

Centralization in floodplain management of world rivers: Comparative case studies of the Yangtze and Mississippi rivers

Alicia Claire Lloyd¹ and Micah G. Bennett²

Watershed Science and Policy IGERT Southern Illinois University Carbondale

¹ Environmental Resources and Policy Program ² Department of Zoology and Center for Ecology

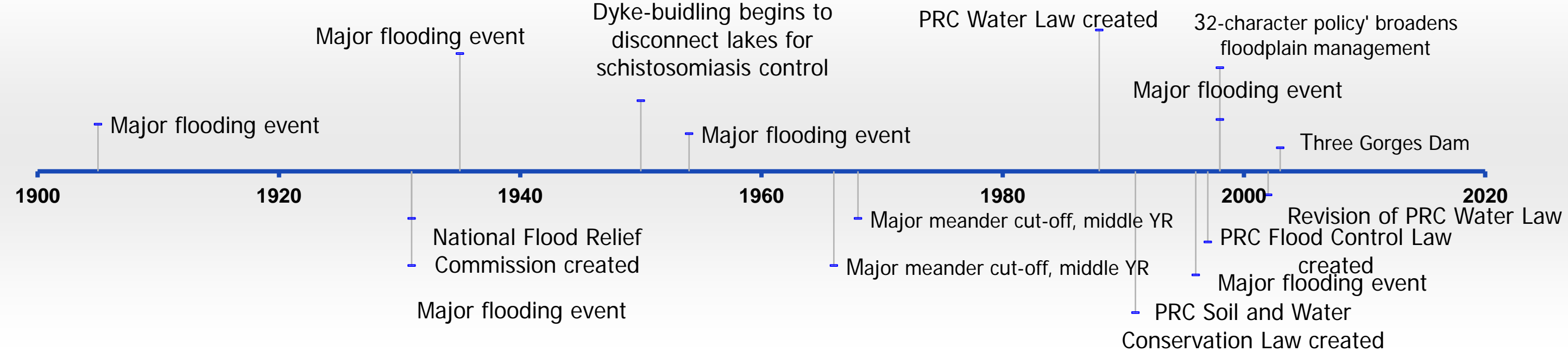
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Introduction

Numerous institutions are responsible for land use planning, pollution abatement, water use and ecosystem service provision aspects of watershed governance. In no area is this more apparent in the world’s large river systems than in floodplain management. Integrated watershed management and regulation of basin management practices at the local and basin-scales are advocated as the most conducive to environmental quality enhancement and flood damage mitigation. Decentralization of natural resource management is argued to be most responsive to local interests, provide flexibility for context-specificities, and establish legitimacy among stakeholders (Mody 2004; Davis 2008). Centralization of governance, however, may be more conducive to efficient and effective watershed management. This project seeks to evaluate the institutional capacities of decentralized and more centralized systems to manage large river floodplains through comparative case studies of China’s Yangtze River and the Mississippi River in the United States.

The hierarchical levels at which floodplain management is implemented have profound implications for the health and functioning of the human and natural systems in a basin. A multitude of interests vie for influence on the policy governing land use in the floodplain and the structural alterations to river systems. Urban development and agricultural production occurring in the floodplain are economically productive land uses. Efficient management , however, should facilitate pollution abatement and ecosystem service provision, which also hold value . This project seeks to apply an institutional analysis lens to a comparative case study of floodplain management within two of the world’s largest and most economically-productive river basins.

