EVALUATION OF ENVIRONMENTAL BENEFITS
OF URBAN FOREST IN CHINA

中国城市森林
环境效益评价

张颖◉著

中国林业出版社

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前言 >>>>>>

目前，我国城市发展进入加速期，城市化率已由1993年的28%提高到2008年的45.68%。但随着城市的发展，如何改变城市环境恶化、能源、资源环境压力加剧等问题，是我国城市化发展所必需面临和解决的主要问题。根据世界银行的统计资料，我国城市化率比世界平均水平低10个百分点，比世界发达国家平均低30个百分点。因此，我国的城市化率会进一步提高，城市环境问题也会更加突出。根据统计，全国有400座城市缺水，其中110座严重缺水，人口在100万以上的32个大城市则普遍缺水；全国城市大气污染物中粉尘和颗粒物的数量比郊区高10倍，硫化物、氮化物、碳化物等有害气体比郊区高5～20倍，一半以上城市的空气质量低于世界卫生组织的标准。2007年，全国建成区绿化覆盖率为35.3%，人均绿地面积9m^2，但不断受到城市建设的挤占。因此，城市化进程正面临人口数量不断增多、资源短缺不断扩大和环境负荷不断加重的压力，加快城市生态环境保护与建设，改善城市的生存与发展条件已成为当务之急。近10年来，城市森林在城市环境建设中的独特地位开始受到中央和地方决策者的重视，1994年国务院通过的“中国21世纪议程——中国人口、环境与发展白皮书”明确提出要强化城市的绿化、美化工作，此后通过的“21世纪议程——林业行动计划”进一步确定了“建设布局合理的城市森林环境，到2000年人均公共绿地面积达到7m^2以上，2050年达到25～50m^2”的行动目标，从而有力推动了绿化、美化城市的浪潮。越来越多的城市决策者意识到，森林在城市发展中有着重要的作用，发展城市森林不仅是一项利国

利民的重要公益事业，也是改善城市环境、提高城市身价、增强城市竞争力的有效手段。因此，开展城市森林环境的影响评价及其政策研究，对于克服日益严峻的城市生态环境、促进城市的可持续发展和实现“城市必须与森林共存”，“将森林引入城市，把城市建立在森林中”的现代化城市理念有重要的价值和意义。

2008 年，我国城市数量 655 个，比 1978 年增加 462 个，其中地级及以上城市由 1978 年的 111 个增加到 287 个。人口数量 37156 万人，比 1978 年增长 1.2 倍。全国城市行政区域土地面积 62.2 万 km^2（不包括市辖县），比 1978 年增长 2.2 倍，其中建成区面积为 2.8 万 km^2。地级及以上城市实现地区生产总值 15.70 万亿元，占全国 GDP 的 62.9%。但研究表明，我国城市森林面积按城市建成区面积计算仅为 0.95 万 km^2，蓄积量 3278.45 万 m^3，与当今世界一些发达国家 60% 以上的城市森林覆盖率相比相差甚远！

城市森林是城市生态系统的初级生产者，在改善城市生态环境质量，维护城市生态系统稳定，促进城市可持续发展中发挥着不可替代的作用。18 世纪中叶以来，工业革命促进了生产要素和社会功能在城市的集中，创造了代表人类高生产力和高度文明的城市型生产方式与生活方式，也逐步形成了具有单调性、脆弱性、依赖性特征的城市生态系统。随着世界范围内城市化进程的加快，人们在享受城市化所带来的丰富物质和精神生活的同时，却不得不面对日益严峻的生态环境，人口爆炸、能源危机、资源短缺、环境污染等引发的诸多“城市病”，并且它已成为人们普遍关注的社会性问题。自从 1965 年美国林务局率先提出城市森林发展规划以来，城市森林在世界各国迅速发展起来，先后出现了华盛顿、堪培拉、巴黎、华沙、东京、圣地亚哥、新加坡等一批绿色城市的优秀之作。城市森林已被视为现代化城市的一个重要标志，发展城市森林也是根治城市环境污染的根本之策。

