Sustainability Innovation

Selection And Configuration Of Main Street Tree Species For China's Northern City Shenyang

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Summary

Our project Selection and Configuration of Main Street Tree Species for China's Northern City Shenyang aimed at solving problems remaining in present street tree system in Shenyang, and improving people’ s awareness to protect the street tree, thereby providing more favorable environment for the growth of street trees, and helping them better contributes to the overall environment of Shenyang.

With such purpose, our group contacted the previous director of Shenyang's greening department for advice and information and also searched for information regarding street trees online. Through our study, we successfully identified some fundamental challenges that in the selection of Shenyang’ s street trees. We categorized the problem into six perspectives: harsh climate condition, pest problems, soil condition, Compatibility with the original vegetation, economic cost, and lack of proper management, communication, and education. We locate the root cause as lack of management and lack of awareness. Addressing the challenges as well as root cause, our solutions are generated, which basically concerns two parts: selecting favorable street tree species for Shenyang and improving people’ s awareness of protecting street trees. After searching for appropriate street tree species for Shenyang both from Shenyang and from other cities with similar climate conditions as Shenyang, we finally identified eight tree species to be our candidates. So as to improve people’ s awareness, we decided to publicize street trees protection and spread knowledge regarding street trees whatever species we choose is best for Shenyang at last. In our criteria, we asked several questions regarding the street trees’ ability to adapt to the climate and soil in Shenyang, compatibility with local plant species, growth period, aesthetic value, and some other influential factors. Based on these criteria, we evaluated our solutions. In our evaluation, the Populus alba 'Berolinensis' L. ranked first among all the other candidates. With our solution, our action plan is formulated, which includes our design for the layout of street trees along the street, planting details, street tree model building, and utilization of social media platforms, which included Tik Tok and official account on WeChat, to publish article and videos for street trees publicity. In order to ensure the effectiveness and feasibility of our solution, we conducted a survey targeting people from all age groups and both genders in the prototype, and asked questions regarding our street tree species(Populus alba 'Berolinensis' L. is included in the choices), our designed layout, and people’ s awareness for protecting street trees after reading and watching our articles, speech, and videos in WeChat official account and Tik Tok. The results show that people’ s awareness for protecting street trees is improved after reading the

content in official accounts. Based on the user feedbacks, we figured out two ways to improve our stree tree layout that not only keeps our original purpose of promoting biodiversity but also provide more sunshine for the shrubs in our layout. We also understand that one of the major problems remains in Shenyang’ s street trees, lack of science-based management, still exists. Therefore, at the end of our project, we would like to sincerely propose to the government to provide internship for undergraduate, graduate students, and doctors, and allow them to take part in the greening of city, and at the same time provide the workers with technical guidance. In this way the problem remains in management for street trees may be somehow relieved. Besides, we can still see that more action is needed. Some people hardly take action after knowing what is the right thing to do and this is what we have to promote in the future. This may include holding more practical activities that can lead more people to take actual actions which are beneficial for the street trees’ growth and adaptation.

Identify the Challenges

1. Climate condition

Shenyang has a temperate continental climate, has distinctive characteristics of each season, and is marked by low temperatures in winter and high temperatures in summer. The largest temperature difference in a year can go up to 60 degrees Celsius. In summer, the city’ s climate is affected by southeast monsoon. The amount of rain is distributed unevenly with about 47% taking place in July and August each year. Each year, the city has around 150 to 170 days of frost free period. Trees face drastic temperature changes throughout the year, as well as unevenly distributed amount of rainfall; these two factors make climate a challenge for street tree selection.

2. Pest problems

Street trees are subjects to pests, so it is important to recognize which species are more prone to be attacked by pests. For instance, Platanus occidentalis L. is subject to Corythucha ciliate Say and Salix babylonica is subject to Anoplophora glabripennis. It happens in Shenyang that trees die because of pest issues. In Shenyang, the pagoda tree, a kind of street tree, is taunted each year in April and May by aphids. Moreover, one single species of street trees are often planted in large sectors in Shenyang. Street trees are more prone to pest issues due to lack of diversity in each large sector. Often, one sick tree can lead to infections of several trees or even the whole group in one area. For example, if an area is covered by many pagoda trees and one pagoda tree is infected by aphids, it becomes very likely that pagoda trees surrounding this one infected pagoda tree will be infected too, because they are all of the same species and subject to aphids and it is possible that this whole area of pagoda trees will be infected by aphids, which can spread among pagoda trees like COVID-19 among humans. As a result, working out solutions, we have to take the cost of controlling pests into consideration when selecting street trees and when planting street trees in large areas, we need to increase the diversity of species so as to prevent massive infection by pests.

3. Soil condition

The soil in Shenyang contains a lower than average amount of organic substances, and is rather alkaline. For plants that flourish in alkaline soil, which means that they can absorb nutrients well under alkaline conditions, alkalinity does no harm to

them. For plants that do not adapt to alkaline soil, the alkalinity can hinder the nutrient absorption of the plants, cause physiological drought, and hurt plant tissue. Therefore, species like the Camellia japonica L. are unlikely to flourish in the soil in Shenyang. In the case of Camellia japonica L., its preference for both rather acidic soil and a warmer climate makes it an unqualified candidate. In contrast, trees like Salix babylonica and Populus tomentosa Carr are adaptable to alkaline soil, and are planted widely in Shenyang, but the catkins they produce each year may cause blockage to drivers' and pedestrians' sights and stimulate allergies. Therefore, the soil condition in Shenyang also adds to the difficulty of selecting street trees for Shenyang.

