URBAN OPEN-SPACE PLAN FOR A SUSTAINABLE CITY : APPLICATION TO THE TOKYO AREA

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1. INTRODUCTION

With the rapid growth of urban spaces, concerns over the 'sustainability' of a city-as applied to development, societies, and livelihoods-has become an increasingly essential objective for most countries over the past two decades. Most countries, including Japan, have recognized the importance of sustainability and have established numerous plans and regulations to ensure the sustainability of their cities. Of these plans, urban open space[1] plans have played an important role in achieving long-term sustainability in terms of the environment, aesthetics, recreation, and the economy, as urban open space, which provides opportunities for recreation, rejuvenation, and restoration, is a vital resource for all communities, especially for densely populated cities. In Tokyo, one of the most densely populated cities in the world, urban open space is now seen as a cornerstone of building a sustainable society.

Until recently, cities' sustainability or regeneration strategies have mainly focused on the man-made built environment, as the concept of 'sustainability of a city' originated from the concept of 'sustainable development,' and little attention was paid to the natural components and open spaces of the urban structure. In addition to the fact that the concept of 'sustainable development' has reached a dead end[2], urban open spaces are strategically important for the sustainability of our increasingly urbanized society in cities such as Tokyo[3]. Numerous empirical studies have indicated that the presence of natural assets and components, i.e., open spaces such as green belts, trees, and water in an urban context, contributes to the sustainability of a city in many ways. Urban open spaces not only provide essential environmental functions such as air and water purification, noise reduction, and microclimate

[1] The use of the term 'open space' started from the enactment of the Open Spaces Act 1906, which provided a definition of 'open space' which referred to, "…land…enclosed or not, on which there are no buildings or of which not more than one twentieth part is covered with buildings, and the whole or remainder of which is laid out as garden or is used for purposes of recreation, or lies waste or unoccupied". In general, open space indicates undeveloped land or common areas in a planned community reserved for parks, walking paths or other natural uses.
[2] Christopher S. Sneddon (2000), p.524
[3] According to the World Urbanization Prospect, Tokyo has the highest population of any city in the world.

stabilization, but they also provide social and psychological functions that are crucially significant for the sustainability of modern high-density cities and the well-being of residents.

In the light of the above, the aim of the present paper is to verify the condition of urban open spaces in Tokyo, whether to satisfy basic criteria suggested through this study, in terms of creating a sustainable city. This aim is achieved by examining comprehensive conceptual frameworks and the present situation of open-space plans for Tokyo, focusing on central areas in Tokyo. In this manner, where urban open spaces should head for to achieve sustainability of a high-density city will be suggested, by regarding them as providers of social and psychological services that are essential to the quality of human life, which in turn is a key component of sustainability[4].

2. SUSTAINABILITY

In this section, the concept and characteristics of sustainability are briefly stated. In addition, criteria for sustainability are categorized via a review of recent studies, as criteria for sustainability are needed to make the complexity of sustainability more understandable when evaluating the accomplishments of sustainability in a city. Sustainability is then considered with regard to urban open spaces, and criteria are reselected to evaluate the sustainability of urban open spaces in Tokyo in terms of the criteria identified previously.

2.1 Concept of sustainability

From late in the 20th century, city planning has turned its focus from economic development and industrial progress to environmental sustainability. Especially following the 1987 Brundtland Report and the 1992 Conference of Rio de Janeiro held by UNCED (United Nations Conference on Environment and Development), policies on the environment have considered visions of the future as well as present issues. In here, ‘sustainability’ is a systemic concept, relating to the continuity of economic, social and environmental aspects of human society, as well as the non-human environment. It is intended to be a means of configuring civilization and human activity so that society, its members and its economies are able to meet their needs and express their greatest potential in the present, while preserving biodiversity and natural ecosystems, and planning and acting for the ability to maintain these ideals in a very long term[5].

The concept of sustainability originated from the idea of sustainable development, which some consider to be closely connected to ‘unceasing development’ and as such should be limited only to the field of development. Ongoing sustainable development is of course essential to complete a city in which to live, work, and play, but the location, composition,

[4] Prescott-Allen (1991)
[5] From Wikipedia, the free encyclopedia

density, and design of new development projects can have an immense and cumulative impact on a city in many negative ways in addition to positive impacts; consequently, some people prefer to use the term sustainability as an umbrella term. The term sustainability can also be defined as a focus on environmental protection in order to achieve well-being and the enjoyment of a high quality of life. Despite these differences in definition, the following common principles are embedded in the concept of achieving sustainability and sustainable development[6]: dealing cautiously with risk, uncertainty, and irreversibility; ensuring appropriate valuation, appreciation, and restoration of nature; integration of environmental, social, and economic goals in policies and activities; equal opportunity and community participation/sustainable community; conservation of biodiversity and ecological integrity; ensuring inter-generational equity; recognizing the global dimension to our lives; a commitment to best practice; no net loss of human capital or natural capital; the principle of continuous improvement; and the need for good governance.

