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10

TOWARDS A GREENER, HEALTHIER AND HAPPIER FUTURE

The 1st Asia-Pacific Urban Forestry Meeting

Meeting proceedings

**Zhuhai, China
6 - 8 April, 2016**



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FOREWORD

Globally, 54 per cent of the world's population was living in cities in 2014. This number is projected to increase to 66 per cent by 2050. Coupling this with climate change, cities are potentially facing a changing and challenging environment with increasing population, land use changes, environmental degradation, extreme events, economic crisis, and social injustice.

In order to address the needs of urban dwellers it becomes crucial to achieve the Sustainable Development Goals (SDGs) and especially SDG 11 "Make cities and human settlements inclusive, safe, resilient and sustainable".

Asia, one of the fastest urbanizing region, is projected to experience major environmental problems including water management, deforestation and land degradation, air pollution, and climate change over the next two decades. Urban and Peri-urban Forestry (UPF) can provide a wide range of benefits ranging from goods production (e.g., fruits, nuts, mushrooms, herbs, fodders) to ecosystem services (e.g., air pollutant removal, heat island effect mitigation, energy saving, biodiversity conservation, water protection, and climate change mitigation). It also plays an important role in green economy by creating jobs, increasing property value, decreasing electricity bill, and attracting investment. Most importantly, it can improve the quality of life as well as health and well-being of residents.

The question is how we can better utilize UPF to mitigate the impacts of urbanization and minimize environmental degradation in this region. In particular, UPF is still a new or relatively new field in many developing countries in the Asia-Pacific region and lack of knowledge, information, and capacity could limit UPF development and consequently impair the functions and benefits of urban forest resources. There is an urgent need to develop effective strategies and solutions based on the specific regional context aiming at sustainable urban development in the Asia-Pacific region.

In response to this need, the Urban and Peri-Urban Forestry Programme of the Forestry Department of the Food and Agriculture Organization of the United Nations (FAO), the Urban Forest Research Center of the State Forestry Administration of the People's Republic of China and the city of Zhuhai, China decided to co-organize "The 1st Asia-Pacific Urban Forestry Meeting".

Participants to the three-day meeting held in Zhuhai, China on 6-8 April, 2016 included representatives of national and local governments, research and academic institutions, non-governmental organizations (NGOs), international and national development cooperation organizations, professors, researchers, urban planners, urban foresters, arborists, landscape designers, urban forest and tree specialists, government officials, and private sectors professionals from the Asia-Pacific region, North America, and Europe.

The objectives of the meeting were to: 1) discuss the current status of UPF in the Asia-Pacific region; 2) exchange successful stories and lessons learned of UPF policy and management; 3) develop UPF strategies and nature-based solutions and discuss possible long-term collaboration between countries and/or cities towards a greener, healthier, and happier future.

ACKNOWLEDGEMENTS

The organizers would like to thank all the participants for their dedication and support in the preparation of and participation to the 1st Asia-Pacific Urban Forestry Meeting (APUFM). The strong commitment of each of them was the key to the success of the meeting.

Over 200 representatives of national and local governments, research and academic institutions, non-governmental organizations (NGOs), international national and development cooperation organizations, professors, researchers, urban planners, urban foresters, arborists, landscape designers, urban forest and tree specialists, government officials, private sector professionals and FAO, coming from 17 Asian countries, Europe, and North America participated to the three-day meeting and discussed the status of UPF in Asia, exchanged experience and lessons learned, and discussed possible long-term collaboration on the development UPF strategies and identification of nature-based solutions towards a greener, healthier, and happier future. Our sincere gratitude goes to all the speakers, who shared their knowledge and experience.

A special thanks goes to the planning and organizing team including Prof Cheng Wang, Dr Guangfa Qie, Dr Lin Gu, Ms Jiali Jin, and Ms Teayeon Kim for their strong support, assistance, and cooperation.

ACRONYMS

AP	Asia Pacific
APUFM	Asia-Pacific Urban Forestry Meeting
CAF	Chinese Academy of Forestry
CSR	Corporate Social Responsibility
EFUF	European Forum on Urban Forestry
EGCA	European Green City Award
ES	Environmental Services
ESS	Environmental Social Services
FAO	Food and Agriculture Organization of the United Nations
GI	Green infrastructure
MoCM	Ministry of City Management
MoUD	Ministry of Urban Development
NBS	Nature Based Solutions
NF	Natural Functions
NGO	Non-governmental Organization
PES	Payments for Ecosystem Services
SDGs	Sustainable Development Goals
SFA	State Forestry Administration of the P.R. China
SPM	Suspended Particulate Matter
SUBR	Southern University and A&M College in Baton Rouge
UCLG	United Cities and Local Governments
UGI	Urban Green Infrastructure
UGS	Urban Green Spaces
UHI	Urban Heat Islands
UN-HABITAT	United Nations Human Settlements Programme
UPF	Urban and Peri-urban Forestry
VOC	Volatile Organic Compounds

EXECUTIVE SUMMARY

The 1st Asia-Pacific Urban Forestry Meeting (APUFM), co-organized by the Food and Agriculture Organization of the United Nations (FAO), the Urban Forest Research Center of the State Forestry Administration of the People's Republic of China, and the city of Zhuhai, China, was held on 6-8 April, 2016 in Zhuhai, China.

More than 200 participants from 17 Asia-Pacific countries, Europe, and North America attended the meeting representing around 60 national and local governments, research and academic institutions, non-governmental organizations (NGOs), international national and development cooperation organizations, professors, researchers, urban planners, urban foresters, arborists, landscape designers, urban forest and tree specialists, government officials, and private sectors.

The participants explored the role of UPF in helping to achieve the Sustainable Development Goals (SDGs), particularly SDG 11, which focuses on making cities in the Asia-Pacific safe, resilient and sustainable. Among the targets of SDG 11 are increasing resource efficiency, mitigation and adaptation to climate change, resilience to disasters in cities, and providing universal access to safe and accessible green and public spaces by 2030.

The meeting consisted of a one-day symposium, a half-day field trip, and a one-and-half day workshop. During the symposium (6 April, 2016), case studies from the Asia-Pacific region including Australia, P.R. China, India, Iran, Malaysia, Republic of Korea, New Zealand, Philippines, Singapore and Thailand were presented. Furthermore, various international speakers from the United Kingdom, Italy, and the United States shared their experiences on UPF policy, management, and education. During the field trip, participants visited the Meihua City Garden, a residential community, and the Seashore Park in Zhuhai. Finally, during the workshop (7-8 April, 2016), 17 countries from the region provided country reports including the main benefits, key issues, successful stories or lessons learned on UPF development in their respective countries. The role of urban forests in environmental quality, health and wellbeing, green economy, cultural heritage, and urban planning was discussed in the five parallel working groups. Future cooperation on information sharing, knowledge exchange, and resource mobilization was also discussed among different stakeholders.

Based on the discussion, the participants agreed that:

- 1) the main benefits of urban forests and trees to cities and residents in the Asia-Pacific region are **beautification, air pollution removal, and opportunities for recreation;**
- 2) the main challenges to urban forestry development in the Asia-Pacific region are **conflicts of land use, weak governance, and limited technical skills and knowledge;**
- 3) the main priorities of urban forestry development in the Asia-Pacific region are **good governance, sufficient investments/funding, and urban forestry expertise;**
- 4) the **Chinese Forest City** experience could be used as an important reference model during the development of urban forestry in the Asia Pacific Region.

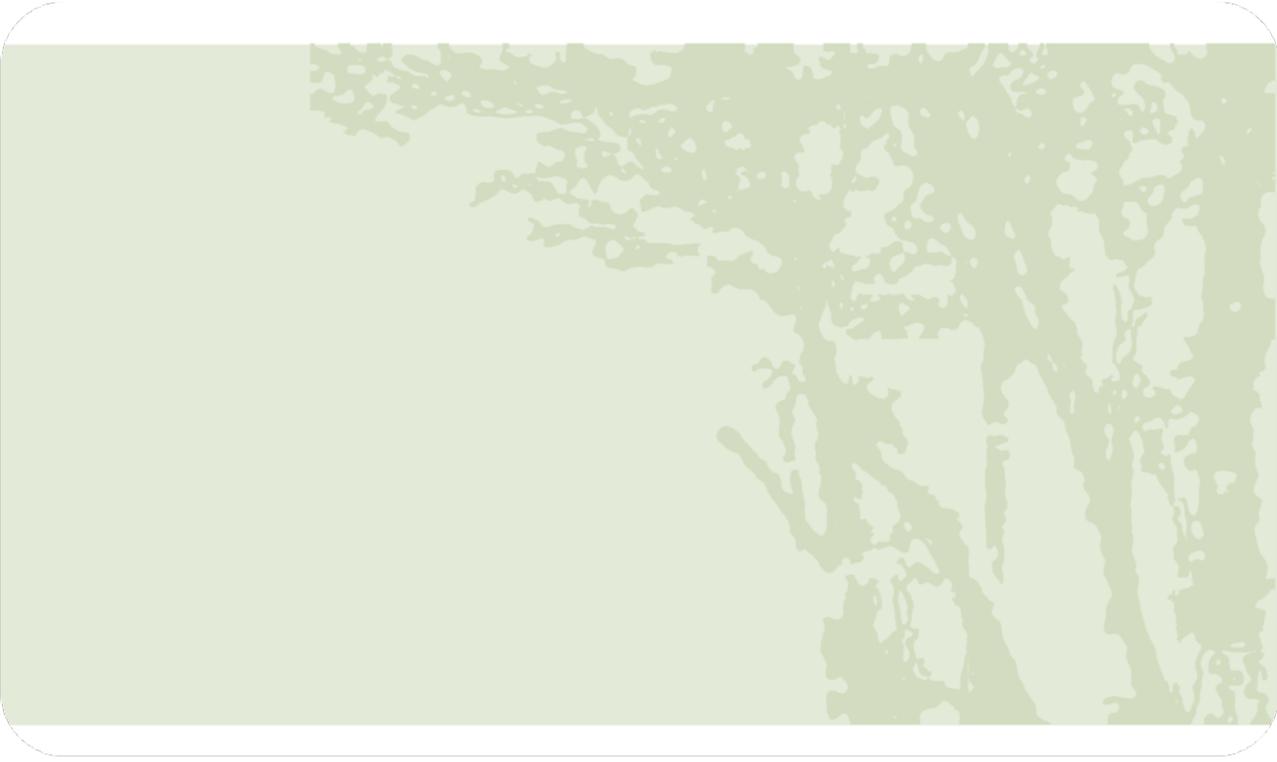
At the end of the meeting, the participants adopted the **Zhuhai Declaration** (see annex I) which sets the roadmap of the UPF development in the Asia-Pacific region with detailed recommendations.

INTRODUCTION

Asia, the home to 53% of the world's urban population, is projected to be one of the largest urban growth regions in the next two decades. Rapid urbanization, especially unplanned and mismanaged urban growth, coupled with climate change, can lead to increased heat island effect, air pollution, soil degradation, water shortages, food insecurity, poverty, and public health issues. Strategies and solutions are urgently needed to help Asian cities achieve sustainable development goals (SDGs).

Urban and peri-urban forestry (UPF) is one of the solutions as it can provide a wide range of goods (e.g., food, fuelwood, water), socio-economic benefits (e.g., jobs, recreation, health), and ecosystems services (e.g. air pollutant removal, shading and cooling, stormwater runoff mitigation, carbon sequestration, and greenhouse gas emission mitigation). However, strategies for development and management of UPF are not yet fully recognized and adopted in Asian countries. It is important, therefore, that countries work together to identify common issues, share information, and develop solutions through strengthened regional collaboration.

This meeting aims to discuss the status of UPF in Asia, exchange experience and lessons learned, and discuss possible long-term collaboration on the development UPF strategies and identification of nature-based solutions towards a greener, healthier, and happier future. This regional initiative will also assist Asian countries in contributing in the global promotion of UPF as a key contribution to the New Urban Agenda that will be discussed during UN Habitat III.



Part 1. Symposium

Opening remarks

The symposium was chaired by Simone Borelli (*Forestry Officer, Food and Agriculture Organization of the United Nations*) in the morning and Cheng Wang (*Director, Urban Forest Research Center of the State Forestry Administration of P.R.C and Chinese Academy of Forestry*) in the afternoon. The opening session included presentations from Simone Borelli (*Forestry Officer, FAO*), Youdong Peng (*Deputy Director, State Forestry Administration of the P.R. China*), Zhi Ye (*Deputy President, Chinese Academy of Forestry*), and Ming Pan (*Deputy Mayor, City of Zhuhai*). Their statements are summarized below.

Simone Borelli, Forestry Officer, Food and Agriculture Organization of the United Nations

First of all, I would like to thank our partners: the Urban Forestry Research Center of the State Forestry Administration of the People's Republic of China and the City of Zhuhai, China for their strong support and cooperation and for the wonderful welcome. I was certain that the Chinese hospitality would be excellent, but I think our hosts have really gone beyond our expectations. I would also like to thank all the colleagues who made the long trip to join us here today, both from all over Asia and the Pacific, but also from Europe and North America, as well as all our colleagues from different parts of China. Finally, a special thanks goes to Prof Cheng Wang and his team, particularly Lin Gu and Jiali Jin, to my colleagues Yujuan Chen and Teayeon Kim in Rome, but also all the others behind the scenes, who have really worked incredibly hard to make this meeting happen.

Now, coming to business:

As you know, Asia, the home to 53% of the world's urban population, is projected to be one of the largest urban growth regions in the next two decades. This rapid urbanization can lead to a number of problems such as increased heat island effect, air pollution, soil degradation, water shortages, food insecurity, poverty, and public health issues. Urban and peri-urban forestry (UPF) can help address these issues as it can provide a wide range of goods and ecosystems services; and that is why we are here. In fact, in the Asia-Pacific region, there is growing attention and interest to the development and management of urban forestry and countries like China have made a fantastic efforts to ensure that cities are greener, healthier and happier. However, it would appear there is still limited communication and cooperation among countries and among cities. Over the last few years, FAO has been working really hard to promote urban forestry globally and part of our mandate is to create meeting places for member countries to meet and discuss issues of common interest. I am very pleased to see that we have been able to put together a wide range of representatives from the public sector, academia and civil society and I am sure that each of us will bring to the table his/her rich experience and provide a significant contribution to the outcomes of the meeting. What we would like to do is to discuss common challenges and issues, share information and experiences, and ultimately develop strategies and solutions for the development and management of urban forestry in the Asia-Pacific region. I also hope that we will be able to identify mechanisms for cooperation and exchange and that this meeting will only be the starting point of future regional collaboration.

I wish you a very successful meeting and I hope you all enjoy the time we will spend together.

Youdong Peng, Deputy Director, State Forestry Administration of the P.R. China

Dear Mr Borelli, Distinguished Guests, Ladies and Gentlemen, and Friends:

I feel delighted to attend the 1st Asia-Pacific Urban Forestry Meeting (APUFM) in the beautiful and green April in Zhuhai to discuss urban forestry development with you. On behalf of the State Forestry Administration of China, I would like to extend my sincere welcome to our national, regional, and international guests and warmly congratulate the host of this meeting!

In recent years, more and more attention has been paid to urban forestry development by countries around the world. Many cities have increased their ecological space, increased the ecological capacity, and improved the livability by adding urban forests and green coverage. The Asia-Pacific region has the largest population and the most rapid urbanization and many countries like China are suffering from air pollution, heat island effect, ecological fragmentation and other environmental problems. Therefore, the need of promoting and facilitating urban forestry development has been greatly recognized. The APUFM, supported by FAO, is in line with this need and its theme and topics are not only timely, but also science- and practice-based which will certainly play an active role in promoting a scientific and healthy development of the modern cities in the Asia-Pacific.

The Chinese government pays great attention on urban forestry development. Especially since the beginning of the new century, urban forestry has played a significant role in the construction of an environmentally friendly and beautiful China and has been incorporated into the medium and long-term national social-economic development plan as an important national strategy. For example, urban forestry should reflect the concept of respecting nature, being in harmony with nature, and fostering the unity of Nature and Man. The urban landscape planning and design should consider to create nature in cities, so that the residents can enjoy mountains, water, and plants as if they were living in natural landscapes. Rather than blindly introduce “exotic flowers and rare herbs”, it would be better to focus on green corridors and explore natural-based solutions.

Since 2004, the Chinese government has carried out urban forestry activities in over 170 cities and 12 provinces, creating a new model and an important starting point for the development of urban forestry. Practice has proven that the development of forest cities has achieved concrete outcomes: First, the amount of greenery has grown. According to statistics, the average annual new forest area was over 13,000 hectares per city during their engagement in the activities, greatly accelerating the pace of urban and rural afforestation. Second, the Residents' Happiness Index has risen by building up suburban parks and green countryside, greening water networks and roads, improving urban and rural living environment, and enhancing residents' environmental awareness. Third, the concept of environmentally friendly civilization has been promoted through advocacy and education as well as the dissemination of ecological knowledge, which has raised the public understanding of the functions and roles of urban forests and formed a new social trend of planting, protecting, and loving greenery. Fourth, green economy has been stimulated. Many resource-based and industrial cities have not only revived their external appearance, enhanced the quality of urban construction, but also intensified the environmental carrying capacity and their competitiveness through the development of a number of forest-based green industries.

Ladies, gentlemen, and friends!

China has made remarkable progress in urban forestry development in a very short time period. I think this is an important reason for holding the 1st APUFM in China. The development of the forest city concept has become a successful model of promoting ecologically sustainable development in urban and rural areas. From now on, Chinese government will strive to facilitate urban forestry development not only at national level, but also at provincial and local levels and actively promote the development of forest cities, counties, towns, and villages. We will further enhance the level of urban forestry development based on regional ecological conditions, the different urban social-

economic development levels and historical and cultural features, so as to green the favorable areas in cities and their surrounding areas where are unsuitable for farming, and gradually form urban green clusters, expand the green space between cities, upgrade ecological functions, improve urban and rural living environment, and support green development patterns for urban social-economic development.

Asia-Pacific countries have all launched many beneficial explorations in urban forestry development. I hope the participants, especially experts and scholars, can share their opinions, participate in the discussion around this theme, provide suggestions and recommendations to solve major conceptual and practical issues of urban forestry development in the Asia-Pacific region, and contribute their wisdom and experience to ensure a fruitful meeting. We would like take this meeting as an opportunity to strengthen the exchanges and cooperation with other Asia-Pacific countries and share ideas, techniques and experiences with you. I believe that Asia-Pacific cities will surely move towards a greener, healthier and happier future.

Finally, I wish this meeting a great success and wish all the participants good health and a good mood.

Thank you!

Zhi Ye, Deputy President, Chinese Academy of Forestry, China

Good morning, everyone.

Last summer, FAO initiated the conversation with our colleagues, urban forestry experts, from the Chinese Academy of Forestry (CAF) about the potential of co-organizing the “1st Asia-Pacific Urban Forestry Meeting”. Later, we reported this proposal to the State Forestry Administration of P. R. China and received strong interests from the party group. The director, Youdong Peng, has provided clear instructions on the holding of this meeting. The CAF also carried out regular and repeated consultations with FAO on this issue. One year later, we are gathering in Zhuhai as expected to discuss the prospects of Asia-Pacific urban forestry development. I wish you a successful meeting with concrete outcomes through your concerted efforts.

I noticed most of the representatives are my colleagues, experts and scholars from research institutes and universities (about 60%) and the remaining 40% are the friends from administrative departments. In my view, it is important for researchers and managers to interact and exchange experiences to stimulate the rapid conversion from research findings into practical and evidence-based solutions to solve problems. The high attention of the Chinese government to the research and practices of urban forestry has played an important role in the rapid development of urban forestry in China. Since 2005, the special scientific research funds invested into urban forestry by the State Forestry Administration and Ministry of Science and Technology have reached more than 60 million RMB and the research grants from local governments at all levels have reached 300 million RMB. At present, the technical staff of master and higher education is over 1000. This has not only brought numerous technical achievements in urban forestry development, but also provided strong scientific and technological support for administrative decision-making resulting in the scientific and healthy development of urban forestry in China.

First of all, scientific and research achievements help to formulate urban forestry strategies

In 1999, the State Forestry Administration invited over 50 experts from more than 10 institutes including Chinese Academy of Forestry, Chinese Academy of Sciences, and Beijing Forestry University to conduct a comprehensive study in the theory, indicators, layout, techniques and risk management of urban forest development based on 12 pilot cities at various scales and levels. In 2002, based on the research findings, the State Forestry Administration formulated the “Chinese Sustainable Development—Urban Forestry Strategy”, which sets forth the development objectives

of Chinese urban forestry in the following 30 years: green coverage rate will reach to 39.5 %, park green area per capita will be 15 m² by 2020, and 70% of the state urban forest coverage rate will be more than 40% by 2030. The research achievements clarify the strategic development plan of Chinese urban forestry with clear development objectives and effective promotion measures plays a significant role in driving the establishment and advancement of Chinese urban forestry theories and practices.

Secondly, scientific and research data are incorporated into the standard system of developing “National Forest City”

The development of “National Forest City” policy played an important role in the development of urban forests. However, it was also vital to establish a clear and realistic evaluation index system based on urban features when dealing with various cities with environmental diversity and different regional culture. Therefore, since 2002, the State Forestry Administration and local governments have initiated and supported research on urban forestry in different cities, e.g., Shanghai, Beijing, Guangzhou, Chengdu, Yangzhou and Wuhan. Based on the research findings, in 2007, the State Forestry Administration invited experts and scholars to formulate and test the “Evaluation Index for National Forest Cities” and amended it based on the experience and scientific and research results obtained in different cities, and then promoted it as the national standard.

