Plant Landscape Configuration Method of Regional Characteristic Rainwater Garden Based on Deep Learning

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Abstract. With the acceleration of urbanization and the continuous expansion and construction of cities, more and more cities in China are facing increasingly serious urban rainwater problems. As a rainwater management measure under the low impact development system, rainwater garden can manage and utilize rainwater resources. Therefore, a plant landscape configuration method of regional characteristic rainwater garden based on in-depth learning is proposed. By analyzing the types and characteristics of rainwater landscape facilities; Constructed rainwater garden runoff management system; Design the plant configuration scheme of wet area, semi-humid area, arid area and semi-arid area of rainwater garden; The plant landscape characteristic parameters are calculated based on the deep learning algorithm to complete the plant landscape configuration. Experiments show that the waterlogging tolerance index D of this rainwater garden landscape configuration method for different kinds of plant landscape is higher than that of the traditional configuration method, which can manage rainwater and improve the ecological environment at the same time.

Keywords: Deep learning · Area · Rain garden · Plant landscape · Configuration method

1 Introduction

As a traditional best management measure, the rain garden is a rainwater management facility under a low-impact development system. The common form is a shallow recessed green space with landscape effects for planting shrubs, flowers, grass, and trees. It absorbs from urban roofs. Rainwater in impervious areas such as roads, sidewalks, parking lots, and impervious lawns, and through the purification, filtration and infiltration of soil and plants to manage rainwater runoff [1]. After more than two decades of development,

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related research and applications of rainwater gardens have become more abundant. The form and structure of rainwater gardens have also evolved and expanded with the continuous enrichment of application ranges and scales. The original more primitive rain garden was a kind of planting and land injection around the building. Its effect was mainly about the retention of rainwater, the purification of rainwater by plants and soil, and the infiltration of groundwater. The form and effect were relatively simple and single [2, 3]. With more and more abundant practice and exploration, modern rainwater gardens are becoming more and more efficient, scientific and reasonable in the function of rainwater management, and more flexible and rich in application scales, which in turn brings more changes in the form of landscape expression, landscape art The design space has also been greatly improved. Today's rainwater gardens are more scientific in the control of rainwater volume and water quality, and the rainwater management system surrounding rainwater gardens is also more systematic [4].

The rich application scale and changeable expression forms also expand the landscape expression space of today's rainwater garden. Therefore, the rainwater garden has developed from an engineering measure for site development of simple rainwater management to a landscape infrastructure, which has been greatly improved in both functionality and artistry. It can be said that the original rainwater garden is a site rainwater management measure with certain landscape value, while today's rainwater garden is more landscape design works integrated with the concept of rainwater management [5]. During the operation of rainwater garden, rainwater is collected from the site and treated in combination with its own soil, vegetation and related facilities. Deep learning (DL) is a subset of machine learning (ML). Inspired by human brain, DL adopts multi-layer interconnected artificial neural network algorithm. Modern deep learning usually adopts tens or even hundreds of layers of neural network structure. Each layer is gradually abstracted on the basis of the previous layer, and finally features are extracted from the training data. The deep learning algorithm is used to realize the automatic design of plant images, and the algorithm is embedded in mobile app and applied to the configuration of garden plant landscape [6–8].

In summary, this article proposes a deep learning-based method for configuring the landscape of regional rainwater garden plants. By using the multi-media effects of vegetation, microorganisms and soil, it provides storage space for rainwater runoff in and around the site to achieve collection and purification. The purpose of rain. In terms of ornamental value, the landscape form of the rain garden presents the beauty of nature. The appearance of the rain garden has the beauty of the traditional garden. It provides citizens with a comfortable place to relax, relax, and relieve fatigue. It can also use the power of nature to change the previous rainwater gathering. The phenomenon of water deterioration and mosquitoes in the land has promoted the closeness of the citizens to the natural environment.

2 Regional Featured Rainwater Garden Plant Landscape Configuration Method Based on Deep Learning

2.1 Analysis of the Types and Characteristics of Rainwater Garden Landscape Facilities

From the perspective of the functional objectives of rainwater management, rainwater garden is firstly an engineering measure. Technically, the construction of rainwater garden is a very specific and detailed work. Excellent and outstanding rainwater garden design requires the close cooperation between landscape designers and environmental engineers, and the engineering and landscape should be combined with each other [9, 10]. Reasonable engineering design and construction is the basis of exerting the efficiency of rainwater management and landscape optimization design. Firstly, taking the ground part of the main structure of the rainwater garden as the reference, this paper summarizes and divides the elements that have an important impact on the design of the rainwater garden.

