BALANCE OF GREEN OPEN SPACE TO SUPPORT GREEN SETTLEMENT IN YOGYAKARTA URBAN AREA

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Abstract

The greatest problem relating to settlement growth in Yogyakarta urban area is the declining number of green open spaces. This study aimed to analyze the balance between the availability of and need for green open space development to promote the existence of green settlement in Yogyakarta urban area. The methods employed in this study were field research and studio analysis by referring to the related research methods previously conducted by the researcher as well as by the others. The results showed that the extent of green open space in Yogyakarta urban area reached 1,469.45 Ha or 16.2% of the total area. Therefore, the need for green open space lacked 13.8% of the total area. The general condition of the green open space was categorized as average in either housing clusters or settlements (non-housing clusters). Good condition was found only in low-density settlement, while poor condition of green open space was located in high-density settlement. The development of green open space should focus on public green open space while maintaining the private one. Some of the potential areas for this included rice fields, village treasury lands, riverbanks, roadsides, railway boundaries, public areas, and others.

Keywords: *development, green open space, green settlement, Yogyakarta*

1. INTRODUCTION

The availability of green open space (GOS) is one of the important factors for urban microclimate. The average temperature of urban area is 40C higher than that of the suburban (Widodo B. et al, 2011). This indicates the decreasing quality of open space in urban area due to imbalanced condition between built-up area and non-built-up area.

According to the UN projection, three out of five world inhabitants will live in urban area by 2030 (Baiquni, 2002). Yogyakarta urban area (YUA) has experienced a significant level of urbanization. The available area is limited, forcing urbanization in Yogyakarta to spread across Sleman Regency and Bantul Regency. Consequently, settlement area becomes broader and denser. Widodo B. (2005) and Widodo B. et al (2009b) predicted that rice fields in Sleman, Yogyakarta, and Bantul would be completely used for settlement by 2030s if no control was taken.

The more complex urban dynamics have become a tough challenge to sustainable development. The urban physical area keeps being filled with buildings, surface of both building roofs and yards is

hardened, and green open space continues to narrow or even almost to disappear. The urban environment tends to develop economically but to decline ecologically (Harjito, D.A., 2007). One of the impacts is an ambient temperature raise that will trigger urban heat island - though on a small scale (Li et al., 2005). On the other hand, global warming issue continues to frighten the world.

The most effective strategy to mitigate the threat of global warming is improving the condition of local environment (Widodo B. et al, 2009a). Widodo B et al (2011) and Dinas Kimpraswil DIY (2006) suggested two main principles to overcome urban heat island, which are to shade hardened surface in public spaces and to sustain the flow of winds. Law No. 26 Year 2007 on Spatial Planning has also mandated urban area to provide GOS with a minimum of 30% of the total extent, consisting of 20% public GOS and 10% private GOS. Micro climate change is an environmental hazard and has the potential to bring disasters (Coburn, 1994; Reed, 1995). One of the efforts to prevent disasters can include law enforcement. In the context of micro climate change relating to green open space, the prevention can optimize the mandate of Law No. 26 Year 2007 on Spatial Planning (*Undang-Undang Republik Indonesia Nomor 26 Tahun 2007 Tentang Penataan Ruang)* to provide at least 30% of urban area for GOS.

The major issue around settlement growth in Yogyakarta urban area is the decreasing green open space. Therefore, this study attempted to map the potential and to design strategies for the development of green open space to encourage the establishment of green settlement in Yogyakarta urban area.

This research aimed to: identify the existing green open space in Yogyakarta urban area, analyze the need for green open space in Yogyakarta urban area and analyze the development of green open space in settlement area.

2. RESEARCH METHODS
2.1 Data Collection Techniques

The socio-economic data were collected primarily and secondarily. The secondary data were gathered from the reports or other official sources of related institutions. Meanwhile, the primary data were collected through semi-structured interview with questionnaire. In addition, the physical data of GOS were obtained from field survey, semi-structured interview with questionnaire, as well as in-depth interview. The survey results were in the form of documentation photos, sketches, numerical figures, and others.

The research population involved households living in Yogyakarta urban area. The respondents were the patriarchs selected through proportional cluster random sampling. The settlement clusters

were divided into the settlement area in large housing complex (elite), medium housing complex, small housing complex, and urban kampong. The total samples used in this study were 100 patriarchs.

2.2 Data Processing and Analysis

2.2.1 Analysis of the existing GOS condition

The analysis of existing condition of GOS in each settlement cluster was conducted for the following aspects:

1. Tree density or canopy volume

   The analysis was performed by interpreting the satellite imagery from GIS-based Landsat 2016.

