INTRODUCTION

A. Background

Badan Pusat Statistik [1] predicts in 2025, 60% of the population in Indonesia will live in the city, and there is an increase of about 10% in the 15 years ahead. The condition has an impact on the increase of a dense city, resulting in reduced green open space. Undang-Undang Penataan Ruang No. 26 Tahun 2007 Pasal 29 [2] stated that the city should provide 20% of its area as a public green open space that is administered and provided by the government and at least 10% provided by parties in the private and citizens. That means the city must provide at least 30% of the city's area which is especially functioning as green open space.

The establishment of a 30% proportion by the government is a standard benchmark to ensure the balance of the city's ecosystem, either between of the balance of hydrological systems, the microclimate, and other ecological systems that can improve the availability of the fresh air, and it also can improve the city's aesthetic value. The city's development which is not accompanied by land function has caused environmental damage that can reduce the support of urban life, furthermore it necessary to do efforts to maintain and improve the environmental quality through green open space provision [3]

The increase in green open space had been done continuously in various ways across Surabaya City that consists of thirty-one Subdistrict. The expanded green open space consists of 20% public space and private spaces originating from private and citizens of 10%. It assures that the entire Subdistricts can participate in expanding its land to contribute. The average per district has a contribution of 0.95% green open space. However, it took hard work from the government to reach that percentage of the open space. Hence, to know the condition of green open space in Krembangan Subdistrict it needs to do some research. The purpose of this research was to identifying green open space type and classifying green open spaces.

B. Literature

Garden City concept emphasizes the importance of environmental and human aspects in urban planning. This implementation inspires the development of each city, by designing the environmental of satellite cities and applying humanist design principles. In Indonesia, urban planning in the VOC era had also adopted the *garden city* concept, evidenced by the existence of the town square and the park. Hence, the concept will be the basis of the development of green open space City.

The green open space is an important element in the development of sustainable development. Green open space is a concept in multidisciplinary sciences as its definition is understandable in various perspectives [4]; [5]. According to [5], The green open space city is defined as the land utilization and land surface covered by the natural plant element that planted by humans. Kementerian Lingkungan Hidup [6] defines green open space as space or open area within the city overgrown by greenery, whether it is a large tree, shrub, shrub, or grass.

According to [4], there are three benefits of green open space that consist of environmental, social and economic benefits. Environmental benefits include three things that are maintaining climate stability (ecological), controlling pollution, and conservation of natural diversity. [7] also formulates the benefits of mental health in addition to the social and physical benefits of green open space development. In the context of green open space development in urban areas in Indonesia [3] mentions the benefits of green open space are:

1. A tool to reflect the region's identity (image).
2. A facility of active and passive recreation, as well as social interactions.
3. Increasing the economic value of urban cities.
4. Used as a social activity for children, adolescents, adults, and seniors.
5. Used as evacuation room for emergencies.
6. Improving urban oxygen reserves.

The spatial plan of green open space is the public open space planned for a land, which is composed of green open spaces and non-green open spaces. The green open space, has a special function and role in each land at each city spatial

planning, planned in the form of the arrangement of plants, plants, and vegetation in order to play a role in supporting the function of ecological, social culture, and architectural, that it can provide optimum benefits to the economy and welfare of the community.

1. Ecological function: green open space is expected to contribute to the improvement of groundwater quality, prevent flooding, reduce air pollution, and support in microclimate settings.
2. Socio-cultural function: green open space is expected to play a role in creating space for social interaction, recreation facilities, and as a landmark area.
3. Architectural/aesthetic function: green open space is expected to increase the value of beauty and comfort of the region, through the existence of parks and green lanes.
4. Economic function: green open space is expected to serve as a development of urban green tourism, attracting people to visit an area hence it can indirectly increase economic activity.

II. Research Methods

A. Location and Data Sources

The research was conducted in Krembangan sub district with an area of 8.61 km2. Primary data are obtained by field observation and do some spatial analysis using GIS to identify the availability of existing public green open space, public green open space type, public green open space area, and its expansion. Meanwhile, secondary data are obtained from the spatial government city office with the form of an administrative map, photo image, spatial plan of Surabaya City area in 2018-2028, legislation related to green open space and land area data.

B. Data Analysis Steps

The first phase is to aggregate, logging, and mapping of existing green open space in Krembangan Subdistrict, hence it can be known green open space area and its expansion as the basis of distribution analysis, needs, and direction of green open space development planning. At this stage, Citra Landsat 8 OLI year 2018 did the interpretation image with ArcGIS software 10.1. The digitization on screen is done to obtain the land cover classification.

After the digitization, the second phase continued with field verification by doing a ground check of the sample object at several points. The outcome is to obtain the land cover map and existing green open space expansion which will covers the distribution of public and private green open space and the area of each type.