Topography
The topography is manifested as the undulating changes of the topography on the surface. The topography is closely related to the formation of surface runoff. The topography and landform determine the natural drainage mode of the site. Rainwater that falls to the ground will form surface runoff when it has not evaporated and penetrated into the soil. Rainwater runoff, runoff direction and runoff speed are closely related to topography [11, 12]. Regulating surface drainage and guiding the direction of water flow are an important and inseparable part of the garden landscape design. Therefore, for the construction of rainwater gardens, the topographical planning and design is the key to the effective collection and management of rainwater. A comprehensive analysis and research of the site topography is an important prerequisite for deciding what rainwater management measures to take and the planning and layout of corresponding facilities in the site. From the perspective of runoff collection and management, the vertical design of the site and the planning and layout of rainwater management related facilities are also carried out based on the original topography of the site.

Rainwater Garden Facilities
Facilities are the main structural support of rainwater garden and the main carrier of rainwater runoff guidance and collection. The facilities in the rainwater garden are mainly divided into structural facilities and rainwater management functional facilities. The structural elements are mainly the main body of the form of the rainwater garden and the landscape functional facilities, such as the form boundary of the rainwater garden and the facilities for visitors and maintenance personnel to enter the garden. Stormwater management functional facilities include relevant facilities that can collect, guide, retain and overflow runoff, such as transmission facilities, overflow facilities, etc. In the construction of rainwater garden, the construction of facilities is first based on meeting

the functional requirements, and then combined with the landscape design of materials and forms to achieve the effect of optimizing the landscape quality.

Rainwater Garden Vegetation

The growth forms of plants that cover most of the ground are diverse. Plants are the most important landscaping element in garden landscape design. Different regions have different plant varieties and plant communities. The shape, color, fragrance, habits and habits of plants are Seasonal landscape performance is the main ornamental characteristic of plants. Plant design and configuration are also an important part of site landscape construction. In addition to the value of landscape, the selection and configuration of plants in rainwater gardens also have important rainwater management functions.

Plants in rain gardens can alleviate many environmental problems, such as air purification, soil and water conservation, water conservation, temperature adjustment, and so on. The surface vegetation has the function of intercepting and conserving precipitation. The leaves and roots absorb part of the moisture from rainfall, dew and fog, and the remaining part of the precipitation penetrates through the soil to maintain the groundwater level or supplement the mouth of the underground aquifer. Plants have a variety of effects on the ecological environment of the site. The respiration of plants can absorb moisture in the soil and then dissipate it into the air in the form of water vapor through transpiration, replenishing air moisture; plants can also improve the microclimate in summer. Can resist the drying effect of wind and sun to maintain a cool environment.

Rainwater Management Function Layer

The rainwater infiltration and purification function layer refers to the structural layer with purification effect experienced by the rainwater in the rainwater garden in the process of infiltration before groundwater supplement or collection and utilization. The common corresponding structural functional layers include planting soil layer, filling layer and rolling stone layer.

Due to different regional characteristics and rainwater management objectives and systems, there are certain differences in the composition of specific functional layers and the main structural components of each layer. In the area with good soil permeability, the filler layer does not need to add artificial materials to improve the permeability, and its main components are generally consistent with the planting stop layer. For sites with poor soil permeability, the surface planting soil should be mixed and improved to ensure that it is suitable for plant growth and has certain permeability. The filler layer needs to be filled with natural or artificial materials to ensure the timely infiltration of rainwater.

The characteristics of rainwater runoff also affect the structural composition of the functional layer of rainwater garden. The rainwater garden with large amount of rainwater resources to be collected and managed or heavy rainwater pollution needs a larger scale and deeper functional layer to prolong the infiltration time of rainwater and fully filter and purify the rainwater. At this time, the composition and thickness of the filler layer are very important design elements. The growth characteristics of plants directly affect the thickness of planting soil layer. In rainwater gardens, vegetation with relatively developed roots is often selected to improve the purification effect of plants on rainwater. Therefore, the corresponding thickness of planting stop layer should ensure the normal growth of plants. Generally, the minimum thickness of planting King layer in rainwater gardens with trees is 120 cm, The minimum thickness of planting stop without trees is 60 cm.