2. Evaluation of GOS quality

An evaluative analysis was conducted through a field survey of GOS availability. The observation result was then compared to the standard of infrastructure for environmental conservation. The analysis results consisted of three (3) criteria, including environmentally friendly (good), less environmentally friendly (average), and not environmentally friendly (poor). The criteria and data gathering techniques are presented in the following table.

Table 1. Criteria and Data Collection Techniques for Settlement Evaluation

Condition			Collection Technique
Good	**Average**	**Poor**	
Owning 20% total area for private GOS	Owning 10-20% total area for private GOS	Owning less than 10% total area for private GOS	questionnaire
Owning 10% total area for public GOS	Owning 5-10% total area for public GOS	Owning less than 5% total area for public GOS	observation/ questionnaire

Source: *Kementerian Negara Perumahan Rakyat,* 2008 (with modification)

2.2.2   Analysis of the need for GOS

Analysis of the need for or shortage of GOS was performed based on the requirement of area in accordance with the regulation. Law No. 26 Year 2007 on Spatial Planning regulated that the proportion of green open space in urban area is at least 30% (thirty percent) of the total city area with 20% area for public and 10% extent for private.

The need for GOS = the total need for GOS – the availability of GOS

3. RESULTS AND DISCUSSION

3.1 Existing Condition of GOS

The identification of GOS existing condition used GIS technique and field survey. Figure 4.1 illustrates the distribution of existing GOS in Yogyakarta urban area according to the Landsat8 Satellite Imagery year 2016. The detail of distribution area is presented in Table 2. In general, the GOS in Yogyakarta urban area reached 1,469.45 Ha or 16.2 % of the total area.

Table 2. Extent of Green Open Space in Yogyakarta Urban Area

Regency/ City	District	Village/Urban Community	Area (Ha)	Existing GOS	
				Ha	%
Sleman	Depok	Caturtunggal	523.14	157.17	30.04%
		Condongcatur	448.57	113.41	25.28%
		Maguwoharjo	694.82	126.31	18.18%
	Gamping	Ambarketawang	336.00	38.48	11.45%
		Banyuraden	232.20	29.94	12.89%
		Nogotirto	329.12	33.40	10.15%
		Trihanggo	554.34	39.62	7.15%
	Mlati	Sendangadi	306.10	42.54	13.90%
		Sinduadi	385.42	78.35	20.33%
	Ngaglik	Sariharjo	398.69	79.77	20.01%
		Total	**4,208.40**	**738.99**	**17.56%**
Yogyakarta	Danurejan	Bausasran	35.18	3.65	10.37%
		Suryatmajan	24.15	4.47	18.53%
		Tegalpanggung	30.00	3.50	11.66%
	Gondokusuman	Terban	55.72	6.02	10.81%
		Baciro	78.47	9.78	12.46%
		Demangan	51.67	9.44	18.27%
		Klitren	57.57	7.09	12.32%
		Kotabaru	52.92	11.27	21.29%
	Gondomanan	Prawirodirjan	24.06	4.64	19.28%
		Ngupasan	55.20	10.93	19.79%
		Prawirodirjan	24.06	4.64	19.28%
	Gedongtengen	Pringgokusuman	43.12	3.81	8.83%
		Sosromenduran	39.81	5.59	14.04%
	Jetis	Bumijo	45.69	6.44	14.09%
		Cokrodiningratan	37.51	5.83	15.55%
		Gowongan	37.37	6.26	16.74%
	Kotagede	Prenggan	44.16	8.12	18.40%
		Rejowinangun	54.71	12.20	22.30%
		Purbayan	21.10	3.17	15.02%
	Kraton	Kadipaten	22.39	5.11	22.84%
		Panembahan	35.23	9.54	27.09%