4. Compatibility with the original vegetation

In the selection of street trees, we must make sure the chosen species is compatible with the local plantation. For instance, Rhus Typhina Nutt possesses many features similar to those of invasive species. It has strong adaptability, propagates through root tillers, matures fast, and often clusters with other entities of its own species. These features allow Rhus Typhina to thrive in new areas and put local vegetation at risk. As illustrated, we must ensure our selected species does not damage local species and ecosystem.

5. Economic costs

The costs of street tree operation and management include annual cost of replanting, annual pruning expenses, annual costs on disposing dead trees and their roots, annual expenses for pest control, annual expenditure for irrigation, annual cost on tree project professional consultation, inspection, service, management cost, annual cost of cleaning and disposing (dead leaves, fruit, and, maybe, catkin), expenses related to disputes and litigation cases, and cost of management and maintenance of over ground and underground infrastructures that are damaged by street trees. The need to find trees which have strong vitality and relatively regular configurations that can reduce some of these costs makes the selection of street trees more difficult.

6. Lack of proper management, communication, and education

Lack of proper management, communication, and education increase the difficulty of selecting street trees. The management staff of street trees lack necessary skills and knowledge to properly nurse street trees, increasing deaths of street trees, and preventing the trees from absorbing carbon dioxide and toxic chemicals and beautifying the city. In addition, there is often a lack of communication between the greening department and construction units, and this negatively affects the growing environment of street trees. For example, some roads along which street

trees are to be planted are occupied by construction companies, and the construction teams randomly abandon and bury waste, making the environment unsuitable for trees to grow. In another example, the construction team places a thick layer of asphalt on the road, leaving palm-sized spaces for street trees to grow. Moreover, some citizens are unaware of the importance of the street trees due to lack of education on benefit of street trees, they tend to pay little attention to the well-being of the trees and, in some cases, damage street trees by cutting off their crowns that are covering shop signs, coiling ropes and mental wires around them to hang clothes, knocking nails in them, etc. It is nearly impossible to find street trees that can thrive with loose management, extremely poor growing conditions, and constant damage, and in order to make our city a greener place, the current situation must be changed.

Identify a Root Cause

Lack of management and lack of awareness

Exotic species that were not suitable to grow in Shenyang’ s climate were planted as street trees and ten years ago, Shenyang’ s government did a great job to replace these trees that could hardly survive with local tree species like Populus L. and Salix babylonica. Nonetheless, there are still many problems in Shenyang’ s street tree system.

To begin with, street tree species in Shenyang lack diversity. Lacking diversity not only decreases the aesthetic value of street trees, but also increases the likelihood of massive pest infections. Normally, the same species are subject to the same disease; as a result, infection of one tree can cause infection of many other trees of the same species.

Secondly, many street trees in Shenyang are often removed just after being planted. Relevant departments decide which trees to plant and remove rather subjectively, instead of scientifically. Consequently, the selected trees may not be the most suitable to plant and this repetition of planting and removing greatly increases costs.

Furthermore, unreasonable allocation of money and resources within the system reduces the budget for proper caring of street trees. For instance, relevant departments employ workers with poor knowledge and skills of how to manage street trees. Because of the substantial amount of money that the government has to pay for these workers, the budget for autumn and winter irrigation and fertilization of street trees is reduced. Due to lack of irrigation and fertilization, street trees are more prone to drought and the color of their flowers fades.

The last but not the least, some citizens do harm to street trees. There are circumstances where people cut off their crowns that are covering shop signs, coil ropes and mental wires around trees to hang clothes, and knock nails into street trees, etc. These damages intentionally or unintentionally caused by citizens reduce street trees’ aesthetic value and undermines their ability to survive.

To address current challenges and problems in the street tree system in Shenyang, we locate the root cause as lack of management and awareness. Better management will benefit Shenyang’ s street tree system as well as city planning by

forming a more reasonable and diverse layout of street trees, selecting street trees more scientifically to save money, and allocating resources rationally to provide sufficient irrigation and fertilization for street trees. In addition, raising citizens' awareness by launching campaigns that aim at educating people about street trees' benefits, which include absorbing carbon dioxide as well as toxic chemicals like lead and cadmium, reducing urban noises, depositing dust on their leaves, adjusting urban climate, and beautifying the city, will stimulate citizens to engage in activities that targets at protecting instead of harming street trees.

Generate Solutions

To address the root cause, we will include in our top solution a campaign aiming at increasing the awareness of the benefits of street trees. The campaign includes filming Tik Tok videos to increase people’ s awareness about behaviors that can harm street trees, publishing articles introducing functions and problems of street trees and calling on people to protect them in an official account on Wechat platform, and creating and publishing a video of an English speech delivered by high school students appealing to people to save street trees. Because according to relevant protocols, without the authorization of the city’ s greening department, common citizens cannot plant street trees, the most workable and practical thing we can do to improve the street tree system is trying to raise people's awareness od street tree protection and attract the attention of the government by increasing publicity of street trees and as well our top solution. We hope in this way, we would influence policy making regarding the planting of street trees. Nonetheless, we understand that we may not have such great influence, so we will emphasize on raising people’ s awareness to protect street trees. (THIS PART IS MORE SPECIFICALLY DEMONSTRATED IN MAKE AN ACTION PLAN PART.)

