

## Article

# Developing Guidelines to Increase Green Space in Communities in Thailand Based on the Integration of Green Space into Commercial and Waterfront Routes in Singapore and Hangzhou (China)

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**Abstract:** The objective of this study is to determine how to increase green space that can overlap with areas that are primarily used for transport in commercial areas and waterfront routes in communities in Thailand, where transportation is limited, in order to provide urban populations an opportunity to access green space in various forms. In this study, the following was found: (1) Commercial routes should be considered. Specifically, green spaces should be created in various forms by considering the sizes of footpaths as well as restrictions on planting; the plants should be native plants because they are easy to care for and help convey the boundaries of an area. A “landmark” that represents the identity of a community should be used to create a meeting point for people entering the commercial area, and designers should use the principles of universal design to make all groups of people feel confident and safe when accessing the area. Finally, vacant or abandoned areas between buildings may also be used. (2) Waterside travel routes should also be considered. Green spaces should be distributed into points, or some routes should be made wider to accommodate various activities; areas along canals or river banks or degraded waterways should be developed or improved to create a recreational area designed with the community’s unique identity in mind, which may develop into a destination for tourists. Importantly, agencies who are responsible for working with the people in the community need to continuously care for these green spaces to enhance sustainability.

**Keywords:** green space; commercial routes; waterfront routes; community



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## 1. Introduction

The value of green space in the urban environment is an important issue that is often neglected because most people think that it does not affect them. This is different from the issue of health, which is an issue that people usually feel is closer to home. Environmental problems are therefore only recognized as important when there is a crisis or when severe damage has already occurred [1]. Thailand is becoming aware of this problem, but this awareness can only clearly be seen in certain areas in Bangkok, which is a capital city that is continuously developing. There has been an increase in population and economic growth, resulting in more construction and space being taken up by buildings. As a result, open spaces and green areas in the city are decreasing, causing the natural and environmental balance of the city to be disrupted. This is both a direct and indirect problem for residents [2]. And in Thailand, there are more cities with this type of spatial restriction. This not only includes large cities, but also many small cities where new communities have been planned for a long time since the changes in land use, especially in commercial areas. This has given rise to the idea of transforming existing thoroughfares and infrastructure into green spaces [3] to create a new type of urban environment that can connect people to each other, revitalize the city, and bring back nature so it may coexist with the way of

life of urban people [4]. One of the types of infrastructures that is often used as green infrastructure is “thoroughfares”. Many countries have piloted the development of green areas in this way, demonstrating clear and concrete benefits; one example is Singapore with the Greenways Plan which, besides designing shady routes for use in connecting various areas, also increases green space to provide other benefits to the city [5]. The city of Hangzhou, China has a continuous urban development plan to provide the city with a good environment. There are green areas along various types of routes that were efficiently developed, managed [6], etc. It would be beneficial to implement the approaches used in both cities in Thailand as well. The current paper is a case study that provides guidelines for designing and managing areas in various communities in Thailand that have limitations to the goal of increasing green space; this is because the development of travel routes along with the development of green areas is important as, in addition to connecting traffic routes, they also facilitate the connection of people within a city [7].

Generally, traffic routes are currently only used for mobility, mainly by cars and motorcycles. The integration of routes and the environment in a way that encourages people to use these routes for relaxation and enhances the city by creating more green spaces in the form of areas that are connected by long lines is considered a very new thing for Thailand. Accordingly, this study aims to search for ways to increase green spaces that are able to overlap with areas that are mainly used for transport in commercial areas and waterfront routes, since it is difficult to expand a community area to create dedicated green spaces, as many areas in Thailand have no community or city plan to support this activity. Therefore, this study will help provide guidelines for creating new types of green space in areas where community expansion is limited. The aim of this is to increase the original potential of forms of infrastructure to become green infrastructure in order to increase the opportunity for people in the community to conveniently access green spaces and have a good environment.

## 2. Research Methods

This study’s process consisted of the following steps: (1) The literature on green space was reviewed in terms of meaning, roles, and types. (2) Related concepts and theories, especially in the area of green space in the community and the quality of life of the people in the community, were studied; the concepts that were studied included sustainable development, livable cities, and green cities. (3) The situation regarding green spaces in Thailand was studied. (4) Criteria were established for selecting case studies, since the settlement of many communities in Thailand did not originate from urban planning but from other factors, such as communities in commercial areas that expanded along transport routes or basic public facilities of the city, the rise in riverside communities due to factors relating to food sources or water transport in the past, etc. In addition, Thailand has many aspects of identity, such as culture, beliefs, ways of life, etc., which are the bases for living life that are difficult to change. The selection of foreign case studies was based on the following criteria: (4.1) countries that formerly had a shortage of green space but have resolved to create sustainable green areas today; (4.2) countries with some cultural basis consistent with Thailand’s identity; and (4.3) countries with green areas that concretely help drive tourism activities. Based on the above criteria, the case study samples that were selected can be summarized as countries located in the same region as Thailand. There are two countries that meet this criterion which have developed green spaces with concrete plans: Singapore, which first struggled with creating new green spaces due to it being a country with almost no natural resources and then became a city that is famous for tourism, and China, as represented by Hangzhou, which is a city that has both natural and cultural areas and, as its original capital had been neglected and deteriorated, had to develop new green spaces. This process of creating green space not only enhances the beauty of a city, which increases the potential for bringing tourism to the city, but also smoothly inserts spatial identity. Consequently, using these two countries in this study could help create guidelines that can be applied flexibly to communities in Thailand