Finally, scientific research practice supports the critical technical aspects of Chinese urban forest development

Urban forest development is a comprehensive and multi-beneficial ecological project which is different from the traditional afforestation and simple landscaping and involves multiple stakeholders in many fields. As a result, research on the key practices is urgently needed and it is also a major feature of Chinese urban forestry research projects. For example, in recent years, the cities in the Pearl River Delta have launched suburban landscape forest renovation projects over a total area of 3 million hectares and with a capital investment of 100 billion RMB. To establish an urban forest with stable community structure, high biodiversity and rich scenery, tree species selection and landscape design is the key. In view of these problems and demands, the Science and Technology Division of the State Forestry Administration as well as the Forestry Department of Guangdong Province have started dozens of research projects on ecological landscape forests since the “9th Five-Year Plan” and created ten research institutes to carry out further research. Now the mature close-to-nature forest development model has been developed and widely applied to the Pearl River Delta urban forestry projects. Meanwhile, the Ministry of Science and Technology and the State Forestry Administration will give priority to urban forestry projects related to health and well-being, e.g., the study on urban forest’s regulatory capacity for the treatment of fine particulate matters (PMs) in the atmosphere, the study on the urban forest’s layout optimization in densely populated areas targeted at the 88 cities of over 5 million residents to address the imbalance of population and natural resources during rapid urbanization, the study on the development of urban forests in arid areas including water saving techniques.

My dear guests, practice has proved that the interaction and integrity of urban forestry’s scientific research and administrative decision-making have promoted the healthy development of Chinese urban forestry. I hope these experiences and actions can be your reference and I would like to learn theories and practices from other countries at this meeting.

On behalf of the Chinese Academy of Forestry, I sincerely invite all of you to visit the Academy for further exchanges in order to jointly promote urban forestry research cooperation and collaboration aiming at creating a happier future with urban forests. Thank you!

Ming Pan, Deputy Mayor, City of Zhuhai, Guangdong Province, China

Honorable Deputy Director, Mr Peng, Distinguished Guests, Ladies and Gentlemen, and Friends:

On the best day of April, we are gathering in Zhuhai in this warm and beautiful green season to discuss urban forestry development. At this moment, on behalf of Zhuhai's municipal party committee and government, I would like to extend our sincere welcome to the present leaders, experts, and every guest, and warm congratulations to the host of this meeting. I also want to show my hearty gratitude to the FAO and the State Forestry Administration for choosing Zhuhai as the host city!

Zhuhai, a bright pearl in the South China Sea, is located in the west bank of Pearl River estuary facing Hong Kong in the east and bordering on Macao in the south. It is known as "A city of 100 Islands" with the landscape adjacent to the rivers and the lands and islands facing each other. In recent years, in line with the Guangdong Provincial Party Committee and government's ecological construction and green growth strategy, with the support from leaders of the state forestry department, our city learns and practices the latest achievements of urban forestry development to carry out the livelihood strategies and projects of building up a forest city for the improvement of urban environment, people's health and well-being, and the sustainable development of economy as well as society. After our persistent efforts, our citizens have depicted a beautiful and flourishing picture for this city with their wisdom and hard work. Today, in the city, we can find numerous parks, either large or small, green spaces on the street which have constructed the urban forest landscape and environmentally friendly system, providing citizens with green space for relaxation, recreation and entertainment. In the countryside, the development of happy villages and residences led by green industries and driven by distinctive culture is in full swing. In the areas between the city and countryside, greenbelts have linked up parks, scenic spots, places of interest, farms, and orchards, expanding the urban greenness and forming a unique green corridor. Green space provides the most common but critical ecological benefits for people in Zhuhai.

The 1st APUFM, held in Zhuhai, is themed with "toward a greener, healthier, and happier future", which is not only a cultural conjunction and developmental resonance, but also a practical guidance and movement. Currently, in line with the theme of "Bringing Forests into Cities and Letting Cities Embrace Forests", our city is carrying out vigorously the development of the forest environment, economy, culture and related systems. We are launching four major activities including City of Parks, Miles of Green Corridors, Colorful Ribbons, and Ecological Networks of Water to optimize urban forest structure and promote its quality. In doing so, it will provide a greener and healthier ecological space and help achieve the goals of the win-win of ecology and development, the joint advancement of both city and countryside, and the sharing of wealth and civilization, and construct Zhuhai as a city capable of "Being in nature brings back the memory of good old days" featuring greenness, beauty, mountains and rivers, and being favorable to live. We wish to leave our offspring a beautiful homeland with blue sky, green lands, and clean water.

Distinguished guests, ladies and gentlemen, the green, full of vigor and vitality, represents the hope and future. The success of the meeting and the wonderful speeches by the experts will bring us the state-of-the-art science and practices which will broaden our minds and vision greatly. We will make full use of the outcomes of this meeting, constantly pushing the national forest city development forward to a new stage and making better contributions to national ecological civilization construction.

Finally, I wish this meeting a complete success, hoping every leader and guest will enjoy better work and life.

Keynote address

Cheng Hong (*Director, Publicity Office of State Forestry Administration of P.R.C*) and Wang Cheng (*Director, Urban Forest Research Center of the State Forestry Administration of P.R.C and Chinese Academy of Forestry*) delivered keynote speeches. Their statements are summarized below.

The Practice of Forest City in China

Cheng Hong, Director, Publicity Office, State Forestry Administration of P.R.C

The Chinese Forest City was officially launched in 2004. It is an innovative practice of advancing urban and rural ecological construction by the State Forestry Administration based on the achievements of urban forestry development in line with the national conditions and development stage. At that time, our main objective was “One Theme, Two Goals”.

The “One Theme” was “Bringing Forests into Cities and Letting Cities Embrace Forests” by mobilizing and uniting the strong support from government and society to pay more attention to forests and better participate in the national forest city construction aiming to achieve the sustainable development goals (SDGs) of urban economy and society.

The “Two Goals” was focusing on applying the “planting trees on the earth and growing green minds among citizens” into practice. One goal is to increase forest green areas through tree planting, to create a modern cityscape of “forests in city and city in forests”. The other goal is to foster environmental culture, advocate environmental morality to spread the ecological education to every corner of urban and rural areas and to root it in the residents’ minds.

The Chinese Forest City concept is now 13 years old. Looking back to the history, it can be divided into three main stages:

The first stage, 2004-2007, was a stage of communicating ideas and building consensus.

The second stage, 2008-2012, was a stage of accelerating promotion and improving regulations.

The third stage, 2013-present, was a stage of recognizing, developing, and flourishing.

With the Chinese Communist Party’s commitment to construct an ecologically sustainable civilization and beautiful China, Forest City development plays a more prominent role in governmental work and has been adopted at the strategic level of national development, as can be demonstrated by the following points:

In 2014, Forest City development has been listed in the “National New-type Urbanization Plan” and “National Medium and Long-term Reform Implementation Plan”.

In 2015, Forest City development has been included in the 13th Five-year Plan.

In 2016, Forest City development has been highlighted by President Xi as one of four top priorities in forestry development to ensure forest ecosystem sustainability.

During the 13 years of Forest City development in China, we have received an active response from the government and sincere appreciation from the public and have accomplished remarkable achievements. At present, there are more than 170 cities involved in the programme and 96 of them have already been granted the title of "National Forest City". According to statistics, the average annual new forest green area is over 13,000 hectares per city, equivalent to about 1% increase of forest cover. The residents’ supporting and satisfaction rate are both up to 95%. Undoubtedly, Forest City development has become a highlight in urban forestry and ecosystem development, an effective strategy to improve the public’s well-being and happiness. In this process, we have learned from the world’s urban forestry experience, forming some ideas and actions that fit with Chinese characteristics and which can be summarized in seven aspects:

First, adhere to the typical model and promote "National Forest City". Every year the State Forestry Administration selects 10 cities and grants them the status of "National Forest City".

Second, adhere to the priorities of the urban forestry management plan and ensure it has a solid scientific basis. It is rigidly required that every city has to develop a ten-year plan and implement this plan during the process of forest city development.

Third, adhere to the people-oriented approaches and focus on building forest green space in accordance with people's needs.

Fourth, adhere to the comprehensive approaches and focus on creating a harmonious urban and rural natural ecosystem. We consider forest development as our primary task and integrate mountains, rivers, forests and fields into forest city development as important ecological factors.

Fifth, adhere to learning from nature and focus on improving the close-to-nature level of urban forest ecosystem. The forest city development is closely linked with the inner laws of forest ecosystem and close-to nature forestry theory, building self-sustaining forests through artificial means and reducing the priority of beautification and the disregard for ecological principles.

Sixth, adhere to the principle of integration of urban and rural areas and focus on the urban and rural forestation as well as ecological management coordination. Forest City development should cover the whole region, both downtown and in the outskirts and the countryside.

Seventh, adhere to government-leadership and focus on forming a pattern of co-building and sharing. The municipal government should take the leading role of organizer, promoter and manager as well as encourage social forces to actively participate in and promote the forest city development with concerted efforts.

Practice has proved that forest cities meet the new public needs for improving the environment, tallies with the new trend of new-type urbanization, is in line with the plan to construct an environmentally friendly and beautiful China, and has paved a successful way for urban forestry development. Both now and in the future, we will implement earnestly the spirit of President Xi's important words, in accordance with the deployment of 13th Five-year Plan's Outline for forest city development and accomplish the following priorities. **First, scientifically develop the plan.** Determine the major goals and tasks of the next period and incorporate them into the 13th Five-year Plan for national and local economic and social development planning. **Second, promote the project.** Initiate a number of key projects conducive to the forest city development, especially around the city clusters in Beijing-Tianjin-Hebei, the Yangtze River Delta and Pearl River Delta to promote cross-regional projects. **Third, renew the political mechanism.** Strengthen the control and management of utilization of forest lands and wetlands to sustain the required minimum urban ecosystem functions. **Fourth, improve management regulations.** Further improve the index system, technical standards and regulations and management system mechanism of urban forest development, and carry out research on the evaluation index and methods for forest city development at county level.

An Overview of Urban Forestry in the Asia-Pacific Region

Cheng Wang, Director, Urban Forestry Research Center of the State Forestry Administration of P.R.C and Chinese Academy of Forestry

Urban forestry is an important component of the green infrastructure in cities and plays a significant role in constructing an urban ecosystem with proper ecological structure as well as efficient ecological services to ensure sustainable development. In last decades, the Asia-Pacific urban forestry has flourished along with economic growth and urbanization. Here, on behalf of the organizing committee, I would like to give an overview on the Asia-Pacific urban forestry.

Based on the literature and the questionnaires, the conclusions are as following:

1. The Asia-Pacific region, with the greatest GDP and the largest population in the world, is one of the fastest urbanizing region in recent years with imbalanced urban forestry development, as some countries already have thriving urban forestry programmes while others have just started.
2. The health condition of urban trees in most countries from the region is above average. However, as some forests are relatively young, there is still a need for good maintenance and management.
3. In general, the management of Asia-Pacific urban forestry is dominated by public forestry sector, which is engaged in multiple sectors as well as in overall management of the resources. For example, the state-owned forests play a predominant role in Chinese urban forest resources, which is obviously different from the dominance of private forests in Europe and America.
4. Many Asia-Pacific countries have developed medium and long term plans for urban forestry management, mostly at municipal scale. Management funds mainly come from the municipal government, which indicates that they play a leading role in urban forestry development.
5. In terms of management techniques, the urban forests in general have been managed and maintained well, but mulching is rarely applied, therefore, sound management technique and practices need to be promoted.
6. The regular inventory of urban forest resources has not started in full swing, and only a minority of countries has carried out a nationwide inventory. The majority is at municipal level and mainly focuses on street trees.
7. Beautification, recreation, health care, air purification, cooling, energy-saving are identified as important benefits provided by urban forests which are related to human health and well-being. However, it would appear that the attention to soil erosion reduction, regulation of stormwater and flood-related disasters, maintenance of biological diversity and environmental education is still rather limited.
8. The main challenges for urban forestry development are conflicts of land use, followed by the weak management, limited technical skills and knowledge of policy makers, absence of public participation, capital investment and forestry experts and low-level management.

Overall, we need to further explore the effectiveness in urban forestry's ecology, economy and culture and explore the techniques and practices of planting, management and operation. Through this survey, we have noticed the gaps between each city, but we are also surprised by the great attention paid by Asia-Pacific cities, especially the municipal governments. Some nations have accumulated extensive experience in creating urban forests, for example China, which impressed us with its Forest City development and the achievements reported by the State Forestry Administration.

Strengthening the international and regional cooperation and communication is vital in sharing experiences and results of urban forestry development. In recent years, both the FAO and IUFRO have held several urban forestry meetings, and since 1970s, the United States and Canada have organized regular conferences for idea exchanges and Europe also holds regular forums. In 2004, China and Denmark initiated some seminars which continued for some years. However, there is still no stable platform for urban forestry communication as a whole. I expect this meeting to open the dialogue and start a new chapter in the communication and cooperation of Asia-Pacific urban forestry and enable every nation to gain further mutual understanding, exchange and learn from different experiences and outcomes of forest ecological development in cities, better cope with the problems and promote the common prosperity of Asia-Pacific urban forestry.

Regional case studies

The Role of trees in Adapting Australian Cities to Hotter and Drier Conditions - *Stephen Livesley (Australia)*

Urban forest management and research in Australia has recently focused upon the key environmental goal of reducing the urban heat island by providing an overall increase in tree canopy cover and targeted areas of tree canopy shade for human health and wellbeing. At the same time, there has been a growing interest in the role of the urban forests and trees in moderating stormwater runoff and water quality. Other recognized roles that trees can provide are human mental health benefits and a cultural sense of place. Similarly, biodiversity of the urban forest itself, i.e. the number of species, family and genus diversity within the urban forest, and the biodiversity habitat trees provide for iconic Australian bird and mammal species (i.e., kookaburras, cockatoos, parrots, micro bats, ring-tail possums, honey-gliders).

The urban heat island, global warming and human death and hospitalization during summer heat waves has really raised the awareness of the role that vegetation (especially urban trees) can play in mitigating the heat extremes that vulnerable sections of society experience. These shading and evaporative cooling benefits are most pronounced when water is readily available enabling large, leafy trees to grow to full size and to transpire when this latent heat cooling is most required by the tree itself and by people living in the surrounding dry, hot urban landscape. Inequity in tree canopy cover among Australian cities and towns, and within the different suburbs and neighborhoods within a given city, has led to canopy cover targets being set, in an attempt to reverse the trend of tree cover decline with urban intensification. The simple target of increasing tree canopy cover to provide climate change and heat sensitive adaptation of our towns and cities needs to consider the great variation in tree canopy quality (density) and tree water use within the trees planted in our urban landscapes. Similarly, the fact that high tree canopy cover without high water retention and availability will not deliver the cooling and lush greenery our urban planners' desire.

Urban Green Infrastructure: Strategies for Healthy and Sustainable Developing Cities - *Chi Yung Jim (People's Republic of China)*

Urban greening contributes notably to environmental quality, quality of life, human health, and ecosystem services in cities. Responding to the earnest quest for urban sustainability, cities are endeavoring to protect, enhance and create the urban green infrastructure (UGI) to bring multiple benefits to people and wildlife. Compact cities especially in developing countries are commonly beset by nature deficit, being more acute in the old cores and neighborhoods. The tight urban fabric incurs intense competition for the inadequate land pool, resulting in meagre allocation of planting space. The lack of above-ground growing room for urban trees is often accompanied by equally restraining soil volume and quality. Tree growth, health and stability are often gravely suppressed by the stifling soil environment. Older cities suffer more from the shortage than new ones that tend to pay more attention to provision of UGI. Literature review, field studies and laboratory analysis provided the basis to assess the constraints and remedies.

Urban soils are commonly beset by a plethora of physical and chemical problems. The soil is often shallow and stony with highly sandy soil texture, and compacted to conform to prescriptive engineering standards to support vehicular or pedestrian load. Additionally, compaction can be induced by vehicles running and humans trampling on unprotected soil. The surface layer of exposed soils could be compacted by the rain splash effect, which may form a soil crust to seal the soil surface. The poor soil structure with inadequate porosity offers little resistance to compaction pressure and restricts water infiltration, causing poor drainage and limited moisture storage in the pores. Many urban soils are composed of layers of materials with different composition, texture,

structure and porosity. Water will not move down through the interface between two contrasting materials until the upper layer has been saturated. Thus light rain or irrigation will not be able to wet the soil below the interface to limit effective soil to the layer above it.

The lack of rootable soil volume imposes a severe restraint on tree root development. Insufficient soil depth is often aggravated by curtailed lateral soil spread. Tree roots normally demand soil depth of about 100 cm, and lateral soil spread ideally should be as wide as the crown spread. Many planting sites especially at roadsides in compact built-up areas cannot meet this minimal soil volume and soil geometry requirements. The mandatory heavy soil compaction in preparing the roadbed under the footpaths and carriageway also conflicts with root growth. It could mean that the effective soil volume that could be explored by roots is notably reduced due to confinement around the small planting site by hardly rootable soil. The sequestered root system in turn would retard growth rate, weaken trees and jeopardize their stability and safety. Newly planted small trees may fail to establish and could easily be uprooted in strong wind. Even if they struggle and reach larger dimensions, the anchorage tends to be restricted, making them potentially hazardous.

Extensive hard paving at and around planting sites imposes another limitation on root development. Widespread sealing by concrete or asphalt, common in compact cities, leaves only a small area of exposed soil to deprive it of air penetration and water entry. The soil atmosphere will suffer from the lack of oxygen ingress and the undesirable accumulation of carbon dioxide which could not be released effectively, creating inimical conditions to the health of plant roots as well as the microbial decomposers. Rainwater could not infiltrate into the soil to replenish soil moisture storage, often leaving the soil droughty. Leaf fall and other organic litter will be swept away in site cleaning rather than returning to the soil to allow decomposition and release of nutrients. Thus the normal nutrient cycling process is disrupted. The synthetic paving materials tend to absorb plenty of solar radiation to induce a high material temperature. The retained heat can be transmitted via the thermal gradient to the underlying soil to raise its temperature to a level unfavorable to root and microorganism activities, and to accelerate the loss of the already small stored soil-water stock. As the soil is usually compacted to engineering specifications before the paving material is laid, paved areas suffer from the additional problem of soil compaction.

Urban areas are subject to common land level or grade changes. Development areas have to be formed to receive roads, buildings and other facilities. In the process, the land surface is smoothed and levelled by cutting (grade lowering) and filling (grade raising) relative to the original soil surface. Thus the natural soil profiles in compact built-up areas are widely disturbed. The topsoil embodying the valuable O and A horizons, which hold the bulk of a soil's nutrient capital, could be truncated by grade lowering. Alternatively, the topsoil could be buried by earth fills which may be of an inferior quality unsuitable for plant growth. The fill materials in built-up areas are contaminated extensively by construction rubbles, which may include rather large fragments of concrete, cement, plaster and brick. These coarse materials with limited water and nutrient holding capacity impose physical limitations to root growth. If the burial is deeper than 60 cm, the original soil will become largely out of reach to most plant roots. Sometimes, old pavements are buried without removal, thus restricting the effective soil depth to the layer above the subsurface paving.

The remains of construction activities are beset by alkaline calcareous ingredients which could impose deleterious chemical impacts. They are particularly common at roadside strips or off-road areas with site formation mainly due to grade raising. The land surfaces of many compact city areas are dominated by a surficial layer of earth fills often containing construction debris. Their presence in appreciable quantities could push up soil reaction to the alkaline range, thus some nutrients may become less soluble in the soil solution. Iron, manganese copper, zinc, boron, cobalt, and phosphorus may become sparingly available in the pH range 7.5–9.0. Even though these nutrient elements are present rather liberally in the soil, their solubility is sensitive to and contingent upon soil pH. Suffering from deficiency of such mineral nutrients, the affected trees could display symptoms of leaf yellowing called chlorosis.

The lack of organic matter in most urban soils presents a chronic handicap to tree growth. The more available portions of the essential nutrients of nitrogen and phosphorus are intimately associated with organic matter. A sufficient amount of relatively active soil organic matter is a key basis for soil to serve as a medium for plant growth. The inadequate supply of organic constituents could incur long-term deficiency to impose a limiting factor on tree development. Besides, organic substances in the form of organic colloids play a critical role as aggregating agents to form and stabilize soil structure. Their shortage could weaken soil organization to render them susceptible to structural damage, compaction and erosion. Soil pollutants such as heavy metals and complex organic compounds could be present in unacceptably high concentrations due to inheritance and contamination.

The physical limitations in urban soils in relation to tree growth are common if not pervasive. They are often as serious, if not more, than chemical problems. In compact urban areas, they are more acutely expressed but widely neglected or ignored. Yet the attention on soils, if any, is usually focused on the chemical-nutrient aspects. Ameliorating widespread soil constraints can remove a common and major hindrance to urban tree growth. It is high time that this fundamental tree-growth factor should be given appropriate attention. Soil assessment deserves to be included as an integral component of a holistic site assessment exercise. The old practice of out-of-sight hence out-of-mind could be replaced by a package of wholesome soil care which should precede and accompany tree care in a cradle-to-grave urban forestry regime.

Urban Green Spaces in Delhi, India Milestones Behind-Miles Ahead - *Manoj Dabas (India)*

So far as green spaces go, Delhi has had several things going for it. a) It was the seat of power since medieval times and capital of initially colonial, and later independent India since 1911, which made Delhi a beneficiary of good amount of urban planning to which green spaces were integral; b) Its location at the edge of Aravali mountain ranges whose higher elevations escaped human habitation in initial waves of Delhi's expansion and still survive as the largest component of Delhi's natural forest cover and c) 25 km stretch of river Yamuna that flows through the city, giving Delhi a vast open space in the form of a flood plain.

