

Location Determination of Salatiga City Park Potential with Geographic Information System

Noviarta Rizky Manik¹⁾, Bistok Hasiholan Simanjuntak²⁾

^{1,2)} Agrotechnology, Agriculture and Business Faculty, Universitas Kristen Satya Wacana

Correspondence: bhasiholans@yahoo.com

Based on Salatiga Urban Land Use Plan 2010-2030, Salatiga still having lacked 30% of the green open space from its area. The addition of the city park is one of the green open space planning that can support the lack, so the research about Salatiga city park location determination with Geographic Information System (GIS) was as one part of the planning of the city park addition. The purpose of the study is ideal location determine for the city park in Salatiga which it was based on population density, population preferences and city park manager, land characteristics, and government regulation about the green open space. The research method was used the descriptive method through quantitative and qualitative approach by utilizing GIS software, questionnaire, and an interview. The research result showed the city park can be developed in protected areas (especially in urban forest sites) or in cultivation areas. However, the city park development must be in accordance with government regulations, land character and land suitability requirements for the city parks. Potential locations for urban parks in Salatiga city can be distinguished by two categories: 1. Recommended class area with 944,584 ha (16.64% of total area) and 2) Highly Recommended class area with 123.37 ha (2.17% of total area).

Keywords: City Park, Geographic Information Systems (GIS), Salatiga

I. INTRODUCTIONS

The population density is one of the characteristics possessed by a city. If the growth of population density increases to become a city condition in open space would decrease. One form of open space for city is the green open space. Based on the Regulation of Ministry Public Work No.05/PRT/M/2008 [10] the green open space is elongated areas or pathways and or clumps, which are more open space to use, where plants grow, whether they grow naturally or are intentionally planted. The directions for providing the green open space on city consist of Parks, City forests, Greenbelts, Green lines, Pedestrian spaces, Down highways and Certain functions. The park has an important function for a city, the function of the city parks for a city is biological, ecologically, physically, socially, aesthetically [12]. A park is a green open space that can provide enjoyment to urban inhabitants, it can protect wildlife and natural habitats. A park has facilities for rest and recreation and is often owned and managed by a city, state, or nation [14]. Based on land area and service scale to the inhabitant then the park is divided into [3]:

1. Play lots, a park capable of serving 300-700 residents with the size of 150-1500 m²
2. Vestpocket park, parks capable of serving 500-2500 residents with the size of 750- 5000 m²
3. Neighborhood park, parks capable of serving 2000-10000 people with a size of 1-8 ha

4. District/urban park, the park is able to serve 5000 inhabitants, is a city park, with the size of 8-80 ha
5. Large urban park/regional space, parks capable of serving residents in 2 cities or more with an area of 40-400 ha.

The city park is one of the most important forms of a park for the city inhabitant. The city park is parks located in city environments on a wide scale, used by the people to act at any time without having to pay the costs and can anticipate the impact of city development [5]. Based on Salatiga the Urban Land Use Plan 2010-2030 [8], Salatiga still having lacks of 30% of the green open space from its area, 5.678,11 hectares and the government of Salatiga try to fill the lack with several types of the green open space. This refers to the Regulation of Ministry Public Work No.05/PRT/M/2008 [10] that the proportion of green open space in urban areas should be 30% of the total area consisting of 20% of public open space and 10% private space. One type of green open space used by the government of Salatiga city to meet the needs of green space is by the addition of the city park. The addition of the city park is needed one of them to fulfill the function of environmental conservation as urban lungs in urban decay as well as control and reduction of air pollution, dust or particles consisting of several components of pollutants.

The city park addition would require a review of urban park planning because in a plan cannot be done indiscriminately considering one of them in order to avoid waste in development or minimize the uncertainty of errors in the development of the city park. One of the city park plans that need to be done is the determination of the location of the garden city itself. Park location determination can be based

on land suitability with the physical performance of the land, available land area and population density that meets the land and preferences of various parties from the users and the city park managers for proper location determination especially in terms of accessibility.

