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Guangwei Huang
Zhenjiang Shen *Editors*

Urban Planning and Water-related Disaster Management

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Preface

Urbanization has been accelerating worldwide in recent decades. Today, more than half of the world's population lives in urban areas. The continuing trend of urbanization and population growth is projected to add 2.5 billion people to the urban population by 2050, making the proportion of the world's population residing in urban areas reach 66%. Besides, nearly 90% of the increase will take place in Asia and Africa. Nevertheless, the question "urbanization for what?" has been insufficiently addressed and inadequately explored. As a result, rapid and unplanned urban growth threatens sustainable development when the necessary infrastructure is not developed or when policies are not implemented to ensure that environment conservation is given top priority. A typical example is flood disaster, which has shifted from a rural phenomenon to a predominantly urban suffering. It has been well documented that urbanization increases peak flow and shortens its arrival time. So, it is ironic that city dwellers live with higher flood risk due to urban development which is supposed to bring better life to them. In addition to elevating flood risk, urbanization also impacts the health of aquatic ecosystems in many different ways.

To overcome various urbanization-induced problems and connect the urbanization process to the three pillars of sustainable development – economic development, social development, and environmental protection – new ways of thinking and new approaches are indispensible. Spatial planning is one of the promising methods, which can be employed by the public and private sectors to influence the distribution of people and activities in spaces of various scales with various considerations on environment protection, the safety of residents, and the conservation of cultural diversity as well.

This book is one in a series of books focusing on the relationship between spatial planning and sustainable development. It brings together expertises on various aspects of urban water management from different regions. It is aimed at promoting more in-depth dialogues between water researchers and urban planners and serving as a catalyst for innovative research in the arena of sustainable urban water management.

Tokyo, Japan Guangwei Huang

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Chapter 1
Overview of Urban Planning and Water-Related Disaster Management

Guangwei Huang, Zhenjiang Shen, and Rifai Mardin

Abstract The most important message delivered by this book is that water management is multifaceted and the approaches to deal with water-related issues are diverse so that wise water governance including the incorporation of wise water management into urban planning should be pursued in order to achieve an integrated solution for sustainability. The emphasis of the discussions in this book, includes (1) disaster and urbanization; (2) monitoring and simulation of water-related disaster; (3) integrating urban planning and water-related disaster management using shared indicators. In planning process, it is helpful to employ shared indicators for cooperative design in order to integrate the requirements from both planning site and disaster management site.

Keywords Integration · Monitoring · Shared indicators · Cooperative design · Flood disaster

1.1 Introduction

Disasters affecting human society often classified into two main categories: (1) nature-caused disasters such as earthquakes and volcanic eruptions; (2) human-induced disasters such as water and air pollution. In this book, water-related disaster as one the highest threat to human society will be discussed from the views of nature-caused and human-induced disasters due to urbanization, which consist of floods, wave and surges (tsunami), slides, drought, epidemics and extreme storms or windstorm. We mainly focus on the flood hazards, the most anticipated disaster from the group of water-related disasters.

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Flood disaster become one of the prime disaster threat, especially in urban area. Population growth and urbanization are the two primary drivers of the increasing of flood risk in urbanized countries. As many Asian cities have been increasingly urbanized, the changes in land-use associated with urban development have affected surface water runoff and rivers flood regimes in many ways. Thereby, flood disaster is natural disaster while increasing due to rapid urbanization. Having highest tension by providing a better urban arrangement to minimize the water-related disaster, the urban planning is required to contribute to flood mitigation (Howe and White 2004; White and Richards 2007). The reason is that urban planning can influence the incidence of flooding and its consequential damage through regulating the activity locations, types of land-use, scales of development, and designs of physical structures (Neuvel and Van Der Knaap 2010; White and Richards 2007). However, the practical obstacles are impeding the integration of urban planning with disaster risk management due to the diverse causes. Therefore, the attempt of the authors in this book is to integrate water management and urban planning in order to decrease the happening of water-related disasters.

1.1.1 Flood Disasters

Human beings have been dealing with both floods and flooding for millennia. In ancient times, flooding was mainly a natural hazard in the sense that humans could not interfere in river dynamism. Despite the negative impacts of flooding, agriculture in ancient times largely depended upon flooding since floods deposited nutrients and made soils more fertile, this makes humans chosen to live close to waterways defying the danger for convenience. According to historical records, there were 1.092 great floods disasters counted from 206 BC to 1949 in China, equating to one every 2 years on average over the 2155-year period, and the Yellow River breached 1593 times during the period from 602 BC to 1938 AD (Huang 2014).

