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Green City Parks Model to Reduce Air Pollution as Anticipation to the Climate Change

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Abstract: Urban growth has Implications for the emergence of urban problems such as traffic jams, floods, slums, social inequality, and the reduced area of green open space. The phenomenon of climate change adds further weight problems of the city. Came the idea to develop a green city parks program comprehensive and realistic as a solution to climate change. The research purposes are to: (1) study the density of vegetation and air pollution in the city, (2) provide guidance a vegetation green city park, (3) develop a model green city parks to muffle air pollution. The study was conducted in urban areas of Semarang. Object study that examined is only green city park in Simpang Lima Park and KB park. The research material includes data of urban green space, the distribution of vegetation, and air quality. Spatial data, including SPOT 5 satellite imagery, topographic maps, land use maps. The data field is park measuring includes air quality, type and number of trees. Analysis of this research is a descriptive-quantitative, including spatial analysis, laboratory testing, and modeling of a green city. The main results of the study is software models that has optimal green city parks to muffle air pollution, is used as an effort to anticipate the climate change. This model will be able to create a comfortable atmosphere, clean, healthy, controlled air pollution, so that the environment can be maintained and anticipate of the climate change. The final prediction of the analysis of models of green urban park software is to determine the amount and type of vegetation that must be provided in a city park until able to reduce air pollution.

Key words: green city park, air pollution, climate change

1. Introduction

Climate change is the most serious environmental threat to life [1]. Climate Change in Indonesia is already can be felt, and still a lot of confusion in the society in facing the climate change. One of the factors that the public response to climate change is the people's knowledge is lacking about the climate change. Knowledge and understanding of climate change is needed. Several attempts have been made to expand the information on climate change, government and non-government agencies, and many institutions from abroad. Foreign agencies work together to provide an understanding of climate change, how to adapt to climate change, how to increase the resilience of the city in the face of climate change. Even educational institutions together a curriculum to be taught in primary and secondary schools [2].

The principle of climate change is the rising gases carbon dioxide, methane, and other gases. These gases are normally in small quantities in the atmosphere, can continue to direct sunlight at the earth's surface. As a result, the temperature at the earth's surface heated. Gas rising into the air caused by air pollution. Anteplioglu [3] says that air pollution occurs due to the increase in atmospheric contaminants or combinations thereof in the form of dust, moisture, odors, smoke, and various types of other gases. The

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number, concentration, nature, and duration of pollutant gases in the atmosphere, can cause disruption to the environment, such as health problems, damage to goods or certain objects. Leisure living things become disrupted. Air pollution occurs, when there is the addition of materials or substances into the air in sufficient concentrations and amounts, resulting in a negative impact that can be measured in some particular organism.

Transportation denseness in urban areas is the effect of settlement a city that is solid, especially in terms of the impact of exposure and vulnerability of the extreme events. Growth rapid and not planned city will weaken susceptibility to disaster risk. Climate change is a function of extreme weather phenomena which is three, extreme climate andipcc climate change itself [4]. Interactions with the public urban transportation, especially concentrating on entity led to the appearance in a city that is the challenge of climate change. According to Fandeli et al. (2004) [5], fouling of the air pollutant sources in urban is transportation and industrial. Transportation and industrial pollution caused by the burning of oil energy, consisting of a Pb gas, CO, NO, and SO. Environmental conditions as recipient highly dependent on the presence or absence of vegetation, wind strength, wind speed and wind direction [5].

City is the center of community activities, the consequences happen concentration of population, so that the direction of development focuses on the development of the physical infrastructure of the city. As a result, the presence of green space that serves to create a comfortable town (pleasant liveable city), became increasingly disappearing. The implications of the emergence of urban growth issues such as congestion, flood, slums, social inequality, and reduced the area of green space. Air pollution in the city become a serious environmental problem and annoying damaging ecosystem sustainability and the quality of urban life. One of the technical solutions to reduce air pollution are: urban vegetation is recognized as an alternative method of fixing may dampen some air pollutant [6]. The phenomenon of climate change adds to the weight problems of the city. A city park with lush vegetation has cooling effect during the day. Green open space land is effective for heat mitigation [7, 8]. The coming idea to develop a program that is more comprehensive green city at the same time realistic is to anticipate climate change.