We selected our candidates from local street tree species, assuming that local tree species can definitely adapt to the local climate conditions. Additionally, we also selected tree species from other places, whose climate conditions have some aspects in common with Shenyang’ s climate, in or out of China. While working out solutions, we consider the species’ abilities to adapt to Shenyang’ s climate and soil, compatibility with local species, grows periods, aesthetic values, as well as other factors including whether or not the species produce catkins or toxic fruit. Our basic strategy for researching is many applying to Baidu baike and accessible websites like CNKI (China National Knowledge Infrastructure) for information and evidence. Because of the particularity of our project---Selection and Configuration of Main Street Tree Species for China's Northern City Shenyang, we know that just surfing the internet may not help us obtain sufficient practical information, so through the help of Director of Liaoning Environmental Protection Volunteer Federation, we got in contact with former director of Shenyang’ s greening department. From him, we obtained more information about selecting street trees for Shenyang, basically a range of indigenous trees, including poplar, willow, elm, and locust tree, we should select from.

1. Populus alba 'Berolinensis' L.

Populus alba 'Berolinensis' grows in moist sites, often by watersides, in regions with hot summers and cold to mild winters. According to report, they could survive in Qiqihaer, almost the northernmost city of China, where the temperature can be as low as -39.5 degrees centigrade. Such feature helps it easily adapt to the environment of Shenyang, which has drastic temperature change throughout the whole year. Besides, the male populus alba do not submit fluffy catkins, which act as a favorable feature as a roadside tree for creating nothing troublesome for the pedestrians and also complement the problems remains on today’ s street tree in Shenyang. Finally, they are also immune to some particular disease of plant species including gray speck disease, cathay poplar rust, and cryptorthynchus lapathi armour. This feature saves the relevant greening department from a lot of inputs on insecticides and labor-intensive work.

2. Ulmus pumila L.

The Ulmus pumila is usually a small to medium-sized, often bushy, deciduous tree growing to 25m tall, the d.b.h.(diameter at breast height) to 1 m; the bark is dark gray, irregularly and longitudinally fissured. The height of the deciduous trees of Ulmus pumila are suitable to be grown in urban area since it avoid the labor input for consistently clipping and the problem of growing too high that may bother the use of wired power cables (There are still some wired power cables on the ground remained in some old regions in Shenyang). For natural reproduction, the ulmus pumila is able to self-pollinate successfully. For artificial propagation, the ulmus pumilia is mainly planted by grafting and cuttage. The germination rate of seed propagation is 65%~85%, and the germination rate of cuttage propagation is relatively higher: about 85%. The trees also sucker readily from its roots, which avoid them from being blown down by strong breeze. Moreover, this species of trees do not need a lot of management and also grow in a really fast rate, which reduces the greening department’ s expense on labor. However, their fruit and flowers may affect the universal greenness of leaves on the other roads; and the drop of their fruit may block divers’ and pedestrians’ sights.

3. Acer pseudosieboldianum (Pax) Komarov.

The Acer pseudosieboldianum (Pax) Komarov.can grow to a height of about 35 m and the branches form a broad, rounded crown, which also accord with the height regulation of roadside trees in Shenyang. The flowers are greenish-yellow and hang in dangling flower heads called panicles which serves great ornamental purpose. They produce copious amounts of pollen and nectar that are attractive to insects, which may act as a troublesome interference for the citizens. Special cultivars including A. pseudoplatanus 'Brilliantissimum' may be propagated by grafting.Moreover, Acer pseudosieboldianum (Pax) Komarov. is adaptable to Shenyang's climate.

4. Tilia amurensis Rupr.

Tilia amurensis Rupr.is a deciduous tree originated in China. It is distributed in North Korea, Russia, northeast China, Shandong, Hebei, Shanxi and other provinces. It can grow to 20-30m. The species prefers warm, or cool, and humid climate and wet loam or sandy loam soil with good drainage. It is a deep root tree species and has strong tillering. It is not resistant to water, but is resistant to cold, smoke, and poison. Shenyang is in similar latitude with North Korea and the soil structure and type are similar. Therefore, Tilia amurensis Rupr can completely adapt to the climate and soil characteristics of Shenyang. At the same time, from June to September in Shenyang, the climate is warm, the air is humid, and there will not be too much surface water left, which can provide a suitable living environment for the trees.

5. Ginkgo biloba L.

Known as the living fossil, Ginkgo bilobahas a wide geographical distribution. In terms of horizontal natural distribution, Ginkgo bilobais the longest in east-west distribution near 30 degrees north latitude. With the increase or decrease of this latitude, the East-West distance of Ginkgo bilobadistribution is gradually shortened.Ginkgo biloba is mainly distributed in the temperate and subtropical climate regions of China, but can grow in Shenyang. In fact, Liaoning University, located in Shenyang, is famous for her ginkgo scener. It is attractive in appearance, but contains butyric acid (also known as butanoic acid) and has a bad smell. Based on the above environmental standards and the planting experience of Ginkgo biloba in Liaoning University, it is believed that this kind of tree will become one of the choices of street trees in Shenyang.

