

The Study on Urban Landscape Suitability Index of Indigenous Arbors, Shrubs In Nanchang

Xu Qin¹

¹Landscape Architecture Department, Nanchang Institute of Technology, Nanchang, Jiangxi, China

Abstract: This paper through brainstorming, the Delphi method, and in-meeting & after-meeting method, screening out suitability evaluation indicators of indigenous arbors, shrubs plants for urban landscapes in Nanchang. It sets up the suitability evaluation indicator system of indigenous arbors, shrubs to urban landscapes in Nanchang. To improve bio-diversity in cities, we need to focus on indigenous plants in greening initiatives. In this study, the indigenous plants in Nanchang were investigated to analyze the current situations of indigenous plants in this region and their application in urban greening in Nanchang. The problems in using indigenous plants for greening in Nanchang City were analyzed and corresponding suggestions were made.

1 Introduction

The species composition of arbors and shrubs can reflect the vegetation types of a region, and the plant community of urban landscapes, which must be dominated by native plants, should be formed by simulating the natural community structure according to the plant flora of the city. The plant configuration should be dominated by native plants while supplemented by exotic plants, so as to ensure species diversity and landscape diversity, which is the basis for maintaining biodiversity. There are abundant native resources of arbors and shrubs in Nanchang, but there are still few species used in urban greening. How many kinds of them are suitable for urban ecological environment and available for urban greening? For this question, it is necessary to put forward a method for screening excellent native arbors and shrubs so as to provide sufficient basis for the rational selection and application of native plants in urban landscaping.

2 Resources and Methods

2.1 Data Collection and Sorting

The species of indigenous arbors and shrubs in Nanchang studied in this paper are all derived from the author's field survey. The route survey and the special survey are combined to investigate the peripheral and internal areas of Nanchang urban jurisdiction. The urban periphery includes Meiling Forest Park, Shengshuitang Forest Park and Xiangshan Forest Park, and the urban interior mainly refers to Yaohu Forest Botanical Park, Aixi Lake Wetland Park, Bayi Park, People's Park and other large parks, as well as residential areas, enterprises and institutions and major urban roads with relatively better

greening. The investigation contents include plant species, characteristics, habitats and ornamental characteristics, etc., which are investigated through field investigation and inductive statistics, as well as synchronous photography, recording and filing. According to Flora of Jiangxi^{[1][2][3]}, it is concluded after investigation that there are 129 families, 317 genera and 451 species of native plants in Nanchang, including 191 species of indigenous arbors and shrubs.

2.2 Research Methods

2.2.1 Establishment of the Suitability Indexes of Indigenous Arbors and Shrubs for Urban Landscapes

The brainstorming method, the Delphi method, and the in-meeting and after-meeting method are combined to screen out the suitability evaluation indexes of indigenous arbors and shrubs for urban landscapes and to establish the suitability evaluation index system of indigenous arbors and shrubs for urban landscapes.

2.2.2 A Study of the Suitability Evaluation System of Indigenous Arbors and Shrubs for Urban Landscapes in Nanchang

With indigenous arbors and shrubs in Nanchang as the objects, the suitability evaluation indexes of indigenous arbors and shrubs for urban landscapes are stratified by expert scoring method, the weight of each evaluation index on the suitability of indigenous arbors and shrubs for urban landscapes in Nanchang is determined by the analytic hierarchy process, and the suitability evaluation index system of indigenous arbors and shrubs for urban