Increasingly complex of urban areas problems, serious attention must be done using a special approach. Development of a green city is a suitable approach to be implemented, because it is an innovative urban development, which is “out of the box”, to face the challenges in urban as well as answering the problem of global climate change. The area of green space as a catchment area in Semarang city area or an area of 392.2 ha (15.69%). Regions not recharge, such as buildings and houses, covering an area of 2106.8 ha (84.31%). Based on these data, the vast green spaces of Semarang not meet the criteria of an ideal catchment area by 25%. Green space in the city of Semarang are still to be developed and managed optimally. The development of means of transportation and industry indicated a source of air pollutant most dominant. Semarang air quality concern, in a year of 365 days is only 20% or (70 days) is fairly good day, the rest almost 300 days have poor air quality [7].

Need efforts to address air contaminant intensive and predict optimal green space requirements. Green area management aims to achieve comfort, sustainability, and environmental compatibility that can reduce air pollution [9]. Preparation of green space model for the control of air contaminants and the anticipation of climate change, must be designed appropriately. Approach with a simulation model is often used to help plan and make decisions on environmentally sound development. Mangiza (2011) [10] said that the emission in urban areas could not measured accurately, because no method accepted globally to determine the amount. The size of the

emission of motions green house to the city determined by the size of the city, growth, the structure and density of populations .

Green city is realized through greening with parks, urban forests, green or open space. Green City is a city that is utilizing the water resources and energy effectively and efficiently; reduce waste; implement an integrated transportation system; ensure the health of the environment; and synergize the natural and artificial environment [8]. Urban park space in the city is laid out to create beauty, comfort, safety, and health for its users. City park functioned as lungs of the city, controlling microclimate, soil and water conservation, and habitat for a variety of flora and fauna (Cemetery Department, 2010). The main aim of research to develop a model green city parks optimal to dampen air pollution, as an effort to anticipate climate change. The specific objective of the research are: (1) assess the density of vegetation and contamination of the air in the city, (2) providing guidance on the needs of the park vegetation types, (3) develop a model green city parks optimized to damp air pollution.

2. Research Methods

The study was conducted in Semarang dense urban areas of the building. Objects are such as a park or green space, especially in Simpang Lima and KB Park. Both parks are in the center of Semarang City and is the most extensive active parks.

The analysis is spatial analysis, laboratory testing, and modeling. Analysis of the spatial distribution of vegetation cover and comfort index, green catchment area needs to muffle air pollution. Laboratory tests to determine air quality, pollutant levels in the tree or vegetation. Green city modeling to examine the link between green space requirements, air pollution, and the need for trees in the park, as well as designing the ideal park conditions.

Modeling green optimal for air quality control are prepared with regard to the park (number of trees, to scatter density and vegetation), the condition of cemaran the air at the park, and directions management solution city park green. Based on the proposal, then a model of the parameters of the determination of green city optimal cemaran to control the air in the form of an overlay approach join in the spatial. Formula was formulated by algorithma as follows.

OKH = Join Spasial (KRH + SCUB + POT + RTHa)

Information: OKH (optimal room green), KRH (the needs of space green), SCUB (source contamination air and noise), POT (green potential land) RTHA (the area of the green actual).

3. Results

Local Regulation Number 5/2004 on Spatial Planning (RTRW) Semarang, basically a set of green open space. The hope will bring a positive impact to the presence of green space in the city of Semarang. Policies on regulation, among others, set about the extent and the minimum number of trees that must be possessed by every area of the home. Bylaw regulate in detail the provisions, among others: each Neighborhood (RT) shall have a minimum area of 250 m^2 park with 10 shade trees; The area of the park at the local level at least 1.500 m^2 with 20 trees; Park Village level of at least 1 hectare; Houses with an area of 120 m^2 plot of land under the shade trees at least provide 1; House with land 120-500 m^2 must provide a minimum of 3 trees, and above 500 m^2 minimum of 5 trees.