2.2 Criteria for sustainability

To date, city developers and their consultants have endeavored to determine the adequate sustainability criteria to ensure that development projects are sustainable; however, following the establishment of the 1992 Local Agenda 21, there have been increasing problems associated with the opinion that the sustainability metric and established criteria do not consider sufficiently diverse opinions, do not consider fundamental functions, and are subdivided into too many indices[7].

In addition, in response to consultations on Local Agenda 21 or government guidelines, cities have already been developing their own sustainability criteria to evaluate quality of life. For example, the Japanese Ministry of Land, Infrastructure and Transport established principles for river water in March 2006 to preserve the natural environment and maintain human living conditions. However, there are some criteria that need to be assessed with considerable forethought when developing sustainability principles for individual cities, as the principles should be appropriate for the unique circumstances of each city and current ideas and situations. In the present study, criteria of sustainability are outlined in Table 1; these were derived from a number of previously published sets of sustainability criteria[8] and reorganized into nine items.

Table 1 Sustainability criteria

9 Sustainability criteria	
Community participation	- Encourage local action and decision making - Involve your community in developing the proposal - Take into account under-represented groups
Economy and work	- Link local production with local consumption

[6] Hargroves K. and M. Smith (2005)
[7] For examples, 134 indices of DSR model by CDS, 218 indices of DSR model by Dutch government, and 60 indices of PSR model by OECD.
[8] Richard E. Saunier (1999), for examples, the Wingspread Principles, British Columbia's Principles for Sustainability, the Habitat Agenda Principles, UNs' World Commission on Environment and Development Principles of Sustainability, etc.

	- Increase employment/vocational training opportunities - Improve environmental awareness of local business
Transport	- Encourage walking or cycling - Encourage use of public transport - Discourage use of cars/lorries
Pollution	- Reduce/prevent pollution
Energy	- Maximize energy efficiency - Generate energy from renewable sources or waste
Waste and Resources	- Reduce waste and/or maximize resource use - Encourage reuse and/or repair - Encourage recycling or use of recycled products
Building and Land Use	- Provide local amenities - Improve access for disabled - Reuse/conserve buildings
Wildlife and Open Spaces	- Encourage use of open spaces for community benefit - Encourage natural plant and animal life
Integration	- Seek to combine the social, economic and environmental - Seek to integrate the efforts of partners involved

2.3 Urban open spaces for sustainability

As stated above, economic and ecological factors have always been paramount in defining sustainability, but recent trends have seen an emphasis on criteria related to human and cultural aspects such as quality of life and landscape aesthetics in terms of achieving sustainable city. As significant components of a sustainable city, factors related to urban open spaces-amount of open spaces per resident, number, distribution, accessibility, and system of open spaces-are often discussed because urban open space can act as a provider of social services that are essential to the quality of life, which in turn is eventually the key factor of sustainability[9]. Many previous studies have reported that urban open spaces satisfy the substantial and spiritual human need for nature, as well as the fact that people who encounter nature in the city experience positive feelings such as freedom, unity with nature, and happiness. For example, Renema et al. (1999) found that people visited urban open spaces to relax, experience nature, and escape from the stressful city life. Bishop et al. (2001) suggested that green spaces in a city played an important role in helping residents and visitors to escape temporarily from crowded streets and buildings. Klijn et al. (2000) also recognized that freedom and silence are central values in the way that urban residents appreciate nature. Namely, these studies identified open space as an important factor for sustainability through investigating its physical characteristics in common.

Accordingly, sustainability indicators for a city should include more parameters and indices related to urban open spaces as stated above, and should reflect residents' preferences and satisfaction concerning their city environment. This can be taken into account by managing urban open spaces in various ways, so as to fulfill the needs and expectations of all the residents. To this end, relevant topics on urban open space are considered in the next section.

[9] Prescott-Allen (1991)

3. URBAN OPEN-SPACE PLAN

3.1 The meaning of urban open spaces: social and psychological perspectives

In his 1999 Urban Task Force Report, Lord Rogers said, "to achieve urban integration means thinking of urban open space not as an isolated unit - be it a street, park or square - but as a vital part of urban landscape with its own specific set of functions. Public space should be conceived of as an outdoor room within a neighborhood, somewhere to relax, and enjoy the urban experience, an venue for a range of different activities, from outdoor eating to street entertainment; from sport and play areas to a venue for civic or political functions; and most importantly of all a place for walking or sitting-out. Public spaces work best when they establish a direct relationship between the space and the people who live and work around it." Namely, he emphasized aspects of the urban open-space network as *social* space. Given that humans are social animals that crave real contact with each other and with nature, urban open space will always be used as a place with significant meaning within which to meet with people and nature.

