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Preface

Why this book ?

Water environment and ecological risk of wetlands

It distinguishes itself mainly for two reasons:

Spatial and temporal dimension

Aim

To illustrate how solutions work out in environment science field

Readership

Not only for scientific researchers but also for decision making

Undergraduate and graduate students of multi- and interdisciplinary courses in environmental studies/sciences and course focusing on methodology

Graduate students specializing in environmental topics of their discipline

To a lesser degree, the book or the chapters of the book may be useful as a reference to students of some post-academic course or reference book for professionals in the environmental field.

Baiyangdian Wetlands known as famous "Pearl of North China" and as Beijing's "back garden" is decorated by beautiful reed marshes, lotus, wild ducks, and carp. In the contrast, its reputation is hard to live from the perspective of environmental issues. It has been intertwined with ecological and environmental accidents such as killed fish accidents and dried precipitate. The issues on ecology and environment of Baiyangdian Wetlands have attracted public concerns from worldwide experts, government and mass media. The research focused on Baiyangdian Wetlands which have been reported.

In 2000, our research team began to study environmental issues of Baiyangdian Wetlands from the scale of the Haihe River Basin. In order to fulfill the ecosystem recovery of the Haihe River Basin, the initial issue of our research is the calculation methods of eco-water demand of wetlands including the water demand of plant and soil,

which provide a technical support for ecological recovery planning of Haihe River Water Resources Commission. We proposed that wetlands ecosystem played a strategically significant role in the basin eco-system. I dived into the exploration of ecology, environmental and social factors of Wetlands Ecosystem as the consultant of the ADB technical assistance project, 'Baiyangdian Basin Ecosystem Management', from 2005 to 2006. During that time, I affirmed my contention that environmental problems affected by both natural and social factors in Baiyangdian which is a social-natural complex ecosystem. From 2006 to 2009, I had participated in the 973 project of Haihe (No.2006CB403403) and National Water Pollution Control Important Specialized in Baiyangdian Wetlands (No.2008ZX07209-009), taking Baiyangdian Wetlands as a representative unit in wetlands-watershed ecosystem by systematic research and analysis of the ecological monitoring, ecosystem health and ecological risk management. The several times of field visits were held, long-term ecological monitoring carried on, and ecological models built. At the same time, the academic exchanges with field experts in environment, ecology and water resources have been developed worldwide. We had interviewed many local experts in engineering and managing, NGOs technology executives, community leaders, green schools, and public frequent also provided us great help. In the whole term, we made attempt to optimize the theory and research methods between environmental science & engineering with sociology to identify the constructive and functional regular pattern of Baiyangdian Wetlands. Finally the main causes of environmental issues would be clear and the relations between would be told. In the end, we fully understand that the Wetlands Ecosystem protection and restoration after the strong human disturbance are enormous challenge for the management of watershed ecosystem.

Now we are very grateful to the Ministry of Science and Technology and Ministry of Environmental Protection, as well as the platform and financial support that build by the community in China and abroad for the research. We cannot keep on the long-term research and completed this book without their support.

This book is subdivided into six chapters and divisions of labor are as follows:

- Outline was designed by Liu Jingling and Yang Zhifeng.
- Preface was written by Liu Jingling.
- Chapter 1 introduced the overview of Baiyangdian Wetlands including natural and humanist condition. The major contributors are Liu Jingling, Chen Qiuying,

Zhang Lulu and Yang Tao.

- Chapter 2 investigated the spatial-temporal variation of the water quality in Baiyangdian, and the key factors affecting the water resource through employing grey clustering analysis and synthesis pollution index. In response to natural-social aspects, this article provides suggestions to ensure critical water resources and water quality for future decision-making. The major contributors are Liu Jingling, Yang Zhifeng, Su Liya, Zhang Ting and Chen Qiuying.
- In Chapter 3, the spatial-temporal changes of Baiyangdian wetlands landscape pattern from 1987 to 2007 were studied through the analysis of remote sensing images in 1987, 1999 and 2007. Variations of landscape metrics were analyzed using GIS software package. The major contributors are Liu Jingling, Zhang Ting, Liu Feng and Wang Binbin.
- In Chapter 4, organic pollution (PAHs), inorganic pollution (heavy metals) and emergingt pollution were selected as objectives, while distribution and ecological risk was analyzed and assessed in Baiyangdian Wetlands. The major contributors are Su Liya, Per Christensen Liu Jingling, Zhang Jing and Yang Yi.
- In Chapter 5, common resource management policies were researched by comparative analysis through comparing the environmental policies and practices in Denmark and China. Meanwhile, the participation was analyzed and assessed in Baiyangdian Wetlands. The major contributors are Liu Jingling, Su Liya Per Christensen, Luan Yun, Zhang Jing, Yang Yi and Chen Qiuying.
- In Chapter 6, we concluded the full research based on the Chapter 2 to 5, main conclusion and future work were proposed. The major contributors are Liu Jingling, Yang Zhifeng and Chen Qiuying.
- The draft was proofreaded by Liu Jingling, Yang Zhifeng, Zhang Lulu.