The land characteristic is important factors for a specific land use such as the city park. The land characteristic properties that are soils type, slope, air temperature, precipitation, altitude. Demography can determine the city park types, this is related to determining the type and location of the park city [6]. Increasing a population will increase needs for open space and preferences the city park types. Preference is part of the decision-making component of an individual in determining the various options for his needs. Thus, the determination of the city park location is based not only on the assessment of the land characteristic and demographic analysis but the preferences of both the users and the city park management also influence. The location of the park is usually in a strategic location and easily accessible from various corners of the city [1].

GIS is a computer-based system that merges geographic locations with statistical analysis and database technology. GIS allows planners and researchers to combine and analyze statistical information with its geographical representation

[13]. Based on background mentioned above, it was conducted research about location determination of Salatiga city park potential with geographic information system.

II. METHODS

Stages of research implementation

The research was conducted in Salatiga, Central Java, Indonesia, which was held in June 2017. The analyzer was used is software ArcGIS 10.3. The research type is descriptive quantitative research was used survey method to the respondents from 3 Salatiga city park visitors, Salatiga city park managers, number of urban population and the land characteristics such as soils type, soil texture, gravel and stone surface, bedrock, slope, precipitation, altitude, hydrology (rivers and water springs), flooding hazard, city road. Respondents in this study were park users who were doing their activity in 3 the city park Salatiga with age above 12 years with a number of 90 persons. Survey location is Bendosari park, Tingkir park, and Pancasila square with 30 questionnaires for each location. Data were collected using closed questionnaire method with a focus of study based on criteria of preferences about the city park ideal and new located determines of the city park.