according to the current situation. (5) Finally, an analysis of routes in commercial areas and the waterfront of Singapore and Hangzhou (China) was carried out, which can be divided into two issues: (5.1) overall green space design and (5.2) specific green space for commercial routes and waterfront routes. This paper is summarized with a discussion and a summary of approaches for increasing green space in communities in Thailand.

### 3. Definition of Green Space

Green space is an area covered with grass, trees, shrubs, and ground cover for beauty or recreation. It is an outdoor and semi-outdoor area with all or part of the land boundary covered by plants. There may also be buildings included. The existence of green space affects ecosystems and human well-being [8]. Green spaces take many forms and serve to benefit humans both directly and indirectly. They play an important role in creating good environmental quality [9]. For example, Nattaneeporn Noisangiam, Weerawat Ounsaneha, and Chalut Tipakornkiat (2021) [10] classified green areas as a forest area with a wetland, including beaches, waterfront areas, and narrow areas lying along transportation routes, waterways, and various public utility lines. While, the People's Republic of China (1981) divided green space into 6 types: public green space, green space in residential areas, green spaces near the traffic routes, the green landscapes, and productive green spaces, and green spaces formed as fences or partitions [11]. In Thailand, the Office of Natural Resources and Environmental Policy and Planning (2021) [12] categorized green space into six types according to their characteristics and uses: (1) public green areas (parks, botanical gardens, and playgrounds), (2) utility green spaces (private green spaces such as gardens in private development projects, gardens in houses and residential buildings, green spaces in the institute, and green areas in public utility areas), (3) green spaces that are found along public facilities (areas along land transportation routes, roadside areas, road islands, railway zones, and areas along water transportation routes such as riverside areas and irrigation canals), (4) green spaces for the community's economy (green areas that are a source of food production for the community, such as rice fields, orchards, and aquaculture areas), (5) natural green spaces (green areas on hills, peat, water sources, and wetlands), and (6) green spaces that are not yet being used or waiting to be developed, such as abandoned green spaces. When considering the above classification, the definition of green space in this study is consistent with that of public green space, which is defined as a long line along two types of travel routes, namely (1) the spaces along the roadside and in the middle of the road in commercial zones and (2) the spaces along the water or canals of waterfront thoroughfares.

### 4. Related Concepts and Theories

#### 4.1. Sustainable Development

This concept aims to improve the quality of life of the world's population while maintaining humans' use of natural resources so that they do not exceed the production potential of nature, and it focuses on the balance between the environment, society, and the economy [13]. The environment was improved by increasing the variety of plants, linking green spaces to connect the ecosystem to promote sustainability [14], and adding treatment processes and restoring the quality of the river basin ecosystem for better drainage, reducing flooding problems and storing more water for using. Consequently, the area could be used as tourist route and recreation area [15].

#### 4.2. Livable City

In 1986, the World Health Organization—WHO—defined a livable city as a city that continually creates and improves its physical and social environments, including expanding community resources by encouraging the population in the community to participate and help each other with living life in order to achieve the best quality of life [16]. There are 11 characteristics of a livable city: (1) a physical environment and clean, safe living quarters; (2) an ecosystem in a balanced and sustainable state; (3) a strong and supportive community;

(4) people who are involved in matters that affect their health; (5) the areas suitably answer the basic needs of people in the city, (6) an economic system which is diverse and always innovative; (7) access to activities which promote social interaction; (8) the right to have a chance of receiving news, including coordinating and brainstorming; (9) the development and promotion of good characteristics inherited from the past; (10) thorough public health services; and (11) people with good health and a low rate of illness [17].

#### 4.3. Green City

Ebenezer Howard proposed the model of a Garden City aiming to reduce urban congestion, including creating a “Green belt” (green belt) to stop the horizontal expansion of a city [18]. This concept is separated into two meanings: the specific meaning refers to a city that highlights the importance of green space/areas, including public property and properties occupied by private individuals that are used as areas for recreation, and natural areas and semi-natural areas, which are the habitats of living things, including human-made areas such as long routes along roads and public utilities, as well as abandoned green areas [19]; the general meaning refers to a sustainable city that highlights the importance of natural resources and the environment to maintain a balance between the environment, society, and the economy [20] with the following elements: (1) a city with trees or green spaces, (2) a city that creates the least impact on the environment, (3) a city in which urban residents have a good quality of life, (4) solutions to the problems of poverty and slums, and (5) reduced carbon dioxide emissions [21].

