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"Governing the mountains, governing the water" (*chisan chisui*): Developing rivers in modern Japan

1 Introduction: Development and river construction in Japan

When the Second World War ended for Japan, onslaught by nature did not. Shortly after Japan embraced defeat in September 1945, a strong typhoon crossed the city of Hiroshima, which had just been hit by the first of two atomic bombs. This typhoon, dubbed the Makurazaki typhoon, left 2,473 people dead, 1,283 missing, and 2,452 injured, most of them in Hiroshima.[1] This was only the first of several severe typhoon disasters to hit the island almost annually until 1953. Exacerbated by the destruction caused by the war, each of these typhoons killed and injured hundreds of people, amounting to thousands of casualties and tens of thousands of destroyed homes in total (see Table 1). The mounting toll of these typhoon floods was publicly debated, since their damage was perceived as excessive compared to the regular annual typhoons the Japanese were used to.[2] One key reason identified was the 'devastation of national soil' (*kokudo kōhai*). The Japanese forests, which had been planted and protected since the early modern period to retain excess water from heavy rainfalls and thus prevent floods, had been cut down recklessly, first to fuel the war effort and later to account for postwar re-

1 For the Makurazaki Typhoon disaster, see Kunio Yanagida, *Kūhaku no tenkizu* [The empty weather chart] (Tokyo: Shinchōsha, 1975).

2 Japan lies within the influence of the Northwestern Pacific Basin, which is responsible for most of the tropical cyclones in the world, an average of twenty-five per year. From May to October each year, Japan has a typhoon season, during which approximately ten of them approach the islands in an average year. They cause high wind speeds and storm surges. The most damage is caused by the heavy rainfall a typhoon brings, which in turn can trigger floods and landslides. For an overview on the Japanese Climate see Japan Meteorological Agency, "Overview of Japan's Climate," accessed July 22, 2025, https://www.data.jma.go.jp/cpd/longfcst/en/tourist_japan.html. For tropical cyclones in the Pacific see James P. Terry, *Tropical Cyclones: Climatology and Impacts in the South Pacific* (New York: Springer, 2007).

https://doi.org/10.1515/9783111611358-002

source scarcity.[3] The ensuing clear cuts left the bare hills both unable to retain runoff water and vulnerable to landslides. In addition, river engineering had been neglected during the war, and thus, the weakened flood protection was easily overwhelmed by strong typhoon floods. The conclusion was that the badly maintained "national soil" fell easily victim to flooding.[4]

Table 1: Deadliest typhoon disasters during the postwar period (1945 – 1953). Data from the Japan Meteorological Agency, "Saigai o motarashita kishō jirei (Shōwa 20 – 63 nen)," [Examples of meteorological phenomena that caused disasters (1934 – 1984)], accessed July 15, 2025, https://www.data.jma.go.jp/stats/data/bosai/report/index_1945.html.

Year	Name	Dead	Missing	Injured	Houses destroyed[5]	Houses partly destroyed
1945	Makurazaki	2,473	1,283	2,452	89,839	
1945	Akune (Louise)	377	74	202	6,181	
1947	Kathleen	1,077	853	1,547	9,298	
1948	Ione	512	326	1,956	5,889	12,127
1949	Della	252	216	367	1,410	4,005
1949	Judith	154	25	213	569	1,966
1949	Kitty	135	25	479	3,733	13,470
1950	Jane	398	141	26,062	19,131	101,792
1951	Ruth	572	371	2,644	24,716	47,948
1952	Dinah	65	70	28	73	89
1953	No. 13	393	85	2,559	8,604	17,467
Total		**6,408**	**3,469**	**38,509**	**169,443**	**198,864**

To remedy the situation, the "national soil" had to be reconstructed. In the aftermath of the war, Japan had lost its colonies and was troubled by food shortages. The US, which occupied Japan from 1945 to 1952, directed the Japanese adminis-

3 For the introduction of afforestation and protection forests in Japan, see Conrad D. Totman, *The Green Archipelago: Forestry in Preindustrial Japan* (Berkeley, CA: University of California Press, 1989), 93 – 97.