6. Platanus acerifolia

Platanus is distributed in Southeast Europe, India and America. There are three species introduced and cultivated in China for ornamental and street trees. Platanus is a world-famous excellent shade tree and street tree, known as "the king of street trees". It has been cultivated in China for more than 100 years, from north to south. It has good heterosis, rapid growth, easy reproduction, large leaves and thick shade, beautiful tree appearance, and has the function of purifying air.Platanus acerifolia is a fast-growing tree species, with strong resistance to adversity, strong germination ability, strong resistance to heavy shear, smoke and dust, resistance to transplantation, and high survival rate of tree transplantation. It has strong adaptability to urban environment, strong ability of absorbing harmful gas, isolating noise, resisting smoke and dust as well as drought. It is a deciduous species and can grow up to 35 meters high. The Platanus acerifolia likes humid and warm climate, but can be cold resistant. It is suitable for slightly acidic or neutral soil with good

drainage. Although it can grow in slightly alkaline soil, it is prone to yellowing. The distribution of root system is shallow, making it easy to be damaged and inclined in typhoon. Although Platanus acerifolia likes warm and humid climate, it is more resistant to cold, and there is no typhoon in Shenyang all year round, which creates conditions for the survival of Platanus acerifolia.

7. Aesculus chinensis Bunge

Aesculus chinensis Bunge only grows wildly in Qin Ling. It prefers light, warm climate andfertile, moist, and well drained soil, but it is cold resistant and slightly shade resistant. It has deep roots, strong germination, medium growth rate, and long life. The leaves of seven leaf trees can be easily scorched in the hot summer. Aesculus chinensis Bunge can resist the cold and shade resistant, which helps Aesculus chinensis Bunge to spend the cold and sunny winter in Shenyang. At the same time, the summer in Shenyang is relatively cool and the sun light is not strong, which prevents the leaves of Aesculus chinensis Bunge from withering.

8. Liriodendron chinensis (Hemsl.) Sarg

Liriodendron (Hemsl.) sarg is a species unique to China. It is produced in the south of Shaanxi and Anhui, Sichuan and Yunnan to the west, and Nanling Mountain to the south. It prefers light and mild humid climate, has certain cold resistance, has a penchant for fertile, wet and well drained acid or slightly acid (pH4.5-6.5) soil , and grows poorly on dry land. Liliodendron chinensis (Hemsl.) Sarg is resistant to cold and acid, and its appearance and leaves are wide. It is suitable for providing beautification and shade on both sides of Shenyang’ s streets, and is very suitable for the selection of street trees.

Identify the Criteria

1. Adaptation to climate and soil: is the tree able to quickly adapt to the climate and soil conditions in Shenyang?

2. Compatibility with local plant species: does the new street tree species act as a invasive species for the original ecosystem?

3. Growth period: How long does it take to rear a seed until it becomes a tree? (growth period refers to the period when all parts of plant organs show significant morphological characteristics and physiological functions. It can be divided into the following six steps: fruit with seeds, seed planting, germination, sprout, seedling and tree)

4. Aesthetic value: does the street tree have an ornamental value to the cityscape?

5. Other influential factors: How is the tree’ s ability of absorbing carbon dioxide? How well can the new tree reduce air pollution? How much is the cost of the tree, including spending in rearing and following processes like nursing? How is the resistance of the species to pests? How is the ability of the tree to provide shade? How much care does the tree require after it is planted on the road side? Will it bear fruit that can harm people when the fruit falls? Is its fruit toxic? How will it add to the difficulty of the sanitation work? Will it produce catkins that will block citizens’ sight? Does it attract bees or other insects that may harm pedestrians? Is it too high, or too short? (If it is too high, it may damage cables, and if it is too short, it may not provide enough shade.) How deep is the root system?

We believe that all the factors that constitute our criteria contribute to the feasibility of the promissing street trees in Shenyang. We need to note again that according to relevant protocols, we cannot plant street trees randomly without permission of Shenyang’ s greening department, so our action plan in the latter part will emphasize on raising people’ s awareness of protecting street trees and, if possible, influence policy making in related government institutions. Nonetheless, in the prototype and test part, we will also figure out a way to demonstrate our chosen tree species’ growth and configuration beside a street virtually to users.

Evaluate the Solutions

Our evaluation grid is attached, please check!

Evaluation

Make an Action Plan

Our action plan is divided into two parts: how to plant our chosen tree, Populus alba
'Berolinensis' L., and how to raise people’ s awareness of protecting street trees.

The first part: How to plant Populus alba 'Berolinensis' L.?

We understand that we cannot plant trees along roads in Shenyang according to relevant stipulations, so we will use two softwares, speedtree and cities skylines, to build Populus alba 'Berolinensis' L. growth and planting models. Speedtree is a software used to design trees for computer games, and Cities: Skylines is game software users can use to construct an ideal city for themselves. We thought we can use these softwares to construct a basic model of our plan and present it to the public via WeChat official account platform considering the Covid-19 situation.

We also considered specific details that need to be considered when planting real street trees that are not included in just making models via these softwares.Several factors have to be taken into consideration including the detail of how to practically plant the street trees and harmonize them with their surrounding environment. In our action plan, we also incorporated some creative ideas to increase biodiversity of city greening in response to currents problems in Shenyang's street tree system that we analyzed in Identify the Challenges section. We referred to Provisional regulations of Shenyang urban gardening and greening administration for authoritative information about distance between street trees and distance between street trees and infrastructures.