2.2 Build a Runoff Management System for Rainwater Gardens

In the early stage of the design, the rainwater runoff management system of the rainwater garden should be constructed according to the site characteristics. The runoff management system of the rainwater garden constructed in this paper is shown in Fig. 1.

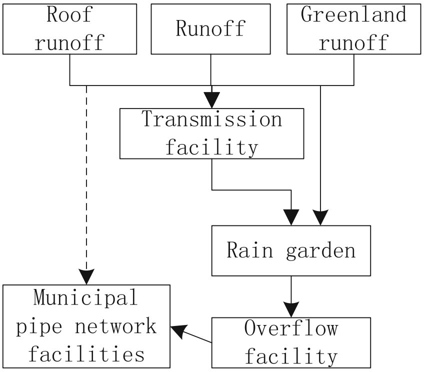

Fig. 1. Runoff management system structure of rainwater garden

As shown in Fig. 1, the rainwater garden mainly collects runoff from building roofs, ground paving, and surrounding green spaces. Part of the rainwater runoff from these areas flows directly into the rainwater garden, some directly into the municipal pipe network facilities, and most of the runoff directly or Indirectly combined with the guidance of the corresponding rainwater transmission facilities to flow to the rainwater garden, and the rainwater exceeding the treatment limit of the rainwater garden will also be discharged into the municipal pipe network facilities by the overflow facilities.

Therefore, the first step in the design of rainwater gardens needs to be combined with the runoff management system to determine the corresponding facilities and the horizontal position distribution of the rainwater garden in the site, so as to build a complete stormwater runoff control system in the site. The layout of facilities should follow the process of surface runoff conforming to the current terrain flow, and arrange transmission facilities, rainwater gardens and overflow facilities in sequence according to the runoff movement process, so as to gradually realize the orderly control of rainwater runoff in stages. Determine the location and distribution of the facilities and gardens. Further work is to clarify the design goals of the rainwater garden and the scale and scale of the garden based on the related characteristics of the site's rainwater runoff. Finally, before construction, the soil characteristics of the site should be carefully inspected, and the soil-related characteristics should be tested to determine the soil improvement plan.

The site selection of rainwater garden design should first consider the area that can conveniently and fully collect and utilize the rainwater runoff around the site. The location of rainwater garden should be located between the source of rainwater runoff and the area where it naturally ends in the landscape, rather than the farthest point that rainwater runoff can reach, because the main purpose of rainwater garden is to collect rainwater as much as possible before rainwater runoff reaches the farthest point, and the farthest point of runoff often means that the regional catchment energy is strong but the drainage performance is poor. In general, the site selection of rainwater garden should pay attention to the following aspects: make sufficient research on the underground pipe network facilities in the site to avoid the harm of rainwater infiltration to the pipe network facilities. The rainwater garden around the building shall be at least 2.5 m away from the building foundation to prevent infiltration runoff from affecting the building foundation. Rainwater from the roof of the building can be guided into the rainwater garden by downpipes; The rainwater garden should not be built in the area close to the water supply system or around the well, so as not to pollute the water source by the rainwater that is not purified in time; The rainwater garden is not a wetland and should not be located in the low injection land with frequent ponding. If the rainwater garden is selected on the site with poor soil drainage, a large amount of rainwater will gather in the rainwater garden, and the rainwater cannot infiltrate in time, which is not only unfavorable to plant growth, but also easy to breed mosquitoes; Choosing a flat site to build a rainwater garden will be easier and easy to maintain; Try to keep the rain garden on the sunny side, which is conducive to the growth of plants and the evaporation of rain; Coordinate the relationship between the location and landscape performance of the rainwater garden and the surrounding landscape environment.

The area and scale of the rainwater garden is determined by many factors, and the rainwater runoff that the site needs to collect and manage is the most critical factor that affects the scale of the rainwater garden. Generally speaking, the designed rainwater garden needs to absorb all the rainwater runoff that may reach it, so the drainage area of the entire drainage runoff into the rainwater garden can be estimated, and then the approximate area of the rainwater garden to be designed can be estimated.

