Research on Planning and Design of Resident-Friendly Community Parks: Taking the Huapu Park of Jinan City as an Example

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Abstract. The outbreak of the novel coronavirus pandemic in early 2020 has raised people’s concern about living and ecological problems in densely populated cities. Community parks turn into the most accessible ecological green spaces shared by the public. Through questionnaires, this paper surveys the functional zones, cultivation of vegetation and public utilities of the Huapu Park which is situated in Jingshi Road, Jinan City. The purpose is to explore the improvement of landscape planning when community parks play a role in emergency and disaster prevention, and interactive participation, so as to provide constructive suggestions for the building of resident-friendly community parks.

1. Introduction
The constant growth of productivity in China inevitably intensifies concentration of population and production in urban areas, bringing both opportunities and challenges to urban parks. Given that people expect to access nature outside their home rather than far away⁴¹, and meanwhile the coronavirus pandemic starting spreading in early 2020 highlights problems ranging from epidemic to environmental pollution in densely populated cities, the planning and design of community parks are required not just to satisfy the basic requirements of greening but more importantly to take into consideration the demand of landscape ecology, emergency and disaster prevention, diversity of activities and economic benefits⁴².

This paper, based on surveys of the Huapu Park among its users, explores the planning and design strategies when such community park incorporates the benefits of emergency and disaster prevention, and interactive participation, in an attempt to build a resident-friendly community park.

2. Overview of the Huapu Park Status Quo

2.1. Analysis of surrounding environment
Situated in the east of Huaiyin District, Jinan City, the Huapu Park in its south adjoins Jingshi Road and remains under the administration of Duandian North Road subdistrict office, occupying a total area of 9.8 hectares. Around its base address are sound infrastructures, including the Fifth People’s
Hospital, Duandian drink wholesale market, and western branch of Shandong Provincial Hospital among other large-size public service institutions. The survey demonstrates that within a service area of 1 km it is the sole community park that principally serves residents inhabited in 13 peripheral residential quarters.

2.2. Analysis of internal status quo

2.2.1. Current vegetation analysis
The Huapu Park is a natural base of plant science popularization where plants total over one hundred, presenting distinctive landscapes such as autumn leaves blanketed with morning frost, fragrant lotuses in bluish ripples and sea of flowers greeting visitors. Inside the park plants in the arborous layer mainly contain: platanus orientalis and Celtis bungeana Blume on both sides of roads; weeping willows and metasequoias among other featured tree species such as mulberries, Japanese pagoda trees (also called Chinese scholar trees), and red maples. In contrast, plants in the shrub layer principally comprise heather, cornus albas, euonymus japonicus, and rosa Chinensis. Moreover, herbaceous plants abound, for instance, sedum spectabile, iris and rudbeckia laciniata. Lianas climbing on gallery frames mainly include rosa multiflora, climbing rose and Chinese wisteria.

2.2.2. Current architecture
Currently the aquarium and flower exhibition center at the entrance and the bonsai garden in the center constitute two exhibition halls of plants inside the park. In the south of the park are office buildings. Furthermore, three public washrooms are scattered across the park.

2.2.3. Current drainage system
The Huapu Park in its east is separated by Duanxing West Road with the Xingji River. There is a 1.5-meter-deep artificial lotus pond serving as the beginning point of a permanently wet ditch where plants grow, stretching towards the north and eventually ending up with an infiltration pond in the northeast corner of the park.

3. Master Plan of the Huapu Park
The Huapu Park integrates construction of ecological environment with its core service functions on the premise of causing no damage to the using experience among nearby residents and to protection of this city, aiming to evolve into a resident-friendly community park that can fulfill such principal functions as ecological protection, interactive participation, and emergency and disaster prevention[3]. Its overall layout takes the form of “one ring and five subareas”. (see Figure 1)
“One ring”, namely the main circular road of the park that is established for the principal purpose of ensuring the normal operation of traffic inside, connects main landscape nodes and function nodes in series. The resulting accessibility allows personnel, supplies, and medical aid among other contingency measures to be transported and distributed promptly.