Area of green space in the Central Semarang Sub District area is of 76.59 ha (12.64%), East Semarang area of 98.06 ha (13.24%), South Semarang area of 179.27 ha (21.14%), and North Semarang an area of 266.04 ha (23.32%). Fulfillment vast green space 30%, the addition of green space in the Central Semarang Sub District of Semarang area of 17.36% and 16.76% area of the east, are presented in Table 1. Where will meet the broad criteria of 30% green open space (GOS), it is necessary to increase the GOS at each district. In the Middle District of Semarang shortage

of green space covering 105.14 ha (17.36%), East Semarang area of 124.15 ha (16.76%), South Semarang area of 75.15 ha (8.86%), and North Semarang an area of 76.22 ha (6.68%) [7, 11].

According to the results of measurements of air contaminants in park planning and Simpang Lima park (Table 2), showed that the concentration of air contaminants in Simpang Lima park higher than that in the Park of KB. Some parameters of the contamination is still below the national ambient standards, but the dust and noise parameters are already approaching the limits of the standard. Higher concentrations is shown in the area around Simpang Lima Park, because of the motor vehicle transport and car and the amount of space that is changed into a concrete building, concrete park and concrete paths. As a result of this all, cause air contaminant concentrations approaching ambient quality standards and higher. Concentration of air contaminants passed ambient air quality standards can cause discomfort to humans as well be bad for his health.

Table 1 Oxygen demand and ability trees produce oxygen.

Village	Extent GOS (Ha)	Ideal GOS (Ha) Needed	Lack of area GOS (Ha) %		O_2 produced	Trees needed
Semarang Tengah	76.59	181.73	105.14	17.36	43,615.2	348,296
Semarang Timur	98.06	222.21	124.15	16.76	53,330.4	384,788
Semarang Selatan	179.27	254.42	75.15	8.86	61,060.8	360,878
Semarang Utara	266.04	342.26	76.22	6.68	82,142.4	677,015

Source: Setyowati [11].

Table 2 Parameter air pollution in Simpang lima park and KB park.

No	Air pollution Parameter	KB Park in 2012	Simpang Lima Park in 2012	Quality Standards
1	Carbon monoxide (CO)	8.016	9.161	30.000 µg/Nm^3 (1jam)
2	Nitrogen dioxide (NO_2)	3.215	1.683	400 µg/Nm^3 (1 jam)
3	Sulfur dioxide (SO_2)	6.730	9.824	900 µg/Nm^3 (1 jam)
4	Oxidant (Ox)	0.283	0.251	235 µg/Nm^3 (1 jam)
5	Ammonia (NH_3)	0.003	0.004	2 ppm
6	Hydrogen sulfide H_2S)	0.004	0.006	0,02 ppm
7	Dust/TSP	174	119	230µg/Nm^3 (24 jam)
8	Pb lead	0.120	0.135	2µg/Nm^3 (24 jam)
9	noise	62.5	65.1	70 dBA
10	temperature	26.5	28.7	18-28^oC
11	humidity	85.5	69.3	40-60%

Source: Setyowati, 2013 [11].

In general, particles that air pollution can damage the environment, plants, animals and humans. The particles are very harmful to human health. These circumstances led to urban public relations are not harmonious with the environment. Park City has a value other than beauty also capable of absorbing dust particles [12, 13].

The effect of greenhouse gases caused by the humans (antropogenik) and derived from the 40-70% is between [10]. One effort that can be done to reduce air pollution in the District of South Semarang-raising programs conducted by planting thousands of trees in strategic areas of the city and the park road worth. Because by being placed in strategic places such, functions as an absorber of green space in addition to the air and producing oxygen contamination, can add aesthetic value and coolness and beauty. Can also with

the holding of the air quality recovery program is to be car free days and greening the city.