The area of the drainage basin that collects rainwater runoff from the surface of the building should be determined by the distance between the rainwater garden and the building and the amount of water discharged from the downpipe into the rainwater garden. If the rainwater garden is less than 10 m away from the building, when all downpipe water is discharged into the rainwater garden, the approximate area of the building itself should be regarded as the basin area. If only part of the downpipe water is discharged into the rainwater garden, only the amount of runoff will be estimated Part of the roof area. If the distance between the rainwater garden and the building is greater than 10m, the drainage surface is not only the roof area, but also the approximate drainage area of the runoff formed. The area value can be estimated by measuring its length and width. There are many calculation methods for more accurate size calculation at home and abroad. The commonly used methods for calculating the area of rainwater gardens abroad are: infiltration method based on Darcy's law, effective aquifer volume method and proportional estimation method based on catchment area.

2.3 Landscape Configuration Design of Rainwater Garden Plants

Configuration of Runoff Control Plants in Humid Areas
The pollutants contained in rainwater are as follows: suspended solids (SS), organic pollutants (COD), chlorine, total phosphorus (TP), dissolved phosphorus, total nitrogen (TN), ammonium nitrogen, total iron, lead, zinc, etc., and are mainly suspended solids (SS) and organic pollutants (COD). It has the following characteristics: the variation range of pollutants is large and the randomness is strong; The pollutant concentration shows a downward trend with the duration of rainfall, and the initial rainwater quality is poor, especially the SS, COD and other indicators exceed the standard seriously; D. There is a good linear correlation between Pb, Zn and SS. SS is not only a pollutant itself, but also the particle surface that makes up it provides attachment conditions for other pollutants.

Due to the large rainfall in the humid area, a certain catchment area will be formed. Therefore, special consideration should be given to the decontamination capacity of wetland plants and aquatic plants. Some studies have shown that the purification ability of wetland plants to water is generally submerged plants > floating and floating leaf plants > emergent plants. Wetland plants with nitrogen and phosphorus removal function in the wet area of rainwater garden are shown in Table 1.

Table 1. Wetland plants with nitrogen and phosphorus removal function in humid areas

Plant type	Plant name
Emergent plants	Cress, Rush, Calamus, Canna, Water onion, Calamus, Yellow calamus Cattail, Di, Lythrum chinensis, Flat stalk recommended grass, Zaili flower, Papyrus, Carex, Luzhu, Barracuda, Cigu, Shilongwei, Alisma, Rumex sorrel, Feng Car grass, Vetiver, Saccharum, Broadleaf cattail, Reed, Wattle, Duck Commelina, Rice, Cattail, Wild rice
Floating plants	Water lily, Yellow water dragon, Gold anemone, Dadang, amphibians, Sophora japonica, Water Turtle, Nymphaea, Manjianghong, Ziping, Eichhornia crassipes, Hydrilla verticillata, Potentilla vulgaris, Potentilla glabra
Submerged plants	Ceratophyllum, Vallisneria, Potamogeton crispus, Hydrilla verticillata, Myriophyllum sp Pickled vegetables

As shown in Table 1, calamus and elephant grass have the best nitrogen removal effects, and windmill grass and calamus have the best phosphorus removal effects. Considering the decontamination ability, stress resistance and ornamental properties of wetland plants, calamus, elephant grass, windmill grass, cattails, jasmine rice, yam, spring yam, pike grass and red eggs are suitable for planting in humid areas. Terrestrial plants should also be matched with plants with strong decontamination ability as much as possible. Such as weeping willow, hibiscus, triangular maple, etc., have a certain adsorption effect on sulfur dioxide. Ficus microcarpa, Cinnamomum camphora, Luan tree, etc. which are resistant to oxygen fluoride, Ailanthus altissima, ash tree and Populus chinensis, etc., which are resistant to chlorine gas.

Reasonable matching design according to the purification effect of different plants can enhance the purification effect of plants. For example, plants with vigorous roots and good oxygen transport capacity are the best plant choices for removing BOD and N from water; for the purification of pollutants such as N, P, heavy metal ions and other organic matter, it is necessary to select plants with rapid growth ability and Plants with strong accumulation ability; the composition of urban precipitation becomes very complicated due to the different pollutants in the air. Therefore, when selecting plants, it is necessary to match plants with different root growth depths, so as to perform more comprehensive rainwater. Treatment: Plant density is directly proportional to the infiltration time of rainwater runoff. High-density planting will slow down the runoff speed and also help improve the purification effect. This kind of rain garden is suitable for selecting plant species that can grow quickly, have a well-developed root system, luxuriant branches and leaves, and have more sprouting peaks a year.