Regency/ City	District	Village/Urban Community	Area (Ha)	Existing GOS	
				Ha	%
		Patehan	21.59	5.69	26.37%
	Mantrijeron	Gedongkiwo	37.58	6.15	16.37%
		Mantrijeron	42.09	8.40	19.96%
		Suryodiningratan	34.37	5.33	15.50%
	Mergangsan	Brontokusuman	38.58	10.48	27.15%
		Keparakan	22.61	3.37	14.89%
		Wirogunan	40.51	7.81	19.27%
	Ngampilan	Ngampilan	34.42	2.83	8.22%
		Notoprajan	21.63	4.05	18.72%
	Pakualaman	Gunungketur	23.07	3.42	14.82%
		Purwokinanti	29.31	2.85	9.71%
	Tegalrejo	Karangwaru	35.06	3.96	11.29%
		Bener	22.93	3.50	15.26%
		Kricak	30.36	3.09	10.18%
		Tegalrejo	30.72	7.56	24.62%
	Umbulharjo	Giwangan	40.16	10.80	26.88%
		Mujamuju	66.02	11.22	16.99%
		Pandeyan	55.79	15.17	27.19%
		Semaki	43.16	7.95	18.43%
		Tahunan	35.60	7.27	20.41%
		Warungboto	37.02	5.45	14.72%
		Sorosutan	56.65	13.02	22.98%
	Wirobrajan	Pakuncen	30.63	6.87	22.43%
		Patangpuluhan	25.03	4.43	17.70%
		Wirobrajan	31.74	4.23	13.32%
		Total	**1,756.75**	**306.37**	**17.44%**
Bantul	Banguntapan	Banguntapan	328.44	44.56	13.57%
		Baturetno	331.06	53.86	16.27%
		Jagalan	11.19	1.42	12.69%
		Singosaren	63.56	43.02	67.68%
		Tamanan	312.26	22.33	7.15%
		Wirokerten	282.22	19.06	6.75%
	Kasihan	Ngestiharjo	249.06	48.31	19.40%
		Tamantirto	344.27	50.45	14.65%
		Tirtonirmolo	258.75	49.67	19.20%
	Sewon	Panggungharjo	389.84	46.79	12.00%
		Bangunharjo	578.65	44.62	7.71%
		Total	**3,149.30**	**424.09**	**13.47%**
	Yogyakarta Urban Area (KPY)		**9,114.46**	**1,469.45**	**16.12%**

Figure 1. Map of Existing Green Open Space in Yogyakarta Urban Area
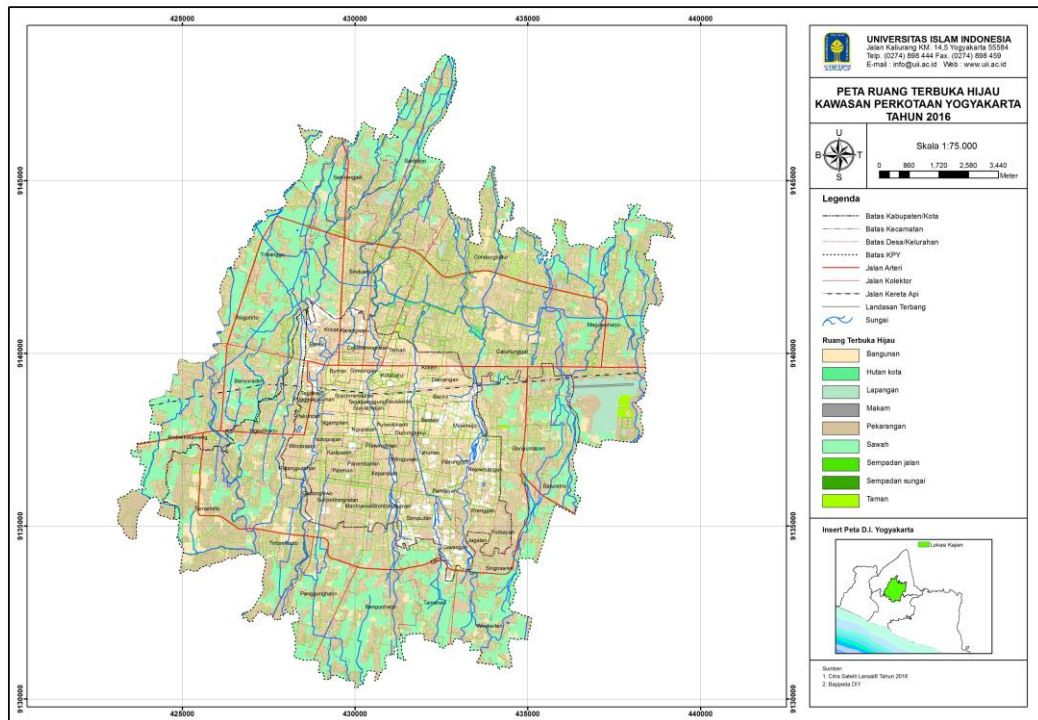
3.1.2   GOS of Housing Clusters

Large Housing Complex (Elite)

The result of field survey analysis for the quality of GOS in large housing complex (elite) is presented in Table 3. The table shows that, in general, the conservation effort through GOS has been made with average quality.