1. Specified dimension and space between infrastructure around the roadside trees
(1) Arbors should be planted in green belt with a width of more than 1.5m
(2) Street trees should be planted in equally spaced tree pool. Pavement transition should be employed between tree pools
(3) Square for normal tree pool size should be 1.25m*1.25m.
(4) The distance between the tree trunks planted in the center of the tree pool and one side of the road teeth must be above 0.5 m.
(5) In general, when the width of the road is relatively large (50-100m), the greening design of the road has the best effect with the tree-lined belt greening technique. The general width of the shade ranges from 5 to 20m.
2. Relationship between road planting and road/planting width
(1) In normal conditions, the proportion of road area in the green separation zone is

preferably over 20%
(2) Minimum planting separation zone width required for greening plants (the unit is in meter)

Plant species Single-line Arbor Double-line Arbor Large Shrub Small Shrub lawn
Minimum planting width 1.25~2.0 2.5~5.0 1.2 0.8 1.0

3．Relationship between road greening and underground pipelines
Minimum horizontal distance between trees and municipal underground pipelines in greening (the unit is in meter)
Names of underground pipelines arbor shrub
Power cable 1.2~1.5 1.0~1.5
Telecommunication cable 1.2~1.5 1.0~1.5
Service pipe 1.0 1.0
Water main 1.0~1.5 1.0~1.5
Drain-pipe 1.0 1.0
Drainage trench 1.0 0.5
Fire cock 1.2 1.0
Gas pipeline(low-medium 1.2~2.0 1.0~2.0
pressure)
Heat pipe 2.0 2.0

4. Minimum Distance between street tree and Municipal overhead wire (the unit is in meter)
Minimum horizontal distance from crown to wire and minimum vertical distance from crown to wire (m) (WE HAVE A GRAPH ILLUSTRATION OF THIS ATTACHED)
voltage Arbor Shrub
Under 1KV 1.0 1.0
1~20KV 3.0 3.0
35~110KV 4.0 4.0
150~220KV 5.0 5.0

Besides referring to authoritative information for street tree planting, we also figured out a way to increase biodiversity so as to decrease chances of massive pest infection and uplift aesthetic value. We also plan to plant shrubs under the trees. Shrubs can generally have the same effect as the street trees like depositing dust and pollutants and reducing soil erosion. Shrubs also provide shelter for insects and can bear pretty blooms that attract butterflies. Moreover, we chose shrubs that have been planted in Shenyang for a long time so they definitely can adapt to the soil and climate conditions here. They are reliable and easy to grow, thereby saving extra maintenance cost for shrubs. The shrub species we chose are Syringa oblata Lindl., Jasminum nudiflorum Lindl., Rosa rugosa var. cathayensis, and Rosa xanthina

Lindl.. (WE HAVE A GRAPH ILLUSTRATION OF THIS ATTACHED) Although we are planting the shrubs under the trees and this may cause the shrubs to receive less sunshine, but Populus alba 'Berolinensis' L. is not a species with large canopies like Ficus microcarpa Linn. f. and there will be staff to trim the canopies to keep them in shape, so it is likely that the shrubs will survive even if they are planted under the trees. Besides, there are cases where shrubs can survive under trees. For instance, beside Shenyang' s Gaorong Road, there are Jasminum nudiflorum Lindl.s surviving under willows.

The second part: How to raise people' s awareness of the protection of street trees?

We understand that improving management of street trees requires changes within the greening department and this is beyond our power, so we decided to start from raising people' s awareness, hoping we would gain influence and change the current system of the greening department. To raise people' s awareness, we suggest that high school students form environmentally friendly clubs to make Douyin(Tik Tok) videos, post articles on a WeChat official account, and deliver and videotape English speeches.

High school students form a special group in this society. We do not have much authority and money, yet we have a unique voice. Together, we can influence kids younger than us, our peers, parents, and grandparents. We can also educate them about issues regarding which we want to make a change. That is why we advocate that high school students should form clubs within and across schools to protect street trees as well as our environment. The reasons why we chose these three forms for publicity are as follows.

First, recording a Tik Tok video may be a great way to increase publicity. Tik Tok is by far one of the most popular entertainment platforms for people among all ages to post, share, and watch music videos. On January 6, 2020, Tik Tok published its 2019 data report, which showed that until January 5, Tik Tok' s daily active users have reached more than four hundred million. We have decided that it may be very effective to use this entertainment platform to increase people' s awareness of the protection street trees and increase awareness. We suggest that clubs' members should make various types of videos to appeal to people to protect street trees.

Second, we also consider posting articles on Wechat platform to be an effective way to uplift people' s awareness of street trees protection. At present, WeChat official account platform is one of the best platform to promote information publicity. For example, some educational institutions can use this platform to provide information, advertising for themselves. Some accounts are designed for entertainment; they can have themes including beauty makeup, food appreciation,

and science popularization. After analyzing the impact official account articles can have on people’ s life, we made the decision that we should also utilize WeChat official account platform to publicize street trees protection and spread knowledge about street trees.

The last but not the least, we also suggest that clubs should make English speeches to publicize street trees protection. Speeches can be delivered in different and creative ways, so one can attract people’ s attention rather easily to protect street trees. Delivering speeches in English not only strengthens out English expression ability but also increases the audience size. The speeches can be understood by international friends if delivered in English. Both Chinese and English written texts are suggested to be posted with the speech, for people that cannot understand or follow the English content can refer to the texts. The increase of audience size will lead to increase of our influence.

Horizontal and vertical distances from crown to wire illustration
Street tree layout design

Prototype and Test

Prototype Design

According to our action plan, our prototype should include two parts.
1.
The first part is building two models showing the growth of Populus alba 'Berolinensis' L. and the layout of Populus alba 'Berolinensis' L. planting.