E-mail: helenxq1983@163.com

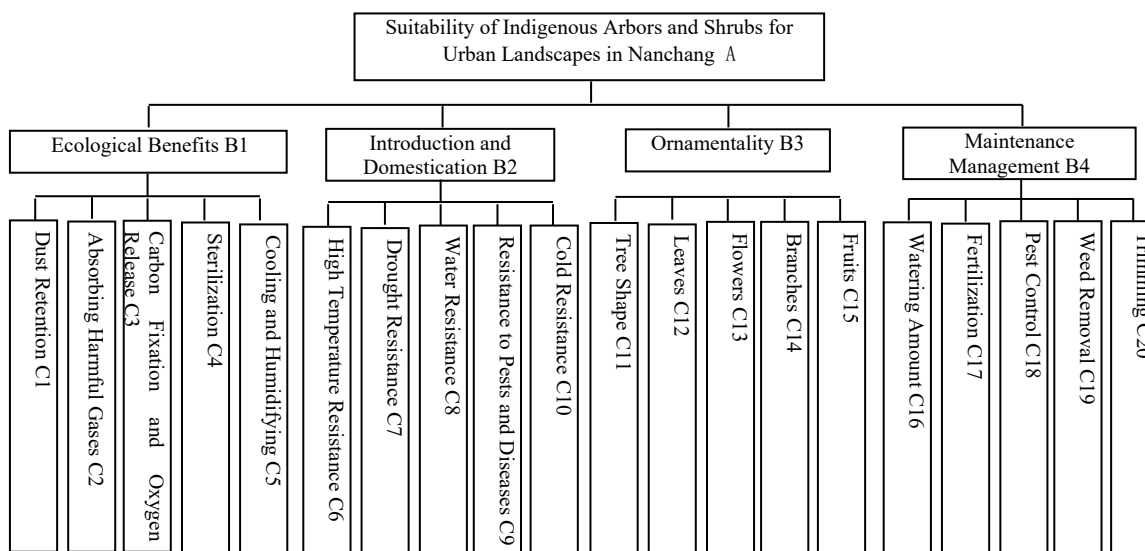
landscapes in Nanchang is established. By calculating the score value of each index and the product of its weight of the suitability evaluation system of indigenous arbors and shrubs for urban landscapes in Nanchang and by obtaining the accumulated value, the suitability indexes of indigenous arbors and shrubs for urban landscapes in Nanchang are obtained. According to the suitability indexes of indigenous arbors and shrubs for urban landscapes in Nanchang, the indigenous arbors and shrubs in Nanchang are divided into the four grades: I, II, III and IV, indicating the excellent, the good, the common and the poor level, respectively [4].

3 Setting Up the Evaluation System

3.1 The Suitability Evaluation Index System of Indigenous Arbors and Shrubs for Urban Landscapes in Nanchang

Through collecting and sorting out the domestic research literature related to indigenous arbors and shrubs, combined with the research contents of forest cities and landscape aesthetics, a total of 30 primary, secondary and tertiary evaluation indexes are collected. Ten relevant experts are invited to combine the brainstorming method, the Delphi method and the in-meeting and after-meeting method to screen out the evaluation indexes of the suitability of indigenous arbors and shrubs for urban landscapes in Nanchang. The target layer is the suitability of indigenous arbors and shrubs for urban landscapes in Nanchang. There are four indexes in the criterion layer and 20 indexes in the scheme layer. The evaluation index system of the suitability of indigenous arbors and shrubs for urban landscapes in Nanchang is determined. See Table 1.

Tab. 1 The Evaluation Index System of the Suitability of Indigenous Arbors and Shrubs for Urban Landscapes in Nanchang



3.2 Calculating the Suitability Indexes of Indigenous Arbors and Shrubs for Urban Landscapes in Nanchang

The suitability of indigenous arbors and shrubs for urban landscapes is measured according to the suitability evaluation indexes of indigenous arbors and shrubs for urban landscapes. By calculating the score values of the 24 indexes of the suitability evaluation system of indigenous arbors and shrubs for urban landscapes and the products of their weights, their accumulated values are defined as the suitability indexes of indigenous arbors and shrubs for urban landscapes. The suitability of

indigenous arbors and shrubs applied in urban landscapes is measured according to the suitability index of indigenous arbors and shrubs for urban landscapes.