Table 3. Quality of GOS in Elite Housing Complex

No	Name of Housing Complex	Condition
1	The Paradise	average
2	North Hill Residence	average
3	Mataram Bumi Sejahtera	average
4	Pondok Kadipiro Permai	average
5	Timoho Town House	average
6	Kusuma Negara Town House	average
7	Semaki Cluster	average
8	Tiara Mas Wonocatur	average
9	Grinhos	average
10	De Asmarandana Resident	average
	Mean	average

Source: Field Survey (2016)

Medium Housing Complex

The evaluation of GOS quality is illustrated in Table 4. This table indicates the condition of environmental conservation facility with average quality. Good condition was located in only one housing complex.

Table 4. Quality of GOS in Medium Housing Complex

No	Name of Housing Complex	Quality of GOS
1	Pondok Permai Palagan	average
2	Citra Nirwana	average
3	Pesona Kuantan	average
4	Harmoni Graha Gemilang	average
5	Timoho Asri 3	good
6	Timoho Asri 1	average
7	Mutiara Town House	average
8	Metro Harmony Residence	average
	Mean	average

Source: Field Survey (2016)

Small Housing Complex

The result of quality evaluation can be seen in the following Table 5.

Table 5. Quality of GOS in Small Housing Complex

No	Name of Housing Complex	Quality of GOS
1	Griya Nganti Asri	average
2	Graha Adi Pratama	good
3	Griya surya asri	good
4	Taman Mas 2	average
5	Tamantirto Asri 1	good
6	PPLH Gunung Sempu	average
7	Bumi Tirto Indah	good
8	Griya Tirtonirmolo Asri	good
9	Nyoto Asri 3	average
10	Purimas Citra Gemilang	average
11	Metro Harmony Residence	average
	Mean	average

Source: Field Survey (2016)

Table 5 indicates that in general the GOS was of average quality. Good condition existed in six housing complexes (45.55%).

3.1.3 GOS of Non-Housing Complex Clusters

High-Density Settlement

The result of GOS quality evaluation is described in Table 6. It shows that the GOS availability was in poor condition.

Table 6. Quality of GOS in High-Density Settlement

No	Village/Urban Community	Quality of GOS
1	Notoprajan	poor
2	Panggungharjo	poor
3	Ngestiharjo	poor
4	Caturtunggal	poor
	Mean	poor

Source: Field Survey (2016)

Medium-Density Settlement

The evaluation result of GOS quality is illustrated in Table 7 indicating that the GOS was of average quality.

Table 7. Quality of GOS in Medium-Density Settlement

No	Village/Urban Community	Quality of GOS
1	Baciro	average
2	Kricak	average
3	Karangwaru	average
4	Prawirodirjan	average
5	Baturetno	good
6	Wirokerten	average
7	Tamanan	average
8	Sinduharjo	good
9	Minomartani	average
10	Sariharjo	average
	Mean	average

Source: Field Survey (2016)

Low-Density Settlement

The respondents' information on the GOS condition is described in Table 8. This table indicates that the quality of GOS was average.

Table 8. Quality of GOS in Low-Density Settlement

No	Village/Urban Community	Quality of GOS
1	Patehan	good
2	Semaki	good
3	Kotabaru	good
4	Tegal Panggung	good
5	Gunungketur	good
6	Bener	good
7	Jagalan	good
8	Condongcatur	good
9	Sendangadi	good
10	Sinduadi	good
	Mean	good

Source: Field Survey (2016)

All the above results of evaluative analysis are summarized in Table 9. On a macro scale, both the housing clusters and non-housing settlements have the average GOS quality. This evaluation becomes the basis for the selection of GOS management and supply model.

Table 9. Recapitulation of GOS Quality in Settlements

Type of Settlement	Quality of GOS
Elite Housing	average
Medium Housing	average
Small Housing	average
Mean for Housing	average
High-Density Settlement	Poor
Medium-Density Settlement	average
Low-Density Settlement	good
Mean for Settlement	average
Total Mean	average

3.1.4. Need for GOS

Table 10. Extent of Need for and Balance of Green Open Space in Yogyakarta Urban Area

Regency/City	District	Village/Urban Community	Ideal need for GOS (Ha)	Surplus/Deficit RTH Ha	%
Sleman	Depok	Caturtunggal	156.94	0.23	0.04%
		Condongcatur	134.57	-21.16	-4.72%
		Maguwoharjo	208.45	-82.14	-11.82%
	Gamping	Ambarketawang	100.80	-62.32	-18.55%
		Banyuraden	69.66	-39.72	-17.11%
		Nogotirto	98.74	-65.34	-19.85%
		Trihanggo	166.30	-126.68	-22.85%

