■Ngày nhận bài: 07/02/2023 ■Ngày sửa bài: 07/3/2024 ■Ngày chấp nhận đăng: 05/4/2024

Developing public parks in Ho Chi Minh City: An opportunity for increasing water absorption to mitigate flood risk

Phát triển công viên công cộng tại TP.HCM: Cơ hội tăng khả năng hấp thụ nước của đô thị nhằm giảm thiểu rủi ro ngập

> PHAN NHUT DUY[1,*], TRAN TRUNG VINH [1], LE TIEN LIEM [2], NGUYỄN TIẾN THÀNH [1], NGUYỄN PHƯƠNG THẢO NGUYÊN [1,2], TRƯƠNG VÕ CÔNG DUNG [1,3]

[1]University of Architecture of Ho Chi Minh City

[2]Department of Planning and Architecture of Ho Chi Minh City

[3]Department of Construction of Ho Chi Minh City

*Corresponding author, Email: Duy.phannhut@uah.edu.vn, (Architect, Urban planner, Ph.D. in Urban and Regional Studies Senior lecturer of Urban Planning Faculty, Deputy Director of Postgraduate Institute)

ABSTRACT

Public parks in cities, with most of their area being green areas, play an important role not only in balancing the living environment, but also in contributing to the minimisation of flood risks through absorption and the storing of water. This creates the motivation to restore, maintain and develop green areas in inner cities, especially in centralised areas, which have a high level of urbanisation potentially associated with a shortage of such green-lands. This can be seen as an opportunity for Ho Chi Minh City, which saw an increase in green-lands around 23% from 2012 to 2018 as an initial development. Although this has contributed to an increase in the average rate along with the goals in different plans for urban development, the urban area continues to face an imbalance in green space between the central inner city area and new development districts, which can be seen as a critical area for attention, and which is focused upon in this paper. In fact, the area of public parks in HCMC are mostly quite small (mostly under 10ha), and rarely have large-scale water areas inside, in comparison with other public parks in the world. This has triggered an encouragement of creating more area or spaces for water in public parks, particularly in the existing in the centre and new parks to be developed in the future.

Keywords: Public parks, spatial planning, flood vulnerability.

TÓM TẮT

Các công viên công cộng của đô thị, với phần lớn diện tích là mảng xanh, đóng vai trò quan trọng không chỉ trong việc cân bằng môi trường sống mà còn góp phần giảm thiểu rủi ro ngập thông qua khả năng hấp thụ và tích trữ nước. Điều này tạo động lực để khôi phục, duy trì và phát triển các mảng xanh trong nội thành, đặc biệt là ở các khu vực tập trung dân cư đông, nơi có mức độ đô thị hóa cao, tiềm ẩn nguy cơ thiếu hụt quỹ đất cho cây xanh. Đây có thể được coi là cơ hội cho TP.HCM, nơi có mức tăng diện tích mảng xanh khoảng 23% từ 2012 đến 2018 như một thành công cho bước phát triển ban đầu. Mặc dù điều này đã góp phần làm tăng chỉ tiêu diện tích cây xanh đáp ứng các mục tiêu đã được tích hợp trong các quy hoạch phát triển đô thị, nhưng TP.HCM vẫn tiếp tục đối mặt với tình trạng mất cân bằng trong quá trình phân bổ không gian xanh giữa khu vực nội thành và các quận phát triển mới, ngoại thành, và có thể coi là một thách thức trong giai đoạn hện nay. Trên thực tế, diện tích các công viên công cộng ở TP.HCM hầu hết đều khá nhỏ (chủ yếu dưới 10ha) và hiếm khi có mặt nước quy mô lớn bên trong so với các công viên công cộng khác trên thế giới. Điều này cũng tạo ra sự khuyến khích phát tiển diện tích hoặc không gian cho nước trong các công viên công cộng, đặc biệt là ở các công viên hiện có ở trung tâm và các công viên mới sẽ được phát triển trong tương lai.

Từ khóa: Công viên công cộng; quy hoạch không gian; nguy cơ ngập.

