Urban Pocket Park System Planning Based on Low Carbon Comprehensive Benefits: A Case Study of Chaowai District in Beijing

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Abstract Low carbon landscape development is an emerging approach of landscape design, which aims to promote sustainable development, and reduce energy consumption and environmental impact by reducing carbon emissions. As an important component of low carbon landscape construction, the construction of urban pocket park system based on mini-parks plays a crucial role in improving the urban greening level, increasing the urban green space, alleviating the urban pressure, improving the living and healthy environment of urban residents, and promoting the urban ecological balance. Taking Chaowai district of Beijing as an example, this paper calculates the ecological value of trees including energy contribution, carbon sequestration, ability to improve rainfall runoff and aesthetic value by collecting the information of trees and the plot on which the trees are located through the i-Tree platform, which provides important reference value for the urban pocket park system planning to create low carbon comprehensive benefits.
Keywords Low carbon benefits, Pocket park, Green space planning, i-Tree platform
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The intensification of global climate change and the accelerating process of urbanization make the healthy development of cities face many challenges. Urban greening is an important part of livable city construction. The i-Tree platform can calculate the ecological value of trees including energy contribution, carbon sequestration, ability to improve rainfall runoff and aesthetic value by collecting the information of trees and the plot on which the trees are located, thereby providing strong support for urban greening system planning. As an important component of urban greening, the construction of urban pocket park system based on mini-parks plays a crucial role in improving the urban greening level, increasing the urban green space, alleviating the urban pressure, improving the living and healthy environment of urban residents, and promoting the balance of urban ecology in the stock era. Therefore, taking the pocket park in Chaowai district of Beijing as the research object, based on low carbon comprehensive benefit assessment, this paper plans and designs the urban pocket park system by using the data operation and information support of i-Tree platform.

1 Brief introduction of i-Tree platform

The i-Tree software platform is a tool to calculate the ecological benefits of urban and neighborhood green resources. It comes from the US Forest Service and can be used to evaluate the ecological benefits and low carbon comprehensive benefits of trees. The practice proves that the application of i-Tree model can effectively improve the structure, and then increase the economic benefit. In order to accurately evaluate the economic benefits of urban forest and street trees, it is necessary to select an appropriate sample plot and collect the information of trees on the plot, including tree species, category, height, DBH, crown width, crown health, crown light, distance and direction to the nearest building, etc. for data recording. By analyzing these data, we can better understand their basic structure, including species composition, tree density, diameter class distribution, and crown width, and further explore other roles of plants, such as energy contribution, carbon sequestration, ability to

Column introduction

The urban pocket park system, which is dominated by mini-parks, plays a vital role in improving the urban greening level, increasing the urban green space, alleviating the urban pressure, improving the living and healthy environment of urban residents, and promoting the urban ecological balance. Current city observer column focuses on the low carbon comprehensive benefits of urban pocket parks in Chaowai district of Beijing, and performs relevant analysis based on the data of the i-Tree platform, hoping that the urban pocket park will not destroy the ecological environment in the construction process, use green building materials and green construction standards for construction, and truly implement the construction concept of "low carbon green city".

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improve rainfall runoff, and aesthetic value. The data mentioned above are not the total ecological value of urban trees, which also play an important role in reducing building energy consumption, regulating local air temperature, reducing noise pollution, improving health and well-being, providing wildlife habitat, and even promoting community solidarity[1]. Overall, i-Tree model and low carbon comprehensive benefit assessment have certain application value in urban forest economic benefit assessment, which can further help urban planners and landscape managers to make multidimensional comprehensive decisions on urban green space planning and management, and formulate urban greening goals with long-term strategic development value. Low carbon comprehensive benefit assessment can also help people better understand and value the importance of trees, protect and manage tree resources, and promote the construction of urban greening.

2 Current situation interpretation of Chaowai district in Beijing

Chaowai district is subordinate to the Chaoyang District of Beijing, and is named because it is outside the Chaoyang Gate[2]. Chaowai district is integrally located in the core area of Chaoyang District, neighboring Chaowai Street in the north, Fangcaodi North Lane in the south, Kuntai Jiahua Hotel in the west, and Workers Stadium East Road in the east. The planned plot is in an inverted “L” shape, covering an area of about 200 hm^2 (Fig.1).