As previously mentioned, there are several types of water-related disasters, which are flood, wave and surges (including Tsunami), slides, drought, epidemics and extreme storms or windstorm (Yoganath Adikari and Yoshitani 2009; Asian Development Bank 2015). These disasters are water-related disaster that threaten people or economic goods. The impact of the water-related disaster is profound, since in top 10 countries with highest disasters events throughout 2016, the 69 disasters (or more than 47%) among the recorded 146 disaster cases were caused by hydrological or water-related disaster alone (Guha-sapir et al. 2017). Referring to world data of human impact by disaster type from 2005 to 2015, the number of death and casualties are 99,197, and 271,822,414. In total, 271,921,611 peoples were affected (UNISDR 2016). Based on this data, the majority of casualties came from flood disaster is 41.43% and followed by drought 31.62% and earthquake and Tsunami (5.74%). The data is parallel with the number of disasters occurrences.

Among the total 713 cases, flood disasters contribute 324 times (45.3%), followed by drought 47 times (6.59% and earthquake and Tsunami 44 times (6.17%). Over the last 30 years, flooding has killed more than 500,000 people globally, and the displaced population was up to around 650 million and caused damage more than $500 billion (Brakenridge 2016).

Recently, most of the newspapers and TV news widely reported flood disasters from the world. In 2000, flooding in Nagoya City, Japan paralyzed metropolitan functions with the associated economic loss reaching 70 billion yen (US $7 billion). In June 2001, floods from Tropical Storm Allison killed over 30 people in the Houston, Texas. In 2002, a series of flash floods occurred in Glasgow, Scotland, causing severe damage with around 140,000 people affected. The number of Chinese cities affected by floods has more than doubled since 2008. The 2009 flooding in Manila due to the Tropical Storm Ketsana inundated more than 80% of the city. In April 2010, Rio de Janeiro, Brazil experienced its worst-ever flood, with over 250 people killed. In 2016, flash flooding caused the main street of Ellicott City, Maryland to be paralyzed for more than 2 months as commerce and residents cleaned up from the flooding and began repairing damaged buildings and sidewalks. These maters represent only a small proportion of the flood disasters that have occurred in urban areas but provide a stark demonstration that flooding, once a classical rural phenomenon, has become a predominantly urban concern.

1.1.2 Increased Risk of Flooding in Urban Areas

Flood risk management and river ecosystem conservation have not been traditionally considered as components of the urban planning process. This fact is due in large part to the division of academic fields. Those who deal with flooding and water quality are trained in river engineering, hydrology, geology, chemistry or geophysics, whereas the urban planners are most likely trained in architecture, traditional landscape, road engineering or social science. The missing or insufficient link to water management can be considered a fundamental flaw in the system of urban planning to date.

It is also increasingly clear that the structural measures put in place to manage drainage in cities are not always an optimum solution. The core problem, as summarized in a World Bank report (Jha et al. 2012), is that poorly designed and managed urbanization contributes to the growing flood risk due to unsuitable land-use change. As cities and towns expand and grow outwards to accommodate population growth, large-scale urban expansion often comes in the pattern of unplanned development in coastal and inland floodplains, as good as in other flood-prone regions. Therefore, the need for a close working relationship between the urban planner and the hydrologist is increasingly recognized. Despite this recognition, many cities are still expanding without sufficient consideration of flood risk. The difficulty in translating the concept of flood risk management into practice may be at least partially attributable to the lack of, or non-practicing of, appropriate planning approaches that take the flood issue into account. Increasing indication suggests that the 100-year floodplain is neither accurate nor sufficient in leading communities and family decisions to mitigate the adverse impacts of rising tides. The unfitness of the floodplain designation to efficiently capture the likelihood of loss of property, and possibly human lives, have left potentially millions of property owners unaware of their flood risk and made it more problematic for local communities to be better organized for potential flood disasters.

We can check statistic data related to urbanization and rivers in those city areas. Shenzhen, today a major city in China, was a market town of 30,000 people before 1980. In the past four decades, the Shenzhen region experienced a rapid urbanization process and the population reached more than 10 million, probably the fastest growing city in the world. A consequence is that the length of rivers in the region shortened by 355.4 km, accounting for 17% of their 1980 length, and river density changed from 0.84 to 0.65 km/km^2 (UPLRC Shenzhen 2018). Such changes are also seen around the world, many waterways have either disappeared or been transformed into ditches during the last century due to urban development.