1. INTRODUCTION

1.1. Urbanisation and unexpected changes in water absorption and storage capacity related to flooding

In recent years, urban water absorption and storage capacity have been a matter of concern for major cities, which have become increasingly vulnerable to flooding following unexpected effects of urbanisation associated with the development process. The increasing population concentration can be seen as an ultimate driver for this trend, as the world has seen an increase in the number of large-size cities, which stood at 33 in 2018 and is expected to reach 43 by 2030 (UN, 2018). Along with this trend, urban green areas are sometimes replaced by new built-up areas, which can affect urban water absorption capacity, with sub-urban areas that used to be swampy and low lying land or wetlands being replaced by such built-up areas. It is estimated that approximately 1% of low lying lands near the coast were lost each year during the late 20th century (Nicholls, 2004; Hoozemans et al., 1993). This trend was accelerating by the turn of the 21st century, when more than 67% of the world's coastal wetlands had been lost (Barbier, 2011; Davidson, 2014; Li, 2018; Lin, 2018, cited in Novoa et al., 2020). Such a situation is particularly acute in large cities, where rapid urbanisation often occurs along with economic development, but with the resulting risk of natural disasters such as flooding in relation to water absorption capacity. Despite being a lesser concern during the global Covid-19 pandemic, flooding is still considered to be a serious disaster to many cities. Indeed, flooding caused the loss of 539,811 lives, affecting 2.8 billion people, during the 30 year period from 1980 to 2009 (Doocy et al., 2013). Statistics presented by Guha-Sapir et al. (2016) covering the 45 years from 1970 to 2014 show that flooding events occurred with increasing frequency compared to other disasters such as earthquakes and volcanoes, especially affecting many coastal areas in Asia (see Figure 1). The resulting effects show no sign of lessening, with flooding causing more than 10,300 deaths, and estimated damage of $434 billion, over the two-year period from 2020 to 2021.

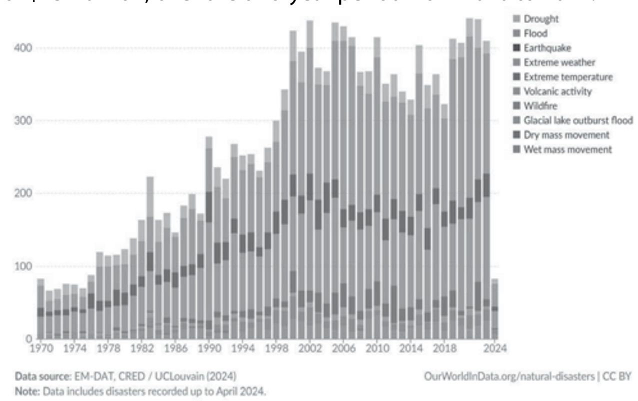


Figure 1. Flood occurrence and distribution: the increasing occurrence of flood-related natural disasters in comparison to other types (earthquakes, storms, and drought), particularly since the 2000s.

1.2. Increasing water storage and infiltration in urban areas to mitigate flood risk: An approach to sponge city theory

As cities expand their infrastructure, the coverage of asphalt and concrete increases, enlarging impermeable areas, while reducing the space for water to escape, thus contributing to flooding problems. urban solutions such as increasing urban temperatures, climate change, flooding, etc. The term "Sponge City" first appeared in China in relation to reducing the problem. These are cities that rely on the installation of additional green spaces and the replacement of concrete with permeable surfaces. Such surfaces absorb water from rainfall, which then evaporates and cools the city. Like a sponge, urban surfaces absorb rainwater that is naturally filtered by the soil and allows it to reach urban aquifers. Sponge Cities focus on solving urban water problems, limiting flooding, improving clean water supplies, and controlling water pollution in urban areas by creating a suitable ecological environment. In this way, the water is absorbed naturally and recycled into a clean water source for urban use. Similar concepts have been applied in many parts of the world and are becoming an increasingly popular method to reduce the urban heat island effect. These include Water-sensitive Urban Design (WSUD) in Australia and the Middle East; Sustainable Urban Drainage Systems (SuDS) in the UK; and Natural Drainage Systems in Seattle, USA.

The trend towards urbanisation has been strengthening, especially in developing countries, with many related problems such as flooding regarding water surface. To respond to this, the Sponge City concept was first introduced in the "Low Carbon Cities 2012" programme at the Technology and Development Forum in Shenzhen 2012 (Xing et al., 2016). In 2015, the conference "Guiding Opinions on Promoting the Construction of Sponge Cities", in support of this concept, proposed that at least 70% of rainwater needs to be absorbed into the ground instead of being discharged into the nearest rivers and lakes, as is the traditional way (OCS, 2016). This approach has been supported and gradually integrated into the national development strategies of many countries. Among these, China, with the goal of implementing "new urbanisation" and building a moderately prosperous society in all aspects by 2020 (Xia et al., 2017), has applied in pilot to 30 cities. The target is for 20% of urban areas to have infrastructure systems allowing rainwater infiltration by 2020, increasing to 80% by 2030 (UNE, 2018). Although the Sponge City notion has attracted widespread attention in both research theory and practical application, there remain many interpretations of the definition of the term, Wang et al. (2018) synthesised the meaning, goals and characteristics of 'the Sponge City' as a strategy for integrated urban water management based on the rules of the water cycle related to natural and social processes and related processes, with the aim of minimising flooding, controlling water pollution and utilising rainwater resources, as well as restoring the ecological degradation of water in urban areas.