2.1 Large regional carbon emissions

The lack of carbon assessment before landscape planning and design leads to excessive carbon footprint during construction. The Chaowai district is full of high-rise buildings, with large building density, large floor area ratio, many construction projects and high land utilization rate, resulting in a large amount of carbon emission in some areas[3].

2.2 Poor continuity and unity of landscape

The spatial street environment lacks integrity and unity, and there is no unified style and color of landscape space design. The spatial form and landscape level lack unity, while the street landscapes are short of connections, and are filled with a large number of closed residential areas and commercial buildings, leading to poor continuity of landscape experience.

2.3 Unreasonable plant arrangement and insufficient carbon sequestration capacity

Simple species of plants have been selected, and there is no plan for cultivated plant community, with single cultivation form. The low proportion of green cover and the fragmentation of green spatial structure will lead to the decline of the overall spatial carbon sequestration capacity of green vegetation[4].

2.4 Insufficient landscape planning space

Green space has not been planned sufficiently. The use of hardened ground in a large area, the blind pursuit of design sense in buildings and public spaces, the lack of flexible space, and the abuse of energy-consuming materials further increase the carbon emissions in the region[5].

2.5 Poor retention of landscape space

There are few space and facilities for people to stay and rest for a short time, no relaxing outdoor gray space or plant landscape, and the landscaping function of plant landscape can not be brought into play[6].

2.6 Heavy traffic flow in the district

A large number of vehicle exhaust emissions and traffic noise affect the street environment of the district, and increase carbon emissions. Meantime, a large number of traffic flows through the area cause certain security risks.

2.7 Imbalance of urban form

Too single property development of Chaowai district results in insufficient complex function, which makes the whole area less diverse in form. Particularly, the street space is transformed into shopping centers and office areas, and the commercial and living functions are mixed, forming a large number of overlapping plots.

2.8 Low carbon benefit assessment of street greening in the district

According to the calculation and analysis of various ecological benefits mentioned in Chaowai district by i-Tree model (Table 1), the annual ecological benefit of *R. pseudoacacia* is the largest of 54,345.17 dollars, accounting for 28.58% of the overall average annual benefits, with a considerable proportion. From the perspective of various comprehensive benefits, the energy-saving benefit of landscape trees is the most obvious, accounting for about 20.23% of the total benefits; followed by the benefits of rainwater interception, carbon sequestration and air quality improvement; and the benefit of air quality improvement is the least, accounting for only 0.04% of the total[7].


Fig.1 Red line range of the planned plot of Chaowai district

3 Pocket park system planning ideas of Chaowai district

3.1 Site function planning

According to the geographical location and the needs of surrounding population, the public space can be divided into three types: ribbon-like road rest landscape, point-like open interactive landscape and block-like regional functional landscape. The ribbon-like road rest landscape includes the road landscape belt along the Second Ring Road and the landscape belt along the Third Ring Road, which are mainly for pedestrians and workers in surrounding buildings and office buildings. The point-like open interactive landscape is mainly located near residential areas and public spaces with large flow of people, providing a quiet natural landscape for relaxation, fitness for the elderly, closeness to nature, rest and health, and also helping to enhance neighborhood feelings and promote community exchanges and communication. The block-like regional functional landscape generally covers a large area and is located on public land with actual and urgent functional needs, including traffic function, parking function, rest function, walking function and fitness function blocks, providing more targeted and effective services for surrounding residents and users (Fig.2).

3.2 Road traffic system planning

A bicycle-oriented landscape slow traffic system connects 10 landscape nodes with different functions in series, which not only increases the accessibility of each node, but also provides the convenience of the urban slow traffic system in the red line of Chaowai district, providing convenient green traffic methods for citizens. Meantime, bicycle storage points and sheds are also designed and increased in the site, which integrate with external traffic environment as well as subway, public transportation and other green transportation modes inside the site, and further improve the accessibility of the site, so as to achieve the purpose of encouraging low-carbon and green travel of users.