### 5. Green Space in Thailand

Recently, various agencies in Thailand that are involved, including the Office of Natural Resources and Environmental Policy and Planning, have developed working guidelines to drive sustainable green space management to provide a framework for the direction and trend of future operations so that target groups and related sectors can push and operate successfully in a concrete way. Goals and indicators are set to responded to at both the national and local levels, and currently, the operation is in Phase 2 of the plan (2023–2027) [22] (the goal of increasing the amount of green space is shown in Table 1). The World Health Organization (WHO) states that the average green space ratio for the population should be 9 square meters per person or more. The standard in Thailand is 16 square meters per person.

**Table 1.** Target of increasing green space in cities and communities in Thailand.

Indicator	Public Green Space as a Whole of the Country (Square Meter/Person)	Green Space in the Cities and Communities (Percent) <sup>1</sup>		
		Big Cities	Medium Cities	Small Cities
Short term: 1–5 years (2018–2022)	Not less than 5	5	5	10
Medium term: 6–10 years (2023–2027)	Not less than 10	10	10	15
Long term: 11–20 years (2028–2037)	Not less than 15	15	20	25

Source: Office of Natural Resources and Environmental Policy and Planning, 2019 [23]. <sup>1</sup> The term big cities refers to the city municipality and special form of local government administration, the term medium cities refers to municipality, and the term small cities refers to subdistrict municipality and subdistrict administration organization.

According to this criterion, it was found that in Thailand, many cities or communities still have green spaces that are below the standard, such as Nonthaburi (3.92 square meters per person), Samut Sakhon (5.31 square meters per person), Samut Prakan (10.37 square meters per person), Lamphun (11.36 square meters per person), Phrae (12.92 square meters per person), etc. Singapore has an average of 66 square meters of green space per person [24]; therefore, increasing green space is another option to solve

environmental problems. Green spaces help filter pollution and promote strong physical and mental health for city dwellers. But the problem is that there is not enough green space in the city to meet the needs of the people, and access is difficult in some areas [25].

## 6. Analysis of Guidelines from Case Study

### 6.1. Singapore

Singapore is a country that takes environmental and sustainability issues very seriously due to geographic limitations, such as a lack of natural resources, limited alternative energy, etc. [26]. In the past, more than fifty years ago, Singapore had almost no resources that could be used to financially support the creation of a good environment [27]. In 1967, Lee Kuan U, the former leader of Singapore, initiated the “Garden City” policy with the objective of transforming Singapore into a city full of green spaces with a clean environment in the form of an intensive tree planting project in the area next to the road. Trees in Singapore must be planted in a way that allows for “people” and “trees” to live together harmoniously. People must take full advantage of green spaces [28]. This goal of harmony can not only be achieved by planting a large number of trees, but also by strategically growing trees densely along roads to provide shade to travelers, such as roads along the airport, routes that connect to important areas, etc. [29]. Later, in 1972, Singapore implemented the Parks and Trees Act to create cooperation among all agencies to allocate space for planting trees in every project, such as residential construction or during the building of roads or parking lots. This act also prohibits causing damage to trees [30]. Then, the Green & Blue Plan was developed to link the green areas along the land and waterway routes to create a green network for the whole country called the “Park Connector” [31]. These park connectors also help stimulate the development of lonely neighborhoods to help them come back to life. In addition, various concrete canals were changed and made to be beautifully landscaped within nature, restoring the ecosystem in the city, helping to treat water, and creating an area to absorb floods in addition to being an animal shelter. Most recently, this development has allowed otters to come and live in the city [32], making Singapore the greenest city in Asia in 2014 (compared to 22 major cities in Asia) according to a survey of Economist Intelligence data [6]. Although Singapore has an area comparable in size to Phuket in Thailand, it has 350 public parks (data as of June 2017), but Bangkok, which has an area that is 2.5 times larger, only has 37 public parks, which constitute approximately 3% of Bangkok’s area [18]. Recently, Singapore has announced the “City in a Garden” policy, which is in the city development master plan C. 2014–2030 and the Singapore Investment Master Plan 2030 under the concept “More Land, More homes, More Greenery”, showing that Singapore continues to advance its policy to increase green space in the city [20]. The investment in creating these environments, in addition to developing the city, it is also an important economic stimulus for Singapore’s tourism.