To access some form of nature, open space, is clearly a fundamental necessity and a critical part of life. Numerous studies and experiments have emphasized the *psychological* benefits of gaining access to nature in the city. Failure to provide such natural relief within the urban environment can lead to substantial health costs in the long term. In addition, urban open spaces have been depicted as places for both "meeting of strangers[10]," and finding "privacy" in the busy and dense city, thus providing residents with *psychological* stability.

While much less attention is paid to open spaces than to the built environment in most cities (including Tokyo), an increasing number of studies indicate that the presence of open spaces in a city contributes to the quality of life in various ways, as mentioned above. In addition to many environmental and ecological functions, urban open space provides important social and psychological benefits to human societies as a place to meet strangers and escape crowds, thereby playing an important role in the existence of the city, especially in the case of high-density city. In other words, urban open spaces are socially and psychologically essential for the well-being of citizens and the sustainability of the entire city within which they live. Therefore, for encouraging these social and psychological functions of open spaces for community benefit, we should support the development conditions of open space to reach at a certain level.

3.2 Urban open-space plan for Tokyo

To understand the nature of open-space plans and regulations for Tokyo from a perspective of sustainability, we now briefly address the features, historical evolution, present situation, and vision of the open-space plan for Tokyo.

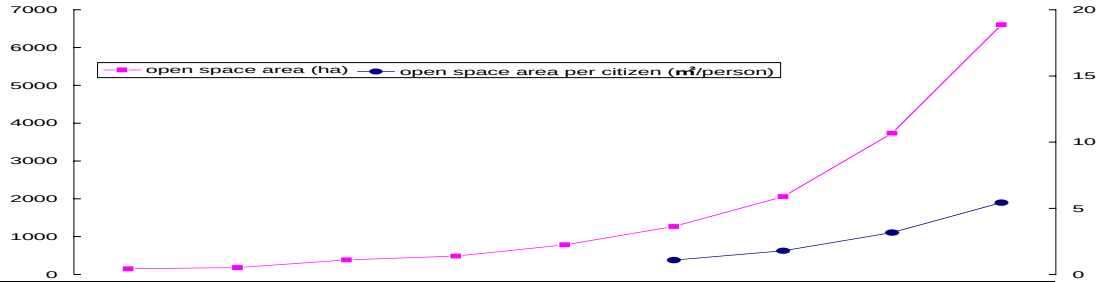
[10] Ward Thompson (1998)

Above all, the most important feature of the open-space system in Tokyo is the emphasis on sustainable safety: protecting the city from natural disasters. Because there have been several large fires in the past following major earthquakes, Tokyo has developed its open-space plans to prevent the spread of fires and to provide amenities for its citizens.

In terms of the historical evolution of open-space planning in Tokyo, we recognize four stages: (1) the period from 1923 to the 1950s when the open-space system was introduced as a disaster-prevention measure and large parks were constructed and connected to major roads as part of the reconstruction plan following the Kanto Big Earthquake; (2) the period following World War II (1950s and 1960s) when planning for the open-space system occurred as a reconstruction project and a green belt was designated along the fringes of Tokyo to prevent urban sprawl; (3) the period 1995-2002 when planning of the open-space system functioned as a reconstruction project following the large Hanshin-Awaji earthquake and diverse reconstruction projects were implemented, including various community parks intended to mitigate damage during natural disasters, and the introduction of streams to the open-space plan; (4) the period of revitalizing the open-space system, creating the Safe Living Environment Zone, and reinforcing the metropolitan park system, including the area of the Imperial Palace, the waterfront area along Tokyo Bay, and riverside areas. In particular, revision of Japan's Urban Green Spaces Conservation Law in 1994, enabled municipalities to draw up master plans for parks and open spaces, although the amount of open space per resident in Tokyo is only 5.42 ㎡, far less than that in other international cities.

the Municipal District Revision(1889) the Tokyo Reconstruction Plan(1946) the Tokyo Special City Plan(1950) the Tokyo City Plan(1957)

Figure 1 Transition of distribution of open spaces in Tokyo



Years	1873	1903	1931	1945	1951	1965	1972	1985	2002
Tot. Pop	-	-	-	-	-	10,550	11,490	11,790	12,190
Area (ha)	148	182	382	484	783	1,267	2,055	3,736	6,601
O.S. per cap.	-	-	-	-	-	1.08	1.79	3.16	5.42

Figure 2 Increase of open spaces in Tokyo[11]

[11] 日本の都市公園 (2005), p.191

In terms of the present status of the open-space system in Tokyo, a zoning system is currently being implemented, whereby green area[12] is maintained in the form of public facilities such as parks, green belts, forest, and agricultural areas. As of April 2000, the 23 wards of Tokyo contained 2,907 ha of parks and 2,886 ha of green areas, while the rest of Tokyo (Tama and Islands regions) contained 2,445 ha of parks and 2,209 ha of green areas. Therefore, the total area of public parks and green spaces in Tokyo is 10,473 ha, with nine public cemeteries covering an additional 429 ha. The urban planning system for regional green areas designates scenic beauty districts, green zone conservation districts (Urban Green Zone Conservation Law), productive green zone districts (Productive Green Zone Law), and national capital suburban green zone conservation districts (designated by the government).