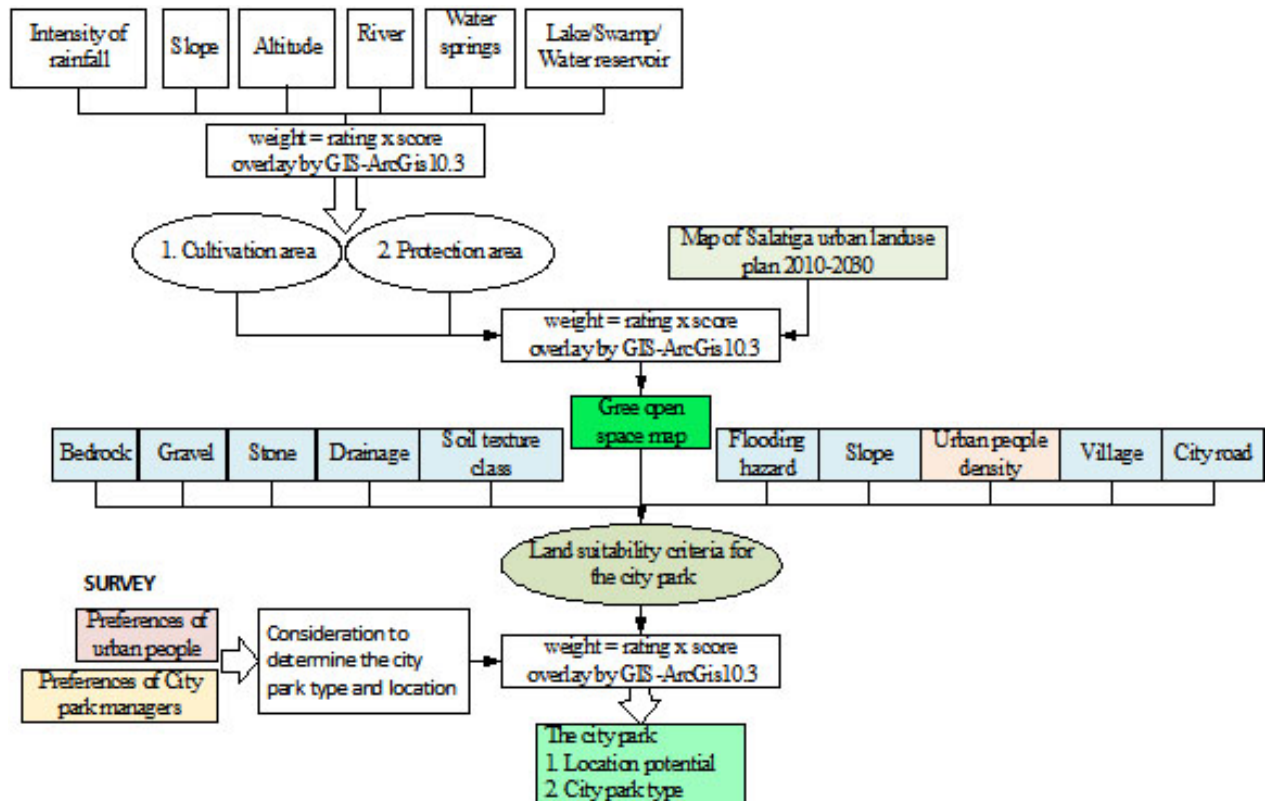


Figure 1. Flowchart of location determination of salatiga city park potential with GIS

Determination of cultivation area or protected area

Based on the Regulation of Minister of Public Works No.41 / PRT / M / 2007 [11] to determine the cultivation or protected area, that following stages are used:

1. Determining factor of cultivation area or protected area is a slope, soil type according to their sensitivity to erosion and rain intensity.
2. To establish a cultivated area or a protected area, the score value of factors such as slope, soil, rainfall intensity are summed. The total of score value of the factors (slope,

soil, rainfall intensity) are ≥ 175 indicates that the area concerned is categorized as a protected, while the total score value of factors (slope, soil, rainfall intensity) < 175 is a cultivation area.

3. Notwithstanding the above provisions, the protected area may be defined by the following criteria:
 - a. Forest area with slope $> 40\%$.
 - b. Soils are very sensitive to an erosion of soil type regosol, lithosol, organosol and rendzina with slopes $> 15\%$.
 - c. River border at least 100 meters on either side of the large river or 50 meters on the small river
 - d. Around the springs at least with a radius of 200 meters
 - e. Protective area of the spring, at least with the radius of 200 meters around the springs;
 - f. Forest area with altitude $> 2,000$ meters above sea level;

Table 1. Slope classes score

Slope (%)		Weight
0%-8%	Flat	20
8%-15%	Undulating	40
15%-25%	Moderately steep	60
25%-45%	Steep	80
$\geq 45\%$	Very steep	100

Table 2. Soil type classes score

Soil Type Group	Sensitivity to erosion	Weight
Alluvial, Gley soil, Planosol, Grey Hidromorf, Laterit soil water	No erosion sensitive	15

Latosol	Somewhat sensitive to erosion	30
Cambisol, Mediteran, Soil of Brown Forest, Non calcic brown	Less erosion sensitive	45
Vertisol, Andosol, Grumusol, Laterit, Podzol, Podzolic	Sensitive erosion	60
Lithosol, Organosol, Rendzina, Regosol	Very erosion sensitive	75

Table 3. Rain intensity classes score

Rain Intensity (mm /day rain)		Weight
8 – 13,6	Very low	10
13,6-20,7	Low	20
20,7-27,7	Medium	30
27,7-34,8	High	40
$>34,8$	Very high	50

Determination of City park location

The city park location determination was based on land suitability for the city park [7] (Table 4), population density, and preference of user and manager of the city park.

The city park location determination was not only based on land suitability but also must consider the preferences of urban people as park users, preferences of city park managers as the park management authority and people population densities that will determine the land availability.

Table 4. Land suitability criteria for the city park

No	Land characteristics	Land suitability class			
		S1 (4)	S2 (3)	S3 (2)	N(1)
I	Rooting medium (40)				
a	Texture	Medium	Moderately fine, Moderately coarse	Fine	Coarse
b	Drainage	Well drained, Moderately well drained	Somewhat excessively drained	Somewhat poorly drained, Poorly drained	Very poorly drained, Excessively drained
II	Mechanization potential (40)				
a	Slope	0-8%	8-15%	15-25%	$>25\%$
b	Gravel (\emptyset 2 mm-25 cm)	0-15%	15-30%	30-50%	$>50\%$
c	Stone ($\emptyset >25$ cm)	0-3%	3-10%	10-15%	$>15\%$
d	Rock (Bedrock)	0-0.01%	0.1-2%	2-3%	$>3\%$
III	Flooding hazard (20)	Never	Rarely	Sometimes,	Often times, very often times