The rainfall in the humid area is large, so it is necessary to effectively control the rainwater runoff through the configuration of rainwater garden plants, increase the rainwater infiltration time and avoid siltation. Therefore, trees and shrubs with developed roots and flood resistance should be selected as the main plants. Such as Metasequoia, weeping willow, duying, mulberry, triangular maple, etc. Tall fescue, Pennisetum, iris, horseshoe gold and other waterlogging resistant plants with developed roots can be selected as the ground cover, which can not only slow down the runoff speed, but also achieve the natural connection with the surrounding environment and roads.

The rainwater collection tank can be in the form of a reservoir, i.e. a precast concrete tank. The reservoir collects rainwater in the rainy season, and the plants planted in it can be used as an ornamental planting tank outside the rainy season. The two plants planted in the house, flat rushes and multi flower blue fruit grass, have the habit of moisture and drought tolerance. The root system of Juncus latifolia is developed, which can slow down its flow rate in the process of rainwater flow and facilitate the infiltration of rainwater in the rainwater garden area.

Plant Landscape Configuration in Semi-Humid Area

Judging from the existing rain garden engineering practice, in winter, except for plants in warm areas that did not appear to die due to low temperature, wet plants in most areas of my country will suffer from the problem of above-ground die. The basic reason for the problem is that the currently used rain garden plants are mainly single herbaceous aquatic plant types such as reed, canna, windmill grass, cattail, water onion, water axe, ginger flower, calamus, and barracuda. In the cold and low temperature season in winter, most herbaceous plants will inevitably die in winter. Due to the loss of winter plant effect, it will affect the water purification and landscape effect of the winter rain garden. Therefore, the selection of cold-tolerant wetland plants is very important for this area. According to research, the purification capacity of wetland plants is mainly divided into the following three categories: The first category has strong purification potential, including canna, reed, windmill grass, water onion, Zai Lihua, Lythrum chinensis, Canna Canna, etc.; The purification potential of the major categories is medium, including Pueraria lobata, Arundina striata, Cattails, Barracuda, etc.; the third category has a weak purification potential, including wild taro, warbler tail, rush, green onion, Alisma sinensis, and flower head According to their attributes, these wetland plants can be used in humid and semi-humid areas.

The selection of runoff control plants in semi humid area mainly considers their cold resistance, drought resistance, water humidity resistance and deep root, such as weeping willow, metasequoia, Populus microphylla, maple poplar, juniper, Ligustrum lucidum, etc. The ground cover can be tall fescue, ryegrass, iris, etc.

Plant Landscape Configuration in Arid and Semi-Arid Areas

Since the rainfall in semi-arid areas is not suitable for ponding, the purification of water quality is mainly through the purification of rainwater by trees, shrubs and terrestrial plants in the process of runoff and infiltration. The purification effect of xerophytes needs to be considered. At the same time, most plants are not suitable for survival in winter. In order to ensure the purification effect in winter, evergreen plants must be properly matched to ensure the purification function and landscape effect in winter. The optional plants in arid areas include weeping willow, metasequoia, triangular maple, Bauhinia, small leaf boxwood and other plants, which have a certain adsorption effect on heavy metal elements in rainwater.

In the semi-arid area, plants with drought tolerance and developed roots are mainly selected, trees can be strange willow, Platycladus orientalis and juniper, shrubs and ground covers can be Lespedeza, iris, Amorpha fruticosa and Sabina mongolica, which have developed roots, have good water conservation effect and delay the flow rate of rainwater. At the same time, it can be properly matched with Begonia and Tianmu Qionghua to increase the landscape color.

As one of the most important elements in the design of sponge city, rainwater garden should firstly focus on its functional benefits. After the water purification and runoff control are optimized, its aesthetic benefits should be considered on this basis, because rainwater gardens are used as urban green spaces., Need to bring people entertainment and sensory feelings. In short, the rain garden is an urban green space design that takes functional benefits as the main and aesthetic benefits as a supplement, and combines the two perfectly.