We used speedtree to stimulate one Populus alba 'Berolinensis' L.' s growth after being planted along the roadside at April. The tree' s original height in April is 3.95ft; in May, June, and July, it grows to 4.13ft, 4.68ft, and 4.92ft. In September of the following year, the tree grows to 14.18 feet, about the sum of three people' s heights. The model simulated the growth of the tree' s height as well as root root, providing a vivid image of a thriving tree. We also used Cities: Skylines to simulate our layout of planting Populus alba 'Berolinensis' L. with the four shrubs: Syringa oblata Lindl., Jasminum nudiflorum Lindl., Rosa rugosa var. cathayensis, and Rosa xanthina Lindl.. In out model, Populus alba 'Berolinensis' L. is planted alternately with the shrubs. (Please refer to the graph we attached in the Make an Action Plan section.) Because cities skylines cannot show the specific types of shrubs we want to use, so we explained the types of shrubs in the introduction section of the article we posted on the Wechat platform showing these two videos as well as our questionnaire.

We posted two videos showing our models in an article on WeChat platform. We also added an electronic questionnaire asking users' feedbacks of our prototype. The link of this article is attached.

2.
The second part is establishing a club to publicize the protection of street trees. Members that participate in this project are also members of Model COP club (Model United Nations Climate Change Conference club), an environmentally friendly club. To complete this prototype of publicizing street trees protection, we call on members of Model COP club to film Tik Tok videos, post articles on WeChat platform, and deliver an English speech with us.

First of all, we called on members of Model COP to shoot Tik Tok videos with us. Until now, we have made three videos, each with different plots and content to

show to people the importance of protecting those trees. In the process, the first thing we did is writing scripts. The second thing we did is shooting the video. Our second video, a short comedy featuring a guy watering a street tree but mistaken as peeing to it by another person, was shot outside one of our members' home, Wankebocuiyuan. The first video required the least shooting, one of our members took selfies with street trees at the same place we shot the second video and posted it on WeChat; we commented the selfies according to the script and one member recorded her screen for the video. The third video required shooting of different scenes, so we did it separately at places we live. After finishing the shooting, we editted the videos and add music to it. At last, we posted the video on Tik Tok and on our WeChat account Model COP.

The second method we took is posting articles on our WeChat official account Model COP to educate people about the functions and problems of the street trees and raise people's awareness. Before we sent out our questionnaire, we posted a series called dairy expressing love towards street trees and one passage written by one of our club members calling on people to protect street trees. In the series, we not only introduced the functions of street trees, problems within the greening system, reasons why we choose Populus alba 'Berolinensis' L. as the best species for Shenyang, different types of street trees in different regions in China, but also posted literary work by author Xiaofeng Zhang praising street trees spirit of dedication. We hope these articles would raise people's awareness of protecting street trees and spread relatively professional knowledge of street trees.

Thirdly, we asked Model COP members to make an English Speech with us. The speech begins with the monologue by one street tree, who contrasts his wonderful life in the mountains when he was young and his miserable life in the city as a street tree. The speech ends with street trees' friend introducing the functions of street trees, including absorbing carbon dioxide, depositing dust, adjusting temperature, canceling noises, and beautifying the city. We want to use this English speech to influence more people and make them realize what important roles street trees play in our lives and the urgency to protect them.

We continued posting articles regarding street trees after we had gathered the data we needed. We did this not for data collection anymore, but purely for the publicity of street tree protection. When the questionnaire was posted, four articles in the series called diary expressing love to street trees, three Tik Tok videos, one English speech, and one original passage written by one Model COP member were posted; then we collected data from the questionnaire, after which we continued posting articles. Currently we have eight articles in the series called diary expressing love to street trees. We included knowledge about standards for selecting street tree species and history of street trees in latter articles that we posted in our series. The Model COP member who wrote an original passage appealing people to protect

street trees wrote a sequel and we fortunately invited a remarkable author to comment on her sequel and the comment was also posted. However, we understand that we need to do more to make bigger impacts on the street tree system.

- Wechat official account article we posted to show two models built to demonstrate the growth and planting layout of Populus alba 'Berolinensis' L.
- Diary expressing love towards street trees (1)
- Diary expressing love towards street trees (2)
- Diary expressing love towards street trees (extra)
- Diary expressing love towards street trees (3)
- The first and second Tik Tok videos we shot(we posted them again on WeChat platform to increase our audience size)
- The thid Tik Tok video we shot(we posted it again on WeChat platfrom to increase our audience size)
- English speech delivered to raise people's awareness to protect street trees
- Original article writen by Model COP club member to raise people's awareness of street trees (1)
- Original article writen by Model COP club member to raise people's awareness of street trees (2)
- Diary expressing love towards street trees (4)
- Diary expressing love towards street trees (5)
- Diary expressing love towards street trees (6)
- Diary expressing love towards street trees (extra 2.0)

Feedbacks learnt from users

Our original questionnaire is in Chinese; we translated it into English and attached it.