Figure 3 Distribution of open spaces in Tokyo

Table 2 Conditions of open spaces in Tokyo

Contents		Number			Area(ha)			Per(%)
		23 wards	the rests	Total	23 wards	the rests	Total	
Basic parks for community use	City block parks	2,832	2,171	5,003	493.96	339.14	833.10	17.2
	Neighborhood parks	99	148	247	176.51	264.19	440.70	9.1
	Community parks	19	16	35	100.60	86.26	186.86	3.8
Basic parks for city wide use	Comprehensive parks	38	21	59	541.78	228.07	769.85	15.9
	Sport parks	25	20	45	239.68	157.06	396.74	8.2
Specific parks	Landscape parks	33	14	47	235.50	79.24	314.74	6.5
	Zoos and botanic gardens	3	4	7	1.94	146.74	148.68	3.0
	Historic parks	14	4	18	111.02	7.09	118.11	2.4
	Cemeteries	4	4	8	54.23	258.90	313.13	6.4
Large scaled parks	Regional parks	2	5	7	104.31	263.00	367.31	7.5
	Recreation parks	-	-	-	-	-	-	-
National parks		-	1	1	-	137.70	137.70	2.8
Buffer greenbelt		1	2	3	0.25	2.67	2.92	0.1
City greenbelt		293	327	620	296.21	444.86	741.07	15.3
Forests		2	3	5	0.21	1.11	1.32	0.1
Plazas		4	8	12	0.72	7.94	8.66	0.2
Greenways		47	28	75	38.90	33.58	72.48	1.5
Total		3,416	2,776	6,192	2,395.82	2,457.55	4,853.37	100.0

Mar. 31. 2001

[12] As city facilities, includes parks, green areas, open areas, and cemeteries.

There are three types of city parks in Tokyo in terms of the development process: (1) planned parks created as urban facilities with consideration of the scale and type of park; (2) memorial parks established to commemorate national events or preserve natural and cultural heritage; (3) and public spaces developed from vacant areas donated to the city by the Imperial Household, the repossession of leased land, landfill, and the utilization of riverbeds.

Figure 4 Hibiya park

Figure 5 Miyamoto park

Figure 6 Tsukitikawa park

Figure 7 Hamamachi park

Figure 8 Shiba park

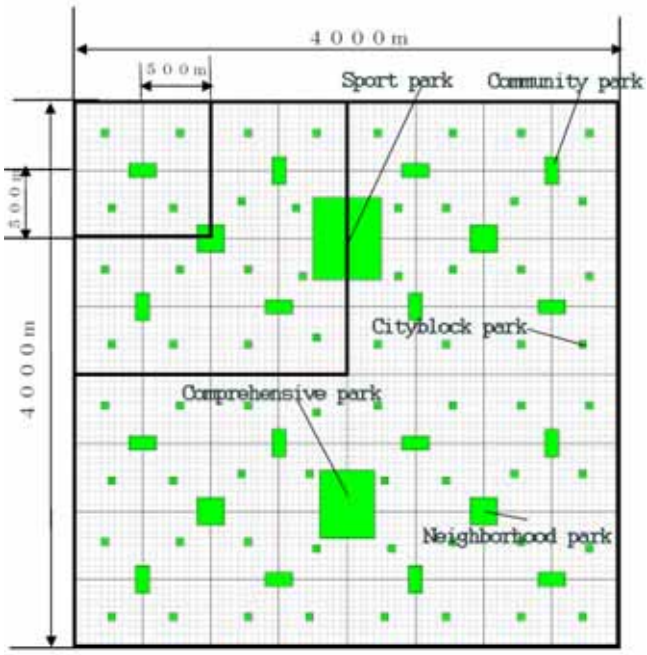
Figure 9 Waseda park

Finally, to enrich open spaces within the overall urban structure, the government of Tokyo announced "The Green Tokyo Plan" in December 2000. The target size for such open spaces is 12.9 ㎡ per citizen in the ward area and 21.9 ㎡ in the Tama area. The target percentage of open spaces plus regional green areas is generally 20% in the ward area and 48% in the Tama area. This plan also defines Tokyo in 2050 as the "dignified city Tokyo with a network of water and green" and states policies to be implemented by 2025 to achieve this vision of Tokyo from the following five viewpoints: an urban environment protected by greenery; a disaster-resistant city, supported by green; the lure of Tokyo created by green; a green habitat for living creatures; and Tokyo citizens are to perform the main role in generating green.