III. RESULTS AND DISCUSSION

City inhabitant population density, preference of the city inhabitant and the Salatiga city park manager

The total inhabitant population of Salatiga City in 2016 is 186,316 people. Kelurahan (Village) with the highest

population density is Kelurahan Gendongan which reached 778 souls / km² and village with the lowest population density is Kelurahan Kalibening which reach 74 soul / km². Population density in Salatiga City is divided into 4 class, which is very high density, high density, medium density and less dense.

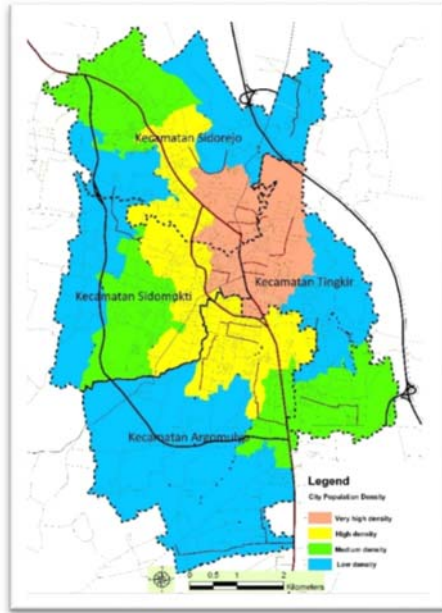


Figure 2. People density in Salatiga city

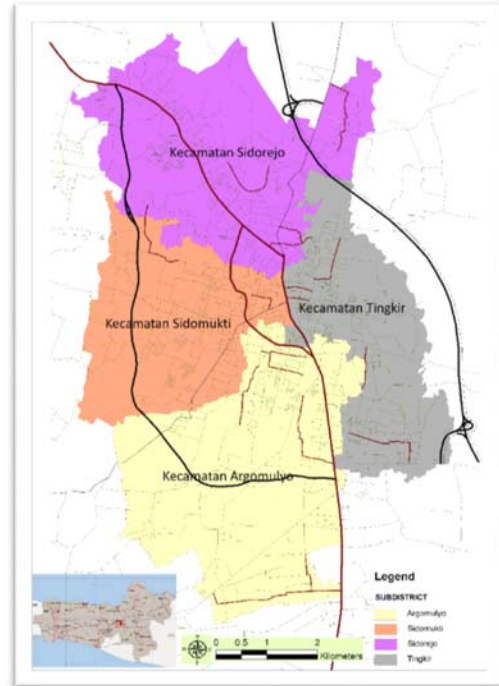


Figure 3. Salatiga city with 4 subdistricts

The cause of high population density in the city one of them caused by increased urbanization. High population density, will give effect to the urban space management. The city park development will be hampered in areas with high population density due to the open space absence. Therefore, the city parks development would always be directed to areas with low to moderate population density. The main factor to be considered in choosing a public park location is the social requirement to build the park [4]. Therefore, the public preferences analysis on urban park development is very necessary. The preference survey result on inhabitant population and Salatiga city park manager were showed passion on the city park development in Salatiga as follows:

1. 77% of the inhabitant population use the city park for recreation and play
2. 66% of the inhabitant population wants a city park development to add to the city beauty
3. 96% of the inhabitant population wants a city park can provide visitors comfort
4. 61% of the inhabitant population wants the existing city park and to be built many elements of vegetation especially flowers and trees
5. 81% of the inhabitant population wants the city park located near the main road and is easily accessible

The results of a preference survey of Salatiga city park managers show:

1. The city park will be developed in an area easily accessible and located near the main road.
2. The city parks will be developed for city inhabitant that could be used for recreation, studying, playing, exercising and improving biodiversity.