The suitability indexes of indigenous arbors and shrubs for urban landscapes are set as the percentage system, and are attached to different scores according to the weight of each index. On this basis, according to the suitability indexes of indigenous arbors and shrubs for urban landscapes, the suitability of indigenous arbors and shrubs for urban landscapes is divided into five grades: I, II, III and IV, indicating the excellent, the good, the common and the poor level, respectively. The division results are shown in Table 2.

Tab. 2 Division standard table of indigenous plants suitability index rank in urban landscape

Grades of Indigenous Arbors and Shrubs	Grades of the Suitability Indexes of Indigenous Arbors and Shrubs for Urban Landscapes	Remarks
I	90-100	Excellent
II	70-90	Good
III	60-70	Common
IV	0-60	Poor

3.3 A Study of the Suitability Evaluation Index System of Indigenous Arbors and Shrubs for Urban Landscapes in Nanchang

3.3.1 Constructing the Judgment Matrix

Through practicing the expert investigation on the experts from Jiangxi Provincial Forestry Department,

Central and South Forestry Survey, Planning and Design Institute of State Forestry Administration, and Jiangxi colleges and universities, the pairwise judgment matrix to construct the relative importance of each criterion layer under each target layer of the suitability evaluation of indigenous arbors and shrubs for urban landscapes in Nanchang is obtained. The judgment matrixes are shown in table 3, table 4, table 5, table 6 and table 7.

Tab. 3 Judgement matrix (B1-C)

	Ecological Benefits	Introduction and Domestication	Ornamentality	Maintenance Management
Ecological Benefits	1	1	2	3
Introduction and Domestication	1	1	2	2
Ornamentality	0.5	0.5	1	2
Maintenance Management	0.333333333	0.5	0.5	1

Tab. 4 Judgement matrix (B1-C)

	Dust Retention	Absorbing Harmful Gases	Fixation and Oxygen Release	Sterilization	Cooling and Humidifying
Dust Retention	1	2	2	3	2
Absorbing Harmful Gases	0.5	1	2	2	2
Carbon Fixation and Oxygen Release	0.5	0.5	1	2	2
Sterilization	0.333333333	0.5	0.5	1	0.5
Cooling and Humidifying	0.5	0.5	0.5	2	1

Tab. 5 Judgement matrix (B2-C)

	High Temperature Resistance	Drought Resistance	Water Resistance	Resistance to Pests and Diseases	Cold Resistance
High Temperature Resistance	1	2	1	2	2
Drought Resistance	0.5	1	2	1	3
Water Resistance	1	0.5	1	2	1
Resistance to Pests and Diseases	0.5	1	0.5	1	0.5
Cold Resistance	0.5	0.333333333	1	2	1

Tab. 6 Judgement matrix (B3-C)

	Tree Shape	Leaves	Flowers	Branches	Fruits
Tree Shape	1	2	2	3	3
Leaves	0.5	1	1	2	2
Flowers	0.5	1	1	2	1
Branches	0.333333333	0.5	0.5	1	2
Fruits	0.333333333	0.5	1	0.5	1

Tab. 7 Judgement matrix (B4-C)

	Watering Amount	Fertilization	Pest Control	Weed Removal	Trimming
Watering Amount	1	2	2	2	2
Fertilization	0.5	1	2	2	3
Pest Control	0.5	0.5	1	2	1
Weed Removal	0.333333333	0.5	0.5	1	2
Trimming	0.5	0.333333333	1	0.5	1

3.3.2 Hierarchical Ranking and Consistency Checking

The feature vectors of the criterion layer corresponding to the target layer and the scheme layer corresponding to

Tab. 8 Consistency Checking of Hierarchical Single Sequence

Single Sequencing	A-Bn	B1-Cn	B2-Cn	B3-Cn	B4-Cn
λ_{max}	4.045692	5.145981	5.38494	5.153899	5.157475
CR	0.016923	0.032585	0.085924	0.034352	0.035151

3.3.3 Total Hierarchy Permutation

According to the above relationship of the hierarchical structure, the comprehensive weight of the suitability of indigenous arbors and shrubs for urban landscapes in Nanchang is calculated, and each index is weighted and

the criterion layer are obtained by each judgment matrix, and then the weight is calculated by the feature root method, and the consistency of the results of the total weight is checked. The results are shown in Table 8.

quantified. The percentage system (upper limit exclusion method) is used to determine the score value of each index, each index is divided into three grades, and each grade is given a certain score. The results are shown in Table 9.