3.3 Plan for the distribution of urban open space

The distribution plan of Tokyo's open space reviewed with reference to relevant literature[13] is as below. Factors to be considered are the number and location of open spaces and accessibility to these sites.

- City block park(2500 ㎡): one in every 500 X 500 m area
- Community park(2 ha): one in every 1000 X 1000 m area
- Neighborhood park(4 ha): one in every 2000 X 2000 m area
- Comprehensive park(20 ha), Sports park(30 ha): one in every administrative district
- One administrative district is assumed to be 4000 X 4000 m in size (16 ㎢.)



City block park: 16 ha (0.25 ha X 64)
Community park: 32 ha (2 ha X 16)
Neighborhood park: 16 ha (4 ha X 4)
Comprehensive park: 20 ha
Sports park: 30 ha

Total: 114 ha (7.125 ㎡/resident)

Regional park: 1 ㎡/resident
Specific park: 1 ㎡/resident
Green belt: 3 ㎡/resident

Total: 5 ㎡/resident

Total Area = 1600 ha
Open space Area = 194 ha
Population = 160,000
Density = 10,000 / ㎢

4. APPLICATION TO THE STUDY AREA

A study area was selected which was the most representative area of the densely populated Tokyo and therefore significant to maintain adequate open space plan within the framework of the sustainable city environment. The study area comprises Chiyoda ward, Chuo ward, Minato ward, and Shinjuku ward within central Tokyo. While collecting data on open spaces in the study area, the physical conditions of open spaces were examined, including site density, location, and accessibility. We consulted maps and photographs and assessed whether the open spaces satisfy sustainability conditions.

The total amount of open space in Tokyo's four central wards totals approximately 1,100 ha, and the amount and types of major open spaces is respectively 590 ha, and divided into six categories, including the Imperial Palace, Akasaka Palace, the grounds of the State Guesthouse, Aoyama Cemetery, etc. (Table 3).

[13] 東京都市整備局 (Bureau of Urban Development, Tokyo Metropolitan Government)

Figure 10 Location of the study area

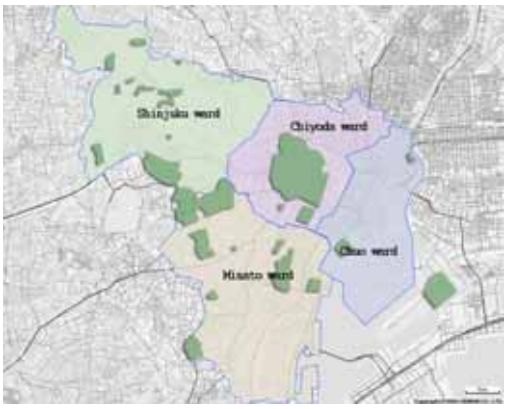


Figure 11 Open spaces in the study area

Table 3 Area of major open spaces in the study area

Open spaces			Area(ha)	Open spaces		Area(ha)
City parks	Municipal parks	Hibiya Park	16.2	Other parks	Kokyo Higashi Garden	20.7
		Hamarikyu Garden	25.0		Kokyo Garden	95.6
		Shiba Park	12.3		Kitanomaru Park	19.3
		Kyu-Shibarikyu Garden	4.3		Chidorigafuchi Nat'l Cemetery Park	1.6
		Daiba Park	3.0		Kokkaimae Garden	5.5
		Aoyama Park	3.8		Nat'l Park for Nature Study	19.9
		Toyama Park	18.7		Shinjuku Garden	38.4
		Meiji Park	2.9		Meiji Jingu	27.3
		Sotobori Park	3.9	Cemeteries	Aoyama Cemetery	26.4
	Major ward parks	Chidorigafuchi Park	1.6	Green space	Imperial Palace	115.0
		Hamacho Park	4.5		Akasaka Detached Palace	50.9
		Arisugawanomiya Park	6.7		State Guesthouse	11.7
		Shinjuku Central Park	8.8	Others		37.4
		Otomeyama Park	1.5	Total		584.3
		Kansenen Park	1.4			

Table 4 Names of open spaces in the study area in each ward (in Japanese)