#### 6.1.1. Green Spaces in Commercial Routes

The routes in commercial zones are designed to be easily accessible by cars and focus on pedestrian walkways. This can be seen from the clear proportions of the sidewalks. They are at least 3 m wide, but if they are in a crowded commercial zone, they may be as wide as 10 m and use colorful tiles as flooring material. There are also elements of the route that are conducive to people of all ages (universal design), such as the design of signs on the sidewalk for the visually impaired, benches, electric lighting, etc. As for electrical lines, they are neat and orderly because they use electrical wiring underground along the road, which has been developed into an underground electrical cable system that will help extend the time that it can be used [33]. An interesting point is that in commercial and residential zones, there are small parks (pocket parks) along the walkways that create a network of narrow but long connected green spaces. They increase the amount of green space in that area. There is a distribution of green space that gives convenient access to people in the community. It is utilized as a recreational area, helps create an atmosphere, preserves biodiversity, slows down rainwater, and also promotes walking (Figure 1).





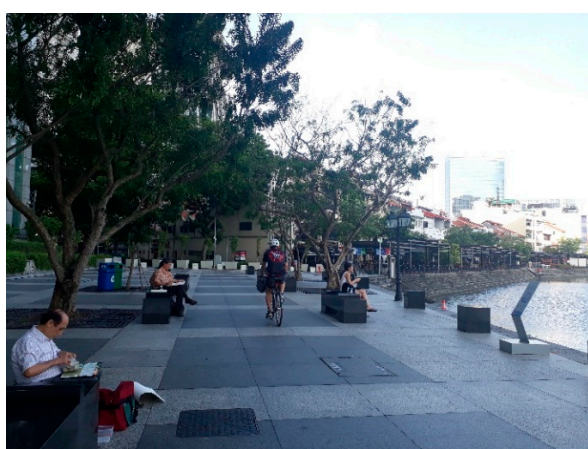
**Figure 1.** (a) presents the routes in commercial zones in Singapore with different sizes, and (b) presents patterns of green spaces. (Source: (a) photo taken by the author; (b) photo taken by the author).

Another important issue is that Singapore has concrete guidelines for creating green areas and has a policy for continuous development in this area in the form of rules, regulations, and creating incentives for the private sector, such as the government issuing regulations, policies, awarding awards, and providing funding, encouraging private sectors to participate in creating a green city that is beneficial for business and is admirable. For example, private sectors that design buildings to have public spaces with a lot of green space will receive more construction rights [32]. Thus, green areas along various routes in Singapore will be more practical and sustainable. At present, Singapore is not only a garden city, but also a city in the garden, and it is transforming itself into a city in nature or a country with the most green spaces per capital in the world.

#### 6.1.2. Green Space in Waterfront Routes

In the 1960s and 1970s, Singapore declared independence, quickly bringing the country into the modern era. Urban expansion occurred from the center of Singapore to the eastern coast, which is a flat area below sea level. Therefore, canals were dug, and drainage pipes were built to deal with flooding problems that affected the city on a large scale. This concept of drainage using engineering technology resulted in many rivers and canals being converted into concrete canals [34]. Later, there was a development policy, and these canals were turned into green areas. For example, the Bishan-Ang Mo Kio Park project improved a 3 km long concrete canal that was originally designed to run directly along the road as a boundary separating the park from residential areas. The drainage channel was redesigned to be naturally winding [35]. The architect team intended to have people become close and perform activities along the water by adding landscape elements such as bridges and waterfront terraces. They also added a gravel walkway across the river. It includes restrooms, a restaurant, and an observation deck called “Recycle Hill”, which was built from concrete blocks recycled from the original drainage channel. The parks along the river were designed to accommodate excess water that overflowed the riverbank. Natural materials are used along with cover crops to slow water flow and prevent erosion. In addition to making the drainage channel look natural, this method also increases its capacity for transporting water by 40% [33]. The above design concept is known as the ABC Waters project, which aims to change the structure of the blue network or the country’s waterways to have more complex functions with beauty according to the abbreviation ABC, which stands for Active, Beautiful, and Clean Waters [36].

Other green spaces along Singapore's waterfront were generally designed as public walkways to connect key commercial areas. The walkways are along both sides of the river with guardrails for safety. The entire route is decorated with perennial plants and shrubs for shady beauty [37], and it reaches areas such as the Singapore River, the Kallang River, the Serangoon River, and other canals. The surrounding area is designed to look like a long park along the waterfront emphasizing the use of large perennial trees to provide shade and sculptures to convey various stories, including street furniture such as benches, lamps, and signs in various spots. This area functions as a place to relax, a meeting space, a landmark area, and a tourist area, and it is also a place for city activities such as painting, exercising, cycling, etc. [21]. Some waterfront areas are so beautifully designed that they become places that attract tourists to take photos. For example, in the Marina Bay area, there are landmarks like Merlion and the Helix Bridge, which looks like twisting waves across the river (Figure 2).



(a)



(b)

**Figure 2.** (a) presents an activity area for Singaporeans where green space is along the waterfront. (b) An example of using green space to attract tourists. (Source: (a) photo taken by the author; (b) photo taken by the author.).