Salatiga land characteristic

Salatiga is a city in Central Java, Indonesia with 4 sub-districts, which 4 sub-districts have 22 urban villages. Salatiga has an area of ± 56,78 km² and according to the Central Bureau of Statistics (2015), Salatiga city has a population of 183,815 inhabitants.

Salatiga city is located at an altitude of 450 - 800 m above sea level, where 67.05% of total area has a slope of 0% -8%, 24.04% of total area has a slope of 8% -15%, 4% of total area has a slope of 15 - 25% and the rest with slopes > 25%

Table 5. The diversity of slopes in Salatiga City

Slopes	Area (Ha)	Percentage (%)
0%-8%	3807,08	67,05
8%-15%	1364,84	24,04
15%-25%	360,04	6,34
25%-45%	129,97	2,29
>45%	16,19	0,29
Total	5678,11	

Precipitation data from 2011 to 2015, Salatiga's precipitation type has an average annual rainfall of 2,124 mm per year with a daily rain intensity of 25.29 mm per day. Based on the precipitation characteristics, the Salatiga city has a precipitation on the moderate class.

Table 6. Precipitation in Salatiga city 2011-2015

Month	Rainfall (mm)	Rain day	Rain Intensity (mm/day)
January	374	16	23,37
February	239	11	21,73
March	374	16	23,37
April	460	16	28,75
May	153	6	25,5
June	0	0	0
July	0	0	0
August	0	0	0
September	0	0	0
October	0	0	0
November	174	7	24,85
December	350	12	19,16
Total	2.124	84	25,29

Salatiga city was dominated by Latosol soil its covers 71.14% of land area, Alluvial soil covers 13.89% of land area, Latosol-Andosol soil associations cover 10.71% of land area and Andosol soil covers 4.32% of land area. Latosol is the soil with a consistency of loose soil and crumbling soil structures, infiltration and percolation velocities from moderate to moderately slow, water retention is good enough and somewhat sensitive to erosion, while the Alluvial soil is not sensitive to erosion and Andosol is a sensitive soil erosion.

Based on the soil physical properties, the soil texture group ranges between consisting of coarse, moderately coarse and moderately, with a soil surface that has a gravel of <15%, a stone of <3% and a rock that does not exist on the soil

surface. Salatiga city has the well-drained conditions and there is never of flooding hazard.

Table 7. Salatiga soil type

No	Type of soil	Area (Ha)	Percentage (%)
1	Latosol brown	4039,42	71,14
2	Alluvial brown	788,83	13,89
3	Association brown Andosol and Latosol brown	608,16	10,71
4	Andosol brown	241,70	4,32
	Total	5678,11	