Floodplain management in the Yangtze River



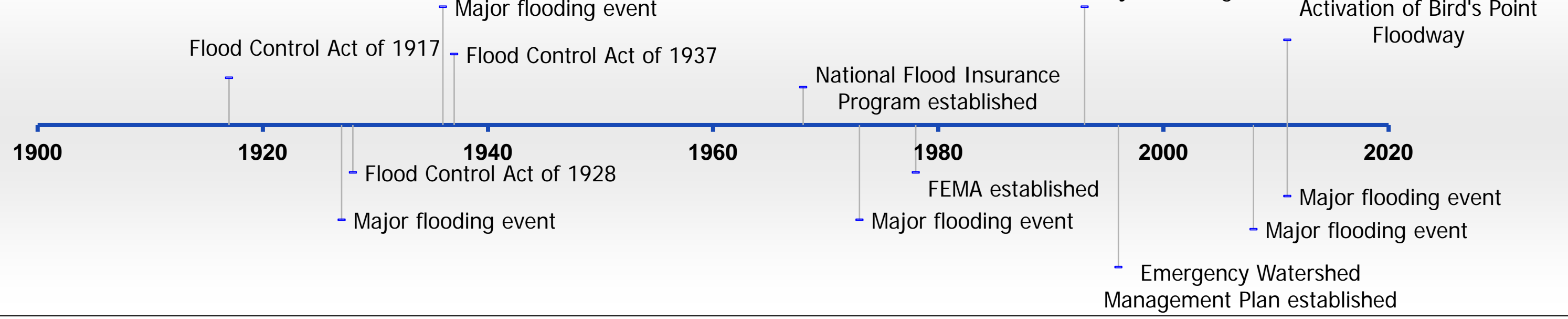
Institutions and Approaches in China

China has managed rivers for flooding on a broad scale since at least the mid-300s (A.D.) when construction on the Jinjiang Levee began. This was completed in 1650, protecting the north bank of the middle Yangtze River (Yin et al. 2007). The Yangtze River now has over 45,000 km of levees along the mainstem and tributaries as well as over 100 reservoirs and 40 floodways and storage basins (Zhang & Wen 2001). Water governance in China is centralized but fractured, with the Ministry of Water Resources responsible for unified water resource management. Seven river basin commissions serve as extensions of the MWR to handle water administration at the basin level and the MWR has bureaus at the provincial and municipal levels which are responsible for water administration within their jurisdiction but answerable only to their respective local governments. Flood management is more centralized than general water management and is the responsibility of the State Flood Control and Drought Relief Headquarters (located within MWR, but answering to the State Council) and its basin-level counterparts which handle flood forecasting, conducting flood operations and mobilizing personnel and resources for flood response (Zhang 2004).

Three major laws since the 1980s govern floodplain management in China: the Water Law (1988, rev. 2002) governs water quality and water use as well as establishing unified basin management; the Flood Control Law (1997) establishes the responsibility of all individuals and agencies to contribute to flood control efforts and requires integration of flood management plans into river basin plans; the Soil and Water Conservation Law (1991) establishes the importance of soil water conservation and mandates certain nonstructural measures such as reforestation. Until 1998, the dominant paradigm was flood *control*, focusing mainly on levees and reservoirs; however, recognition that land degradation and floodplain encroachment had contributed to the severity of the 1998 flood (causing over US\$20 billion in losses; Zong & Chen 2000) prompted a new policy of flood *management* that incorporates ‘soft’ or non-structural approaches (Gleick 2003) such as reforestation, retirement of hillslope agricultural lands, wetland restoration, and levee set-backs (‘32-character policy’; te Boekhorst et al. 2010).

Since the 1980s, government-driven flood relief has attempted various forms of insurance including crop, flood control infrastructure, and disaster relief. The financial risks posed by flooding have prompted the Chinese government to include relocation of residents from the floodplain and approximately 2.4 million people have been relocated with significant government support (~ US \$1.6 billion)(Pittock & Xu). Success of relocation at a broader scale may be limited, however, because of China’s large and growing population and individual and national incentives to farm in the rich floodplain soils (Zong & Chen 2000). The Flood Control Law contains provisions on the types of residential and commercial structures that can be built in flood-prone areas, requires government approval for these projects and adopts national standards for flood control structures. Despite regulation, hundreds of small levees along the Yangtze were constructed to ‘reclaim’ farmland in floodplains and to protect towns without government approval, contributing to the severity of flooding. The central government has provided specific policies for land use in flood-prone areas, but to be effective, require implementation at the provincial and basin levels. The planning and vision of the central government has been identified as a major factor in the widespread success of river management policy reforms in China since 1998 (Pittock & Xu).

