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Wetland Restoration

Shanghai Dalian Lake Project



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Foreword

I am glad to know the book titled *Wetland Restoration—Shanghai Dalian Lake Project* would be published very soon. Dalian Lake restoration project is a water source rehabilitation demonstration project launched by our cooperative partner, World Wide Fund for Nature (WWF), under the support of the HSBC Climate Partnership program; in view of the concerns about the drinking water safety of the megalopolis of Shanghai, the project was launched for trying to solve the agricultural nonpoint source of pollution and domestic community pollution in the water source area.

As the sponsor of the project, I was lucky to make a personal survey on the project in the field of Dalian Lake, and I am impressed by it: after rehabilitation, the wetland has not only acquired a beautiful environment but also a clean water source; the local communities participated in the water source area protection by launching organic agriculture, which realized the win-win situation of water source protection and economic benefit. Such a “1 + 1 partner in water source area” mode, namely the mode that attracts and absorbs the local communities, government, experts, NGOs, and enterprises, is very worthy of popularization for wetland rehabilitation, popularization for organic agriculture, and urban water source purification.

I am also glad to know that the project had won multiple honors after it was implemented successfully, such as “The first Occasion of Shanghai Award for Protection of Mother River,” “Excellent Proposal Award of Shanghai Municipal CPPCC,” and “Best Project of the first Occasion of Foundation for Guangcai Program.” I think this is the affirmation of the government and all circles in the society for the achievements of the Dalian Lake project.

In June 2012, HSBC launched a new round of the 5-year-term HSBC Water Resource Program with WWF and other cooperative partners, aiming to jointly boost the protection, preservation, and sustainable utilization of the water resources in the middle and lower reaches of the Yangtze River. We believe that the future of the Yangtze River basin is very important to the economic growth of China. By being established in the enterprise’s sustainable development, HSBC is willing to boost the harmonious and healthy development of economy, community, and enterprise with our cooperative partner WWF through species protection, wetland

restoration, enterprise participation in water management, environment-friendly fishery industry, and integrated watershed management and then finally help out with the green transformation of the Yangtze River basin.

To invest in water is to invest in future. I sincerely express my best wishes for the publishing of the book.

HSBC Bank (China) Company Limited
Shanghai, China
October 2013

Bijuan Huang

Preface

After the Jiangsu Jiangyan Qin Lake “Wetland Forum” conference was convened in April 2008, Dr. Wang Limin, the deputy director of the World Wide Fund for Nature (WWF) China Programme Implementation and the director of World Wide Fund for Nature (WWF) Shanghai Programme Office, came to my laboratory in Nanjing University for visiting and communication. Dr. Wang was impressed on the achievements of the wetland restoration engineering completed by the ecology department of Nanjing University; after that, Dr. Wang invited me and my wetland restoration engineering team to go to the Shanghai Dianshan Lake for conducting a similar scientific research work so as to finally make a contribution to the protection of the water source area of Huangpu River in Shanghai City.

With the support of the HSBC Climate Partnership China Programme, the wetland restoration engineering team of Nanjing University conducted a systematic and detailed survey with regard to the ecological environment, social economy, and natural geography of the Shanghai Dalian Lake and the area where the program will be launched in July 2008 and its surrounding area and prepared the *Feasibility Study Report on Science & Technology Demonstration Programme for Shanghai Dalian Lake Wetland Restoration*. On this basis, with the full support of the Shanghai Lake Construction and Development Co., Ltd. (formerly Shanghai Dianshan Lake Development Co., Ltd.), and the Shanghai Administration for Afforestation and City Appearance, the wetland restoration engineering team of Nanjing University completed the *Protection Planning for Wetland Restoration and Water Source Area in Shanghai Dalian Lake* (2,000 mu¹), *Construction Scheme Design for Shanghai Dalian Lake Wetland Restoration* (625 mu), and *Shanghai Dalian Lake Wetland Restoration Engineering Based on Community Participation* (150 mu), among which the first two were sponsored by the Shanghai Municipal Development & Reform Commission and were almost completed and the last one was sponsored by WWF, which is the first “tough” subject in the field of engineering in the sponsorship history of WWF.