In 1970s, things began to go haywire and migration from the hinterland overwhelmed Delhi's urban planning efforts. Now 60% of Delhi's population (17 Million as per last official census) lives in various types of unplanned settlements. The pressure of economic development incapacitated Delhi's plan for open spaces and green spaces. So today we have two Delhis rolled into one. Delhi-A that is an outcome of official planning, howsoever shoddy in the post-independence phase, that has retained its greenery and gives Delhi the status of one of the greenest capitals of Asia. And Delhi-B which bears little resemblance with Delhi A in terms of green spaces, no matter what amount of retrofitting it may have seen or may be subjected to.

Judicial activism, civil society action, regulatory & executive measures, and manifested public concern have collaborated to bring urban green spaces back to the forefront of public discourse. As a city Delhi of today is far more alive to the need for green spaces to stay and survive. This is manifested in an increase, at least in quantitative sense, in forest cover in Delhi from 6 per cent in 1999 to 20.8 per cent in 2013. This has been mainly due to plantation activity carried out in non-forest areas. This is notwithstanding the fact that qualitative challenges (biodiversity profile, recreational/outreach infrastructure in, and public participation in management of, green areas etc.) still remain work in progress and lot of work is required to integrate Delhi's green cover with public psyche. But beginnings have been made by involving public/school children in annual planting drives, conduct of regular tree census, setting up of eco-clubs on more than 5000 schools of Delhi with attendant educational projects. Delhi may be running late. But it is now running, and running hard.

Urban Forestry in Iran - Fariborz Gheibi (Iran)

Nowadays, cities face many challenges from the environmental and natural resources point of view, namely: population explosion, waste, urban and rural sewage, air pollution, noise pollution, magnetic pollution (radio and cell phone waves, etc.), water pollution, dusts, deforestation, desertification, drought, and climate change. In this respect, some of the effects of green spaces and urban forests include: Maintaining health in urban and peri-urban communities; Decreasing stress and speeding up disease recovery; Improving the quality of living in cities; Decreasing the frequency and severity of car accidents; having significant positive effects on blood pressure, self-confidence and mental condition.

In order to create urban forestry, the following issues should be considered: Increase urban green space per capita and reach the standard green space per capita; Take benefits from local community and people's belief into consideration in planning and creation of parks and green spaces; Create a mixed urban forest (Ecosystem); Enhance biodiversity; Create forested parks in the name of renowned people such as artists (planting memorial trees for renowned people and artists); Install interpretive signs for trees and shrubs; Determine the places for plantations around new roads and highways; Create green belts around cities, examples include Boushehr, Kermanshah, Hamedan, Kerman, Kashmar, Esfahan and Shiraz.

A successful story of urban forestry in Iran is the one of Tehran: One of the environmental challenges of Tehran capital is growing vegetables with urban sewage in southern Tehran which threatens people's health. In order to address this issue, authorities (Jihad Agriculture Organization, Natural Resources and Watershed management Directorate, Forests, Rangeland and Watershed management Organization and Research Institute for Forests and Rangelands) proposed substituting farming pattern and concentrate on tree farming instead of vegetable production.

Joining Forces for Improved Urban Green Space Management in Malaysia - Noor Azlin Yahya (Malaysia)

Malaysia is a rapidly developing country with a projection that 75% of the total area will be urbanized by 2020. Providing a wide range of important social, physical and economic benefits for society, urban green space needs to be professionally managed to ensure effective contributions. In general, local authorities with affluence can afford inputs into establishment and management of green areas. Less affluent bodies on the other hand, have urban greening as the least of their priorities. It is also found that there is a lack of man power with skills relevant to urban green space management in many of the municipal councils. The presenter discussed Malaysian urbanization conditions and problems encountered in urban green space management. Examples of three municipal councils were presented to show the different perspectives on urban greening. Having networks of smart partnerships, was suggested as a way to improve the management of urban green space especially for local governments with lack of human resource and funding.

Quantification of Sustainability Index of Urban Forests in Korea - Chan Ryul Park (Republic of Korea)

Both of land price and urban population are very high at the metropolitan city of Korea, so not only quantitative secure but also qualitative enhancement of urban forests is most essential to establish and manage urban forests in Korea. This study was conducted to develop the sustainable index including quantitative and qualitative index of urban forests in seven major metropolitan cities in Korea. We extracted candidate indicators for evaluating urban forests with extensive review on literature, and we selected indicators based on the degree of representative, degree of ease measurement and quantification. We suggest three criteria and six indicators for quantitative evaluation of urban forests: 1) natural ecological function (areas of green space and vegetation vitality), 2) function for environmental regulation (climate mitigation and air purification), and 3)

management function of urban forest (ability of animal movement, degree of landscape importance). Natural ecological function can be evaluated based on the area of green space and vitality of urban forests. The indicator on the function for environmental regulation considered the absorption volume of carbon dioxide and emission volume of oxygen from forests. The management function can be utilized to quantify citizen access to urban forest and connectivity among urban forests. This sustainability index should be incorporated with socio-economic factors in the near future.

A Case Study on the Impacts of Lawn Maintenance Activities on Christchurch's Urban Forest - Justin Morgenroth (New Zealand)

Urban trees surrounded by grass are susceptible to mechanical wounding caused by lawnmowers and trimmers. Anecdotally this problem appears to be pervasive, affecting trees planted in school and university grounds, parks, botanical gardens, golf courses, roadsides and indeed any location where grass is maintained on a regular basis. The presentation focused on the results of the first formal study to document the incidence and severity of tree damage caused by lawn maintenance equipment. Recent field data was used to explore whether land use, mowing frequency, or tree size are correlated with the observed pattern of wounding in surface roots and stems. The presentation concluded with a discussion on the long-term tree health and economic implications of mechanical wounding as well as the role of tree protection.

Toward a Sustainable Planning and Management of Urban Green Spaces in Metropolitan Manila - Josefina Faulan (Philippines)

The forest cover in the Philippines has been decreasing significantly from 16.9 Million hectares in 1934 down to 6.984 Million hectares in 2010, recording a 23% drop. In Metro Manila alone, which is the National Capital Region of the country, open forest cover is only 2,124 hectares which is 3% of the total land area of the region.

Despite the countries laws and policies promoting urban forestry and greening activities, the country, specifically, Metro Manila faces challenges in planning and managing urban forests to ensure sustainable implementation. These include insufficient land for urban green spaces, low prioritization to urban forestry activities, poor management, operation and maintenance and low public participation and cooperation. These challenges have to be addressed to make the metropolis responsive to the requirements of environmental greening especially in an urban setting when determining land use is basically more a factor of the cost of land depending on location and development direction, among others. There must be a paradigm shift to maximize green architecture and landscaping activities in the midst of urbanization, combining traditional but innovative strategies and technological advancement while maximizing use of limited urban space as well as limited resources devoted to urban forestry.

In promoting sustainable planning and management of urban green spaces especially in Metro Manila, the government does not have the monopoly of the responsibility. The private sector and the civil society should contribute in this effort and, of course, resources to complement those of the government. This requires political will, commitment and determination to continue on pursuing what has been started and to continue on planning and implementing for sustainable use of urban green spaces.

Loss of Secondary Forest as an Emerging Concern for Urban Forest Management in Singapore - *Tan Puay Yok (Singapore)*

Singapore is widely regarded as a green city in the sense that there is a pervasive sense of greenery throughout the city despite its high built and population densities. When one looks at the land cover changes in the city over the past two centuries, it is clear that this has been achieved through a dramatic transformation of land cover types, from natural forests to more managed forms of urban greenery. What is not so apparent is that to date, such land cover changes continue, albeit involving different land cover types, at a different pace and quantum, but with impacts that have often not been fully appreciated. More specifically, the loss of secondary forests in Singapore due to various types of land developments account for about 50% of all vegetation cover loss that Singapore has witnessed between 2007 and 2012. The presentation highlighted the patterns in the loss of secondary forests in Singapore over the past decade, potential projected losses based on national land use plan, and discuss the socio-ecological concerns of such changes. He also suggest that while land development over forested sites are often inevitable, trade-offs between land conservation and land development need not be a zero-sum game. The fields of urban ecology and design provide some directions on how more sensitive approaches could be adopted to mitigate the consequences of secondary forests loss in Singapore.

Ecosystem Function and Service of Urban Forest for Air Quality and Water Supply - *Woo-Kyun Lee (Republic of Korea)*

The application of ecosystem service concepts in environmental related decision making could be a numerical and objective standard for policy makers to strike a balance between preserving and developing perspectives of environment. Despite increasing interest in ecosystem services, the difference between ecosystem functions and ecosystem services were still not being clearly understood by policy makers and stakeholders. A study on proposed methods of evaluating ecosystem functions and services based on environmental and socio-economic factors was presented. The differences between ecosystem functions and services were presented in terms of air purification and water yield of a forest ecosystem. The study suggested Natural Functions (NF), Environmental Services (ES) and Environmental Social Services (ESS) to specify ecosystem functions and services. NF are direct and potential functions from a specific ecosystem that could be connected with other specific ecosystem functions. ES are the ecosystem services that employed only to environmental conditions. ESS are the ecosystem services related to social conditions as well as environmental conditions. In the case of air purification, air pollutants absorption capacity was employed for NF. On the other hand, in the case of water yield, InVEST model was applied for the NF quantification. Air pollutant and precipitation were set as the environmental condition for ES to indicate the natural or human influence which made actual quantification among NF capacity. Population was set as the environmental social condition to indicate the human needs which made service demands in both air purification and water yield. The study found that the value of NF was spatially, randomly distributed according to the forest condition, while the values of ES and ESS were higher in urban areas where industrial and human activities occur. With an understanding of the differences among the NF, ES, and ESS concepts, decision makers could be equipped with more efficient and effective tools for the management of ecosystem services.

Urban Forestry: Does Bangkok Care? - Oraya Sutabutr (Thailand)

Bangkok suffers from a severe lack of green spaces. According to the Siemens green city index, Bangkok's green space is 4 m² per capita, well below the WHO standard of 9 m² per capita. It only has 5 large parks in the city center while the rest are mostly in the outskirts. Meanwhile, potential large green spaces such as Makkasan which is a run-down train depot but a huge expanse of greenery and large old trees, and the grounds of the Tobacco Monopoly, who will soon move out, leaving behind huge trees, potential bike and jogging lanes and recreational spaces, are being infiltrated by commercial interests. Bangkachao, 16 km² of mangroves and fruit plantations, just across the river, is threatened by reckless commercial developments. Lacking of understanding, public awareness and skilled experts to take care of existing urban trees contribute to the situation. Trees are poorly maintained, being cut down, planted with no roots and being viewed as hazards. Big Trees Project, with nearly 100,000 Facebook followers, was established by concerned citizens 6 years ago to campaign for awareness, collaboration with government agencies, academics, professionals and businesses, and the public in greening Bangkok via public activities i.e. tree planting, tree pruning, tree diagnosis, big tree cycling trips. Through public workshops, dramatic media events and negotiation with authorities, we pressure responsible agencies to increase green spaces. In the following cases, recognition of green spaces and the necessity for all parties to work together, have been the central focus: Sukhumvit 35 felling of old trees, protecting old street trees at Central World and Mercury Ville; media spotlight on Bangkachao, citizens' fight against BMA plan to destroy Bangkhunnon Park. Among other events was the Bangkok protest march against, Maewong Dam, the first street protest by city people who marched hundreds of kilometer for the sake of Maewong National Park.

International experience

'Management is the Tool by which Design Never Ends' — Reflections upon the Successful Establishment of an Urban Forest Landscape Structure Plan in a UK New Town - Alan Simson (UK)

Human beings have had a long, deep, cultural relationship with trees, woodlands and the landscape, which transcends national cultures, and sits as an equal alongside our scientific, economic and spiritual relationships. That said, there are those who believe that, as most of us either have moved or are in the process of moving to inhabit urban areas, these links with trees, woodland and the landscape have dropped down our agendas somewhat and become outdated, as other issues raise their profile and become more pressing. They couldn't be more wrong however. The presentation reflected upon the design, implementation and subsequent management of the urban forestry-based Landscape Structure Plan for Telford, one of the UK's 3rd Generation New Towns.

In 1963, the UK Government designated a New Town to be built to the west of the existing city of Birmingham, primarily to reclaim a post-industrial area, stimulate new economic growth and to provide new areas of housing for the West Midlands region. This New Town was called Dawley. The town was expanded considerably in 1968, and re-named Telford. New infrastructure, industrial and housing estates, educational, health and retail facilities were planned, designed and built, and a comprehensive programme of green infrastructure and urban forestry was implemented to create a 'Forest City'.

The resulting urban area of Telford was characterised by extensive areas of green space and prominent landscape features, which comprises some 40% of the total area of the town. These include naturally regenerated pit mounds and reclaimed land from past industrial dereliction, much of which was integrated with new mass tree planting and large areas of formal and informal parkland. The town was designed and built by a Development Corporation, which was officially wound down in 1991. Responsibility for the town was then handed over to a local authority – Telford and Wrekin Council.

Much of the green infrastructure planned and designed by the Telford Development Corporation was incorporated into the new council's 'Green Network', which formed a Landscape Structure Plan throughout the town and linked with the surrounding countryside. This Green Network was established between 1991 and 2001, as a successor to the original New Town Landscape Structure Plan. It forms an interlinked system of green infrastructure within Telford, which has a collective value for ecology and nature conservation, formal and informal recreation, access, linkage and visual or landscape quality. The Network covers over 2800 ha, some 40% of the area of the town, and includes all open areas of biodiversity, landscape and amenity value.

Thus throughout the town, there are corridors of open land, articulated by urban forestry, that link to the core areas, and create wildlife habitats and corridors. Much of the network is in close proximity and directly accessible to local people, as it intertwines around and through the built-up areas. The total area under trees is about 18% of the area of the town, which contrasts well with the 10% plus national average tree cover of the UK.

The social, functional, environmental, economic and ultimately human dimensions of Telford's urban forest incorporate many design elements, which can be examined in relation to woodland location, the size, shape and structure of the woodland, and the plant sizes used and the tree species selected. Where such woodlands were sited also has many implications, including use, habitat and land use. Distance from the local community influences those who use the new woodland, what they use it for and with what frequency. This in turn influences the amount of use and human impact issues. The proximity of the new woodland to other similar areas affects the

rates of colonisation by flora and fauna. Former land uses have a bearing upon site preparation and species choice, historic continuity, and the incorporation of ancient and remnant landscapes.

The size, shape and structure of the new woodlands affect the level of bio-diversity within the woodland. Large, deeper woodlands support a large number of species, as does structural diversity. Size has a bearing upon the carrying capacity of the woodland, and thus the biodiversity potential of the area. Carrying capacity also relates to the number of people that can be comfortably supported in the area, and how effectively the recreational potential and multi-purpose objectives of the woodland can be met through, for example, zoning. In addition, the relationship between the level of environmental benefits and the size of the woodland should be considered – particularly for shelter and noise abatement issues. The creation of different woodland types within the urban forest offers choice and visual interest for the visitor, whilst creating different habitats that will support a wide diversity of species.

Part of the costs of creating new woodlands is influenced by the size of the plant material used and the choice of species. Generally, the smaller the stock, the cheaper it is to purchase. Small planting stock has the advantage of establishing quickly, and species suited to the site are more likely to survive and develop into robust, resilient woodland. Small, medium and large stocks were used in developing Telford's urban forest, depending upon the location and the need for immediate visual impact.

The way an urban woodland is designed and how it is realised will influence how it is used and by whom. Time is an important consideration, as it can take many years for a new woodland to fully develop and become able to fulfil certain functions. However, once developed, the urban forest has the potential to exist as a functioning unit for many decades, providing the appropriate Design / Management Continuum' is available, which it has been in Telford. If the urban forest is to benefit the whole community, all groups within the community need to be consulted and listened to. The urban forest needs to be designed to meet current needs and pressures, whilst having the capacity to withstand the inevitable changes that will affect it in the future. Urban woodlands that are well-designed will contain common elements that allow for their longevity and long-term appeal, regardless of the changing urban demands and pressures.

The main questions relating to urban woodland design within the Landscape Structure Plan were where will these woodlands be located, who are they to serve, for what purpose and how will these needs be met? Attempting to understand how urban woodlands are to be used provides opportunities for social inclusion, as more groups of the community are likely to be consulted and involved. In addition, an understanding of the public perception of urban wooded areas and their preference for different elements within such woodlands, can guide designers on aspects such as the size, and shape of urban woodland, the distance from the communities they serve, woodland structure and type, pathways and interpretation signs and information.

The planting and establishment of the bulk of Telford's urban forest ended in about 1990. In total, over 6 million trees were planted, and this has led to very significant changes in the urban landscape over the last 25 years or so. If urban woodland can be loosely grouped into three stages – Short-term Impact [0-15 years], Mid-Term Impact [10-25 years] and Long-Term Impact [25-75+ years], then much of Telford's urban forest is emerging from Mid-Term development and entering into the Long-Term stage of development.

Thus, this presentation will consider the rationale behind the concept of Telford's original Landscape Structure Plan, and the social, political and practical issues involved in its delivery. It will also consider the reaction and engagement of the inhabitants of the New Town with their new urban forest, and the influence that urban forestry has had on attracting and retaining economic investment. In particular, the part played by the strong links established between the design and prospective management of a new urban forest over a period of some 30 years in delivering these attributes will be emphasised, together with what lessons we might learn from this reflection to inform the development of urban forestry in the future.

Trees in the City, Our Common Heritage - Fabio Salbitano (Italy)

Cultural landscapes give us place and reveal our relationship with land and environment over time. These are special places that contain aspects of our origin and development through their forms, features and history of use. Cities are much more than just buildings and people. Some of the world's most famous cities are as known for their open space as they are for their culture. Nowhere else as in cities nature meets culture and culture needs nature. Cities are living-labs for nature-based solutions to societal challenges and cultural heritage as a driver for sustainable development.

The “urban adventure” in the Mediterranean region dates back four thousand years or more and the role of trees and forests, even if very often underestimated, has been fundamental all along the history of Mediterranean cities. One of the tasks of SILVA MEDITERRANEA working Group on Urban and Peri-urban Forest, born in 2013 and merging the Urban Forest experience of 24 countries in the region, is to highlight the importance of Urban and Peri-urban Forests as a cultural Heritage of the Med cities and to sustain and promoting their role in the policy agendas of the cities.

The presenter summarized the relationships between trees and cities along history, and then focused on some case studies from Northern and Southern Mediterranean basin by applying the approach of cultural ecosystem services. The perceptual dimension of the cultural role of urban forests will be emphasized according to the results of recent research. Experiences of design-management styles will be reported in order to define the current needs and perceptions and the applicability of nature-based solutions to the creative and collaborative design of “new” urban forest, i.e. the cultural landscape of the future.

The Role of Urban Forests and Nature Based Solutions in the Development and Maintenance of Adequate Levels of Health and Wellness in XXI Century European Cities - Giovanni Sanesi (Italy)

During the last two decades a well-established research stream has provided significant evidences on the beneficial effects of green spaces and urban forests and other nature-based solutions (NBS) on the human health. Several studies on the positive effects of contacting with nature have been mainly conducted in some European countries, on the contrary the experience of nature for people living in other countries is still to be adequately investigated.

Research on the positive effects of NBS is particularly important in dense urban settlements characterized by heavy environmental stress-related problems where people are also suffering from income-related well-being inequalities. The presence and the use of urban forests or similar NBS can have a relevant role in improving human health and well-being and in playing an important role from a social perspective in promoting a sense of safety, social support and cohesion, and integration. Creating and maintaining positive and interconnected urban environments (green infrastructure) and providing ecosystem services for a greater portion of the human population is perhaps one of the most crucial challenges of our times, especially in the context of global change.

Human and Planetary Health in Asian Cities: The Role of Urban Forests - Jose Puppim de Oliveira (USA)

The planetary and human health is tightly linked to the way cities are developed and managed. Forests play a key role to guarantee and improve the well-being of urban dwellers. Using examples in Asia, the presenter discussed why cities should use forests to build nature-based solutions (NBS), how the relation between urban planning and forests evolved over time and the obstacles and opportunities to having forest planning a larger role in our cities.

Urban Forestry as a Water Quality Tool—How Science and Policy Connect in the United States' Chesapeake Bay Watershed - Susan D. Day (USA)

The Chesapeake Bay is the largest estuary in the United States of America and one of the most productive bodies of water in the world. In the face of increased urbanization, however, protecting the Bay's water quality and the fisheries and other ecological systems that rely on clean water has been challenging. This case study will address how the Chesapeake Bay Program, a policy consortium of the states that make up the watershed, relies on urban forest science to inform estimates of nitrogen (N), phosphorus (P), and sediment (TSS) loads entering the Bay. Available urban forest science is vetted by an urban tree canopy expert panel for both scientific rigor and relevance to policy. Using a credit system, Chesapeake Bay Program estimates of N, P, and TSS influence in turn the development of local land use and management policies and practices intended to protect water quality in the Bay. Gaps in urban forest science and challenges in translating science to actionable policy will be explored.

USA Urban and Community Forestry Program - Phillip Rodbell (USA)

Program Delivery

Important national partners have helped the Forest Service to establish and grow federal investment in urban and community forestry programs, educating the public, telling a shared story and growing their own capacity to do work in cities. These include the National Association of State Foresters, Arbor Day Foundation, International Society of Arboriculture, American Forests, and the Sustainable urban Forests Coalition.

Each administrative region of the Forest Service delivers the program tailored to the unique needs defined by independent State and local partners. With partial funding provided by the Forest Service, each state develops and implements plans to engage metropolitan regions, communities, and the public. Many states are providing competitive funding to cities and NGOs to demonstrate best practices and create momentum for local investments in storm water management, energy conservation, business development, and tourism.