3.3 Low carbon design means

The public space within the red line of Chaowai district is divided into 10 landscape nodes with different functional areas, including

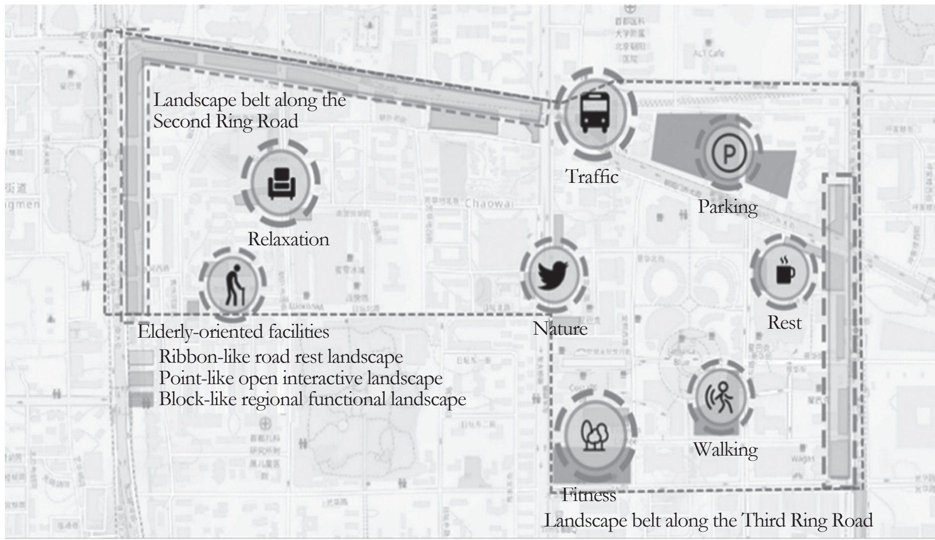


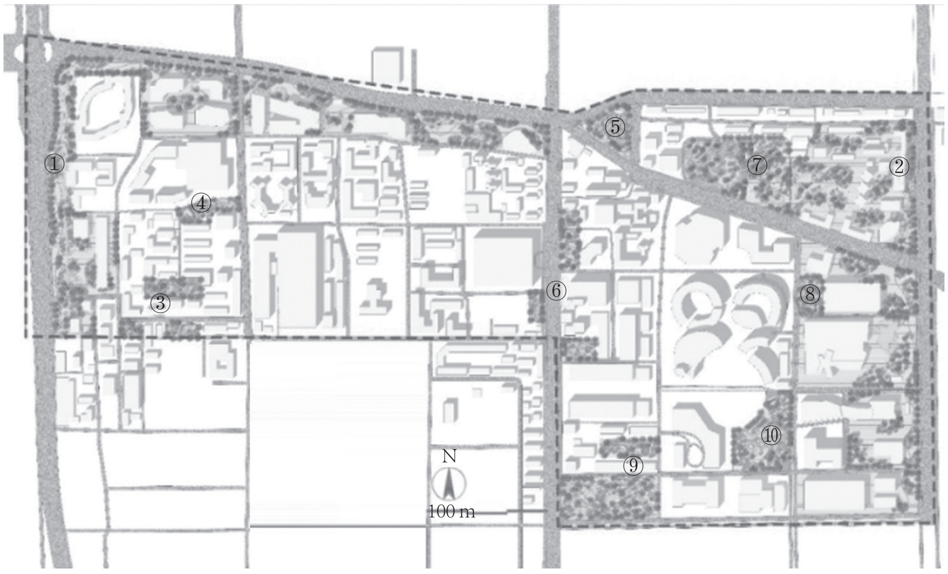
Fig.2 Function planning of pocket park system in Chaowai district

Table 1 Average annual benefit of current tree species in urban pocket parks in Chaowai district dollars