In order to improve the diversity and practicality of our sample, in our survey, the sample includes people from both genders, different age groups, and also from different status and positions. 92 people provide responses for us in the survey. Due to the current outbreak of Convid-19, our survey is send though our official account on WeChat and also publicized on the social media accounts of our team members; in this part, we avoid leading question or language and guaranteed that we will not share personal information such as names of the users to decrease bias in our results. The survey is sent after our publishing of articles about street trees' general knowledge and also introduction about Populus alba 'Berolinensis' L., which is the NO.1 tree species in our evaluation of solutions. Consequently, we presume that for people who had read our articles and filled our survey had at least some background knowledge about the content and main topic in our survey. According to the results of our survey, which we ended at around 8:30 p.m., 17th of April, 34.78% are male, and 63.04% are female and all of our interviewees are between

the age of 10 to 59. Among our interviewees, about 45.65% are between 10~19, and about 23.91% are from 40~49, which are two major age group that are interviewed. Moreover, about 95.65% of our interviewees are local residents in Shenyang, who are familiar to the local environment and our topic is about selection and configuration of street trees for Shenyang, therefore we may conclude that their responses are relatively more reasonable. To make it clear, in our questionnaire, for question 5, 6, 13, people can choose more than one answer, while for other multiple choice questions, people can only choose one answer. We saved two decimal places for our data.

According to the data we have gathered, 73.91% of the people surveyed are not very familiar (63.04%) or not at all familiar (10.87%) with street trees (types, functions, planting methods etc.). And their information concerning street trees mostly come from science popularization books as well as speeches (39.13%), website (41.3%), and official account (32.61%). Therefore, we should publicize more information about street trees in these aspects, in which people are more likely to learn about. Besides, 63.04% of people regard short videos as an effective way of publicizing, from which we can realize that short videos have many benefits, and people will not only watching them for entertainment, but also they would take in the information positively by watching those interesting videos. However, there is one thing to keep in mind, 71.74% of the people that filled in our questionnaire subscribed our official account, so maybe that is why 32.61% of all the interviewees suggested that their knowledge of street trees come from official accounts---we posted many articles regarding street trees. Probably in reality, there are less people whose knowledge of street trees comes from official accounts, but this does not mean that official account is not an effective tool to publicize information. We will continue publishing articles on our account to increase street trees publicity.

According to the survey, we can know that most people think Populus (32.61%) and phoenix tree(26.09%) are the most suitable street trees. There is only one person who thinks Liriodendron chinense (Hemsl.) Sarg. is a proper choice. 82.61% of the people interviewed agree with the method of planting trees and shrubs alternately, which means that our method of increasing biodiversity is relatively acceptable to the public. However, since not all people agreed with this method, we assume that there is still space for improvement. 93.48% of the people surveyed think that if people’ s awareness of street trees protection is raised, then street trees could better survive in the city and serve their functions. Nonetheless, we need to bear in mind that simply increasing people’ s awareness does not entirely addressed the root cause; scientific management is also required for the better survival of street trees in Shenyang.

In the question of which measurement government should take in order to broaden street tree workers’ knowledge and promote their planting skills, 54.35% of the

people choose that the government should encourage support people, undergraduate students, graduate students, and doctors specializing in relevant fields to have voluntary internship opportunities at the greening department. They can take part in urban greening and planning and at the same time guide and teach the workers the necessary knowledge and skills to plant and care for street trees. Therefore, we can see that many people that filled the surveyed want the young to take active part in street trees management.

For spreading knowledge about street trees and evoking people’ s awareness to protect street trees, we posted articles in an official account on WeChat, Model COP. In this survey we asked some questions concerning our influence and effectiveness of street trees articles that we posted. Among all of our subjects, about 73.91% are followers of our official account, and 73.91% of them suggest that they acquire more knowledge about roadside trees though those articles we issued in the account. About 65.22% people surveyed state that their awareness of protecting street trees is improved and 32.61% of them took action to protect the street trees. All these positive response shows that our official account and Tik Tok videos are relatively influential, and really have practical influence on people’ s minds. Although we can still see some drawbacks like some people know what is the right thing to do, but they hardly take any action. And this is also what we have to progress in the future that may include holding more practical activities that can lead more people to take actual actions which are beneficial for the street trees’ growth and adaptation.

Questionnaire(translated into English)

Improvement for next iteration

From the survey we concluded that our selection and layout design of Populus alba 'Berolinensis' L. is generally successful. However, we understand that there is still space for us to improve.

First, the layout of shrubs and Populus alba 'Berolinensis' L. can still be progressed. Part of the reason why a minority of people did not agree with our layout can be lack of sunshine for the shrubs, which we planted alternately with the tree species and under the tree species. Despite a case we mentioned in Make and Action Plan part where Jasminum nudiflorum Lindl.s survive under willows’ canopies, we figured out two ways to provide more sunshine for the shrubs we decides to plant so as to increase biodiversity. The first way is to choose shrubs that can survive in northeastern city Shenyang’ s climate and soil condition and also adaptable to shades. One great example can be Sorbaria sorbifolia, which is adaptable to climate in places including northeastern China, Japan, and Russia, and also resistant to cold

and shade. The second approach is to plant Populus alba 'Berolinensis' L. and shrubs alternately but in a zig zag pattern. We hope in this way, the shrubs would receive more sunshine and might thrive even better.

In addition, from our survey, we also concluded that this is not the only ideal species to play the role of street tree in Shenyang. We can also explore different possibilities and make out plans more complex that includes not one but many tree species. A northern city like Shenyang can also have vegetation as diverse as that of a southern city like Guangzhou. Nonetheless, further research and efforts must be made to achieve this goal.