2.4 Calculating Plant Landscape Feature Parameters Based on Deep Learning Algorithms

Plant Landscape Data Collection and Preprocessing

Firstly, 1000 common garden plants were photographed to collect data. Because the shape, color and texture of plants change in different periods, it is necessary to select cloudy and sunny days in spring, summer, autumn and winter, and take 50 photos of each plant every day, a total of 1000 $\times$ four $\times$ two $\times$ 50 = 400k original photos. Then ask landscape plant experts to screen the original photos, eliminate the photos that do not meet the requirements, mark each photo, and finally form about 300K photos of 1000 kinds of plants. These photos are stored on the hard disk in JPEG format. Each plant has a directory, and the directory name is the name of the plant.

The labeled data is divided into three sets: training set, verification set and test set. The training set accounts for 60% of the total data and is used to train the deep learning model; The validation set accounts for 20% of the total data and is used to adjust the super parameters. The adjustment process needs to use the performance of the model on the validation set as feedback; The test set accounts for 20% of the total data and is used to evaluate the training results.

Since the data set is limited, over-fitting may occur during training, resulting in poor generalization performance. In order to reduce the over-fitting phenomenon in the neural network training process, the data is preprocessed. Preprocessing will randomly generate more data from the training set data. There are 5 steps in preprocessing, and the parameters of each step are randomly generated. Among them, the first step of image rotation, the parameters include rotation center and rotation angle; the second step of image cropping, the location of the cropped area is randomly selected, and the size after cropping is 80% of the original image; the third step is mirroring, including X Axis mirroring and Y Axis mirroring; Step 4 γ correction, γ correction is performed on each of the three color channels of RGB; Step 5 Gaussian white noise, add Gaussian white noise of $N\left(\mu, \alpha^2\right)$, where ($\mu = 0, \alpha = 10$); Finally, format the data as a tensor.

Calculate the Characteristic Parameters of Plant Landscape

The separable convolution of deep learning decomposes the standard convolution into deep convolution and a 1×1 point-by-point convolution. The deep convolution uses 1 filter for each input channel to filter, and the point-wise convolution uses a 1×1 convolution operation to combine the outputs obtained by all the deep convolutions. The depth separable convolution divides the convolution into 2 layers. This decomposition can effectively reduce the amount of calculation and the size of the model. Set the convolution kernel to K, and the calculation formula for the size of the convolution kernel is:

$$K = D_K \times D_K \times M \times N \tag{1}$$

Among them, D_K is the spatial dimension of the convolution kernel; M is the number of input channels; N is the number of output channels, and the plant landscape output characteristic parameter G is:

$$G = \sum Kij \times F_{k+i-1,l+j-1} \tag{2}$$

Among them, i and j respectively represent the input space dimension; k represents the space dimension constant. The calculation formula of the deep learning convolution feature parameters of the plant landscape is:

$$G_T = \sum K_{ij} \times i \frac{F_{k+i-1,l+j-1}}{j} \tag{3}$$

$$i = \frac{K_{i+1}}{D_K} \cdot F_{k+i-1} \tag{4}$$

$$j = \frac{K_{j+1}}{NG} \cdot F_{k+j-1} \tag{5}$$

The output of depth convolution is linearly combined by convolution. In deep learning, most problems are difficult to calculate the global optimal solution, so the iterative optimization method is usually used to calculate the local optimal solution. Applying deep learning technology to the subject of plant landscape configuration and training by using a large number of labeled data can not only effectively solve the number of species identified in plant landscape configuration, but also greatly improve the efficiency of plant landscape configuration in rainwater garden.