The Forest Service provides resources to the states to develop and maintain their program of technical assistance, including these best practices:

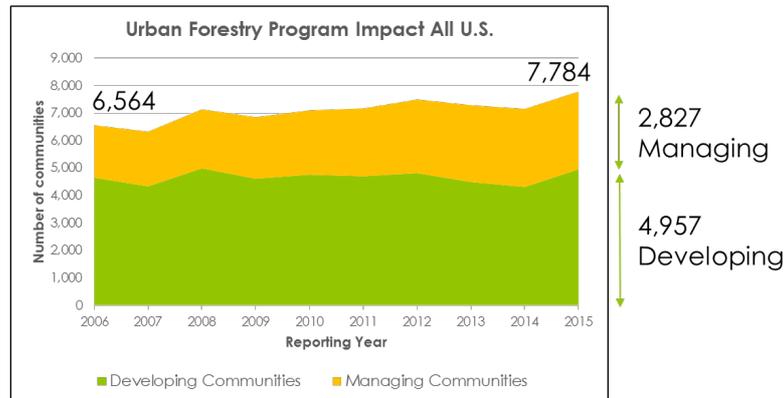
- Hire a program coordinator
- Provide technical and volunteer services
- Maintain a diverse advisory council
- Develop and implement plans for action
- Focus on improving tree canopy cover and benefits for a majority of population where they live
- Assist communities to develop sustainable tree management programs

Impacts and Outcomes

The Forest Service measures its success by the numbers of communities and population in each state and region that are receiving assistance and showing results in developing Staff, Policies, Advocacy, and Plans to protect and improve tree and forests.

The graphic below shows growth in the numbers of communities that are fully managing their urban forest resources as a result of federal and state combined assistance. Managing communities have professional staff, tree protection policies, advocacy organizations, and active management plans. The developing communities do not have all the components. In 2015, more than 200 million residents live in the communities served – nearly 70% of the national population. Outcomes include growing local advocacy and public investment in trees and forest parks, improved public awareness about the value of forests and forest management, and increasing public engagement and volunteerism to plant and maintain trees and green spaces.

National program outputs

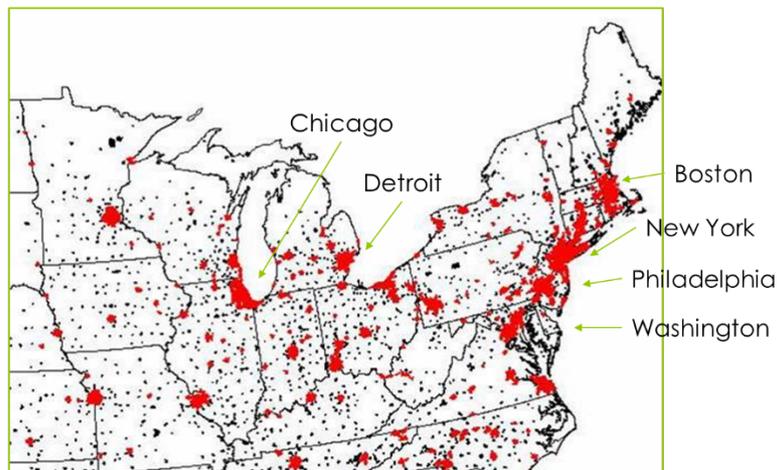


Total population served in 2015: 201 million people

Stories from the Field

The Northeast and Midwest region of the United States has a population of 120 million residents in 100 metropolitan areas. For many of these residents, the urban forest is the *only* forest they encounter. The Forest Service and state forestry agencies assist more than 4,000 communities annually. In their Forest Action Plans, these agencies have placed emphasis on the benefits of trees and forests as green infrastructure, contributing to the quality of life in communities. In an integrated approach, most States seek to protect existing tree cover, implement best management practices, and engage local officials and the public in planning, sustaining, and improving forest resources in and around cities, suburbs, and towns.

The Northeast Story - Population



In a more local example of agency efforts, the Forest Service provided direct assistance to the city of Philadelphia. This city was the nation's capital until the year 1800, when it officially moved to Washington DC. The city began losing population due to crime and public health concerns in the 1950's, losing 600,000 residents to surrounding provinces. More than 40,000 residential buildings became public hazards and had to be removed, making more than 500 hectares of new land. In the year 2002, agency technicians worked with the city to develop a green plan for the future, to help the mayor build the greenest city in America.

Agency staff helped the city to study its alternatives, build public consensus, establish goals for tree cover, and begin work planting and caring for trees – turning vacant lands into green stormwater infrastructure and establishing a new research field station to study tree mortality and contributions to public health and safety.

Forest Service Actions

- Inventory and ecological assessments
- Management planning
- Tree planting and maintenance
- Vacant land enhancement and Park Revival
- Improvements to greenways and green storm water infrastructure
- Forest health and invasive species control
- Practical research & analysis

Since 2004, the *Philadelphia Green Initiative* of the Pennsylvania Horticultural Society and the Governor's *TreeVitalize* program have planted 350,000 trees with the help of many partners and trained community volunteers, called *TreeTenders*. And the city water department launched its own *Green City, Clean Water* program using public utility fees to build 200 green hectares of storm water filtration areas.

Less than 12 years after Forest Service initial investment, the city has become a learning destination for those interested in studying advanced green infrastructure planning, construction, and maintenance.

Financial Assistance

Today, Forest Service investments in inner city communities and metropolitan areas continue on a competitive basis across the United States. Close to USD \$4 million is awarded annually in project funding and is leveraged heavily by state and local investment. An additional USD \$1 million annually supports social science and biophysical research through universities and the private sector. The agency has hired new scientists and funded fellowships and post-doctoral studies totaling more than USD \$5 million in urban research stations in Philadelphia, NYC, Baltimore, and Chicago, Athens, Georgia, Gainesville, Florida, and our newest in Los Angeles, California.

Tools and Technology

To support our state and local partners, we have developed new tools that enable local analysis, planning, monitoring and evaluation. *I-Tree Landscape* provides a mapping service available freely across the U.S., which layers tree canopy cover over top of census demographic data and political boundaries to help residents and policymakers study options and impacts in air quality, storm water runoff, and carbon capture. It answers the question: Where should I plant and maintain trees to have the greatest impact on public health and the environment?

Finally, to support traditional and urban forestry the Forest Service is expanding its continuous forest inventory to include the nation's urban forests for the first time in its 80 year record. 55 million hectares of urban land will be surveyed continuously to track trends in tree cover and associated benefits at a landscape scale. This includes tree species mix, forest structure and dollar value for Carbon storage, air pollution reduction, avoided runoff, residential energy conservation, and biomass production.

Conclusion

The Forest Service and its partners have many lessons learned from their 25 year investment in urban forestry and building more livable, resilient cities and communities. The principal lesson may be that urban forests depend on the people who care for them. The agency knows how to plant and grow trees, but there remains much still to learn on how to grow future stewards of our urban forests.

Integrating Education and Research in Urban Forestry – A Higher Education Perspective in USA - *Yadong Qi (USA)*

Urban forestry has matured over the last 30 years in the U.S. It is no longer just tree planting; it is a holistic approach using art, science, and technology to managing trees, forests, and natural systems in and around cities, suburbs, towns and small communities for the health and well-being of all people. Urban forest is recognized as a vital urban green infrastructure, providing enormous environmental, ecological, social-economic benefits when managed properly. However, effectively managing urban and community forest resources requires well educated and highly skilled urban forestry professionals. The presentation focused on urban forestry education and research programs in the U.S. higher education using Southern University and A&M College in Baton Rouge (SUBR), Louisiana as a case study. The SUBR has the oldest and the most comprehensive urban forestry education programs in the U.S. that offer BS, MS, and PhD Degrees in Urban Forestry. The SUBR uses its multidisciplinary urban forestry research programs to complement urban forestry education and provide undergraduate and graduate students with diverse experiential learning and training opportunities in urban forest science and management along with the state-of-the-art technologies. The SUBR has made significant contributions to urban forestry profession and workforce diversity in the U.S. over the last 20 years. The paper presented BS, MS, and PhD urban forestry curricula and major urban forestry research and outreach projects at the SUBR.

Poster session

A poster session was also held at the end of the symposium. Young scientists and graduate students submitted 41 posters for the session which had five thematic areas, 1) urban forests and environmental quality, 2) urban forests and human health and wellbeing, 3) green infrastructure and urban planning; 4) urban forests and beautification; and 5) urban forests and cultural heritage. A panel of judges selected the best poster on each thematic area and granted awards. Abstracts are available in Annex IV.

Best Paper Award

Public views of the low-carbon economy in small cities

Zhaohua Cheng

Best Poster Design Award

Bioaccumulation of heavy metals in plant leaves from Yan'an city of the Loess Plateau, China

Dexiang Wang and Youning Hu

Best Paper Award on Urban Forests and Environmental Quality

Eutrophication control and nutrient removal by urban riparian vegetation

Shuai Yu, Wei Chen, Xingyuan He, Zhouli Liu, Xueyang Wang

Best Paper Award on Urban Forests and Human Health and Wellbeing

The contribution of urban forests in achieving sustainable development goals

Teayeon Kim, Yujuan Chen, Simone Borelli, Woo-Kyun Lee

Best Paper Award on Green Infrastructure and Urban Planning

Canopy-based landscape pattern gradient analysis of the urban green land space

Jia Yao

Best Paper Award on Urban Forests and Beautification

A brief description of hedge function and its chemical pruning technology

Lijuan Xv

Best Paper Award on Urban Forests and Cultural Heritage

Analysis of castle settlement landscape based on demand oriented in central region of Fujian

Shuping Huang

#	Poster Title
1	A brief description of hedge function and its chemical pruning technology
2	A study on landscape pattern of the urban forest and green network in Pudong district of Shanghai, China
3	A study on thermal environment effect of urban green space landscape in Yan'an city
4	Analysis of castle settlement landscape based on demand oriented in Central region of Fujian
5	Assessment of urban tree benefits and services based on the i-Tree model
6	Bachelor of Urban Forestry
7	Bioaccumulation of heavy metals in plant leaves from Yan'an city of the Loess Plateau, China
8	Canopy-based landscape pattern gradient analysis of the urban green land space
9	Carbon storage of forest ecosystems in Guangzhou City
10	Characteristic of different life-form vegetation and its relationship with landuse types along riverine zone of Jiushijiu river in Jinjiang city
11	Current urban forestry research at Faculty of Forestry UBC
12	Effects of forest type and urbanization on carbon storage of urban forests in Changchun
13	Eutrophication control and nutrient removal by urban riparian vegetation
14	Evaluation of the scenic beauty quality of garden road landscape of classical gardens in Hangzhou
15	Evaluation technology and demonstration of visual landscape of urban mountain park based on GIS
16	Evolution characteristics and homesickness culture of rural courtyard plant landscapes in Zhuhai
17	Evolution characteristics and homesickness culture of rural courtyard plant landscapes in Zhuhai—Take the Jiexia Zhuang and Paishan village as examples
18	Greenway strings health and happy lives
19	Huge afforestation projects attract birds return in Beijing city
20	Importance of urban forests to temperate urbanized cities in China - Quantifying carbon biomass and variation in the soil
21	Photosynthetic capacity, photochemical efficiency and chlorophyll content of eight bamboo species of different seasons in Zizhu park in Beijing

#	Poster Title
22	Preliminary study on design of urban green space with BVOCs health care effect
23	Public views of the low-carbon economy in small cities
24	Quantitative evaluation on the impact of the street greening in ancient town landscape
25	Research on characteristic of urban ecological space in Beijing plain area
26	Research status, problems and prospect of landscape forest visualization
27	Risk degree assessment of common green trees
28	Short term effect of thinning on carbon storage in Chinese fir plantation
29	Structure and regeneration pattern of the isolated remnant vegetation in urbanized area
30	Structure and species diversity of typical forests in Guangzhou city
31	Studies on adsorbing PM2.5 function differences of tree species in different urban forests
32	Studies on PM2.5 concentrations dynamics of typical urban forest in the southern suburb of Nanjing
33	Study advances on the effects of urban forests on particulate matter
34	Study on accumulation characteristics of <i>Populus tomentosa</i> to heavy metals
35	Study on carbon storage of poplar plantation at different stand ages
36	Study on human comfort and microclimate of small urban forests in Beijing in summer
37	Study on relationships between the factors reflecting ecological and healthy functions in urban forests
38	The color quantization for the fall scenic forest of Jinsi Canyon National Forest Park In Shanxi Province
39	The contribution of urban forests in achieving Sustainable Development Goals
40	The environmental benefits and sustainability of urban forests
41	Variation in particulates of urban forest with different habitat types in summer



Part 2. Field Trip

Field trip

The field trip included three different sites:

1. Meihua City Garden

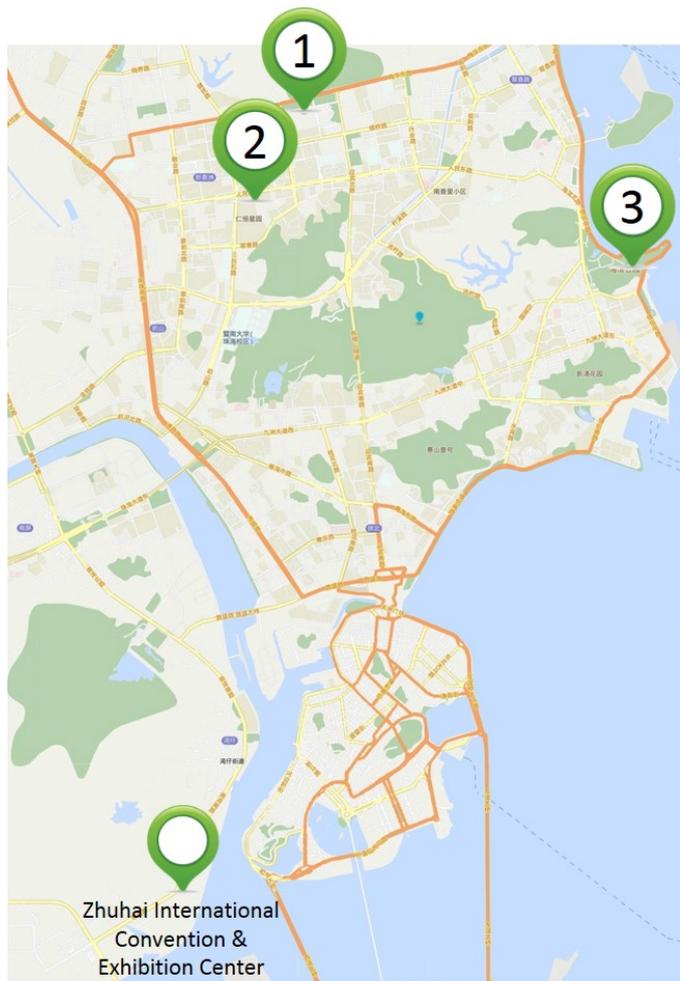
A popular urban garden with urban forests and urban agriculture close to residential areas in the city center

2. Residential Community

A modern residential community with well-maintained green spaces for residents

3. Seashore Park

An urban park near the shore with urban forests, cultural heritage, and ecologically restored beach



1. Meihua City Garden

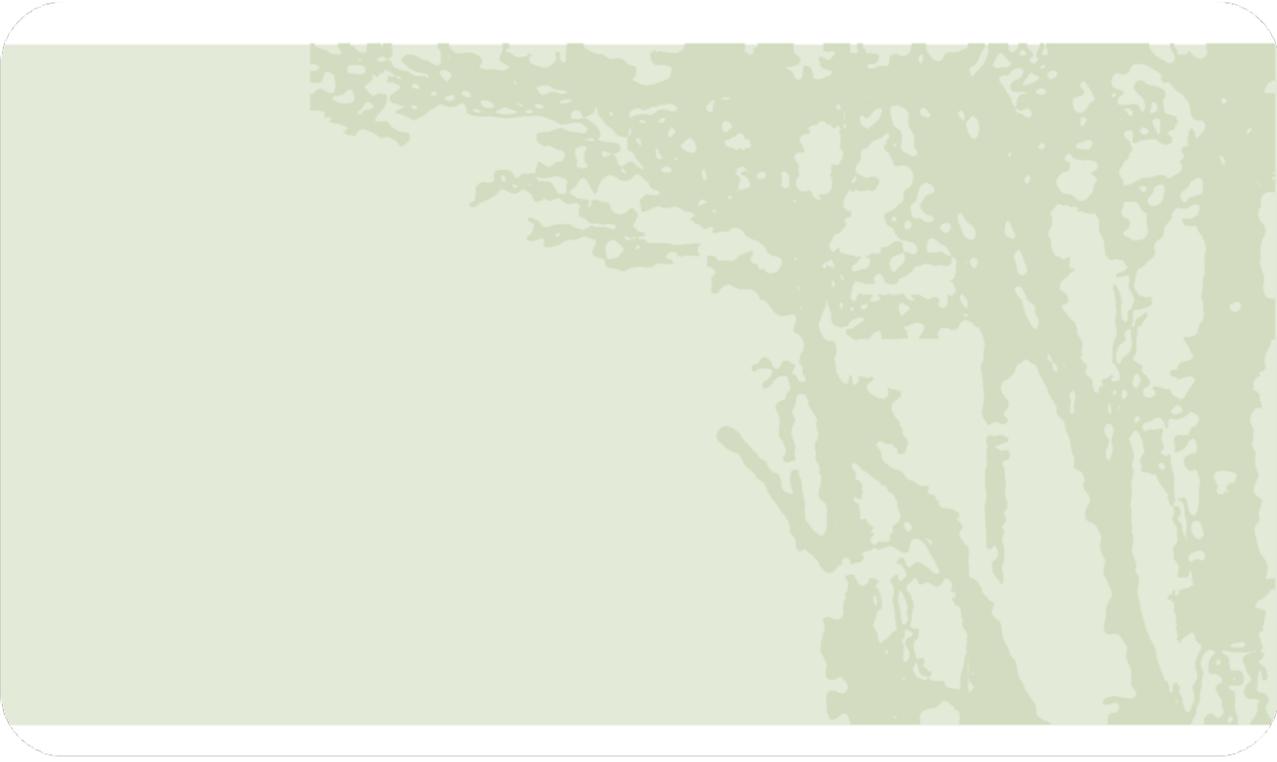


2. Residential Community



3. Seashore Park





Part 3. Workshop

Asia-Pacific region country profiles

Overview

In 2015, urban population in Asia-Pacific region has risen up to 2,138,497, which is about 48 per cent of the total population in the region. Total urban population is expected to increase to 3,349,957, i.e. 63% of the total population by 2050. Rapid urbanization has resulted in environmental, social, and health issues in the region. Well planned and managed urban forests can be one of the solutions for these problems by producing goods and providing ecosystem services.

However, little is known about urban forestry development in the Asia-Pacific region. A Questionnaire on Urban Forestry in the Asia-Pacific Region was designed to collect information on urban forestry development in each participated country including urban forestry resources, governance, and management (*please see the supplementary material for the complete questionnaires*). Questionnaires were collected before the meeting and during the workshop participants from each country presented their questionnaires in the form of country profiles. There were 19 questionnaires from 17 countries in total. The respondents were mainly from governmental agencies (9) and university professors (7). The rest of them were from research institutes (2) and NGOs (1).

Country profiles

In order to understand the main benefits, challenges and priorities to promote urban forestry in the region, the respondents were also requested to highlight three main benefits, key issues and challenges, as well as needs and priorities of UPF development in their countries.

In general, **air pollution removal, beautification and aesthetic view and cooling effect and energy saving** were the most expected benefits in the region. Singapore particularly emphasized their interest in conserving biodiversity in the city. **Conflicts of land use, weak governance and lack of investments/funding** were found to be the main obstacles to the development of forest and parks in cities in the region. **Better governance, best management practices network/ knowledge platform, and sufficient investment/ funding** were identified as main priorities in the region (*please see the table below for details*).