Moreover, positive responses show that our official account and Tik Tok videos are relatively influential, and really have practical influence on people’ s minds. However, we can still see that more action is needed. Only 32.61% of people take action to protect street trees after their awareness has been raised; the reason behind this may be the fact that there are not many accesses available for people to take action, so we can create more accesses for people to take action. These may include holding more practical activities that can lead more people to take actual actions which are beneficial for the street trees’ growth and adaptation. For example, we can imitate what artists in Sheffield, UK, do to protect street trees from being cut indiscriminately: provide drawing tools like color pencils for pedestrians to draw street trees and hold small exhibitions of the street tree art work in our communities. We also need to bear in mind that simply increasing people’ s awareness does not entirely addressed the root cause; scientific management is also required for the better survival of street trees in Shenyang. Therefore, according to the results of our survey, we would like to sincerely propose to the government to provide internship for undergraduate, graduate students, and doctors, and allow them to take part in the greening of city, and at the same time provide the workers with technical guidance and this measure to improve management is agreed by more than half of the people surveyed. In this way the problem remains in management for street trees may be somehow relieved.

We hope that our project, Selection and Configuration of Main Street Tree Species for China's Northern City Shenyang, would contribute to the promotion of increasing people’ s awareness of protecting street trees and improving the street tree system in Shenyang.

Team Credits

Qianqiao Xian is the leader of the group and is responsible for promoting the whole project and assigning tasks for the members. In addition she also shouldered some of the writing work on the native tree species in " Generate solutions" and the action plan. She also came up with ideas for our Tik Tok videos and took part in writing the scripts as well as our articles posted on WeChat platform for the publicity of street trees. Moreover, she organized the group discussions to generate ideas for our project and communicated with members of the Model COP club to call on them to cooperate with us in the promotion of street trees publicity.

Minghao Zhang mainly took part in ranking the candidate tree species in "Identify the solutions" Moreover, he also shouldered some of the editing and writing work for our official account in Wechat, and also acted in one of our short videos on Tik Tok. Moreover, he also analyzed some of the data collected from the survey and wrote some of the feedbacks from users.

Minglang Zhang was responsible for the writing work of "Identify the criteria" and also came up with some great criteria to evaluate our solutions. Moreover, she also helped analyze data collected from the survey and wrote some of the user feedbacks. Moreover, she was one of our main writers of articles we posted on WeChat official account for street trees publicity.

Haotian Luo played an important role in identifying the challenges in our project and also helped turn our ideas generated in this part during group discussion into text. Moreover, he helped with ranking of the tree species while providing some of the criteria for the evaluation. He also helped draft the survey for our project. Besides, he also delivered the speech of protecting street trees online through our official account on WeChat cooperating with one of other members of Model COP club in the prototype.

Fengjun Jiang acted in our short videos, and he was also the person who contributed most to the idea of the root cause and also shouldered the writing work in this part. Moreover, he also took part in the ranking of the trees, and took part in the researching for our Official account on WeChat.

Kexin Geng researched for identifying some of the challenges and root cause. Moreover, she also designed some questions in the survey. Besides, she also helped analyzing some of the data collected from the survey. She was also responsible for

uploading our report and check for obvious grammar mistakes in our writing.

Heyuan Zhang played an important role in our project by using electronic game related software to build virtual models to imitate the growth and layout of our selected street tree species. Moreover, she also came up with the idea of using the game of Cities: Skylines and SpeedTree to build the models.

Chuxiong Meng helped select some candidate tree species from foreign regions as well as from regions in China that are not Shenyang and provided detailed instruduction for each of them in the "Generate Solutions" part. Moreover, he also researched for data of the street trees cultivation practice in Shenyang for the action plan.

Yanxin Yu helped with the ranking of trees and the interpretation of criteria for evaluating whether the tree is suitable to be a street tree in Shenyang. Moreover, she also helped coming up with the idea of delivering an English speech for the publicity of street trees and took part in the discussion of ideas for our tendencious videos on Tik Tok and our articles posted on WeChat platform.

Ruoxing Wang wrote the summary after discussing it in group. Moreover, he also helped with researching for the information of each candidate tree species and took part in the discussion of ideas for our tendencious videos on Tik Tok and our articles posted on WeChat platform.

Judge Comments

" Overall Comments:
The team has done an excellent job of approaching the project from a wide variety of angles. They have also taken the initiative to consult broadly for their research and surveys. The communications content created and shared as part of this work (including the diaries) is commendable. They have systematically arrived at valid approaches to address the issue highlighted. Keep continuing this excellent work!

The criteria could be further improved by focusing more on the tree management more than tree species identification (especially since management and education has been identified as the major issues to be addressed). There are two solutions being identified here –(i) one is identifying the right tree species and (ii) identifying how to manage the tree species (regardless of whichever species is identified). The answers to (ii) is almost independent of the answer to (i) is.

Questionnaire feedback: As a suggestion, a question like "Do you agree with that governments' present maintenance measures for street trees are lack of scientific evidence?" is too complex to be answered in yes or no over a survey. You are likely to get incorrect answers. Complex questions require alternate methods in survey design and the questions asked should be clear enough for people answering. For instance, the following questions addresses this from a budget perspective - "The government currently spends XX yuan each month from the public budget to maintain a tree of this type. To increase tree cover from x% to y% in the street will require spending to be increased from XX yuan to YY yuan. Do you think the government should do this?". Similarly, try to use common tree names (and pictures when possible) in the surveys. A lot of people might not recognize a tree by its scientific name.
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