Species	Energy	CO_2	Air quality	Rainwater interception	Aesthetics/Other	Total	Standard error	Percentage of the total amount//%
Malus spectabilis	196.12	1,683.02	6.96	145.40	17,488.25	19,519.76	(N/A)	10.27
Robinia pseudoacacia	2,563.97	11,942.56	73.66	1 137.87	38 627.11	54,345.17	(N/A)	28.58
Ginkgo biloba	990.76	4,671.30	21.35	472.46	12,890.25	19,046.13	(N/A)	10.02
Prunus salicina	216.61	1,038.46	6.90	93.78	3,721.91	5,077.66	(N/A)	2.67
Ligustrum × vicaryi	86.16	382.51	3.61	50.86	418.70	941.84	(N/A)	0.50
Pinus spp.	182.14	858.43	−35.02	217.49	6,685.04	7,908.08	(N/A)	4.16
Amygdalus davidiana	214.14	1,083.36	6.94	92.72	2,446.78	3,843.95	(N/A)	2.02
Platycladus orientalis	266.65	1,226.59	−39.58	284.91	6,043.45	7,782.03	(N/A)	4.09
Yulania denudata	116.96	567.05	3.74	50.64	1,872.37	2,610.75	(N/A)	1.37
Fraxinus spp.	809.36	3,490.94	26.73	502.17	9,152.15	13,981.36	(N/A)	7.35
Prunus cerasifera	98.03	471.74	3.13	42.44	1,646.26	2,261.60	(N/A)	1.19
Eugenia caryophyllata	53.33	227.77	1.64	23.08	1,522.38	1,828.19	(N/A)	0.96
Sabina chinensis	149.38	694.65	−25.09	167.97	4,320.70	5,307.60	(N/A)	2.79
Koelreuteria paniculata	283.55	1,652.18	9.31	132.58	1,854.64	3,932.26	(N/A)	2.07
Acer palmatum	48.97	278.33	1.28	26.29	1,119.65	1,474.52	(N/A)	0.78
Rosa xanthina	47.71	227.87	1.52	20.65	838.17	1,135.92	(N/A)	0.60
Platanus × acerifolia	331.96	1,436.21	−3.52	192.29	3,674.74	5,631.67	(N/A)	2.96
Sorbaria sorbifolia	60.94	303.68	1.97	26.39	796.94	1,189.92	(N/A)	0.63
Populus tomentosa	447.77	2,083.93	12.82	195.41	6,689.18	9,429.10	(N/A)	4.96
Fraxinus chinensis	40.78	166.86	1.39	14.85	1,238.79	1,462.68	(N/A)	0.77
Pinus thunbergii	39.03	183.95	−7.50	46.61	1,432.51	1,694.59	(N/A)	0.89
Acer palmatum	6.12	51.39	0.13	3.91	2,729.18	2,790.72	(N/A)	1.47
Salix babylonica	154.07	743.66	3.03	116.62	2,339.51	3,356.88	(N/A)	1.77
Zelkova serrata	264.18	1,238.56	7.66	120.11	3,931.70	5,562.22	(N/A)	2.93
Cedrus deodara	35.72	240.48	1.34	21.02	671.96	970.53	(N/A)	0.51
Ulmus pumila	136.85	779.46	4.31	91.83	2,990.94	4,003.39	(N/A)	2.11
Pinus bungeana	85.04	384.16	−9.90	83.06	1,055.89	1,598.26	(N/A)	0.84
Crataegus pinnatifida	21.08	102.10	0.67	9.13	340.00	472.99	(N/A)	0.25
Abies fabri	38.12	172.38	−4.51	37.43	495.53	738.96	(N/A)	0.39
Sabina chinensis	10.70	74.34	0.40	7.07	159.20	251.72	(N/A)	0.13
Total	7,996.24	38,457.92	75.37	4,427.03	139,193.89	190,150.44	(N/A)	100.00

landscape belt along the Second Ring Road, landscape belt along the Third Ring Road, elderly-oriented community interactive landscape, productive community rest landscape, transportation center, closeness to nature, three-dimensional parking, sunken rest space, micro urban wetland park, and low carbon education exhibition base, striving to better serve the users of public space in the district in the context of low carbon landscape design(Fig.3).