## 6.2. Hangzhou, China

Hangzhou is the capital of Zhejiang Province. Most of the area is surrounded by mountains. There is Xihu Lake (West Lake) and other world-famous landmarks that make Hangzhou a “Paradise on Earth”. Hangzhou has an area that is approximately one-fifth of Thailand, but it has a population comparable to Thailand. This results in the problem of population density, and there is little agricultural land. The main income of the city comes from tourism [38]. In addition to being one of the most important economic cities in China, at present, the Hangzhou government has begun to pay attention to the issue of quality of life for the city's people, especially the improvement of the urban environment to return it to its original state [39]. For example, in 2002, the polluted Xihu Lake was restored by moving people who were living around that area to other places and creating four green areas to replace those areas. In order to allow the area to become a source of attraction for tourists, the height of buildings was also controlled so as not to obscure the landscape around that area. In 2011, UNESCO registered Lake Xihu as a World Cultural Heritage Site because it presents the beauty of Chinese style. In addition to natural attractions, Hangzhou promotes walking travel and a public bicycle system to create an environmentally friendly city. The city developed public transportation for the diverse needs of the population, including a subway, regular buses, electric buses, and taxis, and it supports the use of alternative energy vehicles with the installation of car battery charging stations throughout the city that can be conveniently used via a smartphone [40]. Hangzhou City emphasizes the importance of nature and the ecosystem and aims to preserve a good environment [41].



To date, it has been recognized as one of the model cities for development both nationally and globally because it has a stable economy, good quality of life for people, and a good environment [29].

#### 6.2.1. Green Spaces along Commercial Route

Maneerat Pachankoo and Sheng Zhongwei (2023) [42] classified the characteristics of commercial routes into three types: (1) a route along a road with various characteristics and elements, like a general walking route, but with a wider size; (2) a route in form of a wide courtyard in front of a building to open up the view with an empty space or a beautifully decorated garden, normally located in the business district or in large commercial zones for public use; and (3) a route as a large courtyard linking one area to another, acting as an open space for people in the city to participate in various activities with a decorated garden or, in some areas, a wide space with various shops in the basement as if it were a public park or city activity plaza. All three types of routes mentioned above, in addition to using flooring materials with a rough texture, also incorporate the identity of the city by choosing to use plants found in the local area for decorating.

The green spaces of Hangzhou's commercial routes interestingly integrate green spaces with thoroughfares in the form of plazas of various sizes (the size of the courtyard depends on the activities and concentration of people) so that they are connected. The main function of a courtyard is to be a walkway in commercial zones, and it is interspersed with green areas. These green areas will serve as areas for recreation, performing activities, meeting, talking, and other activities for people in the area, and they will also serve as green routes that create an atmosphere with facilities in a universal design for all types of customers traveling into the mall area. The important thing about green spaces found in this area is the choice of use; the beautiful native plants change with the seasons and are easy to care for. There are also local agencies that are responsible for keeping the environment in good condition (Figure 3).



**Figure 3.** (a,b) present green spaces in commercial zones, like public parks or activity halls for people in the city, which are wide spaces with shops underground. (Source: (a) photo taken by the author; (b) photo taken by the author).

#### 6.2.2. Green Space along Waterfront Routes

Hangzhou has implemented more than 605 environmental protection projects, and the most important one is the development of Xihu Lake and the surrounding area to be the heart of a good urban environment because it is a large gathering place for the people of this city to relax, walk, exercise, and cycle, as well as to participate in other activities such as riding a boat to see the lake, dancing, flying kites, etc. [43]. Waterfront routes have many sizes, such as a small path along a canal in an urban area and larger paths along rivers and lakes. They are designed to allow the beauty to be felt visually but prevent access through touch to prevent danger. Some places connect one area to another with beautifully



designed bridges that carry the identity of the local area. Some boardwalks allow people to walk under bridges to reach the other side of the road using floor coverings with a rough surface texture to prevent slipping [32].

The green areas of waterfront routes are designed as riverside parks parallel to the river, canal, etc. Green areas will have different sizes depending on their use, such as if they are only being used as walking paths connecting one point to another. However, they are able to be used for recreation and as exercise areas, and in community areas, they are designed to be large, and some courtyards in points in a community area are designed for various activities, such as gatherings for Tai Chi dancing for the elderly, Mahjong playing, group activities, meeting and talking, etc. The plants chosen for decoration are local trees, such as willows, ginkgo trees, Mei trees, etc., which are not only easy to take care of, but also change beautifully, giving different landscapes according to the season (Figure 4).



**Figure 4.** (a) presents waterfront green spaces which the people in the community use for performing activities together. (b) shows the green spaces as gardens along the river. (Source: (a) photo taken by the author; (b) photo taken by the author).