Tab. 9 Total Hierarchy Permutation of the Suitability of Indigenous Arbors and Shrubs for Urban Landscapes in Nanchang

	Ecological Benefits	Introduction and Domestication	Ornamentality	Maintenance Management	Weight	Scores
Dust Retention	35.92%	32.45%	19.30%	12.33%	12.34%	12
Absorbing Harmful Gases	34.36%				8.62%	9
Carbon Fixation and Oxygen Release	24.01%				6.54%	7
Sterilization	18.20%				3.46%	3
Cooling and Humidifying	9.64%				4.95%	5
High Temperature Resistance	13.79%	29.01%			9.42%	9
Drought Resistance		23.85%			7.74%	8
Water Resistance		19.14%			6.21%	6
Resistance to Pests and Diseases		12.63%			4.10%	4
Cold Resistance		15.37%			4.99%	5
Tree Shape			37.21%		7.18%	7
Leaves			20.87%		4.03%	4
Flowers			18.17%		3.51%	4
Branches			12.70%		2.45%	2
Fruits			11.05%		2.13%	2
Watering Amount				32.55%	4.01%	4
Fertilization				26.75%	3.30%	3
Pest Control				16.27%	2.01%	2
Weed Removal				13.06%	1.61%	2
Trimming				11.37%	1.40%	1

4 Results and Discussion

After a total of 191 indigenous arbors and shrubs in Nanchang are assigned values and calculated, there are a total of 104 species with a comprehensive score above 60 points, as detailed in table 10. Among them, except those that have been used in gardens, the evergreen arbors include *Schima superba*, *Altingia chinensis*, *Cyclobalanopsis glauca*, *Cyclobalanopsis jenseniana*, *Lithocarpus glaber*, *Tutcheria hirta*, *Elaeocarpus duclouxii*, *Castanopsis fargesii*, *Castanopsis sclerophylla*, etc., the deciduous arbors include *Vernicia fordii*, *Betula luminifera*, *Carpinus viminea*, *Castanea seguinii* and *Quercus variabilis*, etc., the evergreen shrubs include *Rosa laevigata*, *Rosa cymosa*, *Sycopsis sinensis*, *Turpinia*

arguta, *Ilex chinensis*, *Symplocos sumuntia*, *ndocalamus latifolius*, etc., and the deciduous shrubs include *Lespedeza davidii*, *Lespedeza formosa*, *Dalbergia mimosoides*, *Lespedeza cuneata*, *Rhododendron ovatum*, etc.. A large number of native species with potentials in application are waiting for development and application.

Nanchang is located in the evergreen broad-leaved forest area of the subtropical monsoon climate, so the urban greening should be dominated by evergreen species. In order to protect biodiversity, the backbone tree species and the keynote tree species should be mainly native tree species, so as to improve plant diversity and create regional characteristic landscape. However, at present, the utilization rate of indigenous arbors and shrubs in the backbone tree species and keynote tree species in Nanchang is relatively low, and

foreign tree species are dominant in various green spaces such as roads, squares, parks and residential areas and so on, which needs to be improved urgently.