3 Experiment and Analysis

3.1 Experiment Preparation

In order to verify the effectiveness of the regional feature rain garden plant landscape configuration method based on deep learning proposed in this paper, the following experiments were carried out. The plants selected in the experiment belong to 8 common garden ground cover plants in 8 families and 8 genera. Among them, 4 kinds of herbaceous plants are water ghost banana, fragrant color finch, four season begonia, and purslane; 4 shrubs, namely Brazilian wild male, red banana, dragon boat flower, hibiscus. The native grass is 0.5-year-old seedlings, and the shrubs are 1–2 year-old seedlings. The test materials were purchased from the market. Plants with healthy growth, no pests and diseases, and uniformity were selected. They were planted in plastic flower pots with a height of 20 cm, a pot diameter of 25 cm, a bottom diameter of 15 cm, and a hole at the bottom. The planting soil was loess and peat. Soil 7:3 is mixed with a layer of ceramsite at the bottom; the seedlings of the test materials are slowed for 3 months after changing pots. The waterlogging tolerance test was carried out in a rain garden test base in Jiangsu Province using the potted water control method. For each plant, 4 pots of plants with the same morphology and growth are selected. Starting from June 10, 2019, the plants and flower pots are placed in large plastic pots, with the water surface 2cm above the upper edge of the plant pot as the benchmark. During the treatment, the water was changed every six days. At 0, 7, 14, 21, and 28 days of flooding stress, the morphological changes of plants were observed and physiological indexes were measured, and each index was repeated 3 times. The growth performance of 8 plants during the stress period, such as flowering, leaf yellowing and new leaf sprouting, were recorded every 7 days. At the same time, the leaves with normal growth and the same size were randomly selected for sampling. The OPTI-SCIENCESOS1p fluorometer was used to determine the PSII original light energy conversion efficiency of the plant leaves (Fv/Fm) value; the relative water content of the leaves is measured according to the saturated water content method; the relative conductivity is measured by a conductivity meter; the content of malondialdehyde (MDA) is measured by the thiobarbituric acid method; the content of proline (Pro) Measured with sulfosalicylic acid method. The obtained data was analyzed by SPSS one-way analysis of variance, and the average value, standard error and difference significance of each physiological index data were obtained, and the Excel software was used for drawing. Principal component analysis is used to obtain the contribution rate of the comprehensive index. At the same time, the membership function method is used to calculate the membership function value of the comprehensive index. Finally, the comprehensive evaluation index D value is calculated to comprehensively evaluate the waterlogging tolerance of 8 plants.

3.2 Result Analysis

Set the plant landscape configuration method of regional characteristic rainwater garden based on in-depth learning proposed in this paper as the experimental group and the traditional landscape configuration method as the control group. Compare the D value of plant waterlogging tolerance index of the two methods. The comparison results are shown in Table 2.

Table 2. Plant waterlogging tolerance index D values of the two methods

Plant species	Test group	Control group
Hibiscus	5.034	2.058
Water ghost banana	8.549	3.649
Fragrant finch	8.319	6.157
Four seasons begonia	10.057	6.199
Dragon boat flower	12.308	9.628
Brazilian wild peony	6.628	3.336
Purslane grandiflora	7.023	4.152
Zhu Jiao	4.168	2.058

As shown in Table 2, the plant landscape configuration method of regional characteristic rainwater garden based on in-depth learning proposed in this paper has higher waterlogging tolerance index D values for different types of plant landscape than the traditional configuration method, indicating that the plant landscape has less litter, the plant landscape grows well in the rainwater garden, and beautifies the environment while managing rainwater, Promote balanced ecological development.

In the experiment, the management efficiency of the runoff management system in this paper is analyzed. By comparing the management time cost of this method, traditional method 1 and traditional method 2, the results are shown in Table 3:

By analyzing the experimental data in Table 3, it can be seen that there are some differences in the time cost of management using this method, traditional method 1 and traditional method 2. Among them, the management efficiency of this method is the shortest, and the shortest time cost is 1.2 s. The time cost of traditional method 1 and traditional method 2 is longer, and is always greater than that of this method. This is because this paper systematically analyzes the types and characteristics of rainwater landscape facilities in the design; Construct rainwater garden runoff management system; Design the plant configuration scheme of wet area, semi-humid area, arid area and semi-arid area of rainwater garden; The plant landscape characteristic parameters are calculated based on the deep learning algorithm, the plant landscape configuration is completed, and the efficiency of system management is improved.

Table 3. Management time overhead of different management systems (s)

Iterations/time	The method of this paper	Traditional method 1	Traditional method 2
20	1.2	1.3	1.5
40	1.3	1.5	1.8
60	1.2	1.9	2.0
80	1.3	2.1	2.3
100	1.3	2.3	2.5

4 Conclusion

This paper studies the design of rain garden with regional characteristics from the perspective of deep learning, and focuses on the methods and approaches of landscape environment construction in rain garden design and application. Analyzed the influential elements of rainwater garden design, and detailed analysis of the influence relationship between each element and rainwater garden design, which provides a solid foundation for the rational design of rainwater garden. Building a runoff management system and a landscape design system, and focus on the landscape design system. From the aspects of site planning and topography design, plant landscape design, construction and construction of facilities, and the use of rainwater elements, the design of the rainwater garden guided by the landscape is studied. The method and approach are of great significance to the landscape configuration of the regional rainwater garden.

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