Chiyoda ward (61 places)	Chuo ward (85 places)
<23 city block parks>・北の丸公園・九段坂公園・千鳥ヶ淵公園・東郷元帥記念公園・清水谷公園・仲良し公園・外濠公園・宮本公園・芳林公園・練成公園・都立日比谷公園・和田倉噴水公園・三宅坂小公園・和泉公園・佐久間公園・秋葉原公園・内神田尾嶋公園・神田橋公園・常盤橋公園・淡路公園・錦華公園・西神田公園・神保町愛全公園 <25 city block parks for children>・心法寺児童遊園・五番町児童遊園・飯田橋児童遊園・富士見児童公園・堀留南児童遊園・堀留北児童遊園・三崎町児童遊園・錦三会児童遊園・神三児童遊園・俎橋児童遊園・中坂児童遊園・いずみ児童遊園・左衛門橋北児童遊園・左衛門橋南児童遊園・美倉橋東児童遊園・美倉橋西児童遊園・美倉橋北児童遊園・和泉橋南東児童遊園・和泉橋南西児童遊園・佐久間橋児童遊園・柳森神社児童遊園・お玉が池児童遊園・岩本町二丁目児童遊園・地蔵橋東児童遊園・鎌倉児童遊園・神田児童公園 <8 small plazas>・隼町広場・四ツ谷駅前広場・岩本町馬の水飲み広場・淡路広場・昌平橋西橋詰広場・昌平橋東橋詰広場・小川広場 <1 green way>・千鳥ヶ渕緑道 <4 other parks>・皇居東御苑・皇居外苑・国会前北庭・国会前南庭	<41 city block parks>・築地川亀井橋公園・築地川祝橋公園・築地川銀座公園・築地川采女橋公園・築地川千代橋公園・はとば公園・あかつき公園・あかつき公園・湊公園・築地川公園・明石町河岸公・常盤(橋)公園・地蔵橋公園・十思公園・箱崎川第一公園・坂本町公園・久安橋公園・楓川宝橋公園・楓川弾正橋公園・千代田公園・浜町公園・あやめ第一公園・あやめ第二公園・中州公園・蛎殻町公園・箱崎川第二公園・箱崎公園・新川公園・桜川屋上公園・佃公園・石川島公園・新月島公園・晴海第一公園・晴海第二公園・春海橋公園・晴海第三公園・都立晴海ふ頭公園・黎明橋公園・楓川新富橋公園・京橋公園・水谷橋公園・数寄屋橋公園 <41 city block parks for children>・明石児童公園・湊第2児童遊園・湊第1児童遊園・南高橋南西児童遊園・地蔵橋南東児童遊園・龍閑児童遊園・東日本橋児童遊園・久松児童公園・堀留児童公園・小網町児童遊園・茅場橋際北児童遊園・茅場橋際南児童遊園・霊岸橋児童遊園・新亀島橋北西児童遊園・新亀島橋南西児童遊園・西八丁堀児童遊園・左衛門橋南東児童遊園・両国橋際児童遊園・越前堀児童公園・高橋北東児童遊園・高橋南東児童遊園・鉄砲洲児童公園・佃児童遊園・佃三丁目児童遊園・月島二丁目児童遊園・月島駅前児童遊園・月島第一児童公園・月島三丁目児童遊園・月島一丁目児童遊園・わたし児童遊園・月島第二児童遊園・勝どき二丁目児童遊園・新島橋北西児童遊園・新島橋南西児童遊園・勝どき五丁目児童遊園・豊海児童公園・新金橋児童遊園・桜橋南西児童遊園・桜橋南東児童遊園・紺屋橋児童遊園 <1 green way>・月島川みどりの散歩道 <1 sports park>・豊海運動公園 <1 other park>・フィールドアスレチックコース園