Sincerely, we are very grateful for everyone who participated in the research and achievements concise process. During the past time, our field investigations, monitoring analysis in the lab day and night, processing the data in front of the computer, and discussing and debating in the conference room earn the development of the outline, draft and revision of the book. There is fruit watered with the hard work and sweat.

There are many thanks to our friends who help us, Dr. Eskild H.Nielsen and Dr. Du Xiangyun in the University of Aalborg in Denmark, Professor James Lassoie in Cornell University in USA, and Mr. Shen Jian in China Environmental Science Press.

Remember our families' love and support forever.

We hope that this book's publication will promote scientific research of the wetlands ecosystem management, development of environmental policy and international cooperation, also attract the attention to the environmental safety and risks of Wetlands Ecosystem. If any, it will provide a new idea and innovative approaches for solving the environmental crisis and achieving the sustainable management of the wetlands.

Early spring in Beijing Lotus Home

Liu Jingling

2012(Year of the Dragon)

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Contents

Chapter 1

Introduction

1.1 Characteristics of Baiyangdian Watershed

Baiyangdian Wetlands (BYD), with an area of 366km^2 (medium-sized wetlands), being an alluvial lowland of the Yongding River and the Hutuo River, is located in Anxin Country, city of Baoding in Hebei Province of the North China Plain (Fig. 1.1), is a typical plant-dominated shallow freshwater wetlands divided into about 143 wetlands parks in North China. It is in the range of 115°38′–116°07′E and 38°43′–39°02′N. It is one of the state's key tourist areas with its rich resources of wetlands and lotus flowers. The wetlands consist of more than 100 small and shallow wetlands that are linked by numerous ditches. The water area is 366 km^2 and the catchment is 31,200 km^2. BYD is the largest freshwater wetlands in North China and the average annual runoff of water is 3.57×10^9 m^3. The major types of land uses or land covers in BYD include water, arable land, construction land, forest, grassland, and urban area.