Tab. 10 The Mark Sheet of the Suitability Indexes of Indigenous Arbors and Shrubs for Urban Landscapes in Nanchang

Specific Name	Latin Name	Comprehensive Evaluation	Grade
Masson pine	<i>Pinus massoniana</i>	91	I
Chinese fir	<i>Cunninghamia lanceolata</i>	92	I
Camphor tree	<i>Sassafras tzumu</i>	90	I
Common sassafras	<i>Sassafras tzumu</i>	91	I
Leatherleaf mahonis	Mahonia bealei	91.5	I
Heavenly bamboo	<i>Nandina domestica</i>	92.5	I
Tea oil camellia	<i>Camellia oleifera</i>	92	I
Tea	<i>Camellia sinensis</i>	95	I
Schima	<i>Schima superba</i>	95	I
Chinese St. John's wort	<i>Hypericum monogynum</i>	92.5	I
Elaeocarpus glabripetalus Merr.	<i>Elaeocarpus glabripetalus</i>	90	I
Chinese tallow tree	<i>Sapium sebiferum</i>	91.5	I
Tungoiltree	<i>Vernicia fordii</i>	92	I
David bush	<i>Lespedeza davidii</i>	91.5	I
Altingia	<i>Altingia chinensis</i>	91	I
Beautiful sweetgum	<i>Liquidambar formosana</i>	94	I
Dry willow	<i>Salix matsudana</i>	93	I
Chinese waxmyrtle	<i>Myrica rubra</i>	91	I
Seguin chinkapin cup	<i>Castanea seguinii</i>	91.5	I
Boue Japanese oak	<i>Cyclobalanopsis glauca</i>	92	I
Cyclobalanopsis jensenniana	<i>Cyclobalanopsis jensenniana</i>	92	I
Pasania	<i>Lithocarpus glaber</i>	91	I
Cork oak	<i>Quercus variabilis</i>	92	I
Hackberry	<i>Celtis sinensis</i>	94	I
Chinese elm	<i>Ulmus parvifolia</i>	92	I
Paper mulberry	<i>Broussonetia papyrifera</i>	90.5	I
Holly	<i>Ilex chinensis</i>	90	I
Tea-of-heaven	<i>Ailanthus altissima</i>	90	I
Chinaberry	<i>Melia azedarach</i>	91	I
Chinese sumac	<i>Rhus chinensis</i>	92.5	I
Chinese wingnut	<i>Pterocarya stenoptera</i>	96	I
Azalea	<i>Rhododendron simsii</i>	90	I
Sumuntia sweetleaf root	<i>Symplocos sumuntia</i>	90.5	I
Chinese privet	<i>Ligustrum sinense</i>	95.5	I
Cape jasmine	<i>Gardenia jasminoides</i>	94.5	I
June snow herb	<i>Serissa japonica</i>	95.5	I
Williams elder	<i>Sambucus williamsii</i>	90.5	I
Hemleaf negundo chastetree	<i>Vitex negundo</i> var. <i>cannabifolia</i>	90.5	I

Specific Name	Latin Name	Comprehensive Evaluation	Grade
Red-fruit greyblue spicebush	<i>Lindera erythrocarpa</i>	71	II
Mountain spicy tree	<i>Litsea cubeba</i>	75.5	II
White-flower longflower stringbush	<i>Wikstroemia trichotoma</i>	74	II
Rough brushwood	<i>Tutcheria hirta</i>	88	II
Elaeocarpus duclouxii	<i>Elaeocarpus duclouxii</i>	87	II
Salem-rose herb	<i>Rubus rosifolius</i>	70.5	II
Mimoselike rosewood	<i>Dalbergia mimosoides</i>	81.5	II
Cuneate bush-clover	<i>Lespedeza cuneata</i>	83.5	II
Beautiful lespedeza	<i>Lespedeza formosa</i>	86.5	II
Stachyurus chinensis	<i>Stachyurus chinensis</i>	79.5	II
Euonymus japonicus	<i>Buxus megistophylla</i>	78.5	II
Betula luminifera	<i>Betula luminifera</i>	84.5	II
Carpinus viminea	<i>Carpinus viminea</i>	88.5	II
Oat chestnut	<i>Castanopsis fargesii</i>	88.5	II
Bitter evergreenchinkapin	<i>Castanopsis sclerophylla</i>	80.	II
Quercus alba	<i>Quercus fabri</i>	70	II
Mulberry tree	<i>Morus alba</i>	80	II
Purple Oriental tephrosia	<i>Celastrus glaucophyllus</i>	72.5	II
Bittersweet	<i>Rhamnus crenata</i>	74.5	II
Oriental buckthorn	<i>Picrasma quassioides</i> (D. Don) Benn.	80	II
Oliver maple	<i>Acer oliverianum</i>	74	II
Acerwilsonii	<i>Acer wilsonii</i>	79	II
Euscaphis japonica	<i>Euscaphis japonica</i>	72.5	II
Wax-tree	<i>Toxicodendron succedaneum</i>	75	II
Lacquer tree	<i>Toxicodendron vernicifluum</i>	73	II
Dyetre	<i>Platycarya strobilacea</i>	84	II
Spinystem aralia	<i>Aralia echinocalis</i>	71	II
Chinese aralia	<i>Aralia elata</i>	74	II
Dentiferous dendropanax	<i>Dendropanax dentigerus</i>	73	II
Rhododendron chrysodoron	<i>Rhododendron ovatum</i>	85	II
Purpus privet	<i>Ligustrum quihoui</i>	88.5	II
Serissa herb	<i>Serissa serissoides</i>	73	II
Moso bamboo	<i>Phyllostachys edulis</i>	73	II
Red poison hemlock	<i>Illicium lanceolatum</i>	68	III
Greyblue spicebush	<i>Lindera glauca</i>	68	III
Glabrous sarcandra herb	<i>Sarcandra glabra</i>	61.5	III

