ENVIRONMENTAL SCIENCE & POLICY 48 (2015) 265–277

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/envsci

Historical assessment of Chinese and Japanese flood management policies and implications for managing future floods

Pingping Luo [a,b,c,*], *Bin He* [d,*], *Kaoru Takara* [c], *Yin E. Xiong* [e], *Daniel Nover* [f], *Weili Duan* [d,*], *Kensuke Fukushi* [g]

[a] *Institute of Hydraulic Structure Engineering and Water Environment, College of Civil Engineering and Architecture, Zhejiang University, Hangzhou, Zhejiang, China*
[b] *United Nations University – Institute for the Advanced Study of Sustainability (UNU-IAS), Shibuya, Tokyo, Japan*
[c] *Disaster Prevention Research Institute (DPRI), Kyoto University, Gokasho, Uji, Kyoto 611-0011, Japan*
[d] *Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences (CAS), 73 East Beijing Road, Nanjing 210008,China*
[e] *Foreign Language Department, Hunan Womens' College, Changsha, Hunan Province, China*
[f] *AAAS Science and Technology Policy Fellow, U.S. Agency for International Development, West Africa, Accra, Ghana*
[g] *Integrated Research System for Sustainability Science (IR3S), The University of Tokyo, Japan*

ARTICLE INFO

Article history:
Available online 17 February 2015

Keywords:
Flood management policy
History
Irrigation
Structure measures
No-structure measures
Extreme events

ABSTRACT

Floods are among the world's most devastating natural disasters, causing immense damage and accounting for a large number of deaths world-wide. Good flood management policies play an extremely important role in preventing floods. It is well known that China has more than 5000 years of experience in flood management policy beginning with the reign of DaYu and Gun. Although culturally related, Japanese flood management developed differently from that of China. Under rapid development of civil engineering technology, flood management was achieved primarily through the construction of dams, levees and other structures. These structures were never adequate to stop all floods, and recent climate change driven extreme events are ever more frequently overwhelming such infrastructure. It is important to take a historical perspective of Japanese and Chinese flood management in order to better manage increasingly frequent extreme events and climate change. We present insights taken from an historical overview of Japanese and Chinese flood management policies in order to guide future flood risk management policy.

* *Corresponding author at*: Institute of Hydraulic Structure Engineering and Water Environment, College of Civil Engineering and Architecture, Zhejiang University, Hangzhou, Zhejiang, China (Pingping Luo); Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences (CAS), 73 East Beijing Road, Nanjing 210008,China (Bin He, Weili Duan).
E-mail addresses: luoping198121@gmail.com (P. Luo), hebin@niglas.ac.cn (B. He), duan.scut.cn@gmail.com (W. Duan).
http://dx.doi.org/10.1016/j.envsci.2014.12.015

1. Introduction

Floods are the cause of devastation worldwide, with frequent occurrence in Asia, particularly in China, Japan, India and Thailand. Flooding has become increasingly frequently in China and Japan in recent years concurrent with observations of global climate change and increasingly frequent extreme weather events. As the occurrence of floods has become common, flood risk and flood prevention have raised public, political and scientific awareness. Moreover, floods are major drivers of pollutant export from sewage, farm chemicals including pesticides and fertilizers, and other sources (Luo et al., 2011b; Duan et al., 2013a, 2013b). There is a growing awareness of the significance of flooding on human health through direct and indirect impacts. Urbanization and extreme weather events leading to greater runoff, higher peak discharges, more rapid response times, and variations in sediment production (Bledsoe and Watson, 2001; White and Greer, 2006; Luo et al., 2013) have intensified flood risks (Pfister et al., 2004, Duan et al., 2014). Predicted climate change will significantly increase water-related risks (Muller, 2007), especially increasingly frequent and intense extreme rainfall events (Browning-Aiken et al., 2007; Mujumdar, 2008). Dams, dykes and levees are often used to reduce flood risk (Lind et al., 2009) and the effect of dam projects on flood management has been assessed in other studies (Hayashi et al., 2008; Luo et al., 2011a). Optimum multi-objective and dynamic control of flood limited water level for reservoir operation has been used to provide a practical way to reduce flood risk (Dittmann et al., 2009; Li et al., 2010). River channel network design has also been used to relieve flood risk (Cui et al., 2009). A risk analysis model was presented to evaluate the failure risk for flood management structures using design floods (Wu et al., 2011). Taking a national viewpoint to review flood management measures and policies offers the benefit of identifying proven effective measures.