In general, although the Sponge City theory still needs to be supplemented with analyses based on quantitative statistics related to data collection capabilities and comprehensive analysis methods and systems, theorists have developed four principles to identify and develop the approaches:

i) Protection. This can be seen as the most important requirement for identification. Accordingly, urban areas need to focus on protecting highlands to ensure safety; on supplementing central areas of urban development with green space; and dealing with the encroachment and pollution of water areas. In addition, natural ecosystems that have been invaded or polluted need to be restored.

ii) Delaying. This is a vital principle to minimise the risk of flooding. For urban areas, using landscape infrastructure to slow stormwater runoff before it drains into canals, rivers, and other water bodies is essential. Therefore, such areas need to exploit the natural ground cover, vegetation, topography and landscape infrastructure that can delay storm water; reduce runoff to control and reduce tidal peaks by increasing storm duration and delay time; and reduce the possibility of flood-related damage.

iii) Storage. Related to the urban water storage capacity, spaces are necessarily created, in connection with a riverine network to keep rainwater inside of the inner city, such in ponds or lake systems, canals or channels, and also wetlands before releasing. Additional, inside spaces of buildings can be considered for potential contribution to water storage.

iv) Release. This refers to the management and release of stored water into streams, and surface water, which should be moved outside urban spaces along with the tidal process. This is considered the final stage of the circulatory process to help the city return to its normal state.

To benefit from the positive value of the Sponge City model, with the key principles of this theory, a city should be a clarified area for protection, while the remaining area needs to aim for keeping water (both on surface and underground space) at the beginning stage before discharging outside the urban areas. During this process, time, referred to as the duration, is also important in connection with tidal changes in levels. The city should take full advantage of the environmental value of green-lands to contribute to water absorption. Furthermore, aesthetic considerations should be considered when designing a wetland to ensure the landscape provides opportunities for play and recreation for the community.

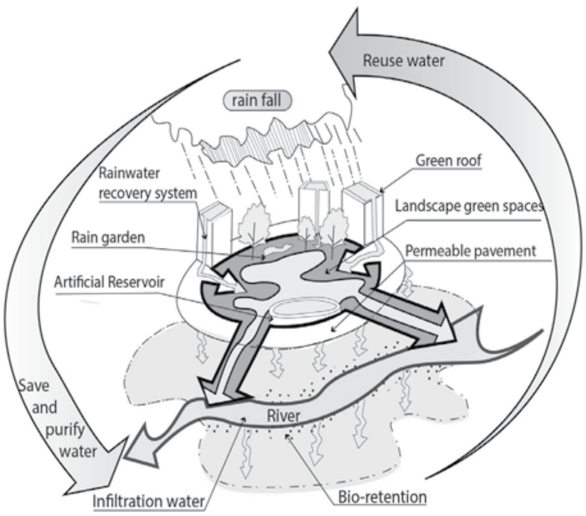


Figure 2. Ho Chi Minh City: A mega-coastal city experiencing increasing flood vulnerability related to unexpected effects of urbanisation.

1.3. Water infiltration

In fact, the urbanisation process can increase impermeable surface cover and affects the water circulation process on earth, including the ability to absorb water by cities (on the surface and in the ground), especially at urban areas with high population density area referred to as the built-up area. According to the results of experimental surveys by the US EPA (2012), natural ground can allow about 50% water infiltration while highly built-up area (with an area ratio of about 75% - 100% impermeable surface) only allows a maximum of about 15% of water to enter the soil (see details in table 1 and illustration in figure 3). These also link to runoff water which can create a 5 times larger amount of water draining on the surface, increasing 5 times (refer to column b, the difference between line 1 - natural ground compared to line 4 - non-permeable coating surface). This implies that maintaining green areas, including natural grass and soil areas in the park, is necessary to ensure the ability to penetrate the soil, contributing to reducing the pressure on rainwater conveyance in the systems. natural rivers and canals.