The terrain inside the site is flat without height difference. In addition to some special terrain processing in necessary places, it is unchanged to reduce the amount of earthwork and mechanical operations, so as to reduce the carbon emissions generated in landscape construction. The natural plant community in the field is protected and enriched, and the area of woodland, lawn and wetland is increased to enrich the diversity of species, which can effectively sequester carbon, increase natural carbon sink, and improve the ecological and landscape value. More vegetation layer structures



Legend
① Landscape belt along the Second Ring Road
② Landscape belt along the Third Ring Road
③ Elderly-oriented community interactive landscape
④ Productive community rest landscape
⑤ Transportation center
⑥ Closeness to nature
⑦ Three-dimensional parking
⑧ Sunken rest space
⑨ Micro urban wetland park
⑩ Low carbon education exhibition base

Fig.3 General layout of urban pocket park system planning in Chaowai district

Table 2 Average annual benefit of all trees in urban pocket park landscape planning nodes of Chaowai district dollars

Species	Energy	CO_2	Air quality	Rainwater interception	Aesthetics/Other	Total	Standard error	Percentage of the total amount//%
S. sorbifolia	54.72	233.68	1.68	23.68	1,561.92	1,875.68	(N/A)	0.78
P. × acerifolia	463.00	2,003.13	−4.91	268.19	5,125.29	7,854.70	(N/A)	3.28
Fraxinus spp.	1,452.28	6,245.66	47.93	902.32	16,810.06	25,458.25	(N/A)	10.64
R. pseudoacacia	3,052.68	14,253.32	88.02	1,367.72	45,800.77	64,562.52	(N/A)	26.99
F. chinensis	24.36	144.43	0.61	14.26	759.12	942.78	(N/A)	0.39
M. spectabilis	277.09	2,356.33	9.81	206.16	25,801.50	28,650.89	(N/A)	11.98
Z. serrata	13.21	61.93	0.38	6.01	196.59	278.11	(N/A)	0.12
S. babylonica	74.04	357.95	1.44	56.86	1,171.95	1,662.24	(N/A)	0.69
Salix matsudana	7.39	35.74	0.14	5.68	117.21	166.17	(N/A)	0.07
Populus tomentosa	513.61	2,390.39	14.70	224.15	7,672.88	10,815.73	(N/A)	4.52
R. xanthina	38.39	181.82	1.22	16.62	707.32	945.36	(N/A)	0.40
A. palmatum	18.35	154.16	0.38	11.73	8,187.54	8,372.15	(N/A)	3.50
L. × vicaryi	124.07	550.81	5.20	73.24	602.93	1,356.25	(N/A)	0.57
P. cerasifera	275.67	1,320.11	8.78	119.34	4,768.25	6,492.15	(N/A)	2.71
Pinus tabuliformis	232.56	1,096.03	−44.71	277.69	8,535.37	10,096.93	(N/A)	4.22
Hibiscus syriacus	72.41	362.29	2.34	31.35	914.73	1,383.12	(N/A)	0.58
Prunus davidiana	250.56	1,278.62	8.15	108.49	2,623.59	4,269.41	(N/A)	1.78
C. deodara	3.57	24.78	0.13	2.36	53.07	83.91	(N/A)	0.04
Aesculus chinensis	28.41	111.75	0.96	10.20	896.41	1,047.73	(N/A)	0.44
P. orientalis	330.94	1,527.90	−51.29	359.82	8,196.34	10,363.71	(N/A)	4.33
P. bungeana	66.79	310.50	−11.18	75.00	1,920.60	2,361.70	(N/A)	0.99
P. thunbergii	43.91	206.94	−8.44	52.43	1,611.57	1,906.41	(N/A)	0.80
C. pinnatifida	22.44	108.71	0.72	9.72	361.35	502.94	(N/A)	0.21
U. pumila	372.93	2,185.22	12.23	174.77	2,401.32	5,146.47	(N/A)	2.15
G. biloba	1,276.08	6,016.56	27.48	611.18	16,235.13	24,166.43	(N/A)	10.10
E. caryophyllata	126.43	588.83	3.99	54.73	2,547.54	3,321.52	(N/A)	1.39
S. chinensis	1.98	13.36	0.07	1.17	37.33	53.92	(N/A)	0.02
A. fabri	4.77	21.55	−0.56	4.68	61.94	92.37	(N/A)	0.04
Sabina chinensis	118.71	535.93	−13.69	115.57	1,431.18	2,187.71	(N/A)	0.91
Y. denudata	225.38	1,105.68	7.24	97.58	3,325.60	4,761.48	(N/A)	1.99
Koelreuteria paniculata	273.69	1,558.91	8.62	183.66	5,981.89	8,006.77	(N/A)	3.35
Total	9,840.41	47,343.03	117.44	5,466.33	176,418.28	239,185.50	(N/A)	100.00