	Main benefits	Key issues/challenges	Needs and priorities
Australia	Cool the UHI, cool people's stress Community mental health and well-being Provide habitat for biodiversity	Community acceptance of old tree removal Need to replace tree species with other to increase drought and temperature tolerance Removal of much tree cover in the private urban landscape through urban densification	Information and knowledge Sufficient investments/funding Awareness raising

	Main benefits	Key issues/challenges	Needs and priorities
Cambodia	<p>Improve environmental conditions in the city</p> <p>Water flow and quality</p> <p>Climate and energy use</p>	<p>Migration and population pressure</p> <p>Land use change from urban and peri-urban forests to settlements</p> <p>Ineffective law enforcement</p> <p>Infrastructure development</p>	<p>Sufficient investments/ funding, Urban forestry experts, Good governance, Best management practices network/ knowledge platform, International/ regional cooperation</p>
China	<p>Beautification/ aesthetics</p> <p>Air pollution removal</p> <p>Recreational purposes</p>	<p>Conflicts of land use</p> <p>Low public participation</p> <p>Weak governance</p>	<p>Good governance</p> <p>Best management practices network/ knowledge platform</p> <p>International/ regional cooperation</p>
DPRK	<p>Beautification/ aesthetic view</p> <p>Cooling effects and energy saving</p> <p>Air pollution removal</p>	<p>Lack of investment/ funding</p> <p>Lack of experts</p> <p>Conflicts of land use</p>	<p>Sufficient investments/ funding</p> <p>Urban forestry experts</p> <p>Information and knowledge</p>
India	<p>Physical fitness, health and recreational services for urban poor</p> <p>Air pollution removal from cars</p> <p>Habitat for birds and small animals</p>	<p>Lack of long term planning and approach</p> <p>Lack of responsible agency for national urban forest program</p> <p>Inadequate participation of local communities to maintain existing green areas and also regulate usage/enhance user experience.</p>	<p>Good governance</p> <p>Focus more on planting, less on maintaining & nurturing</p> <p>Best management practices network/ knowledge platform</p>
Indonesia	<p>Cement dust removal</p> <p>Groundwater recharge enhancement</p> <p>Habitat for birds</p>	<p>Conflicts of land use (economic priority, insufficient green spaces)</p> <p>Lack of funding (low priority on budgeting)</p> <p>Community participation (planning by local government without community participation)</p>	<p>Sufficient investments/ funding</p> <p>Awareness raising</p> <p>Good governance</p>

	Main benefits	Key issues/challenges	Needs and priorities
Iran	Air pollution removal Dust (storm) alleviation Food production and water purification	Water quality Air pollution Dust storm	Increase urban green space Establish green belts around cities Enhance biodiversity
Laos PDR	Air pollution removal Recreational purposes Aesthetic view	Lack of investments/funding Conflicts of land use Low public participation	Sufficient investments/funding Good governance Awareness raising
Malaysia	Aesthetics Recreation and social interactions Cooling effects	Land use change Conflicts of land use Insufficient cooperation between different agencies	Awareness raising Best management practices network/knowledge platform Good governance
Mongolia	Air pollution removal Fuel wood provision Recreational value	Illegal logging caused by poverty, and increased demand of fuel wood by population growth Lack of knowledge and urban forestry experts Land use issue	Urban forestry experts Information and knowledge Good governance
Myanmar	Air and water quality enhancement Strom water retention Wind and soil erosion reduction	Lack of national/municipal urban forestry program Limited technical skills and public awareness Limited networks	Landscape design and species selection Capacity building for multi-stakeholder Development of a standard program and a management plan
New Zealand	Cultural services (recreation, place for gathering, sports, leisure) Improve resilience to natural disasters (storm water attenuation) Regulating services (air pollution reduction)	Lack of urban forest governance Lack of investment and funding Lack of inventory data and therefore management of urban trees	Sufficient investments/funding Good governance International/regional cooperation

	Main benefits	Key issues/challenges	Needs and priorities
Philippines	<p>Air pollution removal Climate change mitigation and adaptation Cooling effects and energy saving</p>	<p>Poor management Limited technical skills and knowledge among decision-makers Weak governance</p>	<p>Good governance Sufficient investments/funding Best management practices network/knowledge platform</p>
Republic of Korea	<p>Cooling effect in summer Oxygen provision and carbon dioxide absorption Positive effect on mental and physical health</p>	<p>Public awareness Urban forest for senior Citizen involvement in urban forestry management</p>	<p>Legal institutions Best management practices network/knowledge platform International/regional cooperation</p>
Singapore	<p>“Garden City” ambience for national image and identity Supporting urban biodiversity for national conservation objectives Urban climate modification, in particular amelioration of the urban heat island effect</p>	<p>Conflicts of land use – land developments over forested sites and loss of mature vegetation in managed sites (related to relative value of economic versus natural capital perceived by stakeholders) Low public participation and entrenched perception of desirable forms of urban forest (managed versus natural forms of urban forests)</p>	<p>Information and knowledge Urban forestry experts</p>
Thailand	<p>Cooling effects, energy saving Air pollution removal Recreational purposes</p>	<p>Public and authorities’ lack of understanding of importance green spaces Lack of knowledge and skills for maintenance of urban green spaces Poorly regulated commercial interests contributing to destruction of green spaces</p>	<p>Information and knowledge Awareness raising Sufficient investments /funding</p>

Parallel discussion session

The objective of this parallel discussion session was to identify main issues and challenges as well as discuss possible strategies and solutions of urban forestry development in the region in the following five areas: 1) urban forests & environmental quality; 2) urban forests & human health and well-being; 3) urban forests & green economy; 4) urban forests & cultural heritage; and 5) green infrastructure for city clusters. The participants from the region actively participated in and contributed to the discussion based on their expertise and experience.

WORKING GROUP 1: Urban Forests & Environmental Quality

Facilitators: Susan D. Day & Andrej Verlič

To facilitate the discussion, participants were divided into 5 subgroups in different thematic areas: 1) soil; 2) water; 3) land use conflict; 4) air quality; and 5) urban heat islands (UHI). Each subgroup was asked to identify main issues/challenges and discuss possible solutions for their themes. The discussion results are as following:

Subgroup 1: Soil

Main issues and challenges include: 1) Soil erosion and sedimentation in urban areas; 2) Heavy metals in urban soils; 3) Poor soil conditions, for example, poor fertility and compaction cannot support good tree growth; 4) Infrequent use of mulching to improve soil conditions; 5) Heavy metals in soils; and 6) Lack of funding, training, and new technologies to implement best management practices. Suggested solutions include: 1) Increasing financial support; 2) Applying mulching, phytoremediation, and other management techniques; 3) Enhancing community engagement; 4) Selecting appropriate species to optimize urban forest structure; 5) Establishing a list of vegetables/forest fruits/fungi that accumulate heavy metals; and 6) Providing better training and public education.

Subgroup 2: Water

Main issues and challenges include: 1) Problems of droughts and flooding; 2) Lack of assessment systems; 3) Insufficient watershed forest protection measures due to land use conflicts; and 4) Water pollution due to lack of standards. Suggested solutions include: 1) Conflict management and law enforcement; 2) Providing sound stormwater management (e.g., pervious surface, mulching); and 3) Integrating urban forests into water management, for example, the “Sponge City” program in China was presented as an example for stormwater mitigation.

Subgroup 3: Land Use Conflict

Main issues and challenges include: 1) Urban expansion and human migration from rural to urban areas is occurring too rapidly for proper planning; 2) Forest land transformation into built-up land; 3) lack of law enforcement due to many reasons, e.g., boundaries/laws are not clearly defined; and 4) Increasing urban population with high demands. Suggested solutions include: 1) Payments for ecosystem services (PES) to compensate for land use; 2) Assessment of UF in A-PAC region; and 3) Social forestry – people may use forests for animals and forest products.

Subgroup 4: Air Quality

Main issues and challenges include: 1) Sources of air pollution (e.g., VOCs, SO_x, NO_x, PM) from vehicles, industry, home combustion systems, and erosion; 2) Measures to control the above-mentioned emissions (this was seen as more important than mitigation through trees); 3) Better norms for industry, vehicles, and construction; 4) Identification of species that absorb/trap pollutants and maximize mitigation effects; 5) Research needs of identifying strategies (e.g.

planting species and configurations) that would be suitable for the Asia-Pacific region. For example, there was a recognition that many cities do not have good air circulation because of topography (they are situated in basins, for example). Suggested solutions include: 1) Communication with policy makers; 2) Species selection; and 3) Transferring science into practice.

Subgroup 5: Urban Heat Islands (UHI)

Main issues and challenges include: 1) Functions of bio corridors and wind corridors (see issue with air circulation above); 2) Role of trees in lowering air temperature; 3) Lack of integrated research on urban design, particularly on the best ways to plant and maintain trees in different situations; and 4) Insufficient open green space. Suggested solutions include: 1) Project of integrating science that exist and share within the region and implement in pilots in the region; 2) Ensuring equal access to urban green space to seek comfort from the heat; and 3) Ensure that urban planners give sufficient and appropriate space for urban forests and trees.

A sixth thematic area, ***management practices*** that influence environmental quality, was added after the five initial subgroups, based on the discussion. Main issues and challenges have been identified on this topic included: 1) Habitat and species management; 2) Overuse of pesticides for urban forest management; and 3) Lack of or inconsistent use of mulch and other recommended management practices. Establishment of a regional advisory board and of an expert working group in every city region was proposed as a suggested solution.

In the second half of the session, all issues were discussed in plenary and solutions were suggested. Increasing levels of funding as well as training, education and research on best practices were raised as solutions in all subgroups. The need for identifying and developing indicators and setting targets for the different areas was also been agreed. Finally, it was felt that integration of urban forest into city management as well as setting standards and enforcing legislation are critical for the success of any urban forestry programme.

WORKING GROUP 2: Urban Forests & Human Health and Well-being

Facilitators: Jose Puppim de Oliveira & Giovanni Sanesi

Urban forests have physical and mental health benefits (e.g., reducing stress and obesity, blood pressure) including non-communicable diseases (e.g., diabetes, heart problems). They improve environmental context (e.g., buffer to reduce air and noise pollution) and social interaction (e.g., community cohesion, social capital). However, there are also some negative effects of urban forests if it is not planned and/or managed well (e.g., mosquito breeding areas, VOCs). The perception of outcomes of the working group was linked to different social, economic and cultural contexts.

The working group identified the linkages between human health and urban forest and discussed possible solutions from four different aspects including; 1) Forest management; 2) Governance; 3) Planning; and 4) Awareness raising.

In terms of forest management, choosing the right tree species and forest management approach for the desired outcomes (e.g., microclimate regulation, exercising, watershed protection, air pollution reduction, carbon sequestration, minimization of VOCs, improving a holistic approach also in reuse of organic matter) and enhancing the engagement of stakeholders and users for the duration of the process were identified as important elements. In order to improve governance, the participants suggested to: 1) improve governance of urban forest links with other sectors to maximize opportunities and outcomes as well as reduce investment costs (such as use of waste composts, development of non-motorized transportation paths, etc.); and 2) apply co-management

as a creative approach to enhance community engagement in urban forest planning, management, governance (that can reduce some costs), and other related activities, as well as reduce conflicts.

To enhance integrative planning, suggestions included focusing on the importance of integrating urban forest in planning to allow forest plantation in the medium and long term and give access to people to the forest (e.g., cases in China where there is no space for growing forest) as well as ensuring both quantity and quality of forests, to maximize health benefits (e.g., it is not attractive to trees and people if forest density is too high). At the end, environmental education (both formal and informal) as important component to engage people with forest and engage people at early stages with urban forests (e.g., bring school children to the forests for different activities) were suggested for awareness raising.

The working group also discussed that not all the green spaces are the same in terms of health benefit potential, so we need to figure out what (and where) kinds of trees composition/landscape bring more health benefits. Also forest as an infrastructure needs the right institutions to bring people to benefit from the forest, so it was suggested to enhance research and practices on sound governance, planning and management that can help maximize health benefits.

WORKING GROUP 3: Urban Forests & Green Economy

Facilitators: *Phillip Rodbell & Zeming Wu*

Urban and peri-urban forests provide products and services that may or not be recognized by key ministries across government and the private sector. Opportunity exists to increase awareness of decision-makers and opinion leaders, including children and youth and to develop new partnerships to grow and maintain urban forests. The working group on urban forests and green economy highlighted the importance of identifying responsible agencies and institutional linkages across sectors, looking to local government for model applications.

The participants identified tangible/direct benefits such as employment, commercial products, informal marketplaces and commerce along shady streets, shade for direct cooling and energy conservation, and reduced water treatment cost. Less tangible/indirect benefits of urban forests were also been identified as following: beautification, attracting business and commerce, biodiversity conservation and eco-tourism, increasing property value and rental rates, improving public health, nutrition, and reduction in stress and health care costs, improving productivity and student learning, and providing water quality benefits. In addition, the working group identified challenge in economy of urban forests is to identify models, metrics, and baseline indicators and monitor over time. It is necessary to explore positive examples of governance, partnerships and investment across the region. The compilation of research and examples would be enhanced by the creation of a regional advisory council made up of representatives from diverse sectors, expertise, skills and abilities including, but not limited to forestry.

WORKING GROUP 4: Urban Forests & Cultural Heritage

Facilitators: *Fabio Salbitano & Yadong Qi*

The participants in the working group of urban forests & cultural heritage recognized that nature and culture in urban forest are currently two separate concepts. Many trees and forests having cultural value are endangered by the increasing demands of urban development. Four major themes were proposed and discussed by the working group including: 1) Trees and Forest as cultural heritage. Bridging the nature/culture divide; 2) Urban Forest and Trees and Cultural Ecosystem Services; 3) Design and Management Implications; and 4) Education and Capacity Building.

The participants identified the city contexts and elements of urban landscapes where trees and forests live and those that are or can be considered as cultural heritage for the cities in the past and in the future. The working group also developed ideas for enhancing the cultural role of urban forests and proposed some specific and concrete actions to be taken based on action-research approach involving researchers, professionals, practitioners, and the civil society.

Theme 1: Trees and Forest as Cultural Heritage. Bridging the Nature/Culture Divide

The working group discussed the elements of urban landscape where trees that have an outstanding cultural role for the past, present, and future cultural heritage of the urban community including: 1) Eco-cultural and religious values; 2) Huge, old and famous veteran trees; 3) Holy trees (symbolic, religious, and holy-medicinal trees); 4) Trees and forest as reference landscape (i.e. iconic trees, special places, landscape labs); and 5) Ancient urban forests and ancient woodlands in peri-urban zones.

However, heritage trees and urban forests are often in conflict with urban development and people very often “forget” traditional aspect of townscapes, especially tree components.

Possible solutions were proposed as following: 1) Including heritage trees and forests conservation rules in city and national laws; 2) Planting trees to improve the perception of reference cultural places in local contexts; 3) Considering the traditional peculiarities of trees and cities in urban planning; 4) Preserving the “old” but do not dilute or ignore the “new” trees/landscapes; 5) Defining a local adapted scheme for recognizing the cultural values of trees; 6) Surveying on the meaning and perception of “what is nature” for contemporary urban people; and 7) Adopting a classification system of trees and urban forests as cultural heritage (e.g. Republic of Korea).

Theme 2: Urban Forest and Trees and Cultural Ecosystem Services

The working group discussed the significance of trees and urban forests as cultural ecosystem services and recognized that the cultural ecosystem services provided by open spaces need to be valued and emphasized in the city governance. However, highly urbanized cities quite often cannot afford investments for open spaces maintenance or improvement. Furthermore, contemporary urban culture ignores or underestimates the cultural ecosystem services of urban forests and trees and their values in economic, social, and environmental terms. Solutions were suggested including: 1) Including cultural indicators in UPF design and management; 2) Considering the traditional peculiarities of trees and cities; 3) Preserving the “old” but do not dilute or ignore the “new” trees/landscapes; 4) Defining a local adapted scheme for valuing the cultural ecosystem services of urban trees, parks, and forests; 5) Developing a Heritage Tree Database; and 6) Incorporating Payment for Ecosystem Services (PES) conservation measures for Heritage trees and compensation for alternative urban land uses.

Theme 3: Design and Management Implications

The working group discussed the aspects to be considered in designing new urban forest and tree settings and making them the Cultural Heritage of future cities. These included: 1) trees as elements towards the perception of the “sense of place”, e.g. Fengshui forests; 2) old styles and rural ways of landscape planning; and 3) trees as meeting places, e.g., South China. However, old trees are expensive to maintain. The budget and skills dedicated to urban forests by the municipalities is decreasing while their management (particularly of heritage trees and forests) requires permanent investment and specific skills. Suggested possible solutions were: 1) Using a place making and place keeping urban planning approach; 2) Ensuring that modern design duly considers old traditions and improves the life styles of today with reference to traditional ways; 3) Planting small but strong trees; 4) Species selection: new varieties of old trees; 5) Developing collaborative management; and 6) Developing assessment and management guidelines for culturally significant trees and promoting sound urban forest design integrating nature and culture.

Theme 4: Education and Capacity Building

The participants agreed that specific actions are required in the educational and capacity building framework to strengthen the role of urban forest and trees as cultural heritage. The discussed issues were: 1) The culture of trees is very often being ignored in official educational programmes; 2) Valuing, designing, and managing urban forests and trees starting from cultural values in the city are often not included in capacity building schemes; 3) Mutual learning among generations needs to be enhanced. Possible solutions included: 1) Preparing communication and facilitation tools for decision makers; 2) Developing lifelong learning programmes on art history *in* and *with* nature accessible to all (equity-equality); 3) Translating research on cultural values of trees into capacity building programmes, for example, developing a comprehensive teachers' kit for primary schools as guidance and education material on trees, forest and culture; and 4) Individual cities should identify urban forest sites in which to offer thematic itineraries for children.

WORKING GROUP 5: Green Infrastructure for City Clusters

Facilitators: *Alan Simson & Qingfei Zhang*

Urban expansion is happening rapidly, however, green infrastructure is rarely being incorporated in urban planning during urbanization process, especially in 'expanding and concentric cities'.

The concept of GI was discussed: GI is a toolbox used to deliver ecosystem services; GI is strategically planned rather than reactive; GI is monitored via evaluation or indicator systems to ensure a fitness for purpose; and GI must work for local cultures.

The issues of rapid urban expansion, lack of strategic plan, trans-boundary working difficulties, and lack of awareness on the benefits of urban forests to local people and communities were raised during the discussion. Possible solutions were suggested by the participants including Landscape Structure Planning, reversal urban development process & integrative and innovative urban planning; promoting and incorporating GI in urban planning, regional/trans-boundary urban forestry/GI award, and regional/global urban forestry networks for policy guidance and technical support.

More detailed suggestions include: 1) Carry out an audit of what you have and its current value/potential; 2) Develop a graphical vision of where you want to be in the future (as far as you could judge); 3) Plan Several 'milestone' plans as to where you want to be along the way in say 10 years' time, 20 years' time; 4) Communicate the concept of GI to politicians, decision makers, fellow professionals and the general public; 5) Promote reversal in the development process for new areas of development, putting green infrastructure first, then the built form and then the grey infrastructure and the resulting urban development would be much greener, healthier and happier, and no more costly than deploying the 'traditional' method; 6) Devise standard approaches to GI for all Asian countries to reduce difficulties of trans-boundary working; 7) Acknowledge that a 'one size fits all' approach would not fit the bill; 8) Create a regional, trans-boundary green city award to promote green infrastructure (e.g. the Chinese Forest City Award in China, the European Green City Award (EGCA) in Europe); and 9) Better guidance and technical support should be made available and easily accessible, together with a better sharing of experience and networking, and appropriate training programmes.



Part 4. The Way Forward

Future cooperation

Following the parallel working group discussion, urban forestry experts and national delegates discussed possible future cooperation together in six major areas: knowledge sharing, capacity building, education and research, communication, advocacy, and funding. As a first step towards stronger regional cooperation, the delegates from Republic of Korea kindly announced their willingness to host the second APUFM in the Republic of Korea in 2017.

Knowledge sharing

Participants suggested to establish two separate bodies: **an advisory council** and **a research consortium**. The advisory council would act as a node for technology sharing, strategy development, and inter-sectoral cooperation. It would target small groups, individuals and regional co-operation networks to transfer technology and knowledge and exchange resources. The establishment a web-based platform to discuss and share successes and failed practices would greatly help working across the region. The council could also promote urban forestry by providing information from global conferences/workshops. Meanwhile, the research consortium would act as a regional research network, by producing and providing database of relevant research and best practices in the field. It would also synthesize knowledge (e.g., scientific journal articles) into highlights that can be used in the FAO website. Of course, financial support would be needed from diverse funding agencies to carry out further activities.

Capacity building

The advisory council and research consortium would offer training programmes and support cooperative research. Participants noted that it is important to understand and set requirements for professional urban foresters and provide targeted training for planning, design and monitoring urban forests. Relevant educational institutions and job opportunities in the field could be identified with the assistance of APUFM participants through their respective organizations. Capacity building for policy makers was also raised as an issue. They should be exposed to the benefits of urban forests and trees through trips, visits, and tours so that they can incorporate them into the decision making process.

Education and research

Developing indicators for sound UPF practices was been recognized as probably the most important research topic. The participants suggested that research should be narrowed down from global to city indicators. They emphasized the importance of quantifying improvements such as timber and food production, cultural heritage and eco-tourism. The research consortium would promote knowledge sharing between researchers through online publishing and exchange opportunities for students. Submitting abstracts and session proposals related to urban forestry to conferences would also help. Also public education through citizen science (e.g. bioblitz) and live, real-time online courses could be used for public education. In this way, public would recognize benefits and effects of urban forestry on regional environment and biodiversity.

Communication

Public participation and community involvement is important component for urban forest sustainability. Urban forestry should be advertised in the big media and public spaces (campaign, re-greening movement, 'Tree Police' program, and repeat reporting to media) and social media. Scientists and communication specialists should cooperate to translate scientific and technical information into creative and attractive media such as infographics. FAO's recently published infographic 'Benefits of Urban Trees' is one example advertising functions of forests and trees in the changing urban environment. Media and public activities should be more people-friendly, fun and interactive. Communication between government and sponsoring companies should employ CSR (Corporate Social Responsibility) while online networking tool would be useful for communication between countries. Compiling and sharing success communication stories and common messages would inspire other cities to foster urban forestry communication.

Advocacy

Improving enabling legislation environment at international, state and local level is needed to support urban forest policy. Working through international organizations would influence responsible government agencies (industry, finance, government and research). The APUFM and the Zhuhai Declaration can be an example for connecting all experts and governmental officers that have interests in urban forestry. Urban forestry certification and testimonials to people, symbolic trees, parks in the region can encourage cities and people to better support urban forestry. Cost-benefit analysis to provide robust data on urban forestry and health is needed at national or local levels.

Funding

Within the knowledge sharing platform, there could be chances to apply for international funding. Funding from private sectors, public and others can be new options. It was agreed to promote concept of "Polluter-to-pay" principle, stipulating for example that companies producing pollution should plant trees to compensate. Some examples from Indonesia were mentioned, but it is expected that public-private partnerships might have more impact (business taking care of greening community in cooperation with local government). Participants proposed a variety of different funding mechanisms such as crowd funding, adopting a tree, encouraging farmers to pay to maintain food forests, and public health research budgets. The proposed Advisory Council would be expected to collect more practices on what cities have already done both within and outside of the region.