The difference between Singapore and Hangzhou is that Hangzhou is a city with spatial capital, both natural beauty and culture, which influence the forms of its green spaces, creating a unique blend of nature and culture on the contours of a growing city with technology. Even though the green spaces were redesigned to be more convenient to use in the present, they still have a hint of their uniqueness, which is inserted through various elements such as local plants, patterns of walkways, models of bridges over the water, decorative lamps, or even activity areas that were designed by studying the usage behaviors of people in the area. Another important factor that has contributed to this difference is the presence of an organization that continuously maintains green spaces to enhance sustainability. And now, green space has come to play an important part in increasing the potential of Hangzhou to become a tourist city that is well known as the top environmental city in China.

## 7. Discussion

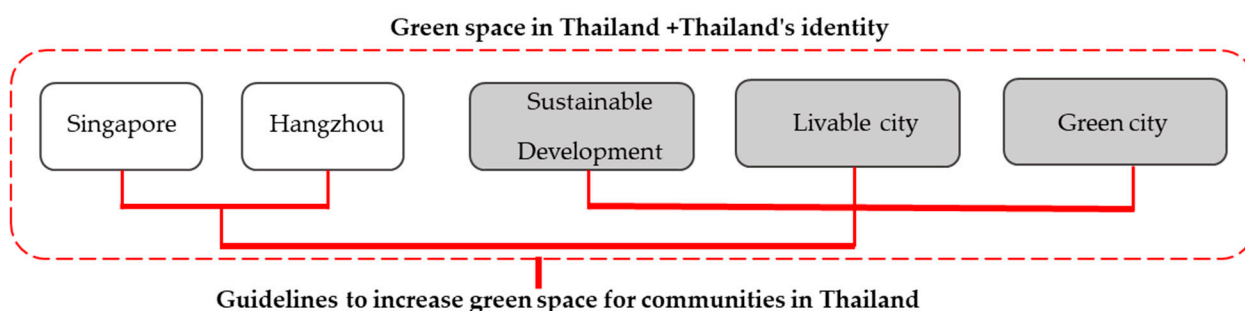
According to the studies mentioned above, both Singapore and Hangzhou have merged green spaces with commercial routes and waterfront routes by applying the concepts of sustainable development, a livable city, and a green city. This resulted in (1) green spaces being increased until the cities became green cities with green trees and green areas; (2) the quality of life of the local people being increased, including physical and social environments, which are continuously becoming better; (3) the city environment being developed beautifully until it became a tourist attraction that is popularly known by other

countries; and (4) a continuous plan for maintenance and development that was made to enhance sustainability, which is also able to be used as guidelines for other areas.

The color green matches well with many similar types of routes. For example, Boonyanusith, N.; Shiannfar, K.; and Hanlian, L. (2015) [5] conducted research on the green transportation routes of Phimai City regarding a green area and a water source area which were connected to each other in a network; the study showed that people in the area were responsible for the development of green routes. The people needed to realize the natural and cultural characteristics of the area. This is an important factor that helps connect green travel routes. This is consistent with the case study of Hangzhou, where natural and cultural capital were developed together to create a green area with a unique identity. Since the physical landscape is enriched with green mountains and a green environment, the green areas of the waterfront routes were designed as riverside parks parallel to the river canal to maintain the concept and signature of Hangzhou. The new green spaces can merge well with existing identities, but they can be improved with the addition of areas for exercising and recreating. Additionally, they are able to solve the problem of an increasing population, where population problems can follow. Consistently, in the research conducted by Inchompoo, P. and Srithanyarat, S. (2017) [3] on the development of green area networks in Bangkok, the capital of Thailand, it was found that it has a continuously increasing population and that there are many environmental problems arising from the expansion of the city in various directions. These affect the health conditions of the people living in the said area. Therefore, we must find a way to increase green spaces and connect existing green areas to alleviate the city's environmental and pollution problems. The results of the research suggest that there is a connection between three main green components: park areas; green spaces, roads, and canals in Bangkok are connected. The results are presented in the form of a master plan and development plan. This is consistent with the case studies of both Singapore and Hangzhou, where green spaces were constructed under a development plan. However, Thailand is still under the consideration of a relatively new matter, and most are still in the planning stage. Meanwhile, the case studies in both countries have green areas of this nature that are concrete and have been developed to promote sustainability.

## 8. Conclusions of Guidelines to Increase Green Spaces in Communities in Thailand

Based on the analysis of the case studies from both countries together with the related concepts above, a study of the situation of green areas in Thailand was conducted, and the unique context of the area was used as a framework to obtain appropriate guidelines for increasing green spaces in communities in Thailand. This process is shown in Figure 5.