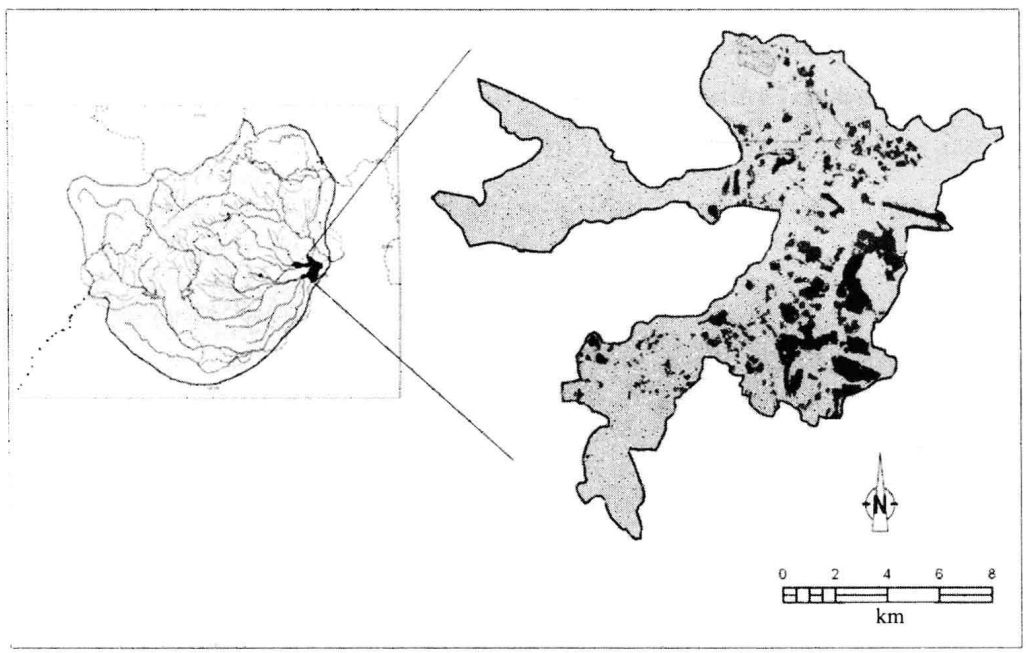

Fig. 1.1 Location of BYD in China

BYD consists of numerous wetlands connected by gullies, creating a lot of small islands where there are villages and gardens. More than 3700 ditches and reed areas divide the whole wetlands into wetlands of different sizes. The main transportation method of the

local people who live on these small islands is by boat. In recent years, climate change has played a decisive role in the process of wetlands degradation. The precipitation and water flow into BYD has decreased in recent years, causing the wetlands area and volume to continue to shrink. Human impact has also been the cause of a decrease in biodiversity. Sewage discharge, aquaculture, and industrial contamination from the nearby city Baoding have been generally acknowledged as the sources of pollution. Compared with the situation 15 years ago, nine species have disappeared from BYD, the number of natural habitats has decreased from 16 to 13, and some predominant communities with large distribution areas, such as *Hydrilla verticillata* and *Najas major*, can be found no longer. Furthermore, the decrease in water supply and increase in water consumption intensify the wetlands degradation. From 1981 to 2003, three reservoirs around BYD which were Wangkuai, Xidayang and Angezhuang transferred 5.02×10^8 m^3 water to BYD. In 2004, same project implemented in Yuecheng reservoir and Yellow River which transferred 5.02×10^8 m^3 and 1.0×10^8 m^3 water to BYD respectively.

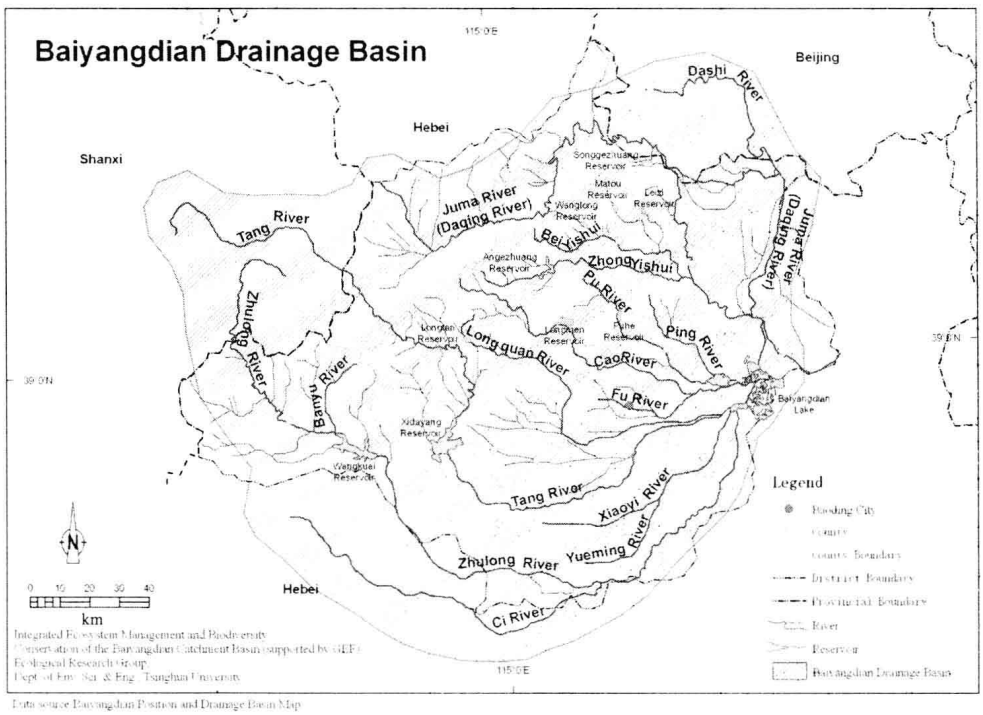

Fig. 1.2 BYD drainage watershed

1.2 Evolvement of Water Environment of BYD

BYD, the only largest freshwater body in the North China Plain, plays an important role in providing water resources, controlling floods, and regulating regional climate. BYD is of great importance with respect to drinking, fishing, tourism and energy generation. In recent decades, the aquatic environment of BYD has changed drastically and come into exacerbated trend because of domestic wastewater inputs, the influent of upstream rivers of through runoff in flood seasons, the release of endogens sediment and the pollutants of tourisms.