Increased air pollution caused by the rising number of vehicles and industrial activity. Air contaminant parameters: CO, NO_2, SO_2, O_3, Pb, H_2S, NH_3, TSP, and noise. CO levels of air pollution conditions approaching ambient quality standards, dust/TSP in several locations already exceeded ambient standards. Other parameters such as NO_2, SO_2, H_2S and NH_3 are still under ambient quality standards. Air quality in Simpang Lima Park CO has a value higher than KB Park. Value of CO in Simpang Lima Park μgr 9.161/m^3 and KB Park 8.016 μgr/m^3. Region that has a parameter of dust/TSP highest in the park at 174 KB μgr/m^3 and in Simpang Lima Park at 119 μgr/m^3, the value quality standard dust/TSP 230 μgr/m^3 so that the condition dust/TSP at both parks approach critical number.

Referral needs vegetation on park planning and Simpang Lima park described based on the value distribution of vegetation, vegetation composition index, and index of vegetation density (Table 3). Distribution of vegetation be identified from the type and amount of vegetation. Distribution of tree species in the KB park include; pterocarpusi indicus, pithecelobium duke, tamarindusindica, polyaithialongifolia, termnaliacatappa, bauhiniasp, and swietenia mahogany. While the distribution of tree species in the Simpang Lima park include tamarindusindica, pithecelobium duke, and polyaithialongifolia. Distribution of vegetation index in the Simpang Lima Park at 0.2. Fig. 3 show the distribution of vegetation condition is very bad, because the composition of the vegetation type and density of vegetation including a few very rare.

Table 3 Distribution, composition, and density of vegetation in Park City.

No	City Park	KB Park	Simpang Lima Park	Criteria
1	Extensive garden (m^2)	10.500	32.400	
2	Area of Park (%)	24.48	75.52	
3	number of Trees	178	292	
4	Number of Tree Species	7	3	
5	Composition Index (C)	4%	1%	very Little
6	Density Vegetation Index	2%	1%	very rare
7	Distribution of Vegetation Index	0.06	0.02	very bad

Source: Research Findings, Iriani and Setyowati [15].

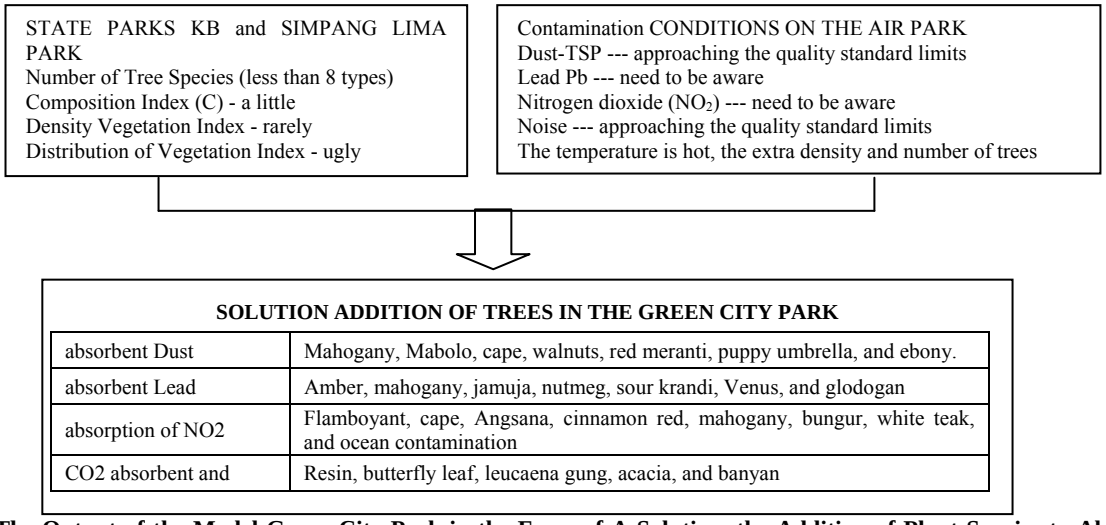

Fig. 1 The Output of the Model Green City Park in the Form of A Solution, the Addition of Plant Species to Absorb Air Pollution.

Index composition of vegetation in the park planning and Simpang Lima Park includes very few categories. Vegetation species composition is determined by counting the number of vegetation types with a total amount of vegetation per unit area. Park KB has a number of 7 types of amenity trees and the total number of trees shadier are 178 trees. Type amenity trees in Simpang Lima Park only two types of trees and the total number of amenity trees 292 trees. Tree density index is included in the category of very rare (< 14.0%). Various types of plants reflect the value of tree density, the higher the density value between trees can minimize and reduce energy radiation from the sun. Tree density was determined by counting the number of amenity trees per unit area acreage.

Vegetation or trees have different abilities to absorb air pollution. Restructuring of the park by selecting the type of vegetation, which serves to reduce air pollution. Semarang region with the potential of air pollution is because of the transportation and industrial activities. The city is in dire need of clean and fresh air. Trees in city parks can help in the recycling of air pollution. The presence of vegetation in urban parks help the public or road users in removing flavor will saturate urban activity, give oxygen demand, coolness, and beauty that can be felt. In some types of trees that produce flowers and fruit, besides looks beautiful also give life to animals such as birds.

Giving direction of tree species that have a role in absorbing air pollution in urban areas is very important. Direction of tree species will help reduce air pollution that occurred in the city center of Semarang. The air condition is maintained so as not to pass the quality standard limits specified.

The results of the data processing of green space on Simpang Lima Park and KB Park indicates that the condition and function of the park is still less than optimal. The number of trees is still less because it produces a value that is still sparse vegetation density and distribution of trees included in the criteria ugly. Composition of the vegetation index value also includes a little. The existence of the park is still not optimal, causing less functional condition of trees in absorbing air pollution. Contamination of air in Semarang, especially in the Simpang Lima Park and KB Park is quite high (although still below the predetermined Quality standard). Levels of dust/TSP was nearing quality standard, trees absorb dust particles that function has not been widely planted ataman pad and around the park. Levels of Lead (Pb) and NO_2 needs to watch out because it is approaching a predetermined number quality standard. Aspects of noise on location of Taman Simpang Lima and KB Park was very noisy with a number very close to quality standard. The existence of temperature of air is also become hot because conditions are less shady trees and the number of trees is still lacking.

Efforts to tackle the second planting trees on the park. Dust absorbing plants need to be planted mahogany trees, Mabolo, cape, walnuts, red meranti, puppy umbrella, and ebony. For trees planted tree Pb absorbent resin, mahogany, jamuja, nutmeg, asam kranji, Venus, and glodogan. For NO_2 absorption Flamboyan, cape, Angsana, cinnamon red, mahogany, bungur, white teak, and sea contamination. To function in the park absorb CO_2 and produce O_2 it is important to plant a tree resin, leaf butterfly, gung leucaena, acacia, and banyan. Because the software is generated in trouble so the research is still simulation of computation in a park needs to be planted any tree species and how many have not been able ditamp Display the on this article. The linkage between the state park, state of air pollution, and tree species should be planted on both parks are presented in Fig. 1.

The IPPC research (2012) [4] found the cause of the impact of disasters and climate change is the result of interaction, factors of climate and humans as well as a factor of non climate. Wlash et al. (2011) [14] said that response a city in addressing climate change is divided into two categories namely: (1) mitigation to

reduce emissions and increase GRK (the process of natural or artificial) that can deprive GRK emissions from the atmosphere, and (2) adaptation to reduce the impact of changes and optimize dangerous development that has the potential for profitable.

4. Conclusion

According to the provisions of Law No. 26/2007, the area of urban green space in Hyderabad is still below 30%. The area of green space in Central Semarang Sub district of Semarang approximately 17.36% and 16.76% East is still lacking. The results of measurements of air contaminants dust/TSP approaches the ambient quality standards. Parameters Pb, NO_2, CO_2, SO_2, H_2S and NH_3 are still far from the standard. Green city park models predict the optimal extent of green space and parks, so it can reduce air pollution from transport activities. The presence of vegetation in determining the ability of a city park park in reducing air pollution. End of the analysis software prediction models of green urban park is to determine the amount and type of vegetation that must exist in a city park.

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