Part 5. Annexes

Annex I – Zhuhai Declaration

8 April 2016

We,

Representatives of national and local governments, research and academic institutions, non-governmental organizations (NGOs), international national and development cooperation organizations, professors, researchers, urban planners, urban foresters, arborists, landscape designers, urban forest and tree specialists, government officials, private sector professionals from the Asia-Pacific region and all over the world assembled in Zhuhai, Guangdong, P.R.China, on 6-8 April 2016, at the occasion of the 1st Asia-Pacific Urban Forestry Meeting (APUFM), co-organized by the Food and Agriculture Organization of the United Nations (FAO), the Urban Forest Research Center of the State Forestry Administration of P.R.China, and the City of Zhuhai, Guangdong, P.R.China,

wish to send to

national and local governments, international organizations, funding agencies, universities and research institutions, NGOs, civil society, urban forestry specialists and practitioners, urban planners, private sector and local communities who have the opportunity to shape the future of cities in the Asia-Pacific region

a message expressing our concerns, calling for action, proposing solutions and reaffirming our belief that forests and trees in and around cities are the key element to make cities in the Asia-Pacific region greener, healthier and happier and more resilient to climate change.

Given that:

globally, 54% of the world's population was residing in urban areas in 2014 and the global urban population will increase to 66% by 2050;

Asia, the home to 53% of the world's urban population, is projected to be one of the largest urban growth regions in the next two decades;

rapid urbanization is posing pressure on fresh water supplies, sewage, the living environment, and public health;

the major environmental issues that policymakers across the Asia-Pacific region will need to address towards 2030 are: water management, deforestation and land degradation, air pollution, and climate change;

strategies and solutions are urgently needed to help cities achieve sustainable development goals (SDGs), especially the one on making cities inclusive, safe, resilient and sustainable (SDG11).

considering that:

urban and peri-urban forests and trees and green infrastructure play an important role in achieving sustainable urban development goals and contributing directly to human health and well-being of residents;

urban and peri-urban forests and trees can provide a wide range of goods, socioeconomic benefits, and ecosystems services, in particular by improving environmental quality, enhancing food security, mitigating climate change, stimulating green economy, preserving natural and cultural heritage, strengthening social cohesion and providing environmental education opportunities.

and having agreed that:

the main benefits of urban forests and trees to cities and residents in the Asia-Pacific region are beautification, air noise pollution removal, and opportunities for recreation;
the main challenges of urban forestry development in the Asia-Pacific region are conflicts of land use, weak governance, and limited technical skills and knowledge;
the main priorities of urban forestry development in the Asia-Pacific region are good governance, sufficient investments/funding, and urban forestry expertise;
during the development of urban forestry in the Asia Pacific Region, the Chinese Forest City experience could be used as an important reference model.

We submit the following recommendations for consideration, awareness raising, and expressing our willingness to work together with policy- and decision makers, practitioners, and other stakeholders:

Recommendation 1

Raise awareness of the functions and benefits of urban forests and trees by enhancing advocacy, communication, and public education, which in turn may increase urban forestry investment by diversifying funding resources.

Recommendation 2

Improve the legal environment for urban forestry by enhancing policy support at international, regional, national, and local levels, in particular, reduce land use conflicts between urban green and gray infrastructures by integrating urban forestry planning into urban planning.

Recommendation 3

Strengthen urban forestry education and research in the region by increasing funding support, facilitating knowledge and information exchange, and prioritizing the needs.

Recommendation 4

To ensure sustainability, increase public participation and community involvement by making urban forests more accessible and creating diverse interactive programmes and activities.

Recommendation 5

Improve environmental quality in the Asia-Pacific region in the next two decades by creating new urban greening spaces and optimizing the functions and benefits of existing urban green spaces.

Recommendation 6

Protect and restore forests between cities, enhance rural-urban linkage through landscape planning and design, build interconnected regional eco-corridors, protect forests for urban water supply, limit unplanned urban expansion, and promote integrated ecological planning of neighboring cities.

Recommendation 7

Strengthen urban forestry regional networking on information sharing, knowledge exchange, and resource mobilization and further develop regional cooperation through periodical meetings such as the APUFM and other joint activities.

Recommendation 8

Develop common tools (including methods, models and indicators) to address research questions, fulfill education needs and develop urban forestry solutions adapted to the needs of individual cities and countries.

We firmly believe that the Zhuhai Statement on Urban Forestry in the Asia-Pacific Region, adopted in Zhuhai at the 1st Asia-Pacific Urban Forestry Meeting, will promote sustainable urban development aiming at a greener, healthier and happier future.

Annex II – Agenda



April 5		Registration & Reception
12:00-18:00 pm	Registration	
18:00-20:00 pm	Reception	
April 6		1st Asia-Pacific Urban Forestry Symposium
Chairperson: Simone Borelli		
Opening remarks:		
8:30-9:10 am Shizimen Hall B	<ul style="list-style-type: none"> • Simone Borelli (<i>Forestry Officer, Food and Agriculture Organization of the United Nations</i>) • Youdong Peng (<i>Deputy Director of the State Forestry Administration of the P.R. China</i>) • Zhi Ye (<i>Deputy President, Chinese Academy of Forestry</i>) • City of Zhuhai 	
Keynote address:		
9:10-10:00 am Shizimen Hall B	<ul style="list-style-type: none"> • The Practice of Forest- City in China <i>Hong Cheng (Director, Publicity Office, State Forestry Administration of the P.R. China)</i> • The Overview of Urban Forestry in the Asia-pacific Region <i>Cheng Wang (Director, Urban Forest Research Center of the State Forestry Administration of P.R.C and Chinese Academy of Forestry)</i> 	
10:00-10:30 am	Coffee break	
Urban forestry case studies in the Asia-pacific region: Part 1		
10:30-12:00 pm Shizimen Hall B	<ul style="list-style-type: none"> • The Role of Trees in Adapting Australian Cities to Hotter and Drier Conditions <i>Stephen Livesley (Associate Professor, The University of Melbourne, Australia)</i> • Urban Green Infrastructure: Strategies for Healthy and Sustainable Developing Cities <i>C.Y. Jim (Professor, University of Hong Kong, P.R. China)</i> • Greening Delhi: Milestones Behind. Miles Ahead <i>Manoj Dabas (Director, Center for Urban Green Spaces, India)</i> • Urban Forestry in Iran <i>Fariborz Gheibi (Head of Arid & Semi-arid Forestry Centre, Forest, Ranges & Watershed Management Organization, Iran)</i> • Joining Forces for Improved Urban Green Space Management in Malaysia <i>Noor Azlin Yahya (Head of Ecotourism and Urban Forestry Program, Forest Research Institute Malaysia, Malaysia)</i> • Quantification of Sustainability Index of Urban Forests in Korea <i>Chan Ryul Park (Senior Researcher in National Institute of Forest Science, Republic of Korea)</i> 	
12:00-13:30 pm	Lunch	

April 6		1 st Asia-Pacific Urban Forestry Symposium	
Chairperson: Prof Cheng Wang			
13:30-15:00 pm	Shizimen Hall B	Urban forestry case studies in the Asia-pacific region: Part 2	<ul style="list-style-type: none"> • A Case Study on the Impacts of Lawn Maintenance Activities on Christchurch's Urban Forest <i>Justin Morgenroth (Senior Lecturer, University of Canterbury, New Zealand)</i> • Toward a Sustainable Planning and Management of Urban Green Spaces in Metropolitan Manila <i>Maripin Faulan (Director of Metropolitan Manila Development Authority, Philippines)</i> • Loss of Secondary Forest as an Emerging Concern for Urban Forest Management in Singapore <i>Tan Puay Yok (Professor National University of Singapore, Singapore)</i> • Ecosystem Function and Service of Urban Forest for Air Quality and Water Supply <i>Woo-Kyun Lee (Professor, Korea University, Republic of Korea)</i> • Urban Forestry: Does Bangkok Care? <i>Oraya Sutabutr (Coordinator, Big Trees Project, Thailand)</i>
15:00-15:30 pm		Coffee break	
15:30-17:15 pm	Shizimen Hall B	International experience:	<ul style="list-style-type: none"> • 'Management is the Tool by Which Design Never Ends' - Reflections upon the Successful Establishment of an Urban Forest Landscape Structure Plan in a UK New Town <i>Alan Simson (Professor, Leeds Beckett University, UK)</i> • Trees in the City, Our Common Heritage <i>Fabio Salbitano (Associate Professor, University of Florence, Italy)</i> • The Role of Urban Forests and Nature Based Solutions in the Development and Maintenance of Adequate Levels of Health and Wellness in XXI Century European Cities <i>Giovanni Sanesi (Associate Professor, University of Bari, Italy)</i> • Human and Planetary Health in Asian Cities: The Role of Urban Forests <i>Jose Puppim de Oliveira (Visiting Research Fellow of UNU-IIGH; Visiting Scholar of MIT-UTM)</i> • Urban Forestry as a Water Quality Tool—How Science and Policy Connect in the United States' Chesapeake Bay Watershed <i>Susan D. Day (Associate Professor of Urban Forestry, Virginia Tech, USA)</i> • USA Urban and Community Forestry Program <i>Phillip Rodbell (Program Leader, U.S. Forest Service, USA)</i> • Integrating Education and Research in Urban Forestry – A Higher Education Perspective in USA <i>Yadong Qi (Professor of Urban Forestry, Southern University and A&M College, USA)</i>
17:15-17:30 pm	Shizimen Hall B	Closing remarks:	<p>UN Habitat III and beyond: the role of urban forestry in achieving SDGs</p> <p><i>Simone Borelli (Forestry Officer, Food and Agriculture Organization of the United Nations)</i></p>
17:30-19:00 pm		Poster session	
19:00-20:30 pm		Dinner	

April 7		Field Trip
8:30-12:00 pm		Field trip: Urban forests in Zhuhai
12:00-13:30 pm		Lunch
April 7		1st Asia-Pacific Urban Forestry Workshop: Day 1
Part 1: Where are we now?		
13:30-13:45 pm	Shizimen Hall B	Opening remarks of the workshop <i>Simone Borelli (Forestry Officer, Food and Agriculture Organization of the United Nations)</i>
13:45-15:15 pm	Shizimen Hall B	<p>Current status of urban forestry in the Asia-pacific region-County profiles: Part 1</p> <ul style="list-style-type: none"> • Stephen Livesley (Australia) • Soun Htwe (Myanmar) • Prak Marina (Cambodia) • Zeming Wu (China) • Pok Sim Jo (DPRK) • Manoj Dabas (India) • Yulianto Joko Putranto (Indonesia) • Fariborz Gheibi (Iran) • Veosavanh Saysavanh (Laos)
15:15-15:45 pm		Coffee break
15:45-17:15 pm	Shizimen Hall B	<p>Current status of urban forestry in the Asia-pacific region-County profiles: Part 2</p> <ul style="list-style-type: none"> • Noor Azlin Yahya (Malaysia) • Dorj Isheekhuu (Mongolia) • Justin Morgenroth (New Zealand) • Maripin Faulan (Philippines) • Tan Puay Yok (Singapore) • Kyong Ha Kim (Republic of Korea) • Oraya Sutabutr (Thailand)
17:15-17:45 pm	Shizimen Hall B	Discussion
17:45-18:00 pm	Shizimen Hall B	Summary of common urban forestry issues & challenges in the region <i>Zhiqiang Zhang (Professor, Beijing Forestry University, China)</i>
18:00-20:00 pm		Dinner

April 8		1 st Asia-Pacific Urban Forestry Workshop: Day 2		
Part 2: What can we do?				
8:30-10:00 am		Parallel sessions of five working groups: Part 1		
WG1 (401A) urban forests & environmental quality	WG2 (401B) urban forests & human health and well-being	WG3 (401C) urban forests & green economy	WG4 (402A) urban forests & cultural heritage	WG5 (402B) green infrastructure for city clusters
10:00-10:30 am		Coffee break		
10:30-11:30 am		Parallel sessions of five working groups: Part 2		
WG1 (401A) urban forests & environmental quality	WG2 (401B) urban forests & human health and well-being	WG3 (401C) urban forests & green economy	WG4 (402A) urban forests & cultural heritage	WG5 (402B) green infrastructure for city clusters
11:30-12:30 pm Shizimen Hall B		WG reports & discussion <ul style="list-style-type: none"> • WG1-Facilitators: Susan D. Day & Andrej Verlič • WG2-Facilitators: Jose Puppim de Oliveira & Giovanni Sanesi • WG3-Facilitators: Phillip Rodbell & Zeming Wu • WG4-Facilitators: Fabio Salbitano & Yadong Qi • WG5-Facilitators: Alan Simson & Qingfei Zhang 		
12:30-14:00 pm		Lunch		
Part 3: How can we work together?				
14:00-14:30 pm Shizimen Hall B		Common vision & goal <i>Simone Borelli (Forestry Officer, Food and Agriculture Organization of the United Nations)</i>		
14:30-15:30 pm Shizimen Hall B		Regional networking platform: round-table discussion (Chairperson: Andrej Verlič) <ul style="list-style-type: none"> • Information sharing • Knowledge exchange • Resource mobilization 		
15:30-16:00 pm		Coffee break		
16:00-17:00 pm Shizimen Hall B		Future cooperation: round-table discussion (Chairperson: Manoj Dabas) <ul style="list-style-type: none"> • South-south cooperation • Twinning cities • Other joint projects and cooperation 		
Part 4: The way forward				
17:00-17:30 pm Shizimen Hall B		Closing remarks of the workshop: The way forward <i>Cheng Wang (Director, Urban Forest Research Center of the State Forestry Administration of P.R.C and Chinese Academy of Forestry)</i>		
17:30-19:00 pm		Dinner		

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Annex IV – Poster abstracts

1. A brief description of hedge function and its chemical pruning technology

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Abstract: Hedge, as an important landscape element in Chinese garden, has the function of space dividing, landscaping and noise reduction which provide many benefits to people. It is widely used in the botanical garden green and has a broad development prospects. But the hedge has been frequently pruned every year because of its high germination rate and strong principal stress. It is spend a lot of manpower and material resources to prune in order to maintain the landscape. To save money and labor saving, and keep the modelling of hedge better, plant growth regulator with chemical pruning instead of artificial pruning was put forward. At present, this study has achieved certain results. In this paper, several functions of hedge is introduced, and the method, research progress, the advantages and disadvantages and prospects of the chemical pruning on hedge with plant growth regulator is summarized.

Key words: Hedge, Plant landscape, Chemical pruning, Plant growth regulator, Urban landscaping

2. A study on landscape pattern of the urban forest and green network in Pudong district of Shanghai, China

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Abstract: The landscape pattern of urban forest and green network structure of Pudong District of Shanghai were interpreted using ArcGIS Software in this paper. The study area covers 533km² including 253 km² of the built-up area. The total area of the urban forest patches (>900m²) and the built-up in district reached to 5.15% and 5.78% respectively. Area of the green corridor network was 101.15 km² while the density was 1.99 km/km². The linkage of green network was 1.301, circuitry 0.196, connectivity 0.478. Tree canopy coverage was 7.02% in the entire study area, 10.27% in the built-up area, and the potential tree canopy coverage (technical) can reach to 8.68%~9.79% in total study area, and 11.49%~ 12.3% in built-up area if more trees are planted at permeable land.

Key words: Landscape pattern, Green corridor, Network, Tree canopy coverage, Distribution gradient, Urban forest

3. A study on thermal environment effect of urban green space landscape in Yan'an city

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Abstract: In all urbanization's eco-environment effect, greater consideration was put on thermal environment. Urban thermal environment was co-influenced by land surface physical properties and human social and economic activities, which is a synthesis manifest of urban eco-environment. In all urban landscape types, the thermal environment effect of green space landscape is very different with the other landscape types. Studies on thermal environment effect of urban green

space landscape are of great significances for urban planning and urban eco-environment evaluating. Spatial data of urban green space landscape patches and land surface temperature (35.758 ± 5.097 °C) obtaining, thermal environment effect of landscape patch characters are discussed in this paper, using the data collected by the Landsat 8 Operational Land Imager (OLI) and spatial analyst is function of GIS in the city of Yan'an. For the spatial pattern of urban thermal environment in Yan'an city, this has an intense urban heat island effect. Heat island center lies on the densely populated interchange of three hills (Bao ta, Qing liang and Feng huang) and Yan'an new city area. There is an intense temperature variance in the inner of heat island. For example, there are some low temperature valleys associating with green spaces. There are apparent negative correlativity between area, perimeter of green space landscape patches ($n=797$) and its associate with temperature. There is an apparent positive correlativity between shape complexity index of green space patches and environment temperature, which is much significant than that of area and perimeter. There are not apparent statistically relationship between areas, perimeter of green space patches and green spaces influence on around thermal environment. By contrast there is a significant positive correlativity between shape complexity index of green space patches and green spaces influence on around thermal environment, the shape is more complexity the influence is more intense. So in urban green space buildings, except for green space types and spatial location selection, the outline shape of green space should be a considered factor for urban thermal environment.

Key words: Green space landscape, Urban thermal environment effect, Yan'an City, Shape complexity index of green space patches, Landscape patches

4. Analysis of castle settlement landscape based on demand oriented in Central region of Fujian

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Abstract: Castle living space is introversion, independence and integrity. Residents based on demand in the planting, self-sufficiency, forming plant landscape of unique ethnic culture. Aiming at the castle of Fujian architecture and landscape research, including types of castle, Garden layouts, plant planting distribution of plant species, purpose, use, analyze, summarize. Through the analysis of castle of plant resources, aimed at better protection and recovery requirements of plant resources.

Key words: Fujian, Castle, Plants

5. Assessment of urban tree benefits and services based on the i-Tree model

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Abstract: Urban trees can effectively mitigate environmental degradation accompanying rapid urbanization via a range of tree benefits and services. To quantify the ecosystem services of urban forest is an important prerequisite to make the maximum use of the services. Currently, the methods for evaluation urban forest economic benefits have developed from conventional methods (such as CLTA method, Burnley method, carbon duty method, etc.) to model calculation methods. In this paper, we introduced the i-Tree model, which has numerous irreplaceable advantages compared with other models such as CITYgreen model, and it has been widely used in

domestic and international urban forest research. The i-Tree tools help communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the environmental services that trees provide and assessing the structure of the urban forest. Here, the research and application progress of this model were described and evaluated by a quantitative review of 50 original urban tree studies based on i-Tree model. The use of i-Tree model mainly focus on the United States, the United Kingdom, Canada and Australia. And the i-Tree model was used to evaluate the tree benefits (economic, social, health, visual and aesthetic benefits), ecosystem services (carbon sequestration, air quality improvement, storm water attenuation, and energy conservation) and disservices (maintenance costs, light attenuation, infrastructure damage and health problems). Further research and application of this model is required to be conducted in a large area of eastern Asia, especially in China. And the evaluation of human health and wellbeing should be considered as the key research content.

Key words: i-Tree model, Urban forest, Tree benefits, Ecosystem services, Disservices

6. Bachelor of Urban Forestry

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Abstract: Faculty of Forestry at University of British Columbia (UBC) in Vancouver Canada has introduced a new undergraduate degree in Urban Forestry. This unique program goes beyond street trees, encompassing forests and green-space systems that serve and protect our cities and communities. The program offers students various unique opportunities including the dual-degree transfer programs with different forestry universities and the Vancouver summer program. A one-year course-based Master's program in Urban Forestry is also being developed at UBC.

Key words: Urban forestry, education, University of British Columbia

7. Bioaccumulation of heavy metals in plant leaves from Yan'an city of the Loess Plateau, China

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Abstract: Rapid and unorganized urban and industrial developments have created substantial environmental pressures on urban areas in developing countries. Urban plants are capable of reducing environmental pollutions through bioaccumulation contaminants in their tissues. The accumulation of heavy metals (Pb, Cu, Cd, Cr, and Zn) in leaves of nine tree species and five shrub species from Yan'an city of China were investigated, and total metal accumulation capacities of different plants were evaluated using the metal accumulation index (MAI). The results indicated that plants in polluted environments are enriched in heavy metals relative to those in pristine environments, this is mainly caused by traffic emissions and coal combustion. Species with the highest accumulation of a single metal did not have the highest total metal accumulation capacity, the MAI should be an important indicator for tree species selection in phytoextraction and urban greening. Considering total accumulation capacities, *Sabina chinensis*, *Juniperus formosana*, *Ailanthus altissima* and *Salix matsudana* var. *matsudana* could be widely used in the Loess Plateau.

Key words: Yan'an, Heavy metal, Loess Plateau, Urban forests, Metal accumulation index, Phytoextraction

8. Canopy-based landscape pattern gradient analysis of the urban green land space

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Abstract: The experiment was conducted to analyze tree canopy coverage landscape pattern of the northern urban-suburb region in Beijing by GIS and RS technology, and this analysis based on the images from 2013 august worldview satellite and combined gradient analysis with landscape metrics. The result showed that Public green lands had the largest tree canopy coverage area and urban accessory green lands of branches had the lowest among nine types. The tree canopy coverage ratio was higher in urban region, the ratio in suburb region showed the rapid growth trend and that could be more than the city center in the future. The tree canopy coverage from the city to suburb presented that the number of green patches and patch density decreased, mean patch area increased, degree of fragmentation decreased; The tree canopy coverage ratio, Shannon landscape diversity index and evenness increased at first then decreased obviously, landscape pattern was not stable in Urban- Suburb Binding Area. Through gradient analysis of the mean patch fractal dimension, edge density and patch shape index , the result showed the second green barriers in Beijing was facing construction land concentration, forest patches fragmentation and poor quality of landscape.

Key words: Beijing, Urban tree canopy, Green land, Landscape pattern, Gradient analysis

9. Carbon storage of forest ecosystems in Guangzhou City

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Abstract: To accurately measure carbon pools of zonal forests is one step to estimate the carbon sequestration capacity of forests in one region. Therefore, a study of the vegetation and soil carbon pool of forest ecosystem was conducted in low subtropical China. Based on the forest area data from the forest resources inventory in 2014, forest plot and soil survey and the tree biomass equations. The carbon storage and carbon density of urban forest ecosystem in Guangzhou were evaluated. The results indicated that, carbon storage of forest ecosystem in Guangzhou was 52.16 Tg C, in which the carbon storage of forest vegetation and of soil organic were 21.97 Tg C and 27.16 Tg C, respectively. The main characters of carbon storage in Guangzhou was following: carbon storage of urban forest was distributed mainly in Conghua and Zengcheng, and the carbon storage capacity of forest in different times sorted in descending order: young forest, middle-age forest, near-mature forest, over-mature forest and mature forest; The largest factions of carbon stock in the forests were soil layer (58%), and the following were the tree layer (40%). The fractions of biomass for shrub layer, herb layer, aboveground litter and fine roots (≤ 2.0 mm) were mostly 1 ~ 2%. The carbon storage of natural forest is near to that in the plantation, but the carbon density of natural forest was significant larger than that in plantation ($P < 0.05$). Carbon density of forest ecosystem in Guangzhou was $178.03 \text{ t C ha}^{-1}$, of which vegetation and soil organic were $79.61 \text{ t C ha}^{-1}$ and $98.42 \text{ t C ha}^{-1}$, respectively. The total carbon storages in low subtropical forests with different community were measured in our study. These results may be helpful to estimate the carbon sequestration capacity for the urban forest ecosystems and to manage the carbon forest in Guangzhou city.

Key words: Guangzhou, Forest ecosystem, Carbon storage, Carbon density

10. Characteristic of different life-form vegetation and its relationship with land use types along riverine zone of Jiushijiu river in Jinjiang city

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Abstract: To conduct the relationship between the vegetation characteristic of various life forms and the major use of riparian land, this paper chose Jiushijiu river which hinterland had a relatively high degree of urbanization and developed industry and agriculture as the subject that had been divided into 9 segments by comprehensive factors of ecology, scenery, land use, city function. Each segment had some matched survey sites (24 for total) for fetching dates to compute and analyze the constitution and diversity of various plant life forms. Based on comparing the grass, shrub, arbor, different vegetation features among them were found out, and according to couple this to the distinction of land use besides river riparian, the relationship between them were discussed. The five research results were: (1) Difference exist between two riversides. Similarities show the general interference from human beings, which is seen in both sides of river banks performing as the dominant species of all life form plants can highly endurance environment change especially the grass which is vitally contribute to riparian vegetation species, and the unbalance of community structure which is indicated by the relatively higher diversity comparing the evenness, and dissimilarities show the wide-ranging type and source of right side of river bank' dominant species (2)Dissimilarities of vegetation constitution, dominant species among grass, shrub, arbor between the two banks are correlated to the distinction of land use in riverside; (3) Divergence of Vegetation diversity between the two banks are correlated to the distinction of land patch's type, shape and proportion along river segments. Finally, the different human interferences corresponding to the various methods of primary land use are the major cause of variant vegetation characteristic.

Key words: Riverine zone, Life form, Vegetation characteristics, Land use, Dissimilarity, Reason

11. Current urban forestry research at Faculty of Forestry UBC

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Abstract: Researchers at UBC's Faculty of Forestry have strong interests in urban forests related issues. Current research underway in the Faculty related to urban forestry covers a wide arrange of areas, including traditional urban forestry methods (such as tree care and ecosystem management), social sciences (such as human well-being, aesthetics and social equality), and technology (such as "app" development, 3D visualization and future scenario development). The poster highlights some recent research in the Faculty.

Key words: Urban forestry, University of British Columbia, valuation of urban forests, future scenarios, visual analytics, citizen engagement

12. Effects of forest type and urbanization on carbon storage of urban forests in Changchun

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Abstract: Rapid urbanization has led to dramatic changes in urban forest structures and functions, and consequently affects carbon (C) storage in cities. In this study, field surveys were combined with high resolution images to investigate the variability of C storage of urban forests in Changchun, Northeast China. The main objectives of this study were to quantify the C storage of urban forests in Changchun City, Northeast China and understand the effects of forest type and urbanization on C storage of urban forests. The results showed that the mean C density and the total C storage of urban forests in Changchun were 4.41 kg/m² and 4.74 × 10⁸ kg, respectively. There were significant differences in C density among urban forest types. Landscape and relaxation forest (LF) had the highest C density with 5.41 kg/m², while production and management forest (PF) had the lowest C density with 1.46 kg/m². These differences demonstrate that urban forest type is an important factor needed to be considered when the C storage is accurately estimated. Further findings revealed significant differences in different gradients of urbanization, and the mean C density decreased from the first ring (6.99 kg/m²) to the fourth ring (2.87 kg/m²). The total C storage increased from the first ring to the third ring. These results indicate that C storage by urban forests will be significantly changed during the process of urbanization. The results can provide insights for decision-makers and urban planners to better understand the effects of forest type and urbanization on C storage of urban forests in Changchun, and make better management plans for urban forests.

Key words: Urban forest, Carbon storage, Carbon density, Urbanization gradients, Climate change

13. Eutrophication control and nutrient removal by urban riparian vegetation

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Abstract: With rapid development of global industrialize and urbanization, air pollution has become the most extensive and heaviest pollution. Being one of the major sources of air pollution, vehicle exhaust emission has attracted extensive attention from the international community. For the current problem of urban forest species lacking of response and sensitivity identified to the vehicle exhaust emission, we choose the typical trees in northern China as the research object. OTC gradient simulation is conducted to compare the sensitivity and response process of different landscape plants to vehicle by such parameters as growth morphology, physiological parameters, photosynthesis, endogenous hormones and ultrastructure. The tolerance mechanisms of urban forest to vehicle exhaust emission stress are to be explained. The main objectives of our study provided a theoretical reference and practical guidance for screening urban greening vegetation, urban ecological security and environmental management, as well as the sustainable development of urban ecosystem.

Key words: Stress tolerance, Environmental Adaptability, Street trees

14. Evaluation of the scenic beauty quality of garden road landscape of classical gardens in Hangzhou

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Abstract: The garden road is an important element in the garden. Its aesthetic value directly affects the comprehensive value of the whole landscape. In order to explore a better evaluation model and to improve the landscape, the study uses Scenic Beauty Estimation method (referred as SBE method) and multiple linear regression comprehensive analysis to conduct the scenic beauty evaluation of the photographs of the Hangzhou classical garden road landscape. It has extracted 19 landscape elements to analyze and to build predictive models. This helped to extract factors that affect the road views, summarize garden road building technologies, including plant arrangement, material selection, form building and other construction techniques, and thus provide a theoretical basis for garden road landscape construction.

Key words: Classical gardens, Garden road, Scenic beauty, Evaluation

15. Evaluation technology and demonstration of visual landscape of urban mountain park based on GIS

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Abstract: Compared with general urban park or forest park, urban mountain park has a great particularity, it has native mountain vegetation types, and the public space to create an artificial. Compared with urban parks under artificial intervention, it owns unique spatial distribution, ecological composition, landscape composition and climate environment. Therefore, the landscape planning and design of urban mountain park requires not only considering the particularity of its own, but also establishing the Multi-layer spatial model to meet people's visual aesthetic experience and achieving effective balance between ecological protection and resource utilization, thus, it is of theoretical value and practical significance to explore the quantitative technology of urban mountain park visual landscape evaluation based on GIS technology. This paper takes Fuzhou Jinji Mountain Park as an example, the data are quantized base on the simulation applied of GIS to small and medium-scale urban mountain's slope and aspect, elevation, and the questionnaire score obtained by human's subjective landscape perception, and then the results were weighted based on GIS and questionnaire score. The results showed that the landscape vision spot 4 (Rockery waterfall), 10 (Fei Hong bridge), 15 (Jin An station), 19 (Qixia station) was the better, while the spot of 5 (forest stage) was the worst. The application in different scales of visual landscape evaluation system were verified on this account, and the results would provide references and suggestions for the establishment of urban mountain evaluation system.

Key words: Urban Forestry, Environment quality, Urban Mountain Park, Landscape vision, GIS

16. Evolution characteristics and homesickness culture of rural courtyard plant landscapes in Zhuhai

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Abstract: Homesickness Ecological Landscape is a new direction for the construction of rural landscape in future. Rural courtyard plant landscape is an important constitution of homesickness ecological landscape and it is also an important carrier of homesickness culture. In this paper, the method of combining the visual interpretation of satellite images with the practical investigation was adopted, then the courtyard plant landscape of traditional and modern rural areas were be compared and analyzed. Research indicates that: firstly, the general evolution trend of spatial location of the courtyard plant landscape showed “from inside to outside of courtyard, from the center to the corner of courtyard”. Secondly, there are 30 and 42 types of courtyard plant in the traditional and modern village in Zhuhai. Compare with the traditional village, the modern village had increased 12 kinds of plants but the number of courtyard plant showed a decreasing trend. Thirdly, the style of the traditional courtyard plant landscape mainly based on fruit trees, the economic edible plants accounted for 81.8%. However, on the basis of inheriting the original features, the modern rural courtyard had more attention to ornamental plants. Ornamental plants accounted for 45.5%, while the economic edible plants reduced to 36.3%. Fourthly, the average green coverage rate, the number of green patch and the green patch area of traditional rural courtyard plants were 10.26%, 142.2 and 8.81 square meters, while at modern rural areas were 4.97%, 92.4 and 5.98 square meters respectively, which showed a significant downward trend. The courtyard ecological space is obviously reduced, and the plant size tends to miniaturization. The homesickness characteristics of rural courtyard plant landscape in Zhuhai which has full-bodied Lingnan flavor is the big tree, fruit fragrance, and the picture of life that people enjoy the cool air and chat to each other under the tree. In the recent years, however, the problem of urbanization and regularization courtyard landscape which lack of characteristics and cultural connotation had appeared. The evolution is the result of the reduction of courtyard ecological space and the disappearance of the regional style which caused by the pursuit of living space maximization and the greening mode of urbanization.

Key words: Rural courtyard, Plant landscape, Evolution, Homesickness culture

17. Evolution characteristics and homesickness culture of rural courtyard plant landscapes in Zhuhai—Take the Jiexia Zhuang and Paishan village as examples

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Abstract: Studying the style characteristics and homesickness culture of traditional rural landscape has important reference significance for guiding the construction of homesickness ecological landscape. In this paper, the method of combining the visual interpretation of satellite images with the practical investigation was adopted, and the evolution of ecological landscape distribution and morphological characteristics of landscape elements were analyzed, the causes of change were discussed, and the change tendency homesickness culture was interpreted, then suggestions were proposed accordingly. Research indicates that: firstly, the proportion of waterfront space was reduced, from 2004 to 2014, the Jiexia Zhuang decreased from 30% to 23%, and the Paishan village decreased from 5.1% to 4.3%. New land types appeared in the rural area, and the proportion was relatively large. Compare with 2004, the tourist facilities land appeared in Jiexia Zhuang accounted

for 11.7%, the factory land appeared in Paishan village account for 2.7%, and mainly occupied the forest land and waterfront space. Secondly, the species of rural plant gradually enriched, the types of plant were 24 and increased to 44 from 2004 to 2014 in Jiexia Zhuang, as well as the Paishan village increased from 32 to 40. The function of new plants had more attention to economy, ornamental and aromaticity. Thirdly, the average forest coverage area of new rural residential space was very low, the Jiexia Zhuang was 0.12 square meters, and the Paishan village was only 0.02 square meters. Fourthly, the influence factors of the change of rural ecological landscape contains six aspects: 1) a serious invasion of township enterprises; 2) fuzzy positioning of tourism development; 3) Pay more attention to the economic value of forestry; 4) urban wind blowing in the country; 5) life demands change; 6) The government lack of decision-making ability. Fifth, the characteristics of rural ecological landscape in Zhuhai which has full-bodied Lingnan homesickness culture is the ancestral hall in the village head, Towering trees, the pond in front of the village, pure river and green banks, streams, the lush bamboos in the back of the village, tree-lined village, courtyard flower and fruit fragrance and the life picture with vitality. In recent years, however, pursue the rural function diversification and follow the pattern of urbanization, caused a decline of rural ecological space and reduce of regional homesickness culture. Combine the features of the rural landscape with the new demand of modern life, so that the countryside becomes the beautiful space which carries the homesickness culture and the modern culture.

Key words: Rural ecological landscape, Ecological space, Plant landscape, Homesickness culture, Evolution

18. Greenway strings health and happy lives

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Abstract: Greenway, which has diverse functions and plays a connection role among all kinds of green space in urban and rural areas, not only protects urban green space ecology system, also facilitates the recreation for city residents, thus the planning and construction of greenway is booming. Planning and construction of Huan Yushanhu greenway network in the center of Maanshan city, which enjoy huge popularity among the citizens, not only create a beautiful and natural ecological landscape, also provide citizens with a green open space of recreation. so it emerges a large number of people walking along the lake in the morning and evening for body exercises. Through the survey of “people walking along the lake”, this paper has an in-depth analysis of the sociological significance from the aspect of city development principle, happiness, sense of security, etc.

Key words: Greenway Planning, Greenway Network, Accessibility, Walking along the Lake, Sociological Significance

19. Huge afforestation projects attract birds return in Beijing city

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Abstract: Biodiversity issues in urban regions attract increasing attention from biological researchers, governmental officers and also the public. The present study focused on diversity patterns of bird species and the interaction with historic records of forest coverage in a Chinese mega-city (Beijing) under temperate zone. Three updated, comprehensive and reliable records of bird species diversity was obtained from the previously published literature; specifically, 344 species was reported in 1987, 375 species in 1994, and 430 species in 2014, respectively. About 15% of bird species were resident in Beijing. The results showed that bird species diversity in Beijing was positively correlated with forest coverage. Large-scale afforestation projects carried out in recent several decades, together with improved environmental quality and reduced anthropogenic disturbance, contributed sufficient foods and nesting sites for birds. The study inferred that the dynamics of bird species diversity might also be affected by multiple factors from biotic, meteorological, and even social dimensions, which could be informative for monitoring and researches on avian diversity in Beijing and other urban areas.

Key words: Urban forests, Forest biodiversity, Avian diversity, Ecological civilization

20. Importance of urban forests to temperate urbanized cities in China - Quantifying carbon biomass and variation in the soil

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Abstract: Greater focus is being placed on the ecological service function of urban forests; however, more information is required on the spatial and temporal variation in C biomass and soil C content during urbanization. To address this issue, this study aimed to quantify variation in C in the trees and soils of the Harbin urban region. In 219 plots of this region, various tree and soil parameters were sampled to determine temporal and spatial variation within the forth ring road region with over 100-year history. In Harbin City, the average density of C in the vegetation and the SOC (soil organic carbon content) density were higher than that detected in other local cities (Shenyang and Changchun), but were much lower than local natural forests. The C density of the vegetation varied 3.2-fold among ring roads (urban-rural gradient), 2.3-fold among forest types, and 3-fold among districts. These variations were closely related with species composition, species Shannon-Wiener index, and DBH, rather than urbanization level or tree density. In comparison, spatial variation in SOC was much lower (1.4–1.5 fold), and was closely related with the urban-rural gradient data of ring-roads, history of settlement, and SOC content. Overall, total SOC accumulation in urban forest soil took over one quarter of stored C biomass. Much larger variation in the C density of vegetation was a casual process, mainly related to tree size. In contrast, variation in the C density of soil was an urbanization-dependent process, mainly associated with urban settlement time and the rate of spread of ring-roads. Our results provide new insights about spatial and temporal variation in above- and below-ground carbon distribution. We recommend that urbanization effects should be incorporated into calculations of soil C budgets in regions subject to rapid urban expansion, such as China.

Key words: Urban forest, Vegetation carbon density, Soil carbon density, Forest type, Ring road

21. Photosynthetic capacity, photochemical efficiency and chlorophyll content of eight bamboo species of different seasons in Zizhu Park in Beijing

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Abstract: Eight bamboo species (*Phyllostachys vivax* McClure *F. aureocaulis*, *Phyllostachys vivax* McClure *f. huanwenzhu* J.L.Lu, *Phyllostachys aureosuleata* McClure *F. flavostriata*, *Phyllostachys praecox* C.D.Chu et C.S.Chao, *Phyllostachys nigra* (Lodd.ex Lindl.) Munro, *Phyllostachys glabrata* S.Y.Chen et C.Y.Yao, *Indocalamus latifolius* (Keng) McClure, and so on) grown in Zizhu Park in Beijing were tested to evaluate and compare their photosynthetic, transpiration rate, stomatal conductance and maximal quantum efficiency of photosystem II (Fv/Fm) reactions in different seasons. Every variety grown demonstrated higher light-saturated photosynthetic capacity in spring. *Phyllostachys vivax* McClure *F. aureocaulis* were found to acclimatize better photosynthetic in spring. *Phyllostachys nigra* (Lodd.ex Lindl.) Munro had high photosynthetic rate in winter. The diurnal patterns of Fv/Fm indicated that bamboo species encountered less photoinhibition in winter. Fv/Fm had no significant difference of every bamboo species in winter. A decrease in chlorophyll (chl) a/b ratio in leaves of bamboos with significant increase in chl b was observed.

Key words: Bamboo, Photosynthetic capacity, Photochemical efficiency, Chlorophyll content

22. Preliminary study on design of urban green space with BVOCs health care effect

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Abstract: In recent years, the function of green space on promoting human health is given more emphasis. And as an important part of forest healthcare, BVOCs, that is called phytoncidere, needs to be put to practical use in urban green space, but it is a class of chemical that easy to be oxidized. So it is necessary to design a suitable green space that the BVOCs could exist steadily to play the healthcare function. In order to determine the minimum area of this target, we collect the BVOCs sample of different distance from the forest edge in the Badaling Forest Park by the method of dynamic head-space sampling with Tenax TA components and contrast the concentration of the main materials. In addition, we made a list of alternative plants list based on the related research, and divided them into healthcare type and space-creating type which could formulate a recreation space suitable for BVOCs existing. And finally, according to the use of green space and the BVOCs quantity released from different healthcare type plants, the plant collocation is discussed.

Key words : Urban green space, Forest healthcare, Phytoncidere, BVOCs, Human health factor

23. Public views of the low-carbon economy in small cities

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Abstract: Low carbon economies have been proposed in many areas of the world as a strategy to mitigate climate change, including in the world's biggest greenhouse gas emitting country, China. While much effort has been put into developing low carbon economies in major cities in China, less attention has been paid to smaller cities and counties. The goal of this research is to understand

citizens' perceptions of low carbon economies and their attitude towards low carbon policies in smaller cities (or counties) in China. A questionnaire-based cross-sectional survey was conducted in Fuding City and Zherong County in Fujian Province (southeastern China), with three sub-populations - general public, community residents, and government employees. Results of the survey indicated several possible knowledge gaps and inconsistencies about climate change and the low carbon economy among citizens. However, citizens did indicate high levels of support for developing a low carbon economy in local areas. Binary and multinomial logistic regression models developed in this study indicated that citizens' knowledge of low carbon economies and their level of concern about climate change were significant factors influencing their level of support for a low carbon economy. In general, citizens with more knowledge of low carbon economies and a greater level of concern about climate change showed greater support for developing a low carbon economy in local areas. However, greater knowledge and more supportive attitudes did not necessarily lead to behavioural changes. This research discovered an 'attitude-behaviour' gap between someone showing greater support for low carbon policies (e.g. developing a low carbon economy) and having less intention to change their behaviour (on average respondents had tried three to four low carbon activities and were willing to conduct one more low carbon activity to further lower their carbon footprint). Findings call for more effort to be put towards informing and engaging citizens in order to more closely align behaviours with attitudes and initiate more behavioural responses to climate change. Significant differences were found between the study areas and between different sub-populations, which suggested priorities for further engagement and social learning among the populations of smaller cities in China.

Key words: Public perceptions, climate change, low-carbon economy, China

24. Quantitative evaluation on the impact of the street greening in ancient town landscape

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Abstract: Streets are important components and spatial connection paths in ancient town landscape and their landscape optimization is beneficial for improving the taste of the ancient cities. The thesis adopts landscape beauty judging method and multiple linear regression method to make comprehensive analysis of Dayan ancient town and Shuhe ancient town in Lijiang and puts forward 13 impact factors of green landscape. From which 9 are removed after calculation as a result of their minor influence and 4 most influential ones on street greening, including layering of the plants, color number of the plants, environmental coordination and the diameter and breast height of the plants, are taken to analyze the green landscape of the streets. With the 4 landscape factors as transformation objects, it proposes the theoretical basis in the protection of the greening of ancient town streets as well as some recommendation for optimizing the green landscape of ancient town streets.

Key words: Lijiang ancient town, Street greening, Scenic beauty estimation (SBE), Landscape enhancement

25. Research on characteristic of urban ecological space in Beijing plain area

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Abstract: The research range in this paper is the plain area of Beijing city. The Beijing forest resources survey in 2009 (1:10000), the plain afforestation project in 2014 (1:10000), the Landsat-8

image in September 2014 and other foundational geographic information (1:10000) were used as the main basic data under the ArcGIS platform to explore the characteristic of plain ecological space pattern and the heat island effect. The purpose of this paper is to study the relationship between ecological space and urban heat island effect, and finally provide scientific strategy for ecological space optimization in plains. The main results showed:

(1) The current land use intensity in Beijing plain is really high, the landscape matrix is non-ecological space (area proportion 65.84%), while the forestry is plain's main ecological space, garden space takes the second place; the number of small patches of each ecological space reaches more than 90% in the plain area.