Floodplain management in the Mississippi River



Institutions and Approaches in the United States

Watershed governance in the United States is highly fragmented among vertical and horizontal institutional levels. While central entities are responsible for the regulation of point-source pollution abatement (US EPA) and flood disaster relief (FEMA), land use planning is almost entirely regulated by municipal and in some cases, sub-national state governments. Flood mitigation efforts include levee construction by levee districts, planning more flood-tolerant development in the floodplain, and implementing local building construction codes to minimize damages. Stormwater management is addressed by municipalities at the local scale. The most prominent contributor to degraded water quality, agriculture run-off is the other largest contributor to non-point source pollution in the Mississippi River and abatement activities include conservation programs at the national scale and state-level cost share programs.

Floodplain governance in the Mississippi River basin was predominantly the responsibility of local governments until, following the great flood of 1927, the central government began taking an active role in its management. The 1928 Flood Control Act provided significant direction and funding to prevent flooding on agricultural land and urban development in the floodplain through levee construction. Flood control projects were implemented throughout the Mississippi River, almost exclusively consisting of structural engineering projects. Federal legislation has been primarily responsive to flood events and geared towards the dual goals of facilitating navigation and mitigating flood damage (Galloway 2004). National flood insurance facilitated the identification of flood-prone land and provided the catalyst for municipal developmental zoning.

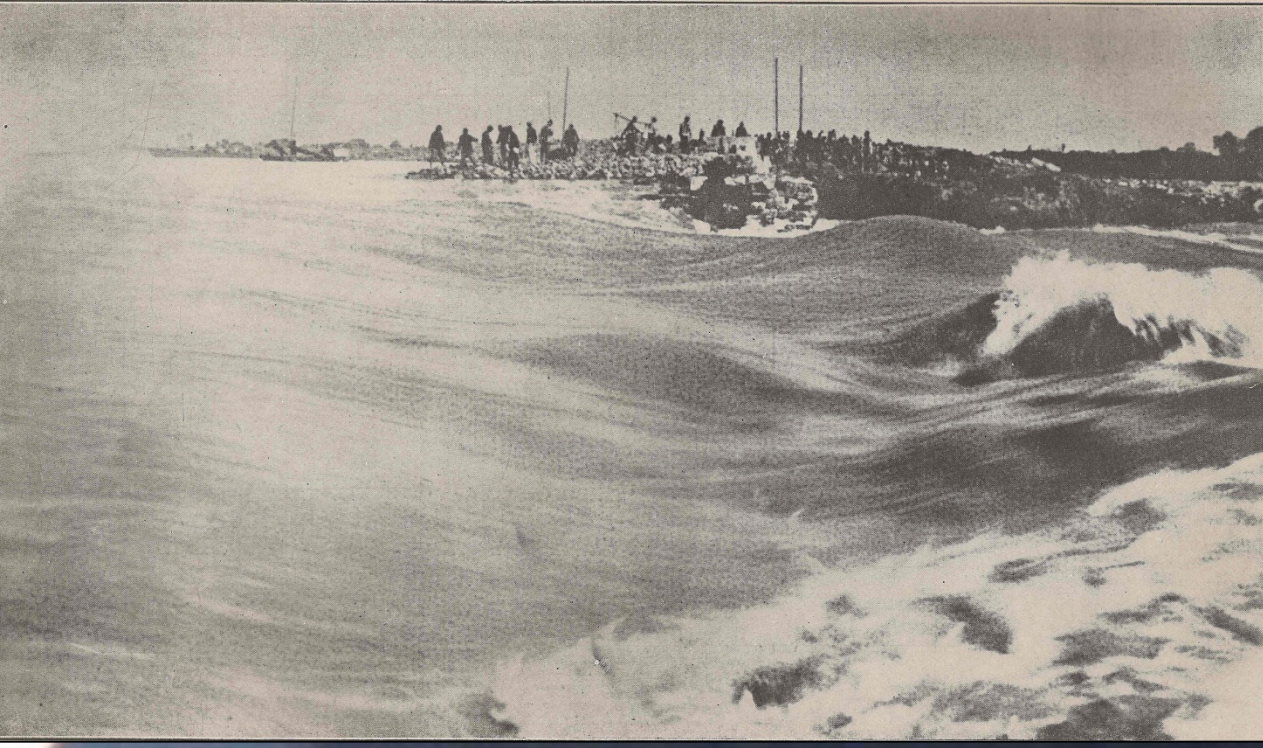
The historic floods of 1993 illustrated the shortcomings of past flood management policies. Despite the expense of constructing flood control structures throughout the system, 1993 saw historic flood stages. Overtopped levees’ protection levels were exceeded and floodplains behind them were inundated throughout the MR causing significant damage to floodplain development. Following the flood, state and local governments increasingly engaged in flood management policy at sub-national levels. The Association of State Floodplain Managers promotes sub-national efforts to mitigate flood damages in collaboration with federal agencies. Concurrently, more attention began to be paid the environmental benefits of floodplain ecosystems and the detrimental effects to these systems of river channelization and other structural changes to waterways. Efforts to account for these benefits and reduce flood damages to floodplain development include public and private acquisition of private lands through easements and buyouts.