Minato ward (136 places)	Shinjuku ward (174 places)
<50 city block parks>・桜田公園・南桜公園・氷川公園・塩釜公園・汐留西公園・イタリア公園・都立芝公園・芝給水所公園・青葉公園・都立青山公園・青山公園・笄公園・さくら坂公園・高輪公園・東八ツ山公園・杜の公園・汐の公園・こうなん星の公園・港南公園・本芝公園・芝浦公園・都立台場公園・お台場レインボー公園・埠頭公園・都立お台場海浜公園・都立品川北ふ頭公園・新浜公園・浜崎公園・都立竹芝ふ頭公園・高浜公園・芝浦中央公園(運動場地区)・芝浦中央公園(本園地区) ・三田台公園・亀塚公園・飯倉公園・網代公園・新広尾公園・一の橋公園・乃木公園・高橋是清翁記念公園・一ツ木公園・六本木西公園・都立青山公園・三河台公園・檜町公園・有栖川宮記念公園・狸穴公園・横川省三記念公園・本村公園・白金公園 <58 city block parks for children>・西久保巴町児童遊園・虎ノ門三丁目児童遊園・北青山一丁目児童遊園・北青山三丁目児童遊園・青山五丁目児童遊園・南青山三丁目児童遊園・南青山四丁目児童遊園・笄児童遊園・西麻布二丁目児童遊園・南青山六丁目児童遊園・白金児童遊園・高輪南町児童遊園・船路橋児童遊園・浜松町四丁目児童遊園・金杉橋児童遊園・芝大門二丁目児童遊園・芝新堀町児童遊園・芝園児童遊園・末広橋児童遊園・南浜町児童遊園・車町児童遊園・芝五丁目児童遊園・三田児童遊園・三田二丁目児童遊園・豊岡第二児童遊園・豊岡町児童遊園・三田松坂児童遊園・古川橋児童遊園・白台児童遊園・白金台四丁目児童遊園・四の橋通児童遊園・白金一丁目児童遊園・白金志田町児童遊園・高輪一丁目児童遊園・松ヶ丘児童遊園・高松児童遊園・二本榎児童遊園・泉岳寺前児童遊園・奥三光児童遊園・雷神山児童遊園・三光児童遊園・田島町児童遊園・絶江児童遊園・南麻布二丁目児童遊園・南麻布一丁目児童遊園・三田綱町児童遊園・松本町児童遊園・東麻布児童遊園・飯倉雁木坂児童遊園・中ノ橋児童遊園・三田小山町児童遊園・六本木三丁目児童遊園・六本木坂上児童遊園・一ツ木児童遊園・広尾児童遊園・宮村児童遊園・桑田記念児童遊園・南一児童遊園 <18 green ways>・赤坂榎町緑地・御成門緑地・南青山三丁目緑地・牛坂緑地・西麻布四丁目緑地・元麻布三丁目緑地・六本木六丁目緑地・高浜運河沿緑地・金杉濱町緑地・芝浦運河沿緑地・新芝運河沿緑地・新芝南運河沿緑地・魚らん坂下緑地・トリニティー芝浦緑地・芝浦四丁目緑地・芝浦西運河沿緑地・白金二丁目緑地・薬園坂緑地 <10 small plazas>・久国神社遊び場・氷川神社遊び場・高輪台遊び場・森の遊び場・港南3丁目2遊び場・白金台三丁目遊び場・瑞聖寺前遊び場・白高児童遊園補完仮設広場・承教寺前遊び場・永坂上遊び場	<93 city block parks>・大久保公園・西大久保公園・小泉八雲記念公園・百二公園・大東橋公園・神田上水公園・中落合公園・清水川橋公園・まつ川公園・甘泉園公園・大日坂公園・東五軒公園・新小川公園・つくど公園・寺内公園・白銀公園・榎町公園・早稲田公園・荒井山公園・宮田橋公園・諏訪公園・諏訪の森公園・鶴巻南公園・漱石公園・矢来公園・若宮公園・中町公園・山伏公園・南榎公園・牛込弁天公園・原町公園・八幡公園・落合中央公園・小滝公園・北柏木公園・北新宿公園・きたしん公園・蜀江坂公園・角筈公園・西落合北公園・葛ヶ谷公園・西落合東公園・西落合公園・上落合西公園・上落合公園・大久保三角公園・都立戸山公園・都立戸山公園・大久保北公園・戸塚公園・藤兵衛公園・高田馬場公園・西戸山公園・西戸山公園・百人町ふれあい公園・戸山東公園・加賀公園・納戸町公園・仲之公園・住吉公園・抜弁天北公園・佐伯公園・下落合公園・下落合東公園・おとめ山公園・西坂第二公園・かば公園・四谷見附公園・若葉東公園・三栄公園・みなみもと町公園・荒木公園・東大久保公園・新宿遊歩道公園・歌舞伎町公園・下落合野鳥の森公園・中井東公園・落合公園・柏木公園・台町すみれ公園・新宿中央公園・新宿公園・花園東公園・花園西公園・花園公園・愛住公園・左門公園・須賀公園・若葉公園・もとまち公園・大京公園・西坂公園・都立明治公園 <58 city block parks for children>・つつじの里児童遊園・西早稲田児童遊園・やまぶき児童遊園・さくら児童遊園・あかぎ児童遊園・みずき児童遊園・みやた児童遊園・高田馬場第二児童遊園・しらゆり児童遊園・早稲田南町児童遊園・あさひ児童遊園・しんかいばし児童遊園・すえひろ児童遊園・さつき児童遊園・なるこ児童遊園・よどばし児童遊園・はごろも児童遊園・十二社児童遊園・こばと児童遊園・ひばり児童遊園・あかね児童遊園・つづみ児童遊園・みなか児童遊園・あおぎり児童遊園・西大久保児童遊園・高田馬場駅西児童遊園・みどり児童遊園・わかまつ児童遊園・水野原児童遊園・なんど児童遊園・若葉児童公園・市谷八幡児童遊園・桝箕児童遊園・津の守坂児童遊園・みずも児童遊園・かわだ児童遊園 ・余丁東児童遊園・東大久保児童遊園・やよい児童遊園・みつば児童遊園・中落合西児童遊園・みなみ児童遊園・よつや児童遊園・あらき児童遊園・西富久児童遊園・中富久児童遊園・余丁町児童遊園・富久町児童遊園・天神山児童遊園・けやき児童遊園・大木戸児童遊園・みょうが坂児童遊園・新左門児童遊園・信濃町児童遊園・出羽坂児童遊園・かすみ児童遊園・大番児童遊園・内藤児童遊園 <6 small plazas>・筑土八幡町遊び場・西落合遊歩道遊び場・聖母病院脇遊び場・須賀町遊び場・大京町遊び場・富久町遊び場 <16 pocket parks>・百人町三丁目ポケットパーク1・2・3・4・5・6・7・8・9・10・11・12・13・14・15・16 <1 other park>・せせらぎの里