Table 1 - *A review of study by* US EPA (2012) *about different levels of permeability responses to water*

	Characteristics of surface	Evaporation (a)	Runoff (b)	Shallow Infiltration (c)	Deep Infiltration (d)
1	Natural ground cover	40%	10%	25%	25%
2	Impervious surface (10 - 20%)	38%	20%	21%	21%
3	Impervious surface (35 - 50%)	35%	30%	20%	15%
4	Impervious surface (75 - 100%)	30%	55%	20%	05%

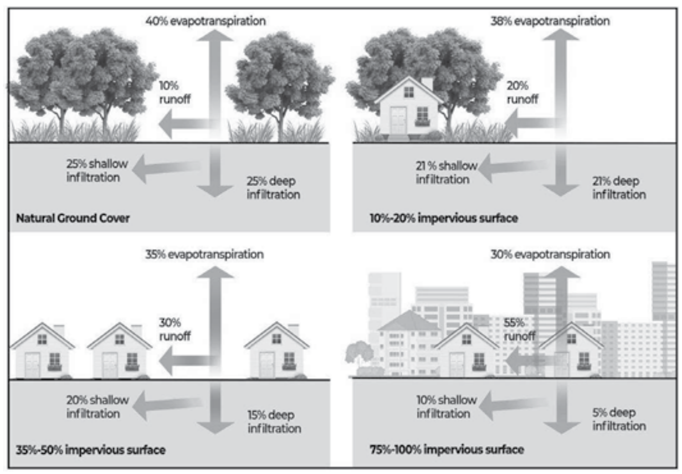


Figure 3. Changes in site hydrology with increasing impervious cover (US EPA)

2. A CASE STUDY OF HO CHI MINH CITY IN VIETNAM

2.1. Flood risk from the increasing water level inner city since the rapid urbanisation

In line with the global context, Ho Chi Minh City, a coastal mega-city in the south of Vietnam, also faces an increase in flood vulnerability during its process of development in relation to uncontrolled urbanisation and inappropriate planning for urban expansion (Storch and Downes, 2011; Phi, 2013; Duy et al., 2017a). Many experts believe there is a relationship between the consequences of urbanisation and flooding risk in relation to built-up areas and the resulting impermeable surfaces in this city. Indeed, the land area with construction works increased about 30%, from 31,962 hectares to 41,827 hectares in the period from 2010 to 2020; and this trend was also along with an increase in a conversion from the area of agricultural land to urbanised areas by about 3,736 hectares (DPA, 2020, p. 26).

As a result, the space for the city's water absorption and storage has been reduced, the water level in water bodies in the inner city shows signs of increasing rapidly, many times higher than the average increase in the seawater level. As evidence, hydrological data covering 40 years (1981 - 2021) show that the annual peak water level at Phu An station (on the Saigon River - the centre of the city in HCMC) increased rapidly over the 40 years (from around +1.33m ASL in 1981 to +1.72m ASL in 2022: SRHC, 1981 - 2022), with an average increase of 9.5mm/year, much higher than the tidal peak at the Vung Tau estuary, and with increasingly pronounced disparities (see Figure 3). At the same time, it is also nearly three times higher than the global average of around 3.4mm/year from 1995 to 2020 (Guha-Sapir, 2020, cited in NASA, 2020). These data further support the concern of many experts that the flooding risk of Ho Chi Minh City is actually as a result of the urbanisation process, leading to a reduced water storage capacity within the city (by the system of rivers, lakes, canals), in addition to the consequences of extreme weather and global sea level rises (Phi, 2013; Duy et al., 2017a, Duy and Proverb, 2019).

In short, the current situation of Ho Chi Minh City shows that economic development is often accompanied by rapid and uncontrolled urbanisation. This process can reduce the water surface areas and those of and green land, which will affect the capacity of water absorption. This may lead to higher inner city river and canal water levels, increasing the risk of flooding in some urban central areas that are already prone to the problem. The restoration of these spaces, through solutions to maintain and regenerate the water surface space, natural rivers, canals, and lakes, is necessary, despite the scarcity of land in the heart of large urban areas, which is seen as a challenge to feasibility. Therefore, this article will describe the current situation and the challenges faced by Ho Chi Minh City,which are similar to those of many other cities, in relation to the flood hazard caused by the increasing water level in the inner city. In addition, the need for the development of inner parks remains a necessity. Accordingly, a number of ideas for theoretical development and integration of the "multi-functional" goal and the "stratified space" solution to contribute to the restoration of water storage capacity and minimisation of the risk of flooding are proposed by the authors. The proposals are expected to constitute a new approach.