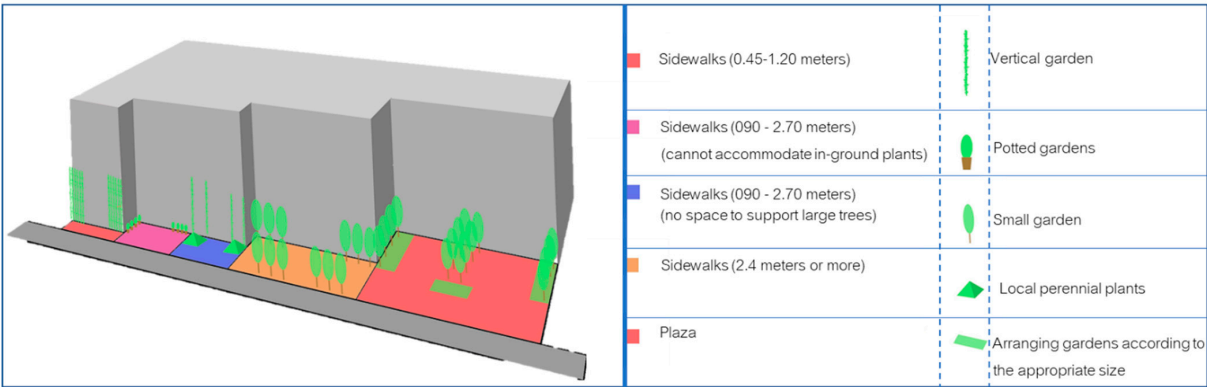


**Figure 5.** Processes leading to conclusion. (Source: author prepared figure using Google SketchUp 8.0.16846).

The processes were applied, and guidelines for increasing green spaces for commercial routes and waterfront routes are presented below.

8.1. Green Spaces along Commercial Routes

In the commercial zones of many communities in Thailand, one will find footpaths that are not very wide and are parallel to the traffic road and decorated with perennial trees to provide shade in a discontinuous pattern because there are obstacles in some places, such as road cuts, hawkers, and stalls. If green space is to be integrated into a part of a travel route to allow for recreational use by the community, changing it from its original narrow path into a long line, please check Figure 6 and the following guidelines should be followed:



**Figure 6.** A model of green space, which can be flexible according to the size of the footpath. (Source: the author prepared the figure using Google SketchUp 8.0.16846).

(1) There are a “pattern” and a “scale”, which are flexible according to the “spaces” of the area because most community routes in this area are difficult to expand or modify. Therefore, green spaces should have flexible patterns and various sizes to be suitably adapted to the original areas without the need to expand the area further. This approach is consistent with the Singapore case study. This can be seen in some commercial areas where there are limitations on expansion. Therefore, there are different forms of green space that are deemed appropriate, for example, designs such as a small garden, a garden that uses smooth wooden fences along the roadside, vertical gardens, etc. This approach is also consistent with the three concepts that were included in this study. In Thailand, the spaces that will be designed in this way will be spaces used for “sidewalk”-type traffic. In this study, references will be made according to the Time-Saver Standards for Landscape Architecture (the Time-Saver Standards for Landscape Architecture set standard sizes for different walkways as follows: private walkways = 0.45–1.20 m, public walkways: 0.90–2.70 m, and walkways in public parks = 1.5 m.) that define the standard values of each type of sidewalk. According to the results of this study, there are five guidelines as follows:

(1.1) Areas without spaces to support horizontal planting. For example, dense commercial areas are designed to have connected commercial buildings. There are sidewalks with a size of 0.45–1.20 m that are used for traveling in the area and may include various infrastructure areas on the routes (overpasses and motorway structures). The guideline to increase green space involves using a space-saving vertical garden by choosing native plants that are durable and easy to care for. And if there is cooperation from people within the same area, this will create a connected green area that is able to help enhance beautiful scenery, slow down rainwater, and reduce the temperature of the area.

(1.2) Areas with small spaces in front of buildings that cannot accommodate in-ground plants. For example, in commercial areas where the sizes of the sidewalks are in the range of 0.90–2.70 m, to increase green space, potted gardens are possibly used because these plants are easy to control and maintain. It is suggested to choose small- to medium-sized shrubs. And if there is cooperation from people within the same area, this will create a route with attractive features and help create a beautiful atmosphere.

(1.3) Small spaces in front of the building where plants can be grown in the ground, but that do not have space to support large trees. For example, in a commercial area where the sizes of the sidewalks are in the range of 0.90–2.70 m, increasing green space may be carried out in the form of a small garden by choosing to use low shrubs to medium-sized shrubs, and there may be other elements for decorating.

(1.4) Free spaces in front of buildings that can accommodate large trees. For example, in commercial areas where the size of the sidewalks is 2.4 m or larger, in order to increase green space, local perennial plants, which are easy to maintain, are possibly used by considering the shape, colors, etc. Additionally, other decorative landscape elements as well as sidewalk amenities can be used.

(1.5) Areas with large spaces in front of buildings, such as wide spaces. For example, in a commercial area, there is a wide plaza to accommodate the concentration of people, and green space may be increased by arranging gardens according to the appropriate size, including possibly designing areas to accommodate various activities within the area.