can be constructed to simulate natural community, and tree, shrubs and grasses are matched with each other to form a wild garden landscape. In landscape design, waste materials and renewable materials are extensively used, reconstructed and refitted, and self-generated waste is recycled to achieve the purpose of material recycling and carbon emission reduction[8]. Local materials and plants are selected to reduce energy consumption and lower carbon emissions caused by carbon footprint generation. Low carbon sports devices are set up in the park, and the energy generated by sports is used for daily maintenance of the park, guiding people to carry out daily low carbon sports in the park, and promoting low carbon concepts while obtaining green energy.

3.4 Low carbon comprehensive benefit assessment after pocket park system planning in Chaowai district, Beijing

According to the calculation and analysis of various ecological benefits of Chaowai district mentioned by the i-Tree platform (Table 2), the annual ecological benefit after the design and renovation of 10 landscape nodes is 239,185.50 dollars, with an increase of 49,035.06 dollars compared with 190,150.44 dollars before the design and renovation. The weighted average ecological benefit of a single landscape tree is 86.34 dollars. As shown in Table 2, the annual ecological benefit of *R. pseudoacacia* is the largest of 64,562.52 dollars, accounting for about 26.99% of the overall annual average benefit, with a considerable proportion. From the perspective of ecological benefits, the carbon sequestration benefit of landscape trees is the most obvious, accounting for about 19.8% of the total benefits; followed by the benefits of energy efficiency, rainwater interception and air quality improvement; and the benefit of air quality improvement is the least, accounting for only 0.05% of the total[9].

Among the 10 landscape nodes planned and designed, the annual ecological benefit of district 2 is the largest of 76,496.30 dollars, accounting for 24.74% of the total ecological benefits. The annual ecological benefit of district 4 is the smallest of 6,680.38 dollars, accounting for 2.16% of the total ecological benefits (Table 3).

4 Summary and prospects

Taking the urban pocket park system planning of Chaowai district of Beijing as an example, this paper discusses the construction and management of urban pocket park system based on the i-tree platform, and puts forward the corresponding planning strategy. To further exert the important role of urban pocket park and its role in green city construction, it is necessary to further improve the planning and design of urban pocket park in the urban green space system[10].

In terms of plant arrangement in the landscape planning of pocket park system in Chaowai district, the i-Tree software has been employed to analyze the tree species used in the design (Table 4). Among all the landscape trees in the site, *Z. serrata* has the highest average annual ecological benefit of 278.11 dollars, and the largest energy efficiency of 13.21 dollars; *P. tomentosa* has the highest carbon sequestration benefit of CO_2 absorption (61.29 dollars); *Z. serrata* and *P. tomentosa* have the same ecological benefit to air quality (0.38 dollars), higher than other tree species; *R. pseudoacacia* has the largest ecological benefit of rainwater interception (5.75 dollars). Therefore, in the pocket park system planning in Chaowai district, the number of *Z. serrata*, *P. tomentosa* and *R. pseudoacacia* should be increased correspondingly in the selection of plant arrangement. Of all the landscape trees in the site, *L.× vicaryi* has the lowest average annual ecological benefit (6.28 dollars); *A. palmatum* has the lowest energy efficiency (0.27 dollars) and the lowest carbon sequestration benefit of CO_2 absorption (2.23 dollars); *A. fabric* has the lowest ecological benefit to air quality (−0.56 dollars); *A. palmatum* has the lowest ecological benefit of rainwater interception (0.17 dollars). Combined with the current situation, although the ecological benefit of a single plant of *L.× vicaryi* is small, it will not be transformed too much because of its small footprint and easy planting. In addition to planting more trees and plants with high carbon sinks, it is also necessary to consider the carbon emissions generated by human resources, fertilizers, water, and mechanical operations used to maintain these trees, so as to achieve the low carbon benefit value of the whole life cycle.