Table 5 Conditions of open spaces in the study area

City	General conditions			Open space conditions			
	Area(㎢)	Population [14]	Density (people/㎢)	Open space area(㎡)	Open space area[15] per citizen(㎡)	Open space rate(%)	Other features
Chiyoda	11.64	855,000	73,453	2,211,600	2.50	19.1	-Mainly large-scale open spaces with few small-scale open spaces
Chou	10.06	648,000	64,413	905,400	1.40	9.1	-Green spaces are unevenly distributed throughout the ward. -There are insufficient open spaces with easy access..
Minato	20.34	838,000	41,199	4,474,800	5.34	22.3	-Target open-space rate by 2010: 30% -Green areas are unevenly distributed (concentrated at the specific region.)
Shinjuku	18.23	799,000	43,828	3,463,700	4.34	19.8	-Green areas are poorly distributed (concentrated at the specific region.)
Total	60.27	3,140,000	52,098	11,055,500	3.52	18.3	-The average open space area is 9,338 ㎡. -The average grid of city blocks is 1,000 ㎡. 
Manhattan	61.39	3,389,200	55,207	15,715,840	4.70	25.6	-The average open space area is 339,690 ㎡. -The average grid of city blocks is 11,700 ㎡. 

[14] In the present paper, the term 'population' indicates the 'daytime population', not the resident population.
[15] 'Open space area per citizen' means the area of open space for the daytime population who use open place practically.

For structural comparison, one of the high-density cities, Manhattan[16] was selected because Tokyo's four central wards (Chiyoda, Chuo, Minato, and Shinjuku) occupied roughly the same land area as the island of Manhattan (approximately 6000 ha.) Also, both have daytime populations around 3 million, although the nighttime population of the four wards is around 500,000, about 1/3 that of Manhattan's. In terms of open space conditions, however, Manhattan's total open space area covers 1,571 ha which is almost time-and-a-half as much as the 1,105 ha of open space in Tokyo's four central wards. Also, the study area has lower open space area per citizen (3.52 ㎡ to 4.70 ㎡), and lower open space rate (18.3% to 25.6%) than Manhattan.

Figure 122 Open spaces in Manhattan

In terms of the accessibility to open space of the four central wards, the average distance to the nearest subway station is approximately 340 m, which can be reached in 2-3 minutes, even though few of them have bus stations close by. Also, about the distribution of open spaces in the study area, the average distance to the nearest open space, that is, adjacent nature, parks and other facilities, is approximately 630 m, almost satisfying the distribution plan of Tokyo's open space.

In conclusion, open spaces in the four central wards of Tokyo have good accessibilities, because they are distributed within proper distance, and the access to them is supported by the mass transport system that can be easily used by citizen. However, the view to the open spaces from the outside is not secured sufficiently because of crowded buildings and narrow street system of Tokyo, and also, the amount and the rate of open space are numerically insufficient compared to those of Manhattan. To make a sustainable city in the social and psychological view points, the city should have enough open spaces qualitatively as well as quantitatively, which means people should be able to visit open spaces whenever and wherever they want. In the qualitative aspect regarding the accessibility and the distribution, we could recognize through the present study that the open space plan of four central wards in Tokyo was implemented with satisfying social and psychological sustainability, but in the quantitative aspect, still did not have sufficient amounts. Through creating and ensuring more open spaces with enhancing their accessibility, therefore, sustainability of Tokyo in the social and psychological perspectives will be completed.

[16] The sample of open spaces in Manhattan was adopted other than the cases of Paris, or London, because the basic circumstances of the city such as area, population, and characteristics were similar to those of open spaces in Tokyo.

5. CONCLUSION

The availability of open space is an important contributor to sustainability of a city. This study examines a set of present conditions of open spaces in Tokyo, intended to secure improved urban open spaces within the framework of sustainability. A comprehensive check-up for availability of open spaces such as amount and accessibility was performed in this study in order to evaluate the equity of the distribution of and access to open space. As a result, we can learn that Tokyo has good accessibility to its open spaces within proper distance, but the amount of open spaces is still not enough. More open spaces are believed to help the high-density city Tokyo to articulate commonly shared values which, in turn, can serve as reference criteria to envision more sustainable city strategies. In all of this, urban open spaces will continue to serve a central function for a city's sustainability.

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