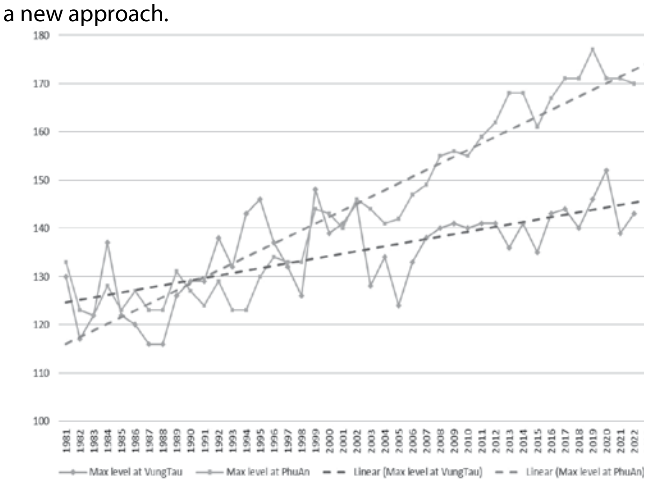
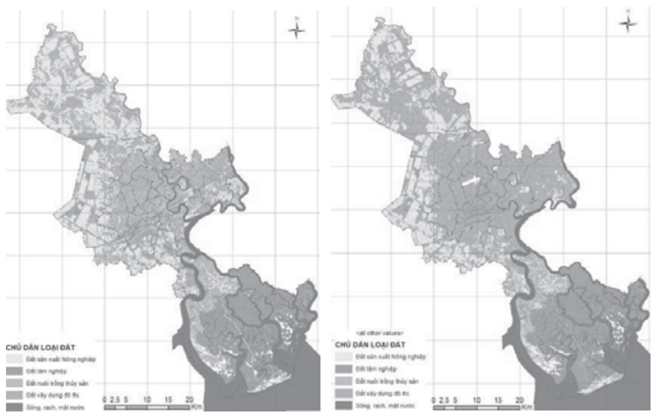


Figure 4. Comparison of the trend of increasing maximum tides in inner city water bodies (Phu An station on Saigon River) compared to the sea-mouth (Vung Tau).

Source: SRHC (1981 - 2022).



Land use in 2010 **Land use in 2018**

Figure 4. Change in urbanised area related to land use from 2010-2020, with the impermeable surface area due to urbanisation increasing from 16,091 to 20,095 hectares (around 30%).

(Source: Report on review and evaluation of Ho Chi Minh City Master Plan 2020, page 60).

2.2. Greenland development in Ho Chi Minh City

Current situation

According to Institute of Construction Planning (2018), the total green area in the city was around 828 hectares in 2018, including:

i) 551.28 hectares of parklands (around 66% of the total) allocated to 369 parks (Mai, 2023), including around 90 urban public parks (referred to large parks at city level), and the remainder referred to small parks at residential level, and

ii) 277.25 hectares of other green areas, such as below bridges, road median strips, sidewalks, and traffic intersections, accounting for 34%.

The statistics presented in a review of the current General Construction Planning of Ho Chi Minh City (PDA, 2020, p. 102), green-lands increased by approximately 26% (around 163 hectares) during 6 years from 2012 to 2018, with the following distribution:

- Public-parklands with an increased area of 76.56 hectares, including an increase of 58.03 hectares to parks at city level, and 18.53 hectares to parks within neighbourhood residences;
- Other green-lands in different areas, with an increase of 81.44 hectares. These green areas are mainly developed along with the traffic and infrastructure development projects;
- Natural forest to be reserved: approximately 32,791 hectares in Can Gio district, primarily mangrove forest, which is recognised by UNESCO as a national mangrove reserve.

<u>Table 2:</u> *Ho Chi Minh City green area development statistics*

Type of Greenland	Green land in 2012 (a)		Green land in 2018 (b)		Increase in green-land 2012-2018 (c)		Green land development by 2040 (d)	
	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)
Public parklands	474.72	70.8	551.28	66.50%	76.56	48.50%	997,50	77,17
Other green land	190.81	29.2	277.25	33.50%	81.44	51.50%	295,15	22,83
Total green area	**670.53**	**100**	**828.53**	**100%**	**158.00**	**100%**	1.292,65	100%

Source: a, b, c from DOT (2018), d (PDA, 2023, p. 155, section 1)

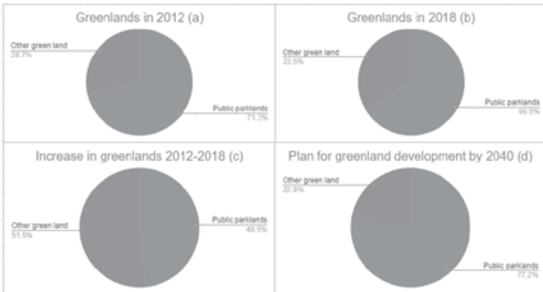


Figure 5. Changes in green area proportion in 2012, 2018, and by 2040
Source: a, b, c from DOT (2018), d (PDA, 2023, p. 155, section 1)

2.2 Plan for green-land development including public parks

Since the year 2010, green-lands in HCMC have been targeted in according to the master plan approved by decision 24/QD-TTg (PMV, 2010, p. 3) as follows:

- Existing inner city area: 2.4 m2/person;
- New developed inner city areas: 7.1 m2/person;
- Urban areas in suburban districts: 12 m2/person.