Regency/City	District	Village/Urban Community	Ideal need for GOS (Ha)	Surplus/Deficit RTH	
				Ha	%
	Mlati	Sendangadi	91.83	-49.29	-16.10%
		Sinduadi	115.62	-37.27	-9.67%
	Ngaglik	Sariharjo	119.61	-39.84	-9.99%
		Total	**1,262.52**	**-523.53**	**-12.44%**
Yogyakarta	Danurejan	Bausasran	10.55	-6.91	-19.63%
		Suryatmajan	7.25	-2.77	-11.47%
		Tegalpanggung	9.00	-5.50	-18.34%
	Gondokusuman	Terban	16.71	-10.69	-19.19%
		Baciro	23.54	-13.76	-17.54%
		Demangan	15.50	-6.06	-11.73%
		Klitren	17.27	-10.18	-17.68%
		Kotabaru	15.88	-4.61	-8.71%
	Gondomanan	Prawirodirjan	7.22	-2.58	-10.72%
		Ngupasan	16.56	-5.64	-10.21%
		Prawirodirjan	7.22	-2.58	-10.72%
	Gedongtengen	Pringgokusuman	12.94	-9.13	-21.17%
		Sosromenduran	11.94	-6.35	-15.96%
	Jetis	Bumijo	13.71	-7.27	-15.91%
		Cokrodiningratan	11.25	-5.42	-14.45%
		Gowongan	11.21	-4.95	-13.26%
	Kotagede	Prenggan	13.25	-5.12	-11.60%
		Rejowinangun	16.41	-4.21	-7.70%
		Purbayan	6.33	-3.16	-14.98%
	Kraton	Kadipaten	6.72	-1.60	-7.16%
		Panembahan	10.57	-1.03	-2.91%
		Patehan	6.48	-0.78	-3.63%
	Mantrijeron	Gedongkiwo	11.27	-5.12	-13.63%
		Mantrijeron	12.63	-4.23	-10.04%
		Suryodiningratan	10.31	-4.98	-14.50%
	Mergangsan	Brontokusuman	11.57	-1.10	-2.85%
		Keparakan	6.78	-3.42	-15.11%
		Wirogunan	12.15	-4.35	-10.73%
	Ngampilan	Ngampilan	10.33	-7.50	-21.78%
		Notoprajan	6.49	-2.44	-11.28%
	Pakualaman	Gunungketur	6.92	-3.50	-15.18%
		Purwokinanti	8.79	-5.95	-20.29%
	Tegalrejo	Karangwaru	10.52	-6.56	-18.71%
		Bener	6.88	-3.38	-14.74%
		Kricak	9.11	-6.02	-19.82%
		Tegalrejo	9.22	-1.65	-5.38%
	Umbulharjo	Giwangan	12.05	-1.25	-3.12%
		Mujamuju	19.81	-8.59	-13.01%

Regency/City	District	Village/Urban Community	Ideal need for GOS (Ha)	Surplus/Deficit RTH	
				Ha	%
		Pandeyan	16.74	-1.57	-2.81%
		Semaki	12.95	-4.99	-11.57%
		Tahunan	10.68	-3.42	-9.59%
		Warungboto	11.11	-5.66	-15.28%
		Sorosutan	16.99	-3.98	-7.02%
	Wirobrajan	Pakuncen	9.19	-2.32	-7.57%
		Patangpuluhan	7.51	-3.08	-12.30%
		Wirobrajan	9.52	-5.30	-16.68%
		Total	**527.03**	**-220.65**	**-12.56%**
Bantul	Banguntapan	Banguntapan	98.53	-53.97	-16.43%
		Baturetno	99.32	-45.46	-13.73%
		Jagalan	3.36	-1.94	-17.31%
		Singosaren	19.07	23.95	37.68%
		Tamanan	93.68	-71.35	-22.85%
		Wirokerten	84.67	-65.61	-23.25%
	Kasihan	Ngestiharjo	74.72	-26.41	-10.60%
		Tamantirto	103.28	-52.83	-15.35%
		Tirtonirmolo	77.62	-27.96	-10.80%
	Sewon	Panggungharjo	116.95	-70.16	-18.00%
		Bangunharjo	173.59	-128.98	-22.29%
		Total	**944.79**	-520.71	**-16.53%**
Yogyakarta Urban Area (YUA)			**2,734.34**	**-1,264.89**	**-13.88%**

4. CONCLUSIONS

The conclusions of the study are as follow:

1. The extent of green open space in Yogyakarta urban area reached 1,469.45 Ha or 16.2% of the total area.

2. The need for GOS was therefore lacking 23.8% of the total area.

3. The GOS condition was generally average in both housing clusters and non-housing or settlement. Good condition was located in low-density settlement, while poor GOS condition was found in high-density settlement.

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