(2) From 2009-2014, the ecological land fragmentation, diversity and evenness in plain area have increased. From the perspective of urban development, this change was to enable more people to enjoy the city's ecological products and service performance which provided by urban forest; from the view of different types ecological space, the fragmentation of garden space increased, and difference between different size patches became larger, the shape of patches tended to more irregularly.

(4) As for the distribution of heat island in the plain area, the middle, strong and powerful island mainly concentrated in City development area, City expanded function area and two green isolation zones.

(5) With respect to the study of ecological space for mitigation of urban heat island found that the maximum effective range of cold island effect produced by ecological space is 300 meters.

Keywords: Beijing, Ecological space, Plain afforestation, Landscape pattern, Heat island effect

26. Research status, problems and prospect of landscape forest visualization

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Abstract: Landscape forest is an important part of attracting visitors in every tourist area, and the rise of the tourism industry urgently needs to improve the quality of the landscape forest. However, the management measure of the traditional forest farm production unit is far behind the demand of the times, and the vigorous development of the forestry information technology has injected new vitality into the management of the landscape forest. At the end of the 1970s, visualization technology was proposed and had been developing rapidly, then involved in medicine, finance, entertainment, public transport, agriculture, forestry, industry research in a very short period of time, and jumped into hot emerging technologies in today's society, absolutely received great attention from the scholars at home and abroad. In contrast, the two-dimensional information technology which has only focused on the simple geometric figure has been unable to express the forest landscape features (i.e., landscape reconstruction), and three-dimensional visualization has become an important method for the research of landscape forest. At present, the research of landscape forest visualization focuses on the visual angle of the forest landscape and the characteristics of the landscape. This paper aims to summarize the application range of the forest landscape visualization, research methods and index decomposition and evaluation technology, and explore the main problems and the application prospect of visualization technology in forest landscape. Finally the aim is to provide more clear direction for the scholars in the future.

Key words: Urban forestry, Landscape forest, Visualization, Landscape visual quality, Evaluation technology

27. Risk degree assessment of common green trees in southern Fujian area coastal villages

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Abstract: To assess the risk degree of rural green trees correctly will improve the management efficiency and decrease the loss of human life and property resulting from damaged green trees. Methods of AHP and VTA will be used to investigate and analyze the potential risks of 20 kinds of common rural greening trees in southern country of Fujian. Results show that: 1) the three indexes with higher weight value including the instable root system, unnaturally inclining trunk and hollow trunk. While the indexes with lower weight value are: water sprout, physical injury of trunk, and die-back. 2) The Green trees in southern country of Fujian include 47 genera, 90 families and 98 kinds. The top 20 green trees in terms of the frequency are mainly fruit trees and other economic optimum tree species, with high proportion of evergreen and native tree species; 3) tree species with higher risk indexes including eucalyptus grandis, loquat, guava and phoenix wood; tree species with lower risk indexes including flicker camphor trees and bamboo, grapefruit; 4) The test items higher than 0.6 include: V-angle trunks, dangerous deadwood, inclining trunk, trunks' internal decay and other symptoms.

Key words: VTA, Rural green trees, Risk degree, Southern coastal villages of Fujian

28. Short term effect of thinning on carbon storage in Chinese fir plantation

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Abstract: In order to explore thinning effects on carbon storage in forest plantation and to provide theoretical bases for sustainable forest management, we investigated the change of biomass in vegetative layer and the stand carbon storage of a *Cunninghamia lanceolata* (Lamb.) Hook pure forest thinned with four intensities, namely, light intensity thinning (30%, the number of trees intensity, the same below), medium intensity thinning (50%), heavy intensity thinning (70%) and the un-thinning (CK), seven years ago in Lishui farm forestry. We found: As compared to the CK treatment, (1) tree growth rate (evaluated by diameter at breast height (DBH), crown diameter and volume) was significantly higher under thinning treatments, and increased significantly with the intensity of thinning; (2) stand carbon storage has increased by 2.86 and 7.83 t·hm⁻² in LIT and MIT respectively, but decreased by 2.85 t·hm⁻² in HIT. We suggest that a proper thinning intensity should be applied to the corresponding forest type in urban forest management.

Key words: Thinning intensity, Stand structure, Carbon storage, Carbon distribution pattern

29. Structure and regeneration pattern of the isolated remnant vegetation in urbanized area

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Abstract: The semi-natural remnant woodland, which is one of the most representative zonal vegetation in urban area, can take important referent for understanding urban vegetation dynamic and ecological restoration. We established an 1 ha permanent plot in an semi-natural forest which the former plantation after more than 50 years natural generation in Chenshan Hill in Shanghai Chenshan Botanical Garden. And all free-standing trees with ≥ 1 cm in diameter at breast height

(DBH) in the plot were mapped, tagged and identified to species. We analyzed the community composition, size class structure, and spatial distribution of the forest. The results showed as follows: (1) There were 11 types of forest vegetation community in the plot which the deciduous broadleaf dominated community accounts for a large proportion. (2) As for community composition, there are 53 species, which belong to 46 genera in 28 families in the plot. At both the family and genus levels, the Pan-tropic plants are the most abundant type, followed by the North Temperate Zone plants. (3) The richness of individuals was higher for the 4 cm<DBH≤10 cm class than that of the DBH>10 cm class. The diversity of individual difference for the 1 cm≤DBH≤4 cm class in different community types was high. (4)The distribution pattern of dominant species in scale 0-15 m showed that *Cinnamomum camphora*, *Robinia pseudoacacia*, *Celtis sinensis*, *Ligustrum sinense*, *Aphananthe aspera*, *Acer buergerianum*, *C.japonicum* and *Broussonetia papyifera* have a clumped distribution on a smaller scale and tend to have random spatial distributions with increasingly enlarged scales. In contrast, *Elaeocarpus glabripetalus* has a clumped distribution and *Ulmus pumila* has a random spatial distribution. With increasingly enlarged scales, *Liquidambar formosana* and *Ilex chinensis* have random spatial distribution to clumped distribution to random spatial distribution. (5) The regeneration of woody plants was mainly through seedlings. There was significant difference in the establishment of seedlings of different height levels in the sampled populations and that the establishment of seedlings appeared to correlate well with biological factors such as diameter class and life form, but not with environmental factors such as crown and elevation.

Key words: Permanent plot of 1 ha, Species composition, Spatial pattern, Seedlings regeneration, Semi-natural remnant woodland

30. Structure and species diversity of typical forests in Guangzhou city

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Abstract: 0.48, 0.48 and 0.24 hm² evergreen broad-leaf forests of Maofeng Mountain, Baiyun Mountain and Tianhe Park in Guangzhou urban scale were selected respectively. Communities structure, species diversity and interspecific association of dominant populations of three vegetation types were comparative studied by the method of community ecology. The result indicated that species number, stand density and canopy density are characterized by Evergreen Broadleaved Secondary Forest (EBSF) > Evergreen Broadleaved Artificial and Natural Forest (EBANF) > Evergreen Broadleaved Plantation (EBP). The same character was showed on the Shannon-Wiener (SW) index and Gleason index of tree layer, shrub layer and all woody plants. The SW index and Gleason index of shrub layer had a higher value than tree layer in EBSF, and it was converse in EBANF and EBP. While the Pielou evenness index showed a changeable feature. The diameter-class structure of EBSF, EBANF and EBP were recognized as Standard, bimodal and peaky inverse “J” type respectively. 20 dominate populations of woody plants showed insignificant positive association in EBSF and EBANF. The interspecific association of 190 species-pairs were the similar conclusion of insignificant positive association analyzed by χ^2 correction test, percentage co-occurring (PC) and association coefficient (AC). Moreover, the interspecific association of EBSF species was more significant. The paper revealed the difference in communities structure, species diversity and main interspecific relevance of three vegetation types in Guangzhou local area, which would provide a good theoretical basis for the construction and evaluation of the near-natural forest and beautiful city forest landscape as a typical example.

Key words: Guangzhou, Urban forest, Community structure, Species diversity, Interspecific association

31. Studies on adsorbing PM2.5 function differences of tree species in different urban forests

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Abstract: Taking the city of Nanjing as an example, this study selected four urban forests on the horizontal gradient which included Mochou lake park, Yuhua terrace park, General mountain scenic spot and Jiangsu academy of forestry, and chose three urban forests on the vertical gradient which included Zhongshan botanical garden, White horse Park and observatory in the Zijin in May, July, August of 2015. In order to make a positive contribution of effectively controlling urban atmospheric PM2.5 pollution, the leaves of 10 tree species respectively collected, and measuring the contribution values of PM2.5 in different typical greening tree species through aerosol generation system. The results showed that absorbing abilities of PM2.5 in each plant of different horizontal gradient environment have certain differences. According to the contribution values of adsorbing PM2.5, the better species in this study orderly were *Cedrus deodara*, *Sabina chinensis*, *Photinia serrulata* and *Magnolia grandiflora*, which should be popularized and applied on the future urban tree species configuration.

Key words: Urban forest, PM2.5, Tree species, Leaves, Absorbing value

32. Studies on PM2.5 concentrations dynamics of typical urban forest in the southern suburb of Nanjing

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Abstract: In order to provide a scientific basis for building the type of dust detention urban forest in the future, the data of PM2.5 concentration from June 2014 to May 2015 were analyzed, the daily, monthly and quarterly variation of PM2.5 concentrations in this urban forest were studied based on the platform of forest health environmental monitoring system in Jiangsu academy of forestry. The results showed that the diurnal variation of PM2.5 concentration in urban forest had an undulate variation characteristics, presented two peaks and two low peaks. A peak appeared in 9-10 am, another peak appeared at night of 22-23. The average concentration of PM2.5 from June 2014 to May 2015 in the urban forest appeared two peaks, in which the highest concentration of PM2.5 was in March 2015, at 100.32 ug/m³, the lowest average concentration of PM2.5 in August 2014, at 40.21 ug/m³. According to seasons, the seasonal variation characteristics of PM2.5 concentration were that the highest PM2.5 concentration was in spring and the lowest was summer.

Key words: Urban forest, PM2.5, Variation dynamics

33. Study advances on the effects of urban forests on particulate matter

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Abstract: Haze phenomena is getting much more serious throughout China recently, especially in northern industry city like Harbin, and has given severe impacts on human life and health. This

paper summarized the effects of urban forests on particulate matter (PM_x), which are the main ingredients of haze, from macroscopic scale to microscopic view, including the time and space distribution of PM_x in different districts, the change of PM_x concentration in and out of the urban forests or other vegetation; the main compositions and characteristics of PM_x, the source apportionment and the interception/deposition or other reduction effects of urban forests and so on, cases studies in Harbin were included. The research methods include Cartography, Geographic Information System, Mathematical Statistics, Model Simulation; physical methods like washing leaves and weighing dusts, different source apportionment analysis tools, modern biology technique and so on. Besides, the climate change is important for PM_x transmission path and concentration change and urban forests are related to precipitation and temperature, so this paper involves the effects of meteorology factors to PM_x. To sum up, in the urbanization course, rational utilization of urban forests and maintaining ecological balance is benefit for reducing particulate matter harm and improve the environment.

Key words: Urban forests, Particulate matter, Time and space distribution, Source apportionment, Climate change

34. Study on accumulation characteristics of *Populus tomentosa* to heavy metals

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Abstract: This study takes the *Populus tomentosa* forest belt besides Beijing Capital Airport Expressway, the enrichment and distribution of Pb, Cd, Cr, Cu, Mn, Ni, Pb and Zn in trees were analyzed. The study results showed that: The heavy metal concentration in tree organs are: Zn> Mn> Cu (Cr)> Pb> Ni> Cd. The concentrations of the same heavy metal element are different among various organs, Cu, Mn, Ni and Pb are highest in the leaves of *Populus tomentosa*, the concentration of Zn is highest in the bark, Cd and Cr are highest in the branch and root respectively. The heavy metal accumulation in various organs depend not only on biomass, but on the concentration, the accumulation of Cd, Cr and Ni elements are all highest in the trunk, while Cu, Mn, Pb and Zn elements are in the branch. From the heavy metal accumulation of individual plant, each element in a descending order as: Zn>Mn>Cr>Cu>Ni>Pb>Cd. The percentage of the amount of heavy metals in fallen leaves to that in the whole tree before leaves fallen is: Mn>Ni>Pb>Zn>Cu>Cd>Cr, which illustrates that the *Populus tomentosa* has a relatively strong purification ability against Mn and Ni elements and a relatively weak purification ability against Cd and Cr elements. In all organs, the cutting strunk measure led to the increase of Mn concentration. In the root, stem and bark, the concentrations of Zn and Cu in cutting-off plant are higher than not cutting-off plants. In the leave and branch, the concentrations of Cu and Zn in cutting-off plant are lower than not cutting-off plant.

Key words: *Populus tomentosa*, Heavy metals, Element enrichment

35. Study on carbon storage of poplar plantation at different stand ages

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Abstract: In this paper, biomass has been estimated and carbon storage and soil organic carbon of poplar stands at ages of 4, 8, 12, 15 and 20 years-old have been studied, based on the survey of sample plots in Dongtai poplar plantation, Jiangsu. The methods of allometric growth function and

sampling harvest were used to investigate the biomass of tree layer, underground vegetation layer and forest floor. As the results showed, with the stand ages increased, the total carbon storage in the five stands increased as well. Besides, the spatial carbon storage distributed as the following, that of soil layer ($130.87 \text{ t}\cdot\text{hm}^{-2}$)> tree layer ($56.32 \text{ t}\cdot\text{hm}^{-2}$)> forest floor($1.2 \text{ t}\cdot\text{hm}^{-2}$)> underground vegetation layer($0.37 \text{ t}\cdot\text{hm}^{-2}$). The dynamic trend of carbon storage of underground vegetation layer and forest floor in different stages enhanced first and then decreased. In different stands, carbon concentration increased first and then decreased. Our study suggested that poplar plantation had a huge potential for carbon sequestration and that the differences in carbon storage of poplar plantation at different stand ages were mainly caused by the differences in carbon storage of tree layer.

Key words: poplar, plantation, stand age, carbon storage, organ

36. Study on human comfort and microclimate of small urban forests in Beijing in summer

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Abstract: To study the meteorological condition and the effects on human comfort of small urban forests during hot period in summer in Beijing, 5 approximate 2000 m² urban forests similar in structure were selected. Wind speed, air temperature and air humidity were observed in every plot during hot period (10:00-14:00) in summer. 1) In the horizontal direction, the small urban forests could decrease air temperature by 0.32°C-2.67°C with an average of 1.67°C, and increase humidity by 1.29%-8.1% with an average of 4.54%. The human comfort index was in a range of 43.73-58.97 in and out of the plots which was comfortable for people. 2) In the vertical direction, the air temperature increased at first then decreased with the height rose, while the humidity was on the contrary. The wind speed decreased with the height rose. The human comfort index was lowest at 1.5m. Small urban forests have certain effect on decreasing air temperature and increasing comfort for people. Management of small urban forests should be paid more attention on in big city with large green area disappearing.

Key words: Small urban forests, Microclimate, Human comfort

37. Study on relationships between the factors reflecting ecological and healthy functions in urban forests

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Abstract: It is significant to understand the relationships between ecological and healthy effects of urban forest. A study monitored the variations of atmospheric masters (TSP, PM10, PM2.5, PM1), microclimate, BVOCs, air negative ions and the relative content of oxygen in typical urban forests of Hui Mountain in Wuxi City during the day time (5:00 am – 19:00 pm) in autumn and winter, 2011 and in spring and summer, 2012. By path analysis, it was found that there were close relationships between the five kinds of ecological and healthy factors within the urban forests. The dominant factors that limiting concentration of negative aero ion was PM10, whereas the stimulatives were cation and TSP. The promoting effects were obvious between TSP and PM10, or PM10 and PM2.5. Temperature was the dominant factor in promoting oxygen content. The small particulate matter, negative aero ion and oxygen content could be enhanced by VOCs.

Key words: Urban forests, Ecological and healthy function, Relationship, Path analysis

38. The color quantization for the fall scenic forest of Jinsi Canyon National Forest Park in Shanxi province

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Abstract: The study analyzes the color quantization for the landscape of the fall scenic forest which located in Jinsi canyon national forest park by using the methods of Community Survey, SBE and color quantization. The results indicate that: 1) In the low altitude region, the values of the species richness index R, the species diversity index H and the species evenness index E are higher than in the high altitude region, there are more species of deciduous trees and the range of deciduous trees distribution are also wider. 2) The main colors of deciduous trees are including yellow and yellow-orange. The color composition of community landscape are including red, red-yellow, yellow-green, green and red-purple. The number of colors is influenced by altitude. 3) When the main color patches of the community are including yellow-brown, yellow-green and red-brown, comparing with the total color area of the community, the proportion of the three color patch is 10.88%, 9.33% and 8.75%, the total ratio of the three color patch is 28.97%, the value of scenic beauty is highest. When the main color patches of the community are including yellow-brown, yellow-green, brown, the proportion of the three color patch is 5.87%, 5.82% and 5.3%, the total ratio of the three color patch is 16.99%, the value of scenic beauty is lowest.

Key words: Scenic forest, Scenic beauty assessment, Color quantization, Jinsi Canyon, ShanXi

39. The contribution of urban forests in achieving Sustainable Development Goals

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Abstract: This year, the United Nations established and launched Sustainable Development Goals (SDGs) as a development agenda for next 15 years. SDGs have 17 goals with 169 targets, continue efforts from MDGs on ending poverty and hunger, improving health and education, but also promoting economic growth and resolving environmental problems with support from society and concrete governance. As more than half of the world's population lives in urbanized area, Goal 11 aims to make cities safe, resilient and sustainable for all people. Urban forestry and green infrastructure can contribute not only SDG Goal 11, but also number of other goals to eradicate hunger, enhance human health and well-being, and improve environmental quality and economics. We are going to state contribution of urban forestry to nine SDGs and with case studies. As for implementation, we state roles and possible collaboration between international organizations such as FAO, national and municipal governments, civil society, private sector, and urban forestry practitioners. Case studies and implementation are mostly focused in Asia-Pacific region, where 53% of the world's urban population live, and the biggest contribution to world urban growth.

Key words: Urban forestry, Green infrastructure, SDGs, Means of implementation, Resilient cities

40. The environmental benefits and sustainability of urban forests

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Abstract: Urban forests are the main body of urban ecosystem and have self-cleaning function in urban ecological construction. Urban forests not only provide relatively clean recreation space for residents in the city, but also play an important role in improving the city environment and promoting its sustainable development. To realize the sustainable development of urban forests, it is very important to study the environmental benefits of urban forests and the effects on human activities. In the present study, the environmental benefits and ecological processes of urban forests were summarized. The sustainable characteristics of urban forests were also evaluated. Meanwhile, the evaluation criterion and future perspective of urban forests sustainability were analyzed. Based on the current urban environmental problems, the author pointed out that urban forest construction is basis and support of healthy urban ecological construction, and the sustainable construction of urban forests is an effective way to the sustainable development of urban environment and economy.

Key words: Urban forest, Environmental benefits, Sustainability, Ecological construction

41. Variation in particulates of urban forest with different habitat types in summer

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Abstract: To provide a scientific guidance for the residents having a reasonable forest recreation activities, the variation in airborne particulate matter of urban forest with different habitat types were studied. In this paper, the mass concentrations of TSP, PM₁₀, PM_{2.5}, PM₁ in urban forests with three typical habitat types as foothills, valley and ridge in Yuanshan Mountain of Shenzhen city were monitored during the whole day (24h) in the summer of 2015, and the town square was chosen as control spot, and the meteorological factors were also observed at the same time. The results showed that: (1) The daily mean concentrations of TSP or PM₁₀ were both the highest in foothills types forest (162.19 and 95.39 $\mu\text{g}\cdot\text{m}^{-3}$, respectively), and were both the lowest in ridge type forest (85.51 and 58.82 $\mu\text{g}\cdot\text{m}^{-3}$, respectively). However, PM_{2.5} or PM₁ concentrations were both the highest in valley type forest (21.76 and 8.29 $\mu\text{g}\cdot\text{m}^{-3}$, respectively), and the lowest in ridge type forest (14.29 $\mu\text{g}\cdot\text{m}^{-3}$) and control (4.4 $\mu\text{g}\cdot\text{m}^{-3}$), respectively. (3) The concentrations of four kinds of particle matters in these three forests were high in the nighttime, and low in the daytime, with the peaks usually appeared at 1:00-5:00, and the vales around 11:00-15:00. (4) The concentrations of air particulates were highly correlated with temperature, relative humidity and average wind speed in each forest. Habitat types could have significant effects on the variations of concentrations of air particulates in urban forest. Moreover, it was more suitable for Shenzhen residents to conduct forest recreation activities at 9:00-15:00 in summer.

Key words: urban forest, habitat types, particle matter

On 6-8 April, 2016, FAO, the Urban Forestry Research Center of the State Forestry Administration of the People's Republic of China, and the city of Zhuhai, China co-organized the First Asia-Pacific Urban Forestry Meeting (APUFM) in Zhuhai, China. The meeting was attended by over 200 participants representing over 20 countries from Asia-Pacific, Europe and North America. The objectives of the meeting were to: 1) discuss the current status of UPF in the Asia-Pacific region; 2) exchange successful stories and lessons learned of urban forest management; 3) develop UPF strategies and nature-based solutions and discuss possible long-term collaboration between countries and/or cities towards a greener, healthier, and happier future.

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