Along with such strategic goal, the revision of plans for the development of Ho Chi Minh City by 2040 with a vision by 2060 (PDA, 2023) developed several solutions:

- Creating spaces for ecological and green infrastructure systems by identifying natural and agricultural sub-regions with connections to main river routes. Accordingly, a number of large ecological parks, which are also expected to be large-area, will be prioritised for development in suburban districts such as Cu Chi and Nha Be in order to preserve the existing ecological characteristics and landscape of the area.
- Accepting floodable areas to ensure continuity of the water-flows, at the same time as protecting river banks from existing or potential encroachment, or opening new canal floodway to reduce the risk of local flooding within the city; for example, a floodway along the Xang canal in the west of the city from Cu Chi to Nha Be - Hiep Phuoc.
- Leaving particular areas for potential reservoirs located in parks, especially in urban areas protected by river dams to deal with rising tide levels.
- Developing urban design with the aim of minimising the potential impact of building construction and urban infrastructure on the natural environment.

In short, Ho Chi Minh City has integrated several goals to develop green-lands mainly for environmental balance, while advocating a potential increase in water absorption and storage capacity, into several key documents, such as the report on the revision of the master plans for development by 2040, and the project report of improving the efficiency of the management and maintenance of green parks in the urban area. To achieve this, the development of large-sized public parks in particular locations on riversides is proposed. These can be seen as appropriate solutions in short-term, but which still need the supergreen-landsport of a theoretical basis as their fundamental foundation, accompanied by a quantitative assessment of the potential contribution in the overall capacity in the longer-term. Regarding the development of public parks, Ho Chi Minh City has the target to integrate these into the revision of the master plans for development but such documents have not focused on or clarified specific solutions, such as the potential requirement of creating large water areas inside the parks, which is considered to be an essential contribution to the goal of balancing and reducing water levels in the inner city, instead of simply increasing the area of greenland per capita.

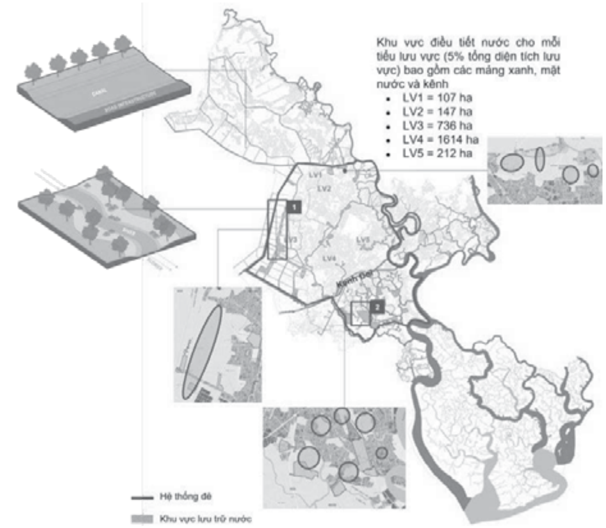


Figure 5. Greenland distribution within urban area being protected in HCMC
Source: PDA (2023)

3. METHODS, DATA AND ANALYSIS

The study mainly uses secondary data in the form of statistics extracted from the reports on the plans for the development of HCMC by 2020 (PDA, 2010), and the revising plans for the development of HCMC by 2040 (PDA, 2023). Additionally, using the case studies of three well-known public parks in some countries (the US, France and the UK) are analysed to compare with some large park , together with the application of a GIS tool (My maps), actual and green-lands areas and water surfaces of some public parks in both Ho Chi Minh City and parks outside the city are compared.