III. Result and Discussion

One of the Surabaya City Government's project according to RTRW year 2012-2032 is to improve the quality of urban spatial planning and its infrastructure. It must ensure public accessibility by environmentally and pleasantly. This establishment is an effort to actualize the development of the ecological city concept, which one of the indicators is a fulfillment of green open space.

Public green open space of Surabaya City is developed to create an environmental city as a cantilever of city water needs, city climate control, social function, aesthetic function, provider of oxygen needs, and ensure citizen's convenience. The minimum set area of Surabaya public is at 20%. Green open space public Surabaya City consists of green open space roadsides, ponds, riversides, crossroads, passive parks, active parks, monuments, city gateways, sports fields, tombs, city forests, flora park, railway security lines, SUTT, and buffers zone [8].

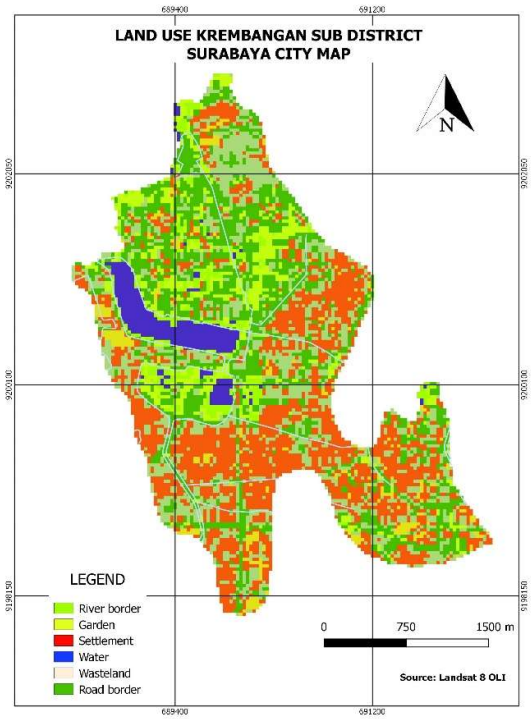

Fig. 1. Land-Use of Krembangan Subdistrict Map

In the land-use of Krembangan Subdistrict map, there are residential, ponds, roadsides, riversides, parks, and vacant lands. The residential evenly distributed in the South and East, while for the riversides, roadsides, parks, and vacant lands are in the North and West. Lastly, the ponds (bozem) are only in the West. Mapping and monitoring of the urban green space are necessary for improving the quality of urban life. Mapping the urban green space is the first step in sustainable urban planning because comprehensive information on vegetation in cities is lacking [9].

Tabel 1. The Proportion of Land Utilization in Krembangan Subdistrict

Land-Use	Proportion Area		
	Green open space Type	*(ha)*	*(%)*
1	Park	33	4,0
2	Vacant Land	202	24.2
3	Residential	218	26.1
4	Ponds / Bozem	78	9.4
5	Roadsides	42	5.0
6	Riversides	261	31.3
Total		834	100

As Fig. 1 shown, the land-use of Krembangan, Surabaya City area can be divided into two classifications consists of residential land and non-residential land (green open space). Non-residential land is a land that can be used as a green open space that in this case reaches 68.7% of proportion, include ponds, parks, riversides, roadsides, and vacant land. Of these results, there is only 4.0% of it will be listed as an active park (Table 1).

The active park is a park that built park-activities so its users can actively use the facilities in it with free activities in the garden or park area e.g. are Bungkul Park, Ekspresi Park, Bratang Flora Park, and others. Meanwhile, the passive park is a park that can only be enjoyed its visual beauty, as accentuation to attract attention because of its shade.

Green open space type of park plays a role for the city as a means in the development of city culture, education, and the center of citizens' activities as well as their social interaction facilities. The city park can create magnificence and also convenience. Besides, the garden with various plants and green lanes can absorb pollutants from existing motor vehicles in the urban areas.

The results showed that an urban park with a dense canopy of trees has maximum cooling effect during summer & winter in daytime. In summer it reduces temperaturs by up to 3,8°C. [10]. In the research, the effects of green spaces on the extent of residents soazialization behaviour as well as the actual presence of people in neighbourhood open space where daily market and held, where integrated [11].

Urban forests can reduce surface temperature which have closely related to land cover and air temperature. Urban forest as aheat absorbent reduce air temperatur by transpiration. The priority of urban forest development to reduce high temperatur in Jakarta use to take a place in public area and private area [12]. So it can be said that green open space is very effective at reducing temperature, reducing pollution, increasing community interaction, and making the environment comfortable

IV. CONCLUSION

Based on the research results, it can be concluded that green open space in Krembangan, Surabaya City has great potential to expand by adding an active park by utilizing vacant land to create a city park. Besides, the roadsides that used as a sidewalk can be planted by plants in the pot. It is simply because of plants play an important role in the absorption of air pollution and the absorption of rainwater, which affects climate stability.

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