Specific Name	Latin Name	Comprehensive Evaluation	Grade
Boxleaf syzygium	<i>Syzygium buxifolium</i>	65.5	III
Twelvestamen Melastoma herb	<i>Melastoma dodecandrum</i>	64.5	III
Rose mallow	<i>Urena lobata</i>	62.5	III
Mountain tallowtree	<i>Sapium discolor</i>	62.5	III
Deutzia setchuenensis	<i>Deutzia setchuenensis</i>	63.5	III
Panicle hydrangea	<i>Hydrangea paniculata</i>	69.5	III
Photinia beauverdiana	<i>Photinia beauverdiana</i>	62.5	III
Everlasting thorn	<i>Pyracantha fortuneana</i>	69.5	III
Cherokee rose	<i>Rosa laevigata</i>	64.5	III
Smallfruit rose	<i>Rosa cymosa</i>	69.5	III
Loropetalum chinense	<i>Loropetalum chinense</i>	69.5	III
Sycopsis	<i>Sycopsis sinensis</i>	68.5	III
Raisin tree	<i>Hovenia trichocarpa</i>	64	III
Medicinal evodia	<i>Evodia rutaecarpa</i> <i>Tetradium ruticarpum</i>	67.5	III
Redwood branches	<i>Meliosma oldhamii</i>	63.5	III
Common craibiodendron	<i>Meliosma rhoifolia</i> var. <i>barbulata</i>	60.5	III
Turpinia arguta	<i>Turpinia arguta</i>	61.5	III
Chinese alangium	<i>Alangium kurzii</i>	68	III
Medicinal evodia slenderstyle	<i>Acanthopanax evodiaefolius</i>	61	III
Chinese ivy	<i>Hedera nepalensis</i> var. <i>sinensis</i>	64	III
Whiteflower tarennia	<i>Tarenna mollissima</i>	67	III
Chinese abelia	<i>Abelia chinensis</i>	64.5	III
Fortune paulownia	<i>Paulownia fortunei</i>	64	III
Purple beautyberry	<i>Callicarpa bodinieri</i>	68	III
Girald beautyberry	<i>Callicarpa giraldii</i>	64	III
Koch beautyberry	<i>Callicarpa kochiana</i>	68	III
Manyflower glorybower	<i>Clerodendrum cyrtophyllum</i>	63	III
Japanese premna herb	<i>Premna microphylla</i>	65	III
Negundo chastetree	<i>Vitex negundo</i>	66.5	III
Indocalamus latifolius	<i>Indocalamus latifolius</i>	66.5	III

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