(2) Using “free space” such as the space between buildings. Some travel areas that do not affect the main traffic, etc., can be transformed into green spaces of different sizes as appropriate. Various amenities, such as benches, trash cans, etc., may be added so that local people or groups of people traveling to shop can have a place to wait and rest along the way. The acquisition of such “free space” may be obtained from private areas. The responsible local agency needs to create mutual motivation or understanding. This guideline is consistent with both case studies as well as the three concepts used in this study.

(3) “Perennial trees” provide shade to the routes. Native plants should be considered using in the area, and the types, sizes, or heights of the trunks should be selected to suit the size of the routes or areas to create an atmosphere for commercial zones and motivate people to walk, both when going shopping or walking through the connecting paths within the area. These kinds of plants are not only easy to maintain but also help promote spatial identity and may become green landmarks for the routes in the commercial area. This guideline is consistent with both case studies, which use the native trees of the provinces for decoration. For example, Singapore used East Indian Walnut trees, whereas Hangzhou used Willow trees and Gingo trees. This guideline is also consistent with the three concepts applied in this study.

(4) A “landmark” may be classified as one element in landscape work. However, having this element together with green space in commercial routes in addition to being a meeting point which is remarkable, if it is designed to be interesting, can also encourage people to come into the area. Landmarks can be designed using ideas from stories, legends, and important identities in each area, etc. This guideline is consistent with both cases studies, but the pattern of a landmark is different due to the identity of different areas.

(5) When integrating green spaces and routes, the principle of “universal design” needs to be considered because there are many different types of people with different ages using the area, such as people with visual impairments, people using wheelchairs, people carrying suitcases or wheeled bags, people pushing baby strollers, etc., and they need to have easy and safe access. This can start with the design of an appropriate walkway with a ready-to-use condition, including the preparation of amenities such as seats, trash cans, road signs, lighting, etc., distributed at various points. This guideline is consistent with both case studies as well as the three concepts applied in this study because it is an international concept.

## 8.2. Green Spaces along Waterfront Routes

“Waterfront” areas in Thailand designed with routes alongside them are mostly found in community areas and tourist attractions. The waterfronts are designed as paths parallel to rivers and canals at intervals and only in certain areas. Therefore, waterfront spaces become green spaces for the community. There are guidelines as follows:



(1) Green spaces along waterfront routes in the community area should be designed to have a functional atmosphere and be able to support a variety of activities, such as recreation, exercise, drawing, local games, and cultural activities. This type of green space may not follow the entire length of the waterfront due to the limitation of sizes or legal restrictions in some areas. Therefore, this type of green space may be distributed in spots or increase the sizes of some routes. And in routes where space expansion is limited, planners may need to consider designing small green spaces or using perennial trees to provide shade along the route to create a good atmosphere.

(2) The canals in the community that were deserted and rotten have been renovated to become community recreation areas in the form of green areas by applying design guidelines to create a natural look. And the community should be involved in designing and caring for the green spaces so that the green spaces can meet the real needs of the people in the area while achieving sustainability.

(3) Inserting the community's unique identity, such as by using plants, various landscape elements, and landmarks, will make the area more interesting because, in addition to enhancing an atmosphere, it conveys spatial identity. If it has a beautiful design, it will also become a destination that can attract tourists and may help stimulate community economics as well.

(4) In addition to the green spaces along the waterfront routes, we may consider designing green areas, including areas along river banks or in the water. They may be designed in a way that allows people to use them, or they may only be accessible visually to increase the quality of the atmosphere and beauty. This will result in an increased amount of green space, and they may become community landmarks that can help stimulate economics and tourism. This guideline is consistent with both case studies as well as the three concepts used in this study.

### 8.3. Other Issues

Thailand more or less already has natural and cultural resources for each community. Are they similar or different? These resources can be used for designing green spaces along various types of travel routes that enhance the local identities with unique beauty and also convey the boundaries of each community. In addition, connecting the green spaces along waterfront routes with the green spaces of other forms of routes, such as bicycle lanes and routes in community areas, will cause an increase in green space and eventually become a network of green spaces. This network will help promote "walking" within the community and connect people to nearby areas. And along the walking route, there should be attractions with various elements such as landmarks, activity areas, a good atmosphere, etc. Another important issue is the "walkways" of various travel routes. It was found that in both case studies, a universal design was used to support groups of all types of users to have access to the area. For example, pedestrian walkways are wide and free of obstacles, as walking surfaces are designed with safety in mind, with materials that are not slippery being chosen, and signs for the visually impaired being placed along the route. In addition, in sidewalk areas with different levels, there are ramps designed to support wheelchairs, baby strollers, wheeled bags, and various types of luggage carts to provide easy access to the area. These green spaces and routes are always maintained in beautiful condition and are ready for use. This is because both countries have local agencies that are specifically responsible for these tasks, including creating policies for continuous and serious development to enhance sustainability. Additionally, having more green spaces in the community will help create good quality of life for the people in the community and will also help absorb pollution and rainwater. These green spaces have also developed into ecosystems that support urban animals, such as birds and squirrels, and they are also sources of food and shelter.

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