¹ 1 mu = 667 m².

With the active collaboration and assistance of the relevant departments of the Shanghai Municipality and the Qingpu District Government and its related organizations, the 150 mu wetland restoration engineering has achieved satisfactory results. The acceptance and summary conference was convened in September 2010. At that time, the Water Source Area Forum was held in the WWF exhibition hall of Shanghai Expo, which was highly acclaimed by the leaders and experts of State Forestry Administration, State Water Resources Administration, Ministry of Environmental Protection, and relevant departments of the Shanghai Municipal Government. The senior experts of WWF International, WWF Britain, WWF China, HSBC, and the external senior assessment experts were invited to visit the construction field and conduct field monitoring during the construction period; after analyzing the reports, all experts highly commented on the project and recognized it as a leading example in the world for the ecological rehabilitation of water source areas in megalopolises, having far-reaching significance.

This book is compiled on the basis of the above projects. It provides a detailed description for every stage of the wetland restoration project, including the wetland background investigation, overall planning of wetland rehabilitation, detailed design, project construction, tracking, monitoring, and assessment of engineering results. Upon the living example of the Shanghai Dalian Lake Wetland restoration project, the book furnishes firsthand data for the wetland restoration project construction and provides a complete and integral description for the overall implementation process of the wetland restoration project. This book can be used as a reference for similar wetland restoration projects in future.

Nanjing, China
December 2013

Shuqing An

Acknowledgments

The integration of the wisdom of the Shanghai Huangpu River water source area protection team and the selfless dedication of all partners has made possible the publishing of the book *Wetland Restoration: Shanghai Dalian Lake Project*. I highly and sincerely appreciate and would like to thank all institutions and individuals that supported the program on behalf of all team members.

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Part I
Project Implementation Background

Chapter 1

Locational Features of Dalian Lake

1.1 Geographical Location

Dalian Lake wetland restoration zone is situated in the south of Lanlu Port, 3.5 km in the southwest of downstream zone of Dianshan Lake, Qingpu District, Shanghai City, with the total land of 14.6 km² and the core area of 4.6 km² (Fig. 1.1). There are nine natural villages of two towns, namely Jinze Town and Zhujiajiao Town in the wetland restoration zone, where the total population is 7,504 (2,650 households). Dalian Lake District is 58 km away from Shanghai People's Square and Hu-Qing-Ping Highway run through the zone to offer a convenient and quick transport (Fig. 1.2). Water from Dianshan Lake, getting through Xietang (Lanlu Port), converges with Yuanxiejing and Damao Port in Songjiang River, all three of them constitute Huangpu River; the Lanlu port runs through the whole region of Dalian Lake Zone. According to *Regulations of Shanghai Municipality for Preservations on Upstream Water Sources of Huangpu River*, the zone is an important water source protection zone of Shanghai Municipality, and its local ecological conditions have important strategic significance for Shanghai's sustainable development.

The water source area of Dalian Lake is an integral part of Dianshan Lake water system; where the latter is an alternately inflow-outflow lake in Tai Lake Zone, with the water area of 62 km², average water depth 2.1 m and maximum water depth 3.6 m. Dianshan Lake receives mainly the water from Tai Lake; where the water from Tai Lake flows into Dianshan Lake via Jishui Port, Dazhushe and other harbours from Northwest to Southeast, and then discharges into Huangpu River through Lanlu Port, Dianpu River and other rivers; generally it dwells about 29 days; the Tai Lake water is about 17 % of total water yield of Huangpu River and is one of main water sources of Shanghai Municipality (Fig. 1.3). The water from Dianshan Lake flows gently, with a flow speed of 0.03 m/s approximately; Jishui Port and Dazhushe are the main water intakes of Dianshan Lake, with the water yield of 35 % and 33 % of the total water inflows respectively; Lanlu Port is the main water outlet of Dianshan Lake, and its water yield is 71 % of the total water output. Dianshan Lake is a tidal lake, its water level and water yield are not only



Fig. 1.1 Location of Dalian Lake

affected by upstream water, but also by the tidal level of Huangpu River. Dianshan Lake is not only the drinking water source of Shanghai people, but also plays the role in transportation, agricultural farm irrigation, aquaculture, impounding control and flood discharge and so on.