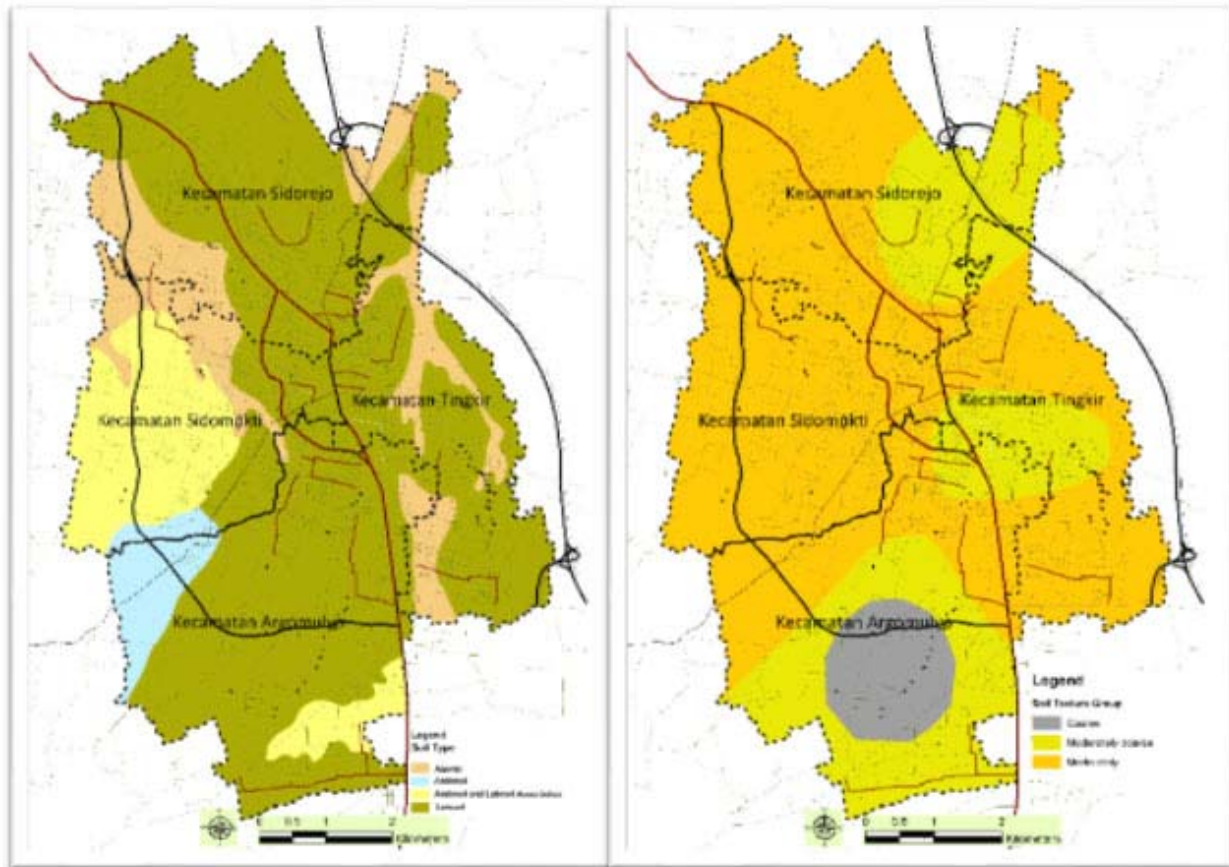


Figure 4. Soil type and texture group in Salatiga city

Determination cultivation and protection area

Based on the Regulation of Minister of Public Works No.41 / PRT / M / 2007 [11] and Salatiga city land

characteristic then the Salatiga city about 75.56% of total area is a cultivation area and 24.44% of total area is a protected area.

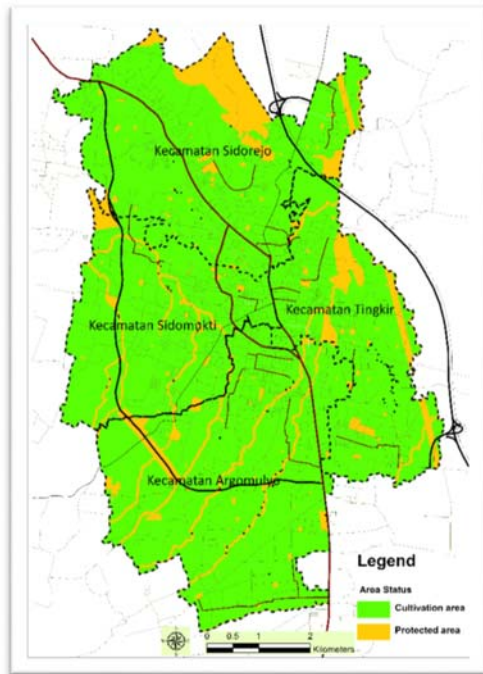


Figure 5. Cultivation and protected are in Salatiga city

Land suitability for the city park potential location in Salatiga city area

The city park can be developed in protected areas (especially in urban forest sites) or in cultivation areas. However, the city park development must be in accordance with government regulations, land character and land suitability requirements for the city parks. Government regulation for the city park development was based on the Regulation of Minister of Public Works No 05/PRT/M/2008 on Guidelines for the Provision and Use of Green Open Space in Urban Areas [10], that the city park is located in the area with following conditions:

1. Open space at the city level
2. The spatial analysis shall be appropriate to the level or class of land suitability for the city parks and regulation in The Urban Land Use Plans.
3. Minimal 100 meters from either side of a large river or 50 meters from both sides of a small river.
4. Minimum 200 meters from the water spring center.