We are solicitous about flood disasters that could be another consequence of urban development. For example, in many urban areas, stream-bank erosion represents an ongoing threat to infrastructure such as roads, bridges that are difficult to control even by normalization or to harden the stream banks. Dams are often constructed for flood regulation, which may lead to a considerable decrease in flood discharge and its probability proportional to the sizes of dams. However, dams are often the cause of irrational development of floodplains because they reduce the inundated areas of small and medium magnitude floods which make the land available for development and give residents the false perception of safety. Besides, dams may reduce beach width around the river mouth by disrupting sediment transport from the upstream, which may increase the vulnerability to coastal flooding in downstream areas.

How the process and pattern of urban sprawl affect the formation of urban flood risk is a question worth exploring. The amount of urban land has more than doubled in the process of urbanization, almost all of which covered with concrete and asphalt. To overcome the flood risk which always threatens the community, the urban planner needs to think of an integrative form of city planning that can minimize the danger of flooding. As a new, broad, collaborative and integrative planning methodology, urban planning provides more opportunities to decrease disaster from the beginning of planning process of urbanization. It goes beyond traditional land-use planning to integrate policies for the development and land-use with other policies and activities which impact the nature of places and how they function and influence the future distribution of activities in space.

All chapters in this book are organized as three parts in order to present our contribution regarding the concept of integration of urban planning site and disaster management site for disaster mitigation and better human settlement.

1.2 Part I: Water-Related Disaster and Urbanization

1.2.1 Flood Disaster and Human History

In ancient time, humans had chosen to live close to waterways for convenience and benefited from the waterways. They defied the danger but dared not to think about imposing reins on rivers. Instead, they prayed for the mercy of nature, and this is an adapted process which became a culture. Culture, as the characteristics and knowledge of a particular group of people defined by everything from language, lifestyle, religion and social habits, can be viewed as urban assets and a growing trend of refurbishing and re-branding properties at worldwide level. Related to how the cites changing their way on adapting the impact of water, Chap. 2 of this book, authored by Yan provides a review on the relationship between floods and culture through some cases in Egypt, China, Italy, and Thailand. It stresses that appropriate water management may produce long-lasting positive effects which can be labeled as water culture. It is intended to deliver the message that we need to take water culture into urban planning. The chapter carried initial thinking about why we need integrated planning from an integrated perspective of urban planning, water-related hazard risk, hydrologic cycle and urban social culture.

1.2.2 Flood Disaster and Urbanization

Disaster Management is a planned process undertaken to minimize disaster impact. It is linked to sustainable development, especially concerning people and economy. In light of the shift of flood hazard in urban area from being nature-caused to largely human-induced, we must address two fundamental questions about water environment degradation related to urbanization and population growth. Firstly, why we have failed in avoiding the negative impacts of urbanization and population growth on river systems and watershed characteristics, and secondly, what we must do to achieve sustainable watershed development. Those issues can be approached in a multifold way that includes urban policy, institutional and planning involved in the process of urbanization.

Chapter 3, authored by Liu, et al., presents historical records of the extreme storm flood events in Beijing. The chapter analyzes the characteristics and causes of storm-induced flooding in Beijing and outlines the overall pluvial flooding management plan including an integrated emergency response system and new initiatives such as sponger city development, strengthening flood warning system and increasing the public awareness of urban flooding. In Chap. 4, authored by Huang, explains the hydrologic cycle and how it may be affected by urbanization. It points out the need to consider the impact of road network on urban flood risk in urban planning and advocates the incorporation of flood damage estimation into urban planning, which is a new concept. By conducting disaster damage estimation in the planning stage, a city can be better prepared for potential losses and post-disaster recovery.

1.3 Part II: Monitoring and Simulation of Water-Related Disaster

To gain a better understanding of flood disaster, planners in the planning process require monitoring data. Appropriate data can help identify flood risk areas and help the plan to reduce the impact of flood disasters. Water-related disaster management depends on monitoring data and hydrological simulations to a large extent. A key to the accuracy of a hydrological simulation is the accurate representation of the spatial and temporal variation patterns, intensity, and duration of precipitation. However, it is hard to obtain reliable and appropriate precipitation data for hydrological modeling. Nowadays, with the advanced of technology, the study of flood disaster models expected to carry out more accurately.

In Chap. 5, authored by Li et al., provides an evaluation of the latest satellite-based precipitation products for the Lower Mekong River basin with a distributed hydrological model. Such an assessment is essential for hydrological modeling works to be conducted in ungagged river basins. The quality of integrated urban planning can only be guaranteed with accurate and detailed simulation results in many cases. Chapter 6 authored by Binaya Kumar Mishra et al., evaluates the impact of climate change on extreme rainfall intensities under different greenhouse gases emission considering a future period. The results can assist the water manager and urban planner to design the sustainable and robust water infrastructure.