Regarding the green rate, according to statistics in the city's green development planning (PDA, 2017), the target for green tree areas for public use in the whole city is 0.65m2 per person by 2025, and 1m2 per person by 2030. In practice, this rate is only 0.5m2 per person in the old inner city area, although in some new development district areas it can reach 2.4m2, and in suburban areas 3.2m2. Additionally, these rates (of current situation) are in fact much lower than those regulated by Vietnam Standard 01: 2021/BXD code, in which the rate was expected to be greater than 7m2 per person (MOC, 2021), and very much lower the ratio in other cities in some developed countries, such as 50 m2/person in Berlin; 44 m2/person in Moscow, 25m2/person in Paris (Hoa, 2024).

On the other hand, the statistics of current parklands also shows an uneven distribution, and the extent of green areas per person in HCMC is much lower than those in other cities worldwide. Additionally, this research also finds that public parks take a large proportion of green-lands but rarely contain a large-water surface in comparison with those in some cities in other countries. For examples, the results by GIS tool - My maps show that:

- Zone 1 (13 districts) including the central area (930 ha) is home for the largest number of parks (207 parks, such as the Saigon Zoo and Botanical Garden), which only account for about 26.5% (219ha) of the total green-lands of the city (828 ha). In this zone, almost all large-area parks are particularly located in district 1, which unfortunately contain a very small water area (under 0.2 ha, and none of them have an inside water area over 5% of the park's area (see table 3).
- Zone 2 (6 new development districts) are located by several small parks, such as Bac Luong Beo park, and hardly allocated large water areas inside.

Table 3: *Comparison of 3 largest public parks in Ho Chi Minh City with 3 other parks in the world*

No.	Name of park	Location/ Country	Parkland area (ha)	Water area in parkland		Notes
				Area (ha)	Percentage (%)	
Some public parks in other countries						
1	Central Park	New York, USA	341.00	53.76	15.8	00 km from then centre
2	Hyde Park	London, UK,	142.00	12.4	8.73	02 km from the centre
3	La Villette Park	Paris, France	55.50	4.29	7.72	07 km from the centre
Public parks in HCMC, Vietnam						
4	Gia Dinh	District 1, HCMC, Vietnam	28.8	0.01	0.04	6.5 km from the centre
5	Saigon Zoo and Botanical Garden	District 1, HCMC, Vietnam	16.70	0.7	4.19	1.2 km from the centre, since 1865
6	Tao Dan	District 1, HCMC, Vietnam	9.90	0.0	0.0	0.5 km from then centre, since 1954

4. DISCUSSION AND CONCLUSION

Within the process of economic development of many cities, uncontrolled and rapid urbanisation can lead to changes in the size and location of large green areas, including public parks within urban areas. This has resulted in a lower capacity for water absorption and storage of green areas and water surfaces, which play an important role in the potential balancing of water levels in the city, referred to as increasing flood risks (e.g. tidal floods, or combined floods with heavy rains). Therefore cities need to develop green-lands, which should be integrated into large water areas, in planning for developments although they can face the challenges of land availability.

Although Ho Chi Minh City has several goals integrated into its plans for development to increase green areas and the ratio of green-lands, with a promising increase in recent years (e.g. around 23% from 2012 to 2018, and expected to increase by 56% by 2040), these are unevenly distributed with regard to both location and type (concentrated or scattered). The city has seen an increase in small green areas particularly in emerging districts and new development districts (zone 2), but still needs more collective green areas on a large scale in public parks including large water areas within them. Some solutions to such challenges have been proposed in the revision of the master plan for HCMC by 2040, but these remain fairly general, without urban areas being particularly specified. To solve the related problems, the approach based on the principles of the sponge city is believed to be appropriate for HCM, but this requires more practical proposals. Indeed, the compared and contrasted evidence shown in section 3 (Table 3), HCMC needs to learn from the case studies in some other cities worldwide. Therefore, it is recommended that the city to:

ii) In a short term, creates water areas inside some existing large public parks in the central area; to achieve this, these parks should be optimised their spaces for necessary functional areas for activities allocated at different levels;

i) In a longer term, develops large-scale public parks with large areas of water even with reservoirs inside, particularly in new development districts (zone 2), and sub-urban areas (zone 3), and

iii) Integrates storage space into buildings in the central area, e.g. underground levels, as return spaces for water according to the fundamental principles of the sponge city in the case of facing difficulty to locate open space for water storage on the ground level.