GIS analysis was based on Salatiga land characteristic, land suitability for the city parks, Salatiga Urban Land Use Plans 2011-2030 [8] and the Regulation of Minister of Public Works No 05/PRT/M/2008 [10], that Salatiga can be categorized into 4 classes of the city park development area:

1. The first area is the class that is not recommended for the construction of the city park.
2. The second area is a class that is quite recommended for the construction of the city park.
3. The third area is the recommended class for the city park.
4. The fourth area is a highly recommended class for the city park.

Recommendations potential location for the city park development were undertaken in areas with land suitability classes the highly recommended (dark green) and the recommended (green) (Fig 6).

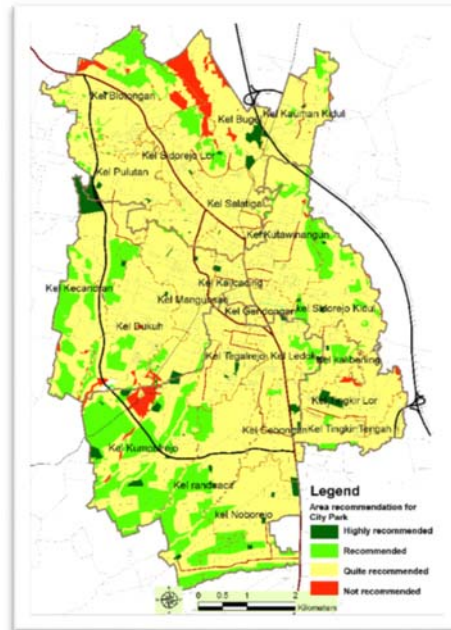


Figure 6. Recommendation potential location for the city park in Salatiga city

Table 8. Land classification category for the city park in Salatiga City

Recommendation classes for the city park	Area (ha)	Percentage (%)
Not recommended for the city park		
Not recommended class	1943,13	34,22
Quite recommended class	2667,03	46,97
Recommended for the city park		
Recommended class	944,58	16,64
Highly recommended class	123,37	2,17
Total	5678,11	

Table 9. Land classification for the potential location of city park development of each village in Salatiga city

Subdistrict	Recommendation classes for the city park	Villages	Area (Ha) per Village	Area (Ha) per Subdistrict	Percentage (%)
Kecamatan Argomulyo	Recommended class	Kel Cebongan	5.626	501.527	8.83
		Kel Kumpulrejo	268.527		
		Kel Ledok	15.552		
		kel Noborejo	68.345		

Subdistrict	Recommendation classes for the city park	Villages	Area (Ha) per Village	Area (Ha) per Subdistrict	Percentage (%)
		Kel randuacir	140.335		
		Kel Tegalrejo	3.142		
Kecamatan Sidomukti	Recommended class	Kel Dukuh	58.368	178.4	3.14
		Kel Kecandran	106.004		
		Kel Mangunsari	14.028		
Kecamatan Sidorejo	Recommended class	Kel Blotongan	76.956	146.213	2.58
		Kel Bugel	18.155		
		Kel Kauman Kidul	14.016		
		Kel Pulutan	12.208		
		Kel Salatiga	2.604		
		Kel Sidorejo Lor	22.274		
Kecamatan Tingkir	Recommended class	Kel kalibening	14.114	118.444	2.09
		Kel Kutawinangun	32.429		
		kel Sidorejo Kidul	57.535		
		Kel Tingkir Lor	0.036		
		Kel Tingkir Tengah	14.33		
Kecamatan Argomulyo	Highly recommended class	Kel Cebongan	9.918	47.513	0.84
		Kel Kumpulrejo	16.558		
		Kel Ledok	1.754		
		kel Noborejo	8.708		
		Kel randuacir	6.095		
		Kel Tegalrejo	4.48		
Kecamatan Sidomukti	Highly recommended class	Kel Dukuh	1.437	30.502	0.54
		Kel Kalicacing	1.752		
		Kel Kecandran	22.056		
		Kel Mangunsari	5.257		
Kecamatan Sidorejo	Highly recommended class	Kel Blotongan	0.596	29.473	0.52
		Kel Bugel	15.037		
		Kel Kauman Kidul	2.189		
		Kel Pulutan	9.383		
		Kel Salatiga	1.009		
		Kel Sidorejo Lor	1.259		
Kecamatan Tingkir	Highly recommended class	Kel kalibening	1.287	15.882	0.28
		Kel Kutawinangun	1.431		
		kel Sidorejo Kidul	3.254		
		Kel Tingkir Lor	9.407		
		Kel Tingkir Tengah	0.503		
Totally recommended and highly recommended area for the city park (Ha)				1067.954	18.81
Total Salatiga city area (Ha)				5678.11	