“Five subareas” comprise: aquarium and flower exhibition area, plant science popularization and recreational area, sightseeing area of waterfront landscapes, fitness activity and interactive area, and tranquil rest area interspersed with color-leafed plants.

Situated at the main entrance of Jingshi Road, the aquarium and flower exhibition area encompasses a plant exhibition conservatory, aquarium market and park management center. This area remains dynamic thanks to economic activities, which 68.18% of respondents express their willingness to engage in to consume. On the south of the aquarium and flower exhibition center lies the park management center, which can conveniently serve tourists and meanwhile regulate flower and bird market.

The plant science popularization and recreational area, the main sightseeing area that is located in the center of this park, comprises bonsai garden, Qunfang Garden (meaning “various blooming flowers”), Lanhu Square, and Liuyi Square. On the lawn of the squares grow abundant herbaceous plants, for instance, garden columbines, chrysanthemum morifolium, asters and schizonepeta. In the center of this area is a conservatory of bonsai garden, in which many bonsai of Bougainvillea spectabilis, Carmona microphylla and banyans are displayed showing peculiar and graceful shapes, and on-site working staff impart knowledge about bonsai maintenance and appreciation. The open area arranged allows nearby residents and tourists to engage in various recreational activities, including square dancing, Tai chi, and display of calligraphy on the ground.

The sightseeing area of waterfront landscapes is situated in the east of this park, composed of a lotus pond, Ginkgo Square, and Changting Square. Around the pond grow such moisture tolerant plants as metasequoias, ginkgoes, weeping willows and Japanese pagoda trees, whereas in the pond are emergent aquatic plants such as lotuses, calami, and Scirpus validus. The lotus pond is a low elevation greenbelt that presents a panorama of rainwater purification and collection. Tourists normally paddle and enjoy cooling off beside the pond in summer, and sing, chat and play Chinese chess in winter.

The fitness activity and interactive area, situated in the northwestern exit and adjacent to the communities of Duandian Village and Duandian Xinyuan, includes exercise plaza, sandlot, Willow Square, and Baihua Garden (hundreds of flowers). Across the exercise plaza and Willow Square line rows of huge planting pools, in which grow arbors such as weeping willows, Platanus orientalis, and Koelreuteria paniculata, and stand solar luminaries for the sake of exercisers’ safety and a quiet and sound atmosphere. The hedge that is made of Ligustrum lucidum isolates sandlot with nearby road, providing a semi-closed space which enhances the safety of playground area. Baihua Garden serves as a healing garden in which grows Dutch chrysanthemum, sedum spectabile, and Dianthus chinensis among other herbaceous plants, allowing tourists to engage in such horticultural activities as expelling insects and weeding.

The tranquil rest area interspersed with color-leafed plants is situated in the south of this park, mainly containing the color-leafed garden and office area, which functions as an emergency command center once any disaster occurs. In the color-leafed garden ornamental plants abound, for instance, the color-leafed trees of photinia serrulata, Cotinus coggygria, Japanese maple, and purple-leaf plum, and trees for courtyard, including punica granatum, Magnolia grandiflora and wintersweet, which create a comfortable and tranquil atmosphere. Nearby residents and tourists usually take a rest or bask in the sun in the recreational corridors established in this area.

4. Survey of the Huapu Park among its Users
Detailed information on the activity spaces, recreational and service facilities, people’s activities and behaviors, using experience, and preferred landscapes are collected through questionnaires. Among the 60 questionnaires which are randomly distributed, 54 are valid.
4.1 Trip characteristics of users
Most of users inhabit in those communities within a service radius of 1 km around the Huapu Park. Among the 79.55% of respondents who can reach this park within 20 minutes (Figure 2), 56.82% arrive there on foot (Figure 3). The majority of respondents come to this park more than three times (Figure 4), mostly lingering for 30 minutes to 2 hours (Figure 5). Moreover, it is demonstrated that 22.73% come here to accompany their children, while 72.73% aim to do exercises or enjoy the fresh air (Figure 6) by themselves or along with their friends (Figure 7).