The planning of urban pocket park system should take into account the functional needs of urban green space, improve the applicability and sustainability of green space, and pay attention to landscape beautification, which should be in line with the purpose of urban pocket park construction. The management and maintenance of urban pocket parks should be strengthened in strict accordance with the regulations of urban park management, including the management and maintenance of greening, safety, health, etc., to ensure the cleanliness and safety of the park environment, so as to improve the utilization rate of the park. The ecological environment evaluation mechanism of urban pocket parks can also be established to strengthen the protection and supervision of the park environment and ecological environment, ensuring that the urban pocket park will not destroy the ecological environment in the construction process, use green building materials and green construction standards for construction, and truly implement the construction concept of "low carbon green city"[11].

Table 3 Total annual benefits of trees divided by region in urban pocket park landscape planning nodes in Chaowai district dollars

District	Energy	CO_2	Air quality	Rainwater interception	Aesthetics/Other	Total	Standard error	Percentage of the total amount//%
1	2,930.62	14,133.02	28.84	1,661.79	53,906.23	72,660.49	(N/A)	23.50
2	3,389.93	15,947.61	50.35	1,891.09	55,217.33	76,496.30	(N/A)	24.74
3	416.47	2,106.73	4.56	226.25	7,313.89	10,067.90	(N/A)	3.26
4	143.68	744.02	−3.39	103.49	5,692.59	6,680.38	(N/A)	2.16
5	295.64	1,425.62	3.91	159.62	6,435.48	8,320.28	(N/A)	2.69
6	665.91	3,350.63	8.16	364.02	10,794.49	15,183.21	(N/A)	4.91
7	682.50	3,383.17	2.41	385.57	15,954.37	20,408.02	(N/A)	6.60
8	463.64	2,212.94	10.35	222.61	9,443.17	12,352.71	(N/A)	4.00
9	3,251.92	15,383.35	40.91	1,800.31	55,204.19	75,680.69	(N/A)	24.48
10	417.14	2,246.15	0.33	242.93	8,418.42	11,324.96	(N/A)	3.66
Total	2,930.62	14,133.02	28.84	1,661.79	53,906.23	309,174.96	(N/A)	100.00

Table 4 Average annual benefit of all trees in urban pocket parks of Chaowai district dollars/tree