本书共 11 章。前 9 章结合我国城市森林的发展情况，主要对环境影响评价的理论、方法、政策等进行了研究，并对我国城市森林的环境影响进行了评价。后 2 章主要进行了北京市、井冈山市城市森林环境影

响的具体案例研究。本书的主要内容包括：（1）城市森林环境影响评价概要：介绍了城市森林环境影响评价在城市发展中的意义、作用及城市森林环境影响评价的国内外研究情况。（2）城市森林现状调查与评价：主要对我国城市森林的面积、蓄积等进行了调查、估算。（3）城市森林环境影响识别和评价的指标体系：主要对城市森林环境影响进行了界定，并建立了评价的指标体系。（4）城市森林对经济环境的影响：主要研究了我国城市森林对林业产业产值的影响，并计算了城市森林资产的价值。（5）城市森林对生态环境的影响：这是本书的一个重点，主要计算了城市森林保护生物多样性、固定 CO_2、净化空气、对所在地局部降温、增加水量、改善水质的价值。（6）城市森林对社会环境的影响：研究了城市森林对就业机会的影响，并计算了城市森林游憩价值，科学、文化、历史价值和增加所在地商业销售额的价值。（7）城市森林对居民发展的影响：主要研究了城市森林与 GDP、恩格尔系数、居民生活环境和城市科技水平的关系，并具体计算了对居民发展的影响。（8）城市森林生态风险损失评价及其管理：主要对火灾的风险损失、森林病虫鼠害的风险损失和城市征占用林地及乱砍滥伐等损失进行了计算，并对有关风险管理进行了研究。（9）城市森林发展政策：在上述研究的基础上，主要对城市森林发展的公众教育政策、所有者政策等进行了研究。（10）北京市森林风险影响因素的分析研究：主要对北京市森林火灾、病虫鼠害、人为干扰胁迫等风险影响进行了定量研究。（11）井冈山市森林游憩价值评价研究：采用条件价值法对井冈山森林游憩价值进行了全面、系统、深入的研究。

本书内容有三个方面创新：（1）采用统计分析的方法，首次对我国城市森林面积、蓄积、覆盖率等进行了较全面的计算，即我国城市森林面积按城市行政区域土地面积计算为 162.1 万 km^2、蓄积 559 407.1 万 m^3；按城市建成区面积计算，面积为 0.95 万 km^2、蓄积为 3278.45 万 m^3；按建成区绿化覆盖面积计算，城市森林面积、蓄积分别为 1.02 万 km^2 和 3520.02 万 m^3。2007 年计算的全国城市森林平均覆盖率为 34.27%。（2）首次对我国城市森林的环境影响进行了全面、系统的评

价，即我国城市森林每年的环境影响总价值为1103.55亿元。其中，每年经济环境影响占总价值的20.37%；生态环境影响占64.79%；社会环境影响占15.98%；生态风险损失占总环境影响的-1.14%。这一研究为城市森林管理提供了依据。（3）首次对我国城市森林的生态风险损失进行了评价，并提出了加强城市森林生态风险损失的管理问题，即我国城市森林按建成区绿化覆盖面积计算，每年的火灾、病虫鼠害、城市征占用地和乱砍滥伐的风险损失为12.61亿元，其中，征占用地和乱砍滥伐的损失所占的比重最大。加强城市森林征占用地和乱砍滥伐等人为干扰胁迫等风险管理是当务之急。

在该项目研究和本书编写过程中，得到了国家统计局核算司曹克瑜处长的大力支持，也得到北京林业大学宋维明副校长、科技处张力、经济管理学院刘俊昌院长、温亚利副院长的帮助。另外，北京林业大学研究生王莉、葛廷婵、吴丽莉、杨志耕、刘丹等参与了部分数据的收集、整理和计算，经济管理学院资料室的张琳老师也给予了大力的支持，在此一并表示衷心的感谢！

千里之行，始于足下。对城市森林环境影响的研究是一个新的课题，相信本书会对科研、教学单位，尤其对从事城市森林管理的单位有一定的参考价值，也对城市管理者和政策制定者有一定的参考作用。

由于时间短，研究内容复杂，书中错误在所难免，敬请广大读者批评指正。

作者

2010.4.20

Foreword >>>>>>

At present, urban development enters the accelerated period, and the rate of urbanization has increased from 28% in 1993 to 45.68% in 2008. But with the development of the city, how to solve the problems, such as the deterioration of urban environment, the pressures of energy, resources and environment, has become the pressing issues faced and to be solved in the development of urbanization in China. According to World Bank's statistics, the rate of Chinese urbanization is 10 percentage lower than the world average and 30 percentages lower than the average in developed countries. So as the further rising in the rate of China's urbanization, the issue of city environment will become more prominent. In China, 400 cities are in the lack of water, in which 110 cities are in serious lack of water and 32 large cities with 1 million people are in general lack of water. The amount of dust and particulate matter in air pollutants in national cities is ten times larger than that in rural areas, and the number of sulfide, nitride, carbide and other harmful gases is 5 to 20 times larger than that of in rural areas. Besides, more than half of the cities' air quality is lower than the World Health Organization standards; In 2007, green coverage rate in the country's built - up area is 35.3%, and the per capita green area is only $9m^2$, but which are continuing occupied by urban constructions. Therefore, the process of urbanization is facing the issues of growing in population, shortage of resources and the stress on environmental load which make the protection and construction of urban ecological environment and improvement of living and developmental condition become the priority. Over the past 10 years, central and local decision - makers are paying more attention to the unique position of urban forest in the urban environ-

mental construction. The State Council passed in 1994, "China Agenda 21 – China's Population, Environment and Development White Paper" has clearly proposed to strengthen the work of city's greening, landscaping, and then the "Agenda 21 – Forestry Action Plan," is further defined as to construct rational layout of urban forest environment, and by 2000 the per capita public green area would be more than $7m^2$, and finally achieve the goal of 25 ~ $50m^2$ by 2050. All of the goals can help promoting greening and beautifying cities. As a result, more and more decision – makers are aware of the importance of forest in the development of cities. Developing urban forest is not only an important public welfare, but also an effective means of improving the urban environment and enhancing the urban competitiveness. Therefore, carrying out environmental impact assessment of urban forest and its policy research are important in overcoming the increasingly serious urban ecological environment problem, promoting urban sustainable development and achieving the modern urban concepts such as "urban and forest must co – exist" and "bring forest into urban and build the cities in the forest".

In 2008, the number of cities in China is 655, with an increase of 462 cities from1978. Among them, the number of cities above the prefectural level are 287 which are 111 in 1978. And the number of population is 371, 560 thousand which is 1.2 times larger than that in 1978. National urban land area is 622 thousand km^2 (excluding the counties under municipal jurisdiction) which is increased by 2.2 times from 1978, and the built – up area is 28 thousand km^2. The GDP (Gross Domestic Product) of cities above the prefectural level is 15.7 trillion yuan which account for 62.9%. But research shows that urban forest area in China which is calculated by the built – up area is 9.5 thousand km^2, and the forest stock is 32784.5 thousand m^3. All of these are far behind some developed countries which the urban forest coverage is more than 60%.

Urban forest is the primary producer in urban ecological system which plays an irreplaceable role in improving the quality of urban ecological environment, maintaining the stability of urban ecological system, and promoting urban sustainable development. Since the mid – eighteenth century, the Industrial Rev-

olution has promoted the factors of production and social function concentrated in urban, creating urban production and life style which represented human high productivity and civilization, and gradually having formed a monotonic, fragile, dependent urban ecological system. With the acceleration of urbanization process worldwide, people are enjoying rich materials and spiritual life brought about by urbanization. But people also have to face the increasingly serious ecological environment problem and many "urban illnesses" caused by population explosion, energy crisis, resource shortages, environmental pollution which have become the social issues of common concern. Since the United States Forest Service first proposed the developmental plan of urban forest in 1965, urban forest has developed rapidly in the world and has sprang up many excellent green cities, for example, Washington, Canberra, Paris, Warsaw, Tokyo, San Diego, and Singapore. Urban forest is regarded as an important sign of a modern city, and becomes the fundamental strategy in solving urban environmental pollution.