4.2 User evaluation
Nearby residents constitute the majority of users that are satisfied with the park which enables them to rest or exercise. 95.45% of respondents show their satisfaction with the overall planning and management. (Figure 8)
With regard to the park design, 27.27% of respondents prefer the aquarium and flower exhibition center and the bonsai garden above all others (Figure 9), while 90.9% are attracted to these two exhibition halls once they stroll in the park, among whom 68.18% would purchase some plants; Baihua Garden proves the second most favorite place where respondents indeed benefit from horticultural activities pertaining to herbaceous plants, which are considered as some kind of edutainment. Concerning this park’s functions, 86.36% maintains that they are aware of its role in emergency and disaster prevention and will seek safety in there should any disaster arise; despite that 90.90% remain unaware of Baihua Garden’s rehabilitative and participatory role, the overwhelming majority of tourists have a fondness for strolling and sightseeing in Baihua Garden, which make them find a sense of relief and delight.

5. Approaches and Strategies for the Planning and Design of Resident-Friendly Community Park

5.1. Emergency and disaster prevention
The novel coronavirus pandemic in early 2020 has raised people’s concern about the role of parks in disaster preparedness in densely populated cities. A larger proportion of green spaces and parks can not only alleviate potential damage that might be caused by natural disasters but effectively prevent infectious diseases from transmitting widely. Scattered community parks are to cities what lungs to
people. Green plants can produce oxygen and increase ventilation, while those plants possessing health functions form a quarantine area by secreting various phytocides.

5.1.1. The main aspects of emergency and disaster planning in the Huapu Park
The Huapu Park is one of the two disaster prevention parks whose construction was initiated in 2014 in the downtown of Jinan City. It is well placed for easy access to the main route of Jingshi Road and convenient for a variety of public services, which expedite the delivery of supplies and medical rescue in case of any disaster. The remaining 3.8 hectares of active area designated for disaster avoidance, if water bodies, buildings, roads and largely closed green spaces are left out from the total 9.8 hectares of this park, can accommodate a maximum of 20,000 people during the 72-hour “golden window”. The abundance of disaster prevention facilities established in the Huapu Park can be used as mid-term shelters (Figure 10).

Figure 10 The distribution of emergency facilities in the Huapu Park

5.1.1.1 Entrances and surroundings
The Huapu Park possesses a total of three entrances, among which the main one in the south next to Jingshi Road is nine meters wide with an open design style, which maximizes its perimeter and contact area with peripheral environment, increasing the chances for numerous citizens to flee into disaster prevention park. The greenbelt in the main entrance stretches until meeting with that in Jingshi Road, contributing to the linear landscapes.

5.1.1.2 Roads
The width of roads in the park ranges from one meter to eight meters. Most of them meet the requirements of barrier-free design. Principal evacuation exits, four to eight meters wide, are paved with pervious concrete and appear uniformly cyan in color, whereas minor roads are distinguishable in red despite identical pavement material used. Materials and methods adopted in paving footpaths vary, the majority being pervious bricks and pebbles.

The broadcasting system installed on the poles of street lamps plays background music regularly and functions as effective equipment, once any disaster strikes, allowing information received from emergency command center to be acquired timely by the masses who have been evacuated. Guide signs of disaster avoidance varying from stickers, low profile signs and to readerboards, are displayed along the major and minor roads of the Huapu Park, effectively, safely and orderly providing people with visual guide.

5.1.1.3 Refuge areas
Emergency material supply and command center: the aquarium and flower exhibition center, which
serves as a conservatory of plant science popularization and exhibition at ordinary times and is used for supplies storage and distribution.

Medical first aid: the medical center adjoins the emergency commander center that can temporarily store medical equipment in its spare space, making health and medical information readily accessible to the public. Around the park lie two large hospitals from which medical care personnel can arrive on the scene promptly.

Emergency shelter area: the four shelter areas designated in the south, north, northwest, and northeast of the Huapu Park are all broad squares or spacious, scarcely forested grassland, which help to pitch tents and circulate air, favorable to hygiene control and epidemic prevention.

Emergency apron: it is situated in Qunfang Garden, where regularly grow Physostegia virginiana, hairbell, Hemerocallis middendorffii, and Carex breviculmis among other low ornamental herbs. This area can swiftly convert flower border and peripheral wide green space into an apron should any disaster occurs.