1.2 Natural Conditions

The water source area of Dalian Lake includes the fresh water lake, marsh, river network, shallow pond, fishpond and waterborne forest. The water source area has the dense water networks and its water area is 55.7 % of the total planned area. In this zone there is the largest *taxodium ascendens* forest; it is the largest one existing in



Fig. 1.2 Tai Lake water system

Shanghai area currently; the *taxodium ascendens* forest covers a land of 83 mu and has almost 8,000 trees; and each of them grows tall and well. There is relatively small population in water source area of Dalian Lake, where the population per square kilometer is 520, which is one sixth of the average population of Shanghai City, and the per capita arable land is 1.21 mu, which is four times of that of farmers of Shanghai City. Dianshan Lake area in which the water source area of Dalian Lake is located has about 80 % of the wetland biological species of the fresh lake of Shanghai City. Due to the local biological resources are quite rich and the biological diversity is at a high level, the Dianshan lake area is always regarded as one of few rare wildlife habitats in Shanghai Area. The water source area of Dalian Lake is the land of Shanghai City for verdurization and is reserved the basic nature of the farm land.

Dalian Lake belongs to the Dianshan Lake water system; its natural conditions are basically consistent with that of Dianshan Lake. Dalian Lake looks like a calabash and covers a land of 4.6 km², where the perennial average water depth is about 2 m. Dalian Lake connects with Lanlu Port; in ancient times it was a land.

Dalian Lake area belongs to the North Asian tropical monsoons climate; where it is mild, moist and there are four distinct seasons, sufficient sunlight, rich rainfall and long frost-free period. The yearly average sunshine duration of the lake zone is 1,930 h,



Fig. 1.3 Shanghai water source protection zone

and the yearly sunshine percentage is 44 %. The time to have the maximum sunshine duration is August, where it is 237 h averagely and its sunshine percentage is 58 %; among the whole winter, the time to have the minimal sunshine duration is February, where it is 112 h averagely and its sunshine percentage is 36 %. According to the record, the sunshine duration in the year of 1967 was 2,277 h, and it was the year having the maximum sunshine duration in past 50 years; the sunshine duration in the year of 1948 was 1,459 h, and it was the year having the minimal sunshine duration in past 50 years; the difference between both of them is 818 h.

The yearly average temperature of Dalian Lake is 15.8 °C; January is the coldest time and the monthly average temperature is 3.6 °C; the extreme minimal temperature (On January 19, 1893) was -12.1 °C; the hottest month is July and the monthly average temperature is 27.8 °C; the extreme hottest temperature was 40.2 °C (on July 12, 1934).

The annual mean rainfall in Dalian Lake area is 1,149 mm; the rainfall in the period from May to September is generally over 100 mm/month; the time to occur

the maximum rainfall is June and it is 174 mm/month averagely; the time to occur the minimal rainfall is December and it is 37.5 mm/month averagely. In 1985, a year in which the maximum rainfall occurred, the rainfall was 1,673 mm; in 1982, a year in which the minimal rainfall occurred, the rainfall was 709.2 mm. There are 132 yearly mean rainfall days locally.

For Dalian Lake area, the S-oriented wind prevails in summer; in the period from June to August, the wind direction frequency is 53 %; the N-oriented wind prevails in winter; in the period from December to February of next year, the wind direction frequency is 54 %; the spring and the autumn are the two seasons in which the south and the north wind alternates; in spring the E-SE wind prevails; but in autumn the E-NE wind prevails; the average wind speed is 3.1 m/s.

In Dalian Lake area, the yearly mean frosty days are 37.8 days; where the time to occur the frost is in the middle 10 days of November averagely; the time on which the frost ends is in the last 10 days of March of next year averagely; the time to occur the frost at the earliest was October 22, 1979; the time on which the latest frost occurred was April 23, 1959; the mean period between the earliest frost day and the latest frost day is 126 days. In a whole year, the month in which the frost day occurs maximally is January and it is 11 days averagely; following it is December and it is 10.3 days averagely; in February and March, the average frosty days are 4–8 days.