This research includes 11 chapters. The first 9 chapters mainly study the theories, methods and policies in environmental impact assessment and evaluate environmental impact of urban forest. The last 2 chapters mainly carry out the case studies about the environmental impact of urban forest in Beijing and Jinggangshan. The research includes: (1) Summary of environmental impact assessment of urban forest, introducing the significance, function and the research situations at home and abroad of environmental impact assessment of urban forest. (2) Survey and Evaluation of urban forest. It mainly investigats and estimates the area and growing stock of urban forest in China. (3) Index system of urban forest environmental impact identification and evaluation. The urban forest environment and the index system are defined and established. (4) Urban forest impact on the economic environment. It studies urban forest impact on the output of forestry industry and calculates the value of urban forest assets. (5) Urban forest impact on ecological environment. This is a key point of this study. It calculates the value of the urban forest in conserving biological diversity, fixing CO_2, purifying the air, cooling the urban, increasing the amount of water, and improving the quality of water. (6) Urban forest impact on the social environment. It researches the urban forest effects on

employment opportunities, and calculates the value of urban forest recreation, science, culture and history and increased local commercial sales. (7) Urban forest impact on residents' development. The study shows the relationship between the urban forest and GDP, Engel's coefficient, the residents living environment and the level of urban technology. It specifically calculates the impact on the residents' development. (8) Evaluating the loss of urban forest ecological risk and its management. It calculates the risky loss of fire, forest insect pest and rat damage and expropriated urban forest land and deforestation, and then studies the relevant risky management. (9) Policies of Urban forest development. Based on the above studies, it also made research on public education policies and owners' policies of urban forest development. (10) Analyzing Beijing forest's risky factors. It focuses on doing quantitative researches of risky factors in forest fire, forest insect pest and rat disease, human interference, and so on. (11) Study on the value of forest recreation in Jinggangshan, conducting the comprehensive, systematic and in-depth study on Jinggangshan's forest recreational value, with the method of Contingent Valuation.

There are 3 innovations: (1) It has comprehensively calculated urban forest area, stock and coverage with the method of statistical analysis for the first time in China. Urban forest area in China is 1.621million km^2, and stock is 5.5594 billion m^3 which are calculated by the urban land area. If they were calculated by urban built-up area, the area is 9500 km^2, and the stock is 32.7845 million m^3. The urban forest areas is 10200 km^2 and the stock is 35.20 million m^3 which are calculated by built-up greening coverage area. It has also calculated the average urban forest coverage in China as 34.27% in 2007. (2) Comprehensive and systematic evaluation on the environmental impact of Chinese urban forest for the first time. The total valuation on environmental impact of urban forest is 110.355 billion RMB yuan per year. Among them, the valuation of annual economic impact accounts for 20.37%, the valuation of ecological environmental impact accounts for 64.79% and social environmentaleffects accounts for 15.98%; Ecological risky loss accounts for -1.14% of environmental impact. These studies provide a basis for urban forest management. (3) Evaluating and strengthening the management of the

ecological risky loss of Chinese urban forest for the first time. It has calculated built – up area green coverage, the risky loss of annual fires, pests and rodents, expropriated urban forest land and deforestation as 1.261 billion yuan. Among them, the loss of expropriated urban forest land and deforestation accounts for the largest share. As a result, reinforcing the risky management in expropriated urban forest land and deforestation has become a priority.

During the research, precious support has been got from Mr. Cao keyu who is the director of National Bureau of Accounting Division, and great help from vice President Song weiming, deputy director of Science and Technology Agency Zhang Li, dean of economics and management Liu Junchang, assistant dean Wen Yali in Beijing Forest University. What's more, graduate students Wang Li, Ge Tingchan, Wu Lili, Yang Zhigeng, Liu Dan in Beijing Forest University have collected, sorted out and calculated part of data, and Zhang Lin in reference room of School of economics and management has provided great support too.

A journey of a thousand miles starts with a first step. The study on the urban forest environmental impact is still a new issue. We believe that the research would have reference value for related research and teaching units, especially for those who engage in the management of urban forest, including urban managers and policy makers. Because of the limited time and the complexity of the research, mistakes are inevitable. The author is willing to take all the responsibility for the mistakes in the book!

Zhang Ying
April 20, 2010

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