4 The argument is discussed in detail, for example, in Kōichi Aki, *Nihon no suigai* [Floods of Japan] (Tokyo: Iwanami Shoten, 1952).

5 Until 1947, only 'damage to housings' (*jūka sonkai*) per housing unit is given. From 1948 onwards, the numbers are divided in housings 'fully destroyed' (*zenkai*) and 'half destroyed' (*hankai*).

tration to develop its own "national soil" and make use of its resources.[6] US experts suggested the model of the Tennessee Valley Authority (TVA) as a solution. The TVA was a New Deal project intended to ease the effects of the Great Depression in the "underdeveloped" American South by comprehensively developing the Tennessee River Valley with a series of hydroelectric dams that powered agriculture production and industries, and also by promoting afforestation and social programs.[7] The vision of turning surplus water in rivers, which could potentially cause flooding, into usable resources was enthusiastically embraced by Japanese bureaucrats. By comprehensively engineering the rivers and forests upstream, they could not only address the problem of typhoon floods but also solve postwar energy scarcity, killing two birds with one stone.

Another reason why Japanese bureaucrats welcomed the TVA solution was that they had already studied and adopted it as a model for river development in the 1930s.[8] The Japanese Empire had run river-based redevelopment programs domestically and in its colonies.[9] In the 1950s, after the TVA briefly gained traction as a buzzword, its vision was reshaped (or reduced) into laws and programs to systematically engineer Japan's rivers: levees in the downstream sections, the construction of multipurpose dams upstream, as well as afforestation and erosion control construction projects for the mountains. These programs marked the completion of river engineering policies that had been pursued since the early twentieth century and again in the interwar period. As a result, Japan became the country with the fourth largest number of high dams after China, the US, and India, with over 3,000 dams, and a key technological player in promoting river development in Southeast Asia.[10]

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6 Jin Satō, *"Motazaru kuni" no shigenron: Jizoku kanō na kokudo o meguru mō hitotsu no chi* [The resource theory of a "have-not country": The other knowledge surrounding a sustainable country] (Tokyo: Tōkyō Daigaku Shuppankai, 2011), 77.

7 For the history of the TVA, see for example Aelred J. Gray and David A. Johnson, *The TVA Regional Planning and Development Program: The Transformation of an Institution and its Mission* (Aldershot: Ashgate, 2005); Daniel Klingensmith, *One Valley and a Thousand: Dams, Nationalism, and Development* (Oxford: Oxford University Press, 2007).

8 Eric Dinmore, "Concrete Results? The TVA and the Appeal of Large Dams in Occupation-Era Japan," *The Journal of Japanese Studies* 39, no.1 (2013): 1–38.

9 Aaron S. Moore, *Constructing East Asia: Technology, Ideology, and Empire in Japan's Wartime Era, 1931–1945* (Stanford, CA: Stanford University Press, 2013).

10 International Commission on Large Dams, "Number of Dams by Country," accessed March 24, 2025, https://www.icold-cigb.org/article/GB/world_register/general_synthesis/number-of-dams-by-country; Aaron S. Moore, "From 'Constructing' to 'Developing' Asia: Japanese Engineers and the Formation of the Postcolonial, Cold War Discourse of Development in Asia," in *Engineering Asia: Technology, Colonial Development, and the Cold War Order*, ed. Hiromi Mizuno, Aaron S. Moore and John DiMoia (London: Bloomsbury Academic, 2020): 85–112.

This chapter examines the complex entanglements between the environment, global knowledge circulation concerning flood control, and development policies in mid-twentieth-century Japan. Disasters were seen as a sign that the environment was not properly maintained and became an incentive to implement a development vision, which led to the redesign of river regimes all over Japan. As an intermediate nation – not fully recognized as a "civilized" peer by the Western powers, but wielding local imperial power in Asia – Japan had gained knowledge and modeled policies after the West, while it also circulated knowledge in its own colonial and later neo-colonial settings. 'Engineering bureaucrats' (*gijutsu kanryō*), who had professional training in engineering and dominated Japanese river development, combined globