GREEN OPEN SPACE MANAGEMENT MODEL IN MEDAN CITY - INDONESIA

Darwin P Lubis, Alvi Syahrin, Budi Utomo, Delvian
University of Sumatera Utara, Indonesia

Abstract : The purpose of this study is operationally elaborated to: (1) arrange and simulate a dynamic model which is weaving the factors of physical, social, economic, and the availability of green open spaces in Medan, (2) formulate a policy which can be recommended for the green city development in Medan. The result shows that: (1) the dynamic analysis model showed that there was some linkages between the components of biophysics, social, and economy. Based on the simulation result, it shows the reduction of green open space in the simulation year period from 10.830,06 Ha (2003) to 4.411,28 Ha (2028). The population increased in the simulation year period from 1.993.602 people (2003) to 2.620.700 people (2028), while the temperature rose from $27,80^{o}$C (2003) to $35,65^{o}$C (2028), for the PDRB in the simulation year period increased from IDR 28.670,91 Billion (2003) to IDR 406.880,37 Billion (2028). (2) The analysis result states that the priority of the development of public green space is in the form of regional green space with a value of 0,45, followed by Twist green space with a value of 0,345 and line green open space with a value of 0,251. The results of level-2 AHP analysis or actors illustrated that the main actors in the policy of green open space development strategy towards green city in Medan, either in areal, twist, or line are as follows: 1. Local Government of Medan City, 2. Society, 3. Universities, 4. Non-Government Organization, and 5. Private party.

Keywords—Green Open Space (GOS), Geographic Information System (GIS), Dynamic

Models

1. INTRODUCTION

The development in Medan City is a series of sustainable development efforts that covers all of the aspects of life. Medan City area is a very attractive place for people to develop the social and economic life. Social and economic life affect on both natural and migration population growth, causing uncontrolled residential development and neighborhood in the Medan City.

Realizing that the residents of Medan City have some basic needs for environment, such as: healthy air, the availability of groundwater, and space for social interaction means. Therefore, it needs some spaces to accommodate it which is usually called as green open space which also plays a role as a Public Space. Rapid changes in land use in Medan City has displaced green open space to be space wore up without maximum restraint, so that it marginalized the concept of a green city as a whole ecology system of the city.

The width of developed space area in Medan City will grow along with the development of the city. The analysis results of *landsat* imaging map in 2009, the width of built space area in Medan City had grown to be 14.096,46 Ha. It is big enough if it is compared to 2005, with a difference of about 347,16 Ha. If it was calculated for the growth per year since 2005, it would be grown for 86,79 Ha a year in this period. It is caused by the development of Medan City, so that the establishment and development in the city was conducted in maximum. Moreover, the pressure from land needs for the residential of hinterland society is also high in this period, and the development of Mebidang (Medan-Binjai-Deli Serdang) area (Pane.2011).

The impact of marginalization of urban management can be broadly categorized into two ways, they are; the impact of ecology and of socio-economic (Briassoulis 1999). The phenomenon of rapid land conversion to marginalize the green open space is ecologically causing some trouble for Medan City to be able to realize or maintain the protected area as an area for hydrological preservation, biological diversity development, the creation of micro-climate areas and city pollutants reducer.

The most important factor in the environmental problems of Medan City is the high population. The population growth is the main factor affecting the development of residential and the needs of facilities and infrastructures. Inaccurate plan and Indiscipline land use can affect the degradation of living environmental quality. The result of the research (Purba 2010) shows that the classification of temperature of Medan City is classified into 3 classes, they are ranging from $26 - 28^oC$, $28,1 - 30^oC$, and $30,1\ ^oC - 32\ ^oC$ which are spread to all of the sub-

districts in Medan City. The highest temperatures are on the asphalt covered area, airport, and also the roadway with a temperature of $32\,^{o}$C. It is because of the lack of growing vegetations in those areas. While for the lowest temperatures are on the vegetation covered areas such as university parks and the zoo with a temperature of 27°C since they have a dense vegetation cover.

2. PROBLEM STATEMENT

Medan City has a strong intention to be a green and environmentally friendly city, which has a characteristic of having a proportional green space. The difficulty in finding an alternative in the management of green space because there is no specific study that describes the characteristics or patterns and the supports of green space and its implication, in particular, the model of the development of green space. Consequently, the pragmatic efforts continuously conducted to solve various problems in the urban environment by the practitioners often had some impasses.

So far, the studies about the urban were more placed in a framework of improving the city and city design studies. While the study of environmental problems and the provision of green space and its implications have not received much attention yet. Therefore, various studies should be done to develop the models of green space development in Indonesia, so that the pragmatic efforts to solve urban problems in Indonesia were not just stuck in using the theories from the west that are not exactly appropriate for the Indonesian context.

The purpose of this research is to formulate the main ideas and priority scales in order to develop the approach of green city management continuously. The main purpose is basically a generalization from several following supporting purposes, as follows:

1.   To arrange and simulate a dynamic model which is weaving the factors of physical, social, economic, and the availability of green spaces in Medan City

2.   To formulate a policy which can be recommended for the green city development in Medan City.

3. RESEARCH OBJECTIVES

3.1. Research Setting (Time and Place)

The research was conducted in Medan City, green open space Sumatera Utara Province. The city represents a high rate of population growth as well as other metropolitan cities. The population growth rate trigger a rapid change in land use to be urban residential / settlement, trade, services, and industry areas. A year of research period was started from

January 2013 - January 2014, which consisted of three stages, those were stages of data collection and classification, analysis and synthesis, and the concept and planning.

3.2 Tools and Data of the Research

The tools used in this research were a set of computer and its equipments which were useful in data processing and analysis.

The tools used were as follows:

- Laboratory tools: computer hardware, with GIS (ArcGIS) and Image management (Er Mapper) Software, Arc View Software and its extension, SPSS Statistics 17.0 software, Powersim Constructor 2.5d software, and Criterium Decision Plus 3.0 software.

- *Global Positioning System* (GPS), compass, and other supporting tools to find the coordinate position of the ground control points which were useful in determining the training area of the vegetation covered areas.

- *Ikonos* satellite imaging of 2003 and 2013.

- Eagreen open space's Appearance Map of Indonesia (*Peta Rupa Bumi Indonesia*) from the Geospatial Information Agency.

The data used were the secondary and primary data. The primary data was obtained through in-depth interviews with the stakeholders with regard to the direction of policy priority. The secondary data included the data of demographic, city utility facilities / developed space and vegetation covered area, temperature, humidity and local income and other processed data.

4. RESULTS AND DISCUSSION

1. **Arranging and Simulating A Dynamic Model which is Weaving the Factors of Physical, Social, Economic, and the Availability of Green Spaces in Medan City**

The basic concept of the model built on this research is a dynamic model which consists of three main subsystems: (1) Biophysics, (2) Social, and (3) Economic. Those main subsystems will be simulated in accordance with the predetermined scenario. In complete, the diagram of the model construction made is presented in Figure 1.

After being analyzed, then, those sub-models will be processed for its dynamic models in order to be seen well both in its data and spatial of the space forms and patterns of each subsystem. The following table is the results of the simulation from the parameter used in the system modeling in each sub-model (Table 1).

Figure 1. Flow Dynamic Models Submodels: Biophysics, Social, and Economic
Table 1. Results of Dynamic System Simulation

Year	Biophysics	Temperature	Social	Ekonomic
2003	10.830,06	27,80	1.993.602,00	28.670,91
2004	10.820,95	28,08	2.015.531,62	35.706,52
2005	10.797,30	28,36	2.037.702,47	43.397,42
2006	10.758,54	28,64	2.060.117,20	51.585,75
2007	10.704,05	28,93	2.082.778,49	60.254,83
2008	10.633,17	29,22	2.105.689,05	69.420,10
2009	10.545,23	29,51	2.128.851,63	79.105,04
2010	10.439,50	29,81	2.152.269,00	89.335,95
2011	10.315,24	30,10	2.175.943,96	100.140,76
2012	10.171,64	30,40	2.199.879,34	111.548,94
2013	10.007,88	30,71	2.224.078,01	123.591,40
2014	9.823,08	31,02	2.248.542,87	136.300,65
2015	9.616,30	31,33	2.273.276,84	149.710,80
2016	9.386,59	31,64	2.298.282,89	163.857,70
2017	9.132,92	31,96	2.323.564,00	178.778,98
2018	8.854,21	32,27	2.349.123,20	194.514,16
2019	8.549,34	32,60	2.374.963,56	211.104,76
2020	8.217,13	32,92	2.401.088,16	228.594,35
2021	7.856,33	33,25	2.427.500,13	247.028,72
2022	7.465,62	33,59	2.454.202,63	266.455,93
2023	7.043,64	33,92	2.481.198,86	286.926,47
2024	6.588,93	34,26	2.508.492,04	308.493,35
2025	6.099,98	34,60	2.536.085,46	331.212,24
2026	5.575,18	34,95	2.563.982,40	355.141,60
2027	5.012,87	35,3	2.592.186,20	380.342,82
2028	4.411,28	35,65	2.620.700,25	406.880,37

The biophysics components consist of: swamp forest, mixed farm, rice field areas, moor areas, open spaces, and riparian which highly affect the green spaces increase in Medan City. According to the results of the simulation conducted on the green spaces sub-model, show that there was a trend of green spaces decrease in Medan City, when in 2003 Medan had about 10.830,06 Ha of green spaces and at the end of the simulation year, which is 2028, it had only 4.411,28 Ha. As well as the temperature, Medan had a temperature of $27,8^{o}$C in 2003 and it was increased up to $35,65^{o}$C at the end of simulation year in 2028. Table 21 presents the change value of green spaces towards the temperature in Medan City during the simulation period.

The results of simulation conducted on a sub-social model (population), indicated a trend of increase in the number of population in Medan City, where in the beginning of the simulation in 2003 the total population was 1.993.602 people and at the end of the simulation in 2028 increased up to 2.605.558 people. Similarly, the needs of residential in Medan City, at the beginning of the simulation in 2003 the land for residential in Medan City was about 1.413.458 Ha and at the end of the simulation in 2028 increased up to 1.719.688 Ha. Table 5.10 presents the effect of population density on the needs of residential land in Medan City during the period of the simulation.

The PDRB component in this model is considered as a level (accumulation) which can increase and decrease due to the dynamics of the numbers of the sectors of agriculture, mining and quarrying, manufacturing, electricity, gas, and clean water, construction, trade, hotels and restaurants, transportation and communication , finance, leasing and business services, and also other services. The dynamics of the flow which cause an increase or decrease in the level are called as flow or rate.

Based on the results of the simulation conducted on the PDRB sub-model, indicate a trend of increase in the amount of PDRB in Medan City, where in the beginning of the simulation in 2003 the amount of PDRB of Medan City was IDR 28.670,91 billion Rupiah, and by the end of 2023 decreased until the end of the simulation which was to be IDR 406.880,37 billion. Likewise, PDRB per capita in Medan City, in the early years of simulation in 2003 was IDR 14,38 billion and by the end of the simulation in 2028 decreased to IDR 155.26 billion.

2.   The Formulation of The Direction of Green City Development in Medan City

A green city is an environmental friendly city by utilizing the water and energy resources effectively and efficiently, reducing the wastes, implementing an integrated transportation

system, ensuring the environment health, synergizing the natural and artificial environment, regarding the city plan and design which were standing for the continuous development principles.

The development of Green City in Medan requires a concurrent movement from all of the stakeholders of the city. The development of green city also requires some changes/innovations/basic (from the practices up to the values) and massive initiatives. Law No. 26 of 2007 about Spatial Management clearly mandates 30% of the area of the city to be in the form of Green Spaces, 20% for Public Green Spaces, and 10% for Private Green Spaces. This 30% allocation of the green space is specified on Local Regulation about *RT/RW* of the City and Regency.

In the previous section, it had discussed that based on the results of simulation conducted on a sub-model of green space in Medan City, which indicates a decrease trend of green space area in Medan City, where in the beginning of the simulation in 2003 Medan City had a green space area of 10.830,06 Ha and at the end of the simulation in 2028 was decreased to 4.411.28 ha. Besides, the fundamental problem in Medan today is the very low number of public green spaces which are available. The public green space that is recorded in detail in the Department of Parks of Medan City is 85,69 hectares or 0,32 percent of the total area of Medan City, while the private green space is still spacious (9.695,24 ha), or 36.57% of the total area of Medan City.

Referring to the conditions above, in order to develop a public green space in Medan City which is in a shortage of the green space area, we use the Hierarchy Analysis Process (HAP) approach. The analysis conducted includes the analysis of individual opinion and of the combined opinion. The results of the combined opinion has a value of Consistency Ratio (CR) of 0,00. This value is the combined value from 30 respondents, where each individual has already had a CR < 0,1. It means that the respondents are consistent in weighting the value with a small deviation level.

The results of the analysis state that the priority development of public green space is a form of green space area with a value of 0,404, followed by the twist green space with a value of 0,345 and the line green space with a value of 0,251. While the selected form is the main priority, the area form with a value of 0.405, with sub-forms, the form of City Park with a value of 0,755, while the second priority is the road shape with a value of 0.586, the third priority is the green line with a value of 0.553, the fougreen open space priority is the riparian

with a value of 0,447, the last priority is the park with < 100 trees and Sports Fields with a value of each of 0,414 and 0,245.

Based on those people preferences, the development of the form of green spaces is firstly prioritized in the sub-form of City Park with a value of 0,755 and the second is prioritized in the form of Sports Fields with a value of 0,245. Fugreen open spaceer information can be seen on the Table 5.15 below.

Tabel 2. The Results of Hierarchy Analysis Process (HAP) to Obtain the Priority of the Form of Public Green Spaces

Form	Sub-Form	Value
Area (0,404)	City Park	0,755
	Sports Fields	0,245
Twist (0,345)	Park with < 100 Trees	0,414
	Road Shape	0,586
Line (0,251)	Riparian	0,447
	Green Line	0,553

Source: Primary Data of 2013

The level-2 AHP analysis results or actors illustrate that the main actors in the policy of development strategies of green spaces towards a green city in Medan City either in the form of areal, twist and line indicate the role of government, in this case the Local Government, has the first (greatest) value, followed by the residents, then by the Universities, Non-Government Organizations (NGO) as the third, and the last by the Private parties.

The Local Government of Medan City plays the biggest role in the policy of green city development. The regulation that supports its role is Law No. 27 of 2006 on Spatial Planning. By this law, the Local Government of Medan City prepares the Spatial Plan of Medan City in 2010 - 2030 which aims at as follows: firstly, realizing the space of Medan City as an environmentally friendly city based on the services, trades, and industries, which are based on the local wisdom and excellence for sustainable development.

5. Conclusions

Based on the results of the research and explained discussions, it can be concluded as follows:

1. The analysis of the dynamic system shows that there are some linkages amongst the biophysics, social and economic components. Based on the results of the simulation, show that the decrease of green space area in the simulation period from 10.830,06 Ha (2003) to 4.411.,28 Ha (2028). The population during the simulation period which was from 1.993.602 people (2003) increased up to 2.620.700 people (2028), while the

temperature increased from $27,80^{\circ}$C (2003) to $35,65^{\circ}$C (2028), for the PDRB in the simulation period increased from IDR 28.670,91 Billion (2003) to IDR 406.880,37 Billion (2028). Based on the scenario simulation and the average history show the proximity between the simulation and historical data. So that, the model can be used as a reference to conduct a scenario of green space management policy towards the development of green city in the future.

2. The role of the government, in this case is the The Local Government of Medan City plays the biggest role in the policy of green city development. The regulation that supports its role is Law No. 27 of 2006 on Spatial Planning. By this law, the Local Government of Medan City prepares the Spatial Plan of Medan City in 2010 - 2030 which aims at realizing the space of Medan City as an environmentally friendly city based on the services, trades, and industries, which are based on the local wisdom and excellence for sustainable development. The second factor in the policy of green city development of Medan City is the role of the society. Society is a very important element to be involved in the development since the society will directly feel the impact of the development. Added by the changes of the development paradigm from the *top-down planning* to *bottom-up planning* which also involve the society in every development includes the green city development in Medan City.

5.1 Suggestions

According to the conclusions of the research, there are some suggestions of efforts which have to be conducted as follows:

1. The policy in the green city development has to be supported by the good-skilled human resources in planning, managing, and monitoring in an obvious organization and good management. In planning, the local government should be able to map the potential area of green space development and its developing system. In managing, it needs the human resources who are able to motivate and encourage the people to be involved in the development of green spaces. Regarding to the monitoring, the human resources should be able to control the activities which can harm the quality of green spaces in Medan City.

2. Need to reconsider the plan of green spaces in arranging of Medan City, especially for the public green spaces (City Forest and Park).

3. Need to conduct a fugreen open spaceer review about the development of green city with the unobserved indicators.

References

Briassoulis, H. 1999. *Analysis of Land Use Change*: Theoretical and ModellingApproaches.http://www.rri.wvu.edu/web.Book/Briassoulis/contens.htm [10 April 2009].

Pane, Efendi, 2011. *Analisis Struktur Ruang Dalam Pengembangan Infrastruktur Hijau Di Kota Medan.* Thesis. Sekolah Pascasarjana USU Medan

Peraturan Menteri Dalam Negeri No.1 Tahun 2007. Tentang *Penataan Ruang Terbuka Hijau Kawasan Perkotaan*.

Program Pengembangan Kota Hijau (P2KH). *Panduan Pelaksanaan 2011*. Kementerian Pekerjaan Umum Republik Indonesia

Purba, Corry Yosi. 2010. *Analisis Spasial Hubungan Penggunaan Lahan dengan Suhu Udara di Kota Medan*. Thesis. Sekolah Pascasarjana USU Medan