Following the devastating 1997 flood that affected many residents in the Red River Basin, historical Canadian flood control policies were reviewed to order to modify flood management approaches and led to the use of flood forecasting, planning of new structural and non-structural flood control measures and emergency operations of existing flood protection systems (Simonovic and Carson, 2003). The social aspects of flood risk perception that shape flood response were analyzed and integrated flood risk management suggested as a suitable way to cope with flood disasters in central Vietnam (Tran et al., 2008). An assessment of floodplain residents' preferences for outcomes of water level management was conducted in Bangladesh using a questionnaire as part of a maximum difference conjoint (MDC) model (Rasid and Haider, 2003). They found that survey respondents have clear ideas regarding flood prevention of their homes and courtyards as well as varied flood depths in rice fields. Hierarchical structure and geographic information system (GIS) were used for flood risk analysis in Taiwan (Chen et al., 2011). A structural master plan of flood mitigation measures was developed via economic evaluation of trade-offs between construction costs and expected value of damage reduction in south-west Iran (Heidari, 2009). Recently, the social perception of floods and flood management has become an important topic for flood control (Lara et al., 2010). However, few historical assessments or comparative analyses of flood management policies have been conducted at national scale. Furthermore, systematic assessment of flood management policies at a national scale has not been conducted for China or Japan. Such an exercise is essential to effectively guide flood management policy.

Flood management in China and Japan has always aimed to control stream-flow for municipal and commercial use while preventing flood disasters. China has a long history of flood management measures beginning with DaYu and Gun's flood management policy (Gu, 2006). For example, the Dujiangyan Irrigation System is a flood management measure that underscores China's long-standing effort to harness water resources. Dujiangyan is an irrigation infra-structure built in 256 BC during the Warring States Period of China by the Kingdom of Qin. It is located in the Min River in Sichuan Province, China, near the Province capital Chengdu. It is still in use today and irrigates over 5300 square kilometers of land in the region. Dujiangyan has a flood management system, an urban water supply system and a sediment transport system (Cao et al., 2010). After a major flood in 1998, the Chinese government changed course on flood management policy, shifting from the exclusive use of structural approaches to using a combination of structural and non-structural approaches. Japanese flood management began with the policies implemented during the Yayoi period (300 BC–AD 300). In 1960, there was an effort to move away from concrete dams and focus instead on the hydrologic function of "Green Dams," which rely on the flow retarding capacity of forests to reduce flood risk (Takara et al., 2004; Calder, 2007).

In this paper, we present a historical assessment of flood management policies in China and Japan, and explore the different characteristics of floods in the two countries. In addition, we provide case studies to identify advantages and disadvantages of policies with respect to historical, engineering and hydrologic dimensions of flood management. This study provides commentary to assist policy-makers and researchers in making flood management plans under the specter of future extreme events and climate change.

2. Methodology of the historical assessment

The detail methodology of the historical assessment in this study is presented in Fig. 1. We selected China and Japan as target study sites for the historical assessment of flood management policies. This study provides an overview of historical floods in these two countries. The hydrologic and geologic characteristics of China and Japan are compared with respect to their flood histories. This is followed by a historical review of the flood management policies of China and Japan. Some traditional flood management policies were selected for case studies in both countries. The case studies are used to assess the advantages and disadvantages of historical flood control policies with respect to historical, engineering and hydrologic dimensions of flood management. Finally, historical flood management policies are discussed given the modern context of extreme events and climate change. First, general history books for China and Japan were selected. Other historical documents such as books, drawings, newspaper