The two chapters above show how an advanced technology data acquisition and delivering it to models can generate detailed and reliable results. The monitoring data and simulation are essential to be used as thinking base in urban planning disaster mitigation.

1.4 Part III: Integrating Urban Planning with Water-Related Disaster Management

An important but less discussed work for disaster management is to integrate urban planning and disaster management at the beginning of planning process. The indicators and parameters employed for both urban planning and disaster management have not been investigated carefully till now. For example, evacuation road and shelters discussed in both planning field and disaster prevention filed. However, the shared indicators which can be used as planning criteria for preventing human-induced disaster in the planning process have not investigated. As a result, experts in the field of disaster prevention are always to start their work after urban planning, they have to start their work after urban development in most of cases.

In a word, to set up a social system that can integrate both planning and disaster management organizations are essential. For this, researchers on planning institution are necessary. Meanwhile, how to unitize the indicators integrating both fields is necessary too so that solutions for disaster management can be found at the beginning of planning process.

1.4.1 Water-Related Disaster and Institution Issues

It is worth mentioning that the effects of planning institution on disaster management are most pronounced for establishing safe society to follow disaster prevention guidelines issued by local municipalities. For preventing city and population damage from water-related disasters, social organization and planning institution for disaster prevention becomes important condition for integrating planning work with disaster management in local communities. In the process of urbanization, the construction of evacuation facilities often lags behind the development of residential areas with urban severe vulnerability occurring. Till now, the effects of urbanization and population growth on flood risk and waterway health have been studied separately. The integration of the two types of studies should be pursued, which may lead to innovation in disaster management.

The world has learned from bitter experience in Indonesian Tsunami in 2004 and Japan Tsunami in 2011. The number of casualties and losses are significant and thus local municipalities realized the need of mature city planning for evacuation process, community involvement (Community Participation Planning) in order to improve the public awareness. Chapter 7, authored by Yamato et al., is focused on the plan formulation for Tsunami evacuation in some Japanese coastal cities, which is intended to classify planning-making methods in different municipalities. Based on the questionnaire survey results, planning-making methods in surveyed cities are classified into three categories, among which the planning-making method of public participation is highly evaluated by officers in local municipalities.

1.4.2 Integrated Indicators of Planning and Disaster Management

There are some studies on indicators that are important to integrate urbanization aspect with disaster management aspect. For example, Wang et al. (2016) investigated the backwater effect of eight bridges along the Huaihe River in China. It found that, in order to eliminate the cumulative effect of two bridges, the minimum distance between two bridges should be larger than 215 times of the bridge pier width. Furthermore, increased delivery of sediment into the channel network is a common consequence of urban development (Douglas 1985). Sediment and debris carried by floodwaters can further constrict a channel and increase flooding. Thus if those issues could be discussed in the urban planning process, flood mitigation would be possible. In addition, indicators reflecting water chemistry can be employed to investigate function changing of waterways because of population growth (Porcella and Sorenson 1980). It can in turn further connect to changes in the biological communities of aquatic ecosystems (Morse et al. 2003; Chadwick et al. 2006; Voelz et al. 2005; Walsh et al. 2005).

In this book, Mardin and Shen proposed a methodology about how to integrate urban planning with flood disaster mitigation in planning process. In Chap. 8, the authors explain their work on integrated criteria of flood disaster mitigation and housing-settlement suitability in urban planning according to the Indonesian planning regulations and present a case study in Palu City, Indonesian. It identifies suitable and unsuitable areas in the city by dangerous degree of flood disaster. It provides a good example of considering flood disaster in the process of urban planning.

1.4.3 Cooperative Design for Sponge City

Integrating urban planning and water management is a land-based engineering concept and an engineering approach that integrates urban water cycles, including rainwater, groundwater and wastewater and clean water management, into planning and management works, it intends to minimize environmental damage and enhance the use of the water. Sponge cities focus on imitating the water system that existed pre-evolution through the utilization of micro-controls distributed throughout a developed site. Rainwater can also be harvested in reservoirs for landscape irrigation and other beneficial purposes. Thereby it creates an urban environment that absorbs water then releases it when required, in a similar manner to a sponge. A sponge city pilot program, the Ministry of Water Resources was launched in China at the end of 2014. The overall objective of this program is that 70% of rainwater will be absorbed and reused. This goal should be met by 20% of urban areas in China by the year 2020, and by 80% of urban areas by the year 2030 (The General Office of the State Council 2015).