REFERENCES

1. Barbier E. B., Hacker, S. D., Kennedy C., Koch E. W., Stier A. C., Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. Ecol. Monogr., Vol. 81, pp. 169–193.
2. Davidson N. C. (2014). How much wetland has the world lost? Long-term and recent trends in the global wetland area. Mar. Freshw. Res., Vol. 65, pp. 934–941.
3. Department of Planning and Architecture - DPA (2020). Report of reviewing and evaluating the current Master Plan for Construction of Ho Chi Minh City, in the period 2010 - 2020.
4. Department of Planning and Architecture - PDA (2023). Revising Master Plan for Development of Ho Chi Minh City by 2040, with a vision by 2060.
5. Doocy S., Daniels A., Murray S., and Kirsch T. D. (2013), The Human Impact of Floods: a Historical Review of Events 1980-2009 and Systematic Literature Review, Published online 2013 April 16.
6. Duy P. N., Chapman L., Tight M., Thuong L. V., and Linh P. N. (2017a). Increasing Vulnerability To Floods In New Development Areas: Evidence From Ho Chi Minh City. International Journal of Climate Change Strategies and Management. DOI (early citation): 10.1108/IJCCSM-12-2016-0169
7. Duy P. N. and Proverbs D. (2019). The Effects of Embankment Solutions on Urban Flooding Problems: Lessons Learned for Ho Chi Minh City from the Failure of Protection Systems in Some Cities in The World (translated from Vietnamese title). Proceedings: "Planning and Development of Saigon River embankments, inner city rivers and canals", at HCMC 2019, pp. 212 - 217.
8. Guha-Sapir, D., Hoyois, P., Wallemacq, P., & Below, R. (2017). Annual disaster statistical review 2016. The numbers and trends, pp. 1-91.
9. Our World In Data (2024). Global reported natural disasters by type, 1970 to 2024. Online accessed 10/04/2024. URL: https://ourworldindata.org/grapher/natural-disasters-by-type
10. Hoa T. (2024). Green urban planning requires forest preservation and afforestation. Vietnam Agriculture. https://vietnamagriculture.nongnghiep.vn/green-urban-planning-requires-forest-preservation-and-afforestation-d356305.html#:~:text=Most%20notably%2C%20many%20major%20cities,50%20square%20meters%20per%20person
11. Hoozemans F. M. J., Stive M. J. F., and Bijlsma L. (1993). A Global Vulnerability Assessment: Vulnerability of Coastal Areas to Sea-Level Rise, Coastal Zone '93, American Society of Civil Engineers.
12. Southern Regional Hydro - Meteorological Center - SRHC (2015). Water Level at Vung Tau versus Phu An 1981 – 2022 (data extracted).
13. Institute of Construction Planning - ICP (2018). Report of Planning for public park development.
14. Li X., Bellerby, R., Craft, C., and Widney S. E. (2018). Coastal wetland loss, consequences, and challenges for restoration. Anthr. Coasts. Vol. 1, pp. 1–15.
15. Lin Q.Y., Yu S. (2018). Losses of natural coastal wetlands by land conversion and ecological degradation in the urbanising Chinese coast. Vol. 8, pp. 1–10.
16. Nicholls R. J. (2004). Coastal flooding and wetland loss in the 21st century: changes under the SRES climate and socio-economic scenarios, Global Environmental Change, Vol. 14 (1), pp. 69-86.
17. Novoa V., Rojas O., Ahumada-Rudolph R., Sáez K., Fierro P., Rojas C. (2020). Coastal Wetlands: Ecosystems Affected by Urbanization? Water Quality and Contamination. https://doi.org/10.3390/w12030698
18. Office of the State Council – OSC (2016). Guiding Opinions on Promoting Sponge City Construction. City and Town Water Supply. Office of the State Council: Beijing, China, pp. 41–43.
19. Phi H. L. (2013). Urban flood in Ho Chi Minh City: causes and management strategy. Vietnamese Journal of Construction Planning, Vol. 63, pp. 26-29, Hanoi. (In Vietnamese).
20. Storch H. and Downes N. K. (2011). A scenario-based approach to assess Ho Chi Minh City's urban development strategies against the impact of climate change, Cities.
21. Xia J., Zhang Y. Y., Xiong L. H., He S., Wang L. F., and Yu Z. B. (2017). Opportunities and challenges of the Sponge City construction related to urban water issues in China. Sci. Vol. 60, pp. 652–658.
22. Xing M. L., Han, Y. M., Jiang, M. M., and Li, H. X. (2016). The review of Sponge City. In Proceedings of the International Conference on Sustainable Energy and Environment Engineering, Zhuhai, China, pp.12–13.
23. United Nations Environment – UNE (2018). Emerging Sponge Cities - Foresight Brief No. 005; United Nations Environment: Nairobi, Kenya.
24. Wang, H., Mei, C., Liu, J. H. and Shao, W. W. (2018). A new strategy for integrated urban water management in China: Sponge city. Sci. China Technol., V. 61, pp. 317-329.