5.1.1.4 Emergency infrastructures
Emergency power supply: a mature and sound power supply system is available, while the emergency command center is equipped with such facilities as diesel generators and cables. The dual power supply in the entire park allows municipal department to rapidly switch to emergency power supply if necessary.

Emergency water supply: municipal water supply network and emergency water source are employed simultaneously. Off-grid water wells located in the east and middle can fill a water truck through a water supply adapter.

Emergency toilets: makeshift toilets on the lawn, which are set up in the form of pervious cesspools, are equipped with rainwater collection and recycle system, utilizing rainwater at ordinary times and coming into service after simple shelters are built in case of an emergency.

5.1.1.5 Plants of disaster prevention in refuge areas
In the Huapu Park stand the fire-resistant and quake-resistant trees with dense canopies and resilient trunks encompassing ginkgoes, weeping willows, elms, hollies, and Robinia pseudoacacia, as well as the healthful plants comprising ginkgoes, Crataegus pinnatifida, Styphnolobium japonicum, Robinia pseudoacacia, and Acer monoës which are conducive to sterilization and healthcare. Plants resistant to disasters abound and vary with pleasing and reasonable match and arrangements. Blossoms are visible for appreciation in three seasons while plants remain green throughout the year.

5.2. Interactive participation
The Covid-19 makes people suddenly realize their increasingly improvement of “tolerance to the absence of nature”, in particular among the new “data generation” whose linkages with nature are weak. In this case, community parks in urban areas play an essential role in nature education among citizens and the next generation. Resident-friendly community parks help people enrich their life experience and cognition, and satisfy people’s innate needs for nature.

5.2.1. Horticultural therapy
The Huapu Park is constructed in the mode of “embedded” rehabilitative and participatory landscapes[4], namely setting up small sites in Baihua Garden. Plant combinations utilizing different varieties create a colorful and sensuous space, ameliorating sub-health. The micro environment of rehabilitative and participatory landscapes is built mainly based on space, sunshine, plants, and water bodies, restoring people’s psychological and mental health by means of stimulating the senses of sight, hearing, smell, and touch.

Various herbaceous plants in Baihua Garden present the effect that a sea of flowers is greeting guests. The sheer abundance of well-arranged and colorful flowers and trees helps people relieve negative emotions [5]. Aromatic herbs of different colors are planted in separate plots of land of
Baihua Garden: Dutch chrysanthemum, sedum spectabile, and Dianthus chinesis appear pink in color; Hemerocallis baltimore oriole and Coleus are red; Heliopsis helianthoides, Hemerocallis cv. and Coreopsis grandiflora Hogg. appear yellow. In Baihua Garden, weeding, scarifying the soil, watering and other horticultural activities that family members engage in are favorable for them to obtain a direct impression of plants and establish close connection, which underlies nature education and have a widespread influence.

5.2.2. Economic activities
The aquarium and flower exhibition center, the most favorite among respondents, is an area where children and old people visit and buy tickets at a high frequency. It, a site for supplies storage in case of an emergency and for science popularization among tourists about plants at ordinary times, also generates more revenue for the park, which helps realize the sustainable development target to maintain a coordinated and virtuously sustained growth between socioeconomic and ecological benefits. Largely the relationship between socioeconomic and ecological benefits can be considered an epitome of sustainable development philosophy in the micro field of community. Ecological improvement in community parks boost economic benefits, and conversely environmental degradation is accompanied by decline in economic revenue.

6. Conclusion
The Huapu Park remains the sole community park in the district of Duandian North Road that has a far longer service radius than 1,000 m as specified in the Standard for Classification of Urban Green Space, while the nearby residential communities are densely distributed and have a large population, compounding the challenge facing routine operation and management. Disputes and conflicts pertaining to the use of public space frequently arise among different groups once any effort to satisfy user’s demand fails. The Huapu Park in Jinan City proves highly effective in resolving such contradictions occurring during use, and meanwhile integrates multiple benefits comprising emergency and disaster prevention, sponge complex, rehabilitation and participation, and economic revenue, from which experience can be drawn on to help construct resident-friendly community parks.

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