In the level of implementation, to use the excess rainwater, the urban planners can promote a rainwater harvesting through all suitable buildings. The rainwater harvesting is the accumulation and deposition of rainwater for reuse on-site, rather than allowing it to run off. It is considered as a solution for both drought and flood management. Chapter 11, authored by Lin et al., proposes a cooperative design method aimed at improving the cooperation of urban planners and rainwater harvesting designers for a more efficient implementation of this solution. It employs numerical simulation to assess the performance of rainwater harvest system under various combinations of cooperative design parameters. It is an example of linking water resources management with urban architecture.

1.5 Conclusion

Learn from different regions of Asia with a different orientation, which spans from medium size city, Palu in Indonesia to mega-city such as Beijing in China. The most important message delivered by this book is that water-related disaster management is multifaceted and the approaches to deal with water-related issues are diverse so that wise water governance including the incorporation of wise water management into urban planning should be pursued to achieve an integrated solution for sustainability.

The emphasis of the discussion in this book, includes (1) water-related disaster and urbanization; (2) monitoring and simulation of water-related disaster; (3) integrating urban planning and water-related disaster management using shared indicators. At the beginning of planning process, it is helpful to employ shared urban planning indicators and building design parameters for cooperative design between both planning site and disaster management site. In the urban planning process, urban plan get much help from technological advances with spatial database, and water management should have a detailed modeling process. Thus, the integration of urban planning and water-related disaster management should be assessed by considering the measurable parameters and criteria shared by both sides. The integration of the two types of studies should be pursued, which may lead to innovation in urban planning and disaster management for disaster mitigation and better human settlement.

References

Asian Development Bank (2015) Water-related disasters and disaster risk management in the People's Republic of China. www.adb.org

Brakenridge GR (2016) Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado. http://floodobservatory.colorado.edu

Chadwick MA, Dobberfuhl DR, Benke AC, Huryn AD, Suberkropp K, Thiele JE (2006) Urbanization affects stream ecosystem function by altering hydrology, chemistry, and biotic richness. Ecol Appl 16(5):1796–1807

Douglas I (1985) Urban sedimentology. Prog Phys Geogr 9:255–280

Guha-sapir D, Hoyois P, Wallemacq P, Below R (2017) Annual disaster statistical review 2016: the numbers and trends. Centre for Research on the Epidemiology of Disasters (CRED)/Institute of Health and Society (IRSS)/Université catholique de Louvain – Brussels, Belgium, Brussels. https://doi.org/10.1093/rof/rfs003

Howe J, White I (2004) Like a fish out of water: the relationship between planning and flood risk management in the UK. Plan Pract Res 19(4):415–425

Huang GW (2014) A comparative study on flood management in China and Japan. Water 6(9):2821–2829

Jha A, Bloch R, Lamond J (2012) Cities and flooding: a guide to integrated urban flood risk management for the 21st century. GFDRR/World Bank, Washington, DC

Morse CC, Huryn AD, Cronan C (2003) Impervious surface area as a predictor of the effects of urbanization on stream insect communities in Maine USA. Environ Monit Assess 89:95–127

Neuvel JMM, Van Der Knaap W (2010) A spatila planning perspective for measures concerning flood risk management. Int J Wat Resour Dev 26(2):281–296

Porcella DB, Sorenson DL (1980) Characteristics of nonpoint source urban runoff and its effect on stream ecosystems. EPA 600-3-80-032

The General Office of the State Council (2015) Guiding opinions on advancing the construction of sponge cities

UNISDR (2016) 2015 disasters in numbers. http://www.emdat.be

UPLRC (Urban Planning and Land Resource Commission) Shenzhen (2018) http://www.szpl.gov.cn/xxgk/sjfb/tjsj/

Voelz NJ, Zuellig RE, Shieh SH, Ward JV (2005) The effects of urban areas on benthic macro invertebrates in two Colorado Plains Rivers. Environ Monit Assess 101:175–202

Walsh CJ, Fletcher TD, Ladson AR (2005) Stream restoration in urban catchments through redesigning stormwater systems: looking to the catchment to save the stream. J N Am Benthol Soc 24:690–705

Wang H, Tang H, Xu X, Xiao J, Liang D (2016) Backwater effect of multiple bridges along Huaihe River, China. In: Proceedings of the institution of civil engineers – water management. pp 1–12

White I, Richards J (2007) Planning policy and flood risk: the translation of national guidance into local policy. Plan Pract Res 22(4):513–534

Yoganath A, Junichi Y (2009) Global trends in water-related disasters: an insight for policymakers. The United Nations Educational, Scientific and Cultural Organization, Paris