Competing land uses, unclear responsibilities, and inconsistent regulation among national, state, and local governments has led to ambiguous and fractured floodplain management. Calls for better integrated management note that coordination among levels of governance has been ineffective and inefficient (Galloway 2011).

Institutional analysis of floodplain management		
	Yangtze River	Mississippi River
Catalyst for legislation	Reactive to major flooding events	Reactive to major flooding events
Major drivers of river management	Flood damage mitigation (and navigation), increasingly ecosystem service provision and hydropower production	Navigation and flood damage mitigation to agriculture and urban development in floodplain
Management approaches	Initial focus on structural engineering, but now incorporating diverse non-structural and landscape-level practices allowing for more natural flood disturbance regime	Structural engineering – flood “control” which facilitates further development and agricultural production in the floodplain
Institutional centralization	Highly concentrated at central level, fragmented among agencies and among provincial/local gov; central gov has increasing power through basin planning	Land use planning, pollution abatement, river management, disaster relief governance responsibilities fractured vertically and horizontally
Institutional legitimacy	Very limited public influence in policy, top-down management structure from central authority	Fractured floodplain management, top-down and bottom-up approaches reflecting diverse public and private interest groups



< Levee breach along the Mississippi River near Bordelonville, Louisiana, 1927. Source: University of Chicago Library.



Levee breach along the > middle Yangtze River, 1931. Source: PRC National Flood Relief Commission Report, 1933.



Inhabitants and livestock on > the levee in Leland, MS. during the 1927 flood. The flood caused an estimated US \$1 billion in damages and inundated homes of > 900,000 people. Source: Mississippi Dept. of Archives & History.



< Workers repair levees along the middle Yangtze after the 1931 flood. The flood reportedly caused US \$2 billion in damages and some 140,000 deaths. Source: PRC National Flood Relief Commission Report, 1933.

Conclusion

Although responsibilities of various floodplain management activities are divided among national agencies in China, management in the Mississippi River basin is more fragmented hierarchically than the Yangtze River. Numerous interests from the local to national scales influence the management activities in the Mississippi River basin including the navigation, agriculture, and environmental protection groups. Although provincial and local governments retain influence over on-the-ground activities, the Yangtze River’s floodplain management is much more concentrated within the central government. Institutional analysis reveals floodplain management of these two world river basins to have developed from similar institutional trajectories based on reactive policy creation, flood “control” as opposed “management,” and promotion of market goods and services over environmental quality. However, since the Chinese government has begun to concentrate efforts on environmental enhancement and water quality improvement, ecosystem service provision has increased in the Yangtze River basin.