In the period from 1875 to 1990, there were totally 300 typhoons happened in Dalian Lake area; its yearly mean typhoon frequency was 2.6; the maximum typhoon frequency was 7 and the minimal typhoon frequency was 0; among which the typhoon being accompanied with the high wind over 10 scale and the typhoon being accompanied with the rainstorm was respectively 21 and 24 % of the total frequencies. Generally the typhoon occurs in the period from May to November; among which it happens maximally in July, August and September, which is 83–89 % of a whole year. In August the typhoon happens maximally, which accounts for 36–39 % of a whole year. Averagely the influence caused by a typhoon lasts for 2.6 days, 8 days maximally and 1 day minimally; over half typhoons last for 1–2 days and the typhoon lasting for 5 days or more accounts for 11 %.

The cold wave occurs 3.5 frequencies averagely in a year in Dalian Lake water area; it occurs frequency up to eight times, at least for 0. The maximum cold wave occurred in 1960s, where it occurred frequency is 4.9 times per year on average, in 1970s, it occurred frequency is 3.1 times per year on average; in 1980s, it occurred minimally and the average frequency was 2.4. The earliest cold wave occurs in the third 10 days of October and the latest one occurs in the middle 10 days of April; the cold wave occurs maximally in March, following it is December.

Influence of Dalian Lake water area cyclone occurrence frequency is 33.1 times per year on average, up to 44, at least for 21 times. Normally the cyclone occurs in May and June maximally; in summer it reduces gradually and becomes minimal in August; among which the cyclone that may develop is 34 %. In a year the cyclone rainstorm occurs frequency is 2.5 times, the large rainstorm with the rainfall over 100 mm is 12 %; most of the cyclone rainstorm are the partial rainstorms, and the

cyclone rainstorm occurs maximally in June; and the large rainstorm occurs in June mainly too; averagely there is a typhoon rainstorm in a year; in the maximum year, the typhoon rainstorm occurs frequency four times; but in the minimal year, it occurs never.

The yearly mean high water level of Dalian Lake is 2.68 m, the yearly mean low water level is 2.03 m; the historical highest water level is 4.04 m, which occurred on July 2, 1999; the historical minimal water level is 1.04 m, which occurred on January 9, 1956 (Data source: Maodian Station).

In accordance with the data of Qingpu Sub-centre (Qingpu District Hydrology Survey Team) of Shanghai Water Environmental Monitoring Center in the year of 2005, the ammonia nitrogen, total phosphor, chemical oxygen demand and other indexes of Dalian Lake water area, in view of the evaluation based on *Environmental Quality Standard for Surface Water (GB3838-2002)*, are mainly centralized in Category V and inferior Category V; where the integrated evaluation of water quality is Category III–V. Among which the water quality of Taipu River and Lanlu Port belongs to Category III basically; the stage performance is Category II; the index of total phosphor and total nitrogen of Dianshan Lake zone belongs to interior Category V basically. The water quality in the west region of Qingpu is better than that of the water in its middle region and eastern region; and the water quality in the non-flood season is roughly better than the one in the flood season.

1.3 Social Economic Conditions

Dalian Lake water source area involves nine natural villages of two towns (namely Jinze Town and Zhujiajiao Town); there are 7,504 populations (2,650 households) in the zone currently, and the local planning area is 14.6 km².

From Fig. 1.4 and Table 1.1, it can be seen there are large village density and population density in Dalian Lake water source area; where the population density is 514 people/km². Despite of the water factors, for instance, lakes, ponds, rivers etc., the density of population on land is 1,160 people/km²; where the per capita agricultural acreage is 0.88 mu approximately.

In view of the analysis described by Table 1.2, it can be seen the economic development level of Dalian Lake water source area is rather low comparing with the other regions of Shanghai City, and the percentage of the local three industries is inharmonious; where its regional development should focus on “the one to improve the percentage of the tertiary industry approximately, limit the secondary industry and transform the primary industry”. The ecological restoration project of Dalian Lake water source area should provide sound opportunity for the local area for adjusting its industrial structure.