Building up a Green Beijing – An ambitious urban forestry program

Metropolises such as China's Beijing play an increasingly vital role for people who have become more and more urbanized. Residents demand fresh air, clean water and green space, as well as access to energy, advanced technologies, information, and culture and business services. Citizens of Beijing, the capital of the world's second-largest economy suffer from traffic jams and congestion, air pollution, and shortages of outdoor green space, even as living conditions and access to cultural events have improved considerably. In Beijing, hundreds of skyscrapers have been constructed and millions of cars move slowly on crowded streets. The number of cars has increased from more than 3.1 million in early 2008 to almost 5.2 million in 2012. Today, urban forests and green space are very valuable to its residents and have become important indicators of the city's livability. Re-establishing urban forests and creating more green space is an urgent goal for Beijing authorities who want to improve the city's quality of life and to build a world-class city.

A "world-class city" is a high-end form of international metropolis with significant impacts on the global economy, politics and culture. In this context, afforestation and landscaping have been regarded as an integral part in the continued development of major cities in the world such as New York and London, where there are extensive urban forests in core areas (Table1). In 2009, the Beijing Municipal Government set the target of building the capital into a world-class city, in which a strategic measure is to establish large-scale forests.

Beijing is located at the northern tip of the North China Plain near the junction of the Xishan and Yanshan mountain ranges. These mountains protect the city from the northern Gobi steppes but also form a semi-circular basin to trap the city's air pollution. Severe smog problems develop in the summer months as hot and humid air prevents pollutants from leaving the basin. Smog is less severe in the fall and winter when the direction of the winds changes to bring in dry, cold air from Siberia.

The Beijing Municipality consists of six city districts, eight suburban districts, two rural counties and covers an area of 16 410km², 60% of which is farmland and sparsely populated mountains. The urban core lies on flat

Republic of China in 1949. Forest cover had been reduced to a mere 1.3%. Beijing's afforestation and greening programs developed rapidly. By the time of the 7th Beijing Forestry Inventory in 2010, forest cover had climbed to 36.7%

Table1. Urban forest cover in major world cities

City	Urban forest cover %	Climate
New York	64	Temperate marine
London	36	Temperate marine
Tokyo	37	Subtropical monsoon
Paris	25	Temperate marine
Singapore	29	Subtropical monsoon

land (elevation 20–60 metres above sea level) in the southeast and covers some 6390 km². By 2011, the population of permanent residents was over 20 million, most of them settled in the urban core, which is home to industries and services. Historically, forests were widely distributed and well preserved up to the end of the Liao and Jin Dynasties in the late 13th century. However, with the establishment of the Yuan Dynasty by Kublai Khan around 1279, forests were destroyed on a large scale to construct the capital, develop agriculture and also as a result of wars and fires. Forest conditions further deteriorated in the middle of the Ming Dynasty (16th century). Destruction continued until the founding of the People's

of the metropolitan area of the city. This cover is unevenly distributed, as plantings are mainly found in the mountainous areas while forest cover on the plain is only some 15%. To improve this figure, an ambitious program to establish urban forests has been launched through Beijing's Overall Urban Planning, Overall Land-use Planning and 12th Five-Year Plan. It is proposed that within five years (2012–2016), there will be 66 700 ha of urban forests established on the plains as a natural, harmonious and healthy forest ecosystem with numerous tree species. By October of 2012, 13 300 ha of urban forests had been established.

On the plain, urban afforestation is intended to form contiguous areas,

Fig. 1. Overall layout of urban afforestation in Beijing's plain area.

Fig. 2. Afforestation in Yanqing County (northwest of Beijing); main species are: China Spruce (*Picea meyeri* Rehd. Wilson); China pine (*Pinus tabulaeformis* Carr.); Ginkgo (*Ginkgo biloba* L.); Goldenrain tree (*Koelreuteria paniculata* Laxm.); Sophora (*Sophora japonica* L.); Ash (*Fraxinus chinensis* Roxb.); Bushclover (*Lespedeza bicolor* Turcz.); China White Poplar (*Populus tomentosa* (Carr.)); Elm (*Ulmus pumila* L.); Maple (*Acer truncatum* Bunge).

green belts and forest networks and to balance the development of forestry and protection of arable land. Through planting on land originally planned for construction, linking existing green belts, increasing density, broadening farmland shelterbelts and planting forest belts along roads and rivers, a green pattern of “Two Rings, Three Belts, Nine Wedges and Multi Corridors” (Fig. 1) will be established. The afforestation program consists of two major parts: ecological landscaping and green corridors. The former will mainly be on lands around the international airport, aviation corridors, and areas between the Olympic Forest Park and the 6th Ring Road in the north. Afforestation (creation of green corridors) will cover the Yongding, Beiyun and Chaobai riverbanks, the Beijing-Shanghai Expressway and other transportation corridors. Outside the 6th Ring Road the width of plantings will be at least 1000 m; inside the 6th Ring Road green belts will be over 500 m, while plantings along outbound trunk roads, railways and major rivers will be more than 200 m. Plantings and landscaping at points where rivers meet, access to expressways and downtown Beijing as well as other key transportation nodes will be enhanced. It is estimated that considerable benefits brought about by the program will be achieved not only in environmental aspects but also social and economic benefits. For example, the value of the forest resource will increase by US \$ 8.4 billion, its ecological service value by US \$ 6.5 billion, the annual fixation of carbon dioxide will be more than 1.2 million tons and annual retention of dust will be 620 000 tons when the program is completed.

The urban afforestation program will incorporate concepts from “close-to-nature” silviculture (Lu, 2006). Indigenous tree species that are adapted to local climates, have an ornamental value, are efficient in water use and drought tolerant, and are capable of dust retention will be planted. Close-to-nature forest landscapes with various tree species of multiple layers, colors and structures will be established to enhance biodiversity (Fig. 2).

Another feature of the afforestation program is being “close to people”. During the program, various measures such as voluntary tree-planting and buying forest carbon credits will be undertaken to encourage public participation. Farmers whose lands have been requisitioned will be subsidized US \$ 2400 to 3600/ha annually by the municipal government until 2028. The subsidy will be increased to account for inflation. Following the afforestation program, the public’s access to forests and opportunities to experience natural environments will be increased, and public awareness for protecting forests will be heightened.

However, establishing urban forests is a trade-off between afforestation and other land uses (such as agriculture and urban construction). This poses serious challenges. A certain amount of farm land will be retained within the metropolis of Beijing but the current size will be reduced. Agricultural output lost as land is converted to forests will have to be replaced by agricultural output from surrounding provinces. It is argued that it is not economically worthwhile to establish urban forests in land-scarce Beijing, as it will sacrifice benefits brought by construction (land used for

businesses or residences). However, due to the high demand for green space in the city, urban forests will be of significant environmental, social and economic benefit, which will be more than those of construction land.

Residents’ pursuit of quality of life is a driving force in the development of a city. This will require authorities to integrate the city’s green infrastructure with the development needed to meet the other objectives of its residents. Urban forests will need to integrate vertical greening, rooftop plantings, indoor greening, parks and courtyards to build Beijing into a green, harmonious and livable city.

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