1.2.1 Water level and water quantity

An analysis of the historical records indicates that the water level has decreased since the 1960s. For example, the maximum water level has decreased from 11.58m to 6.82m, while the minimum water level has dropped from 6.45m to 5.50m (Table 1.1). These changes have exerted profound effects on the wetlands. It increases the frequency or severity of extremely hydrologic events. Taking the frequency of drying up as an example, there were two times in the 1960s, four times in the 1970s, five times in the 1980s, and three times during the period of 2000–2003.

Table 1.1 Variation of water level and frequency of drying up in BYD

Period	Water level/m		Drying-up frequency/times
	Max	Min	
1960s	11.58	6.21	2
1970s	10.18	6.45	4
1980s	9.40	5.50	5
1990s	9.80	6.31	1
2001-2003	6.82	5.50	3

Due to the influences of natural and anthropogenic factors, water level has been decreasing year by year. According to statistics, during 1952 to 2002, BYD even totally dried up for twenty years. At present, BYD has only one inflow river (Fu River), which taking large amount of pollutants from the city of Baoding. In addition, non-point source pollution from life of the residents, aquaculture and farmlands resulted from the villages

within the wetlands caused excessive nutrient-rich pollutants directly discharging into the wetlands, which make BYD seriously eutrophied, with severe negative effects in terms of the wetlands ecosystem health, sustainable development and management. In order to improve the health state of BYD, during Sep. 25th to Oct. 15th, 2009, about $6.00\times10^7 m^3$ water recharges into the wetlands from Fu River. The expectations are to reduce nutrient concentration and regular biological component.

These methods have their own characteristics and shortcomings, though the calculation of pollution index is simple, it divides the pollution level into different grades but un-comparable with the state water quality standards. The fuzzy mathematics, matter element analysis, artificial neural network and other methods are more scientific and reasonable on the correlation analysis and can be combined with the national standards, but the computation is quite complex and could not achieve comparison two water qualities at the same level.

There used to be 9 rivers flow into BYD, but now, only Fu River has water all year around, while the other 8 rivers dried up in different seasons. The annual precipitation is 510.1mm. In 1980s, it was continuous little rain every year and from 1997 to 2004 was another period that shows little rain (Fig. 1.3). The water flow also decreased sharply since 1996 (Fig. 1.4).After 1980s, the wetlands dried frequently. From 1980 to 1990, it dried for 5 years which was the longest time dried up in the history. Shortage of water resource, water pollution and degrade of the ecosystem make water environmental problems in BYD become more and more serious.

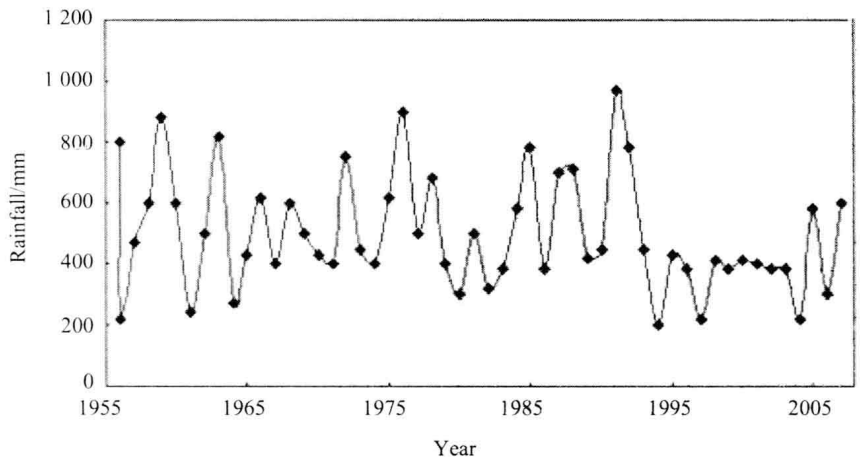

Fig. 1.3 Rainfalls from 1956 to 2007 of BYD