Advantages of sub-national regulation— particularly in natural resource management— include: flexibility, responsiveness to local interests, and differentiation to account for variation among jurisdictions. Competition among government agencies vertically and horizontally can produce more efficient outcomes reflecting broader variation of interests than centralized decision-making (Cannon 2000). Central governments are generally more resource-endowed than provincial and municipal governments and can institute more streamlined regulation with lower transaction costs of implementation. Since the central Chinese government has focused, in part, on ecosystem restoration, environmental enhancement is a floodplain management priority in the Yangtze River.

The fragmented nature of flood control and floodplain policy in China contributed to the failure of structural approaches in the 1998 flood; however, out of the devastation, China has formulated a progressive policy of integrated river basin management that is advanced beyond the U.S. system. Floodplain management in the Mississippi River relies almost entirely on hard engineering and prioritizes economic production over ecosystem service provision. While implementation of integrated river management in China still faces obstacles, not insignificantly from the complicated governance hierarchy, the resolve and direction of the central government may be enough to propel it forward. On the other hand, any changes in U.S. flood policy that do come about will likely involve advocacy and legislation, potentially making the changes more publicly supported, legitimate and long-lasting.

We plan to explore drivers of land use choices in major river floodplains in response to national climate change priorities reflected in energy policies of hydropower production in the Yangtze and the agricultural land use impacts of biofuels promotion in the Mississippi basin.

References & Acknowledgements

Breton, A. 1996. Competitive governments: An economic theory of politics and public finance. Cambridge University Press.
Cannon, J. 2000. Choices and Institutions in Watershed Management. Wm & Mary Envtl. L. & Pol’y Rev. 25 (2): 379-428.
Davis, M. D. 2008. Integrated River Basin Management Through Decentralization. Eos Trans. AGU 89.
Galloway, G. 2004. Integrated Flood Management Case Study: USA: Flood Management - Mississippi River *The Associated Programme on Flood Management*. Geneva: World Meteorological Association.
Galloway, G. 2011. Floodplain Management: A present and a 21st Century Imperative. Journal of Contemporary Water Research and Education:97(1):4-8.
Gleick, P. 2003. Global freshwater resources: soft-path solutions for the 21st Century. Science 302:1524-1528.
Jinchi, H. 2003. Lessons Learned from Operation of Flood Detention Basins in China. Beijing, Research Center on Flood and Drought Disaster Reduction.
Mody, J. 2004. Achieving Accountability through Decentralization: Lessons for Integrated River Basin Management. SSRN.
Peng, S. 2010. China’s legal system for water management. Water Res. Dev. 26:3-22.
Pittock, J. and M. Xu. World Resources Report Case Study. Controlling Yangtze River Floods: A New Approach.” World Resources Report, Washington DC. Available online at <http://www.worldresourcesreport.org>.
te Boekhorst, D.G.J., T.J.M. Smits, X. Yu., L. Li., G. Lei, and C. Zhang. 2010. Implementing integrated river basin management in China. Ecology and Society 15:23. [online] <http://www.ecologyandsociety.org/vol15/iss2/art23/>.
Yin, H., G. et al. 2007. On the river-lake relationship of the middle Yangtze reaches. Geomorphology 85:197-207.
Zhang, H. 2004. China: Flood Management. Integrated Flood Management Case Study. World Meteorological Association and Global Water Partnership Associated Programme on Flood Management.
Zhang, H. and K. Wen. 2001. Flood control and management for large rivers in China. Regional Cooperation in Flood Control and Management in Asia and the Pacific, Phase II, Bangkok, 20-23 November 2001.
Zong, Y. and X. Chen. 2000. The 1998 flood on the Yangtze, Chian. Natural Hazards 22:165-184.

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