Species	Energy	CO_2	Air quality	Rainwater interception	Aesthetics/Other	Total	Standard error
G. biloba	3.95	18.63	0.09	1.89	51.25	75.81	(N/A)
M. spectabilis	0.83	7.14	0.03	0.62	74.98	83.61	(N/A)
R. pseudoacacia	12.94	60.32	0.37	5.75	194.60	273.99	(N/A)
P. cerasifera	1.19	5.67	0.04	0.51	20.94	28.34	(N/A)
L. × vicaryi	0.57	2.55	0.02	0.34	2.79	6.28	(N/A)
A. davidiana	1.85	9.31	0.06	0.80	22.52	34.55	(N/A)
P. tabuliformis	1.63	7.66	−0.31	1.94	59.69	70.61	(N/A)
S. chinensis	2.05	9.55	−0.35	2.31	59.99	73.57	(N/A)
E. caryophyllata	1.25	6.00	0.04	0.54	21.08	28.91	(N/A)
Y. denudata	1.34	6.51	0.04	0.58	21.31	29.79	(N/A)
S. sorbifolia	0.69	2.96	0.02	0.30	19.77	23.74	(N/A)
P. orientalis	2.72	12.50	−0.40	2.90	60.47	78.19	(N/A)
F. chinensis	0.90	5.14	0.02	0.49	21.19	27.74	(N/A)
Fraxinus spp.	9.49	40.94	0.31	5.88	106.62	163.25	(N/A)
K. paniculata	4.43	25.82	0.15	2.07	28.98	61.44	(N/A)
S. babylonica	7.58	36.62	0.15	5.75	117.03	167.13	(N/A)
R. xanthina	1.27	6.12	0.04	0.55	21.14	29.11	(N/A)
P. × acerifolia	8.74	37.79	−0.09	5.06	96.70	148.20	(N/A)
Aesculus chinensis	1.48	6.11	0.05	0.54	44.61	52.79	(N/A)
Z. serrata	13.21	61.93	0.38	6.01	196.59	278.11	(N/A)
H. syriacus	1.69	8.44	0.05	0.73	22.14	33.05	(N/A)
A. palmatum	0.27	2.23	0.01	0.17	118.66	121.34	(N/A)
P. tomentosa	13.17	61.29	0.38	5.75	196.74	277.33	(N/A)
P. bungeana	1.98	13.36	0.07	1.17	37.33	53.92	(N/A)
P. thunbergii	1.63	7.66	−0.31	1.94	59.69	70.61	(N/A)
C. pinnatifida	1.33	6.44	0.04	0.58	21.28	29.67	(N/A)
S. chinensis	4.85	21.94	−0.57	4.76	62.01	92.99	(N/A)
U. pumila	8.05	45.85	0.25	5.40	175.94	235.49	(N/A)
A. fabri	4.77	21.55	−0.56	4.68	61.94	92.37	(N/A)
S. matsudana	7.39	35.74	0.14	5.68	117.21	166.17	(N/A)
C. deodara	3.57	24.78	0.13	2.36	53.07	83.91	(N/A)
Total	3.59	17.28	0.03	2.00	63.44	86.34	(N/A)

References

[1] Danielle, H., Stuart, B. (2021). *Oxford i-Tree eco report 2021*. Falmouth: Treeconomics.

[2] Qian, Q. L., Chen, Y. B. (2007). Modern manufacturing industrial competitiveness cultivating in developed districts: Taking Chaoyang District of Beijing city as an example. *Economic Geography*, (1), 117-121.

[3] Zhao, M. H., Feng, Y. X. & Feng, J. X. (2022). Landscape planning and design of small towns in Kaifeng from the perspective of "double carbon". *Xiandai Horticulture*, *45*(15), 142-143.

[4] Yang, X., Gao, W. W. & Li, S. et al. (2022). Research on correlation between carbon storage estimation based on remote sensing image and climate environment in central urban area of Beijing. *Landscape Architecture*, *29*(5), 31-37.

[5] Yang, X., Zhang, Q. & Xue, W. D. (2023). A study on the evaluation and refinement of low-carbon benefits of urban street green space: A case study of Xinjiekou District in Beijing. *Landscape Architecture Academic Journal*, *40*(1), 25-33.

[6] Anastasia, N., Kathryn, M. & Peter, J. L. (2019). Making sustainable regional design strategies successful. *Sustainability*, *11*(4), 1024.

[7] Zhang, Y. Y., Zhou, C. L. & Dong, Y. Z. et al. (2013). Composition and ecological benefits of street trees in Shinan District of Qingdao City, Shandong Province based on i-Tree Model. *Chinese Journal of Ecology*, *32*(7), 1739-1747.

[8] Wang, H. C., Yang, N. (2018). Low carbon development and cooperation innovation: The construction and management of Tianjin low carbon creative garden. *Chinese Landscape Architecture*, *34*(S2), 34-38.

[9] Xue, X. Y., Zhao, J. & Shi, M. M. et al. (2018). Ecological benefit evaluation of street trees in Zhengzhou City based on i-Tree Model. *Henan Science*, *36*(9), 1460-1467.

[10] Zhu, S. H. (2014). Ecological approach for low-carbon landscape architectural design. *Applied Mechanics and Materials*, *2935*(484-485), 677-681.

[11] Li, F. Q., Lei, F. & Lian, F. Y. et al. (2010). A study on urban low-carbon landscape construction. *Advanced Materials Research*, *983*(129-131), 42-45.