IV. CONCLUSIONS

The potential location of city park development can be developed in protected areas (especially in urban forest sites) or in cultivation areas. However, the city park development must be in accordance with government regulations, land character and land suitability requirements for the city parks. Potential locations for urban parks in Salatiga city can be distinguished by two categories: 1. Recommended class area with 944,58 ha (16.64% of total area) and 2) Highly Recommended class area with 123.37 ha (2.17% of total area).

REFERENCES

- [1] Arifin, H. S., A. Munandar, N.H.S. Arifin, Q. Pramukanto, V.D. Damayanti. "Sampoerna Hijau Kotaku Hijau: Buku Panduan Penataan Taman Umum, Penanaman Tanaman, Penanganan Sampah dan Pemberdayaan Masyarakat". 2007
- [2] BPS Kota Salatiga 2016. "Kota Salatiga Dalam Angka". 2016. Salatiga.
- [3] Gold, Seymour M. "Recreation Planning and Design". 1980. McGraw-hill, New York,
- [4] Jacobs. J. "The Death and Life of Great American Cities". 1992. Vintage books USA, New York.
- [5] Junaidy Abdillah. "Pola Penyebaran Taman Kota dan Peranannya Terhadap Ekologi di Kota Jepara". 2005 (Skripsi). Unpublished. Semarang: Universitas Negeri Semarang.
- [6] Malingreau JP. "Penggunaan Lahan Pedesaan Penafsiran Citra untuk Inventarisasi dan Analisisnya". 1978. Yogyakarta: Pusat Pendidikan Interpretasi. Citra PJ dan Survey Terpadu UGM BAKOSURANAL
- [7] Hardjowigeno S and Widiatmaka. "Evaluasi Kesesuaian Lahan dan Perencanaan Tataguna Lahan". 2007. Yogyakarta (ID): Gadjah Mada University Press.
- [8] Peraturan Daerah Kota Salatiga Nomor 4 Tahun 2011 tentang Rencana Tata Ruang Wilayah Kota Salatiga Tahun 2010-2030. Salatiga.
- [9] Peraturan Menteri Dalam Negeri No.1 Tahun 2007 tentang Penataan Ruang Terbuka Hijau Kawasan Perkotaan. Jakarta: Menteri Dalam Negeri.
- [10] Peraturan Menteri Pekerjaan Umum No. 05/PRT/M/2008 tentang Pedoman Penyediaan dan Pemanfaatan Ruang Terbuka Hijau di Kawasan Perkotaan. Jakarta: Direktorat Jenderal Penataan Ruang Departemen Pekerjaan Umum.
- [11] Peraturan Menteri Pekerjaan Umum No.41/PRT/M/2007 tentang Pedoman Kriteria Teknis Kawasan Budidaya. Jakarta: Direktorat Jenderal Penataan Ruang Departemen Pekerjaan Umum.
- [12] Rutledge, Albert. 1971. Anatomy of a park: the essentials of recreation area planning and design. The McGraw-Hill Companies, Inc. USA.
- [13] Trafton Bean and Marc Schlossberg. "Downtown Parks Connectivity Analysis with Geographic Information Systems (GIS)". 2010. Sustainable Cities Initiative. University of Oregon.
- [14] Weir LH. "Parks: a manual of municipal and county parks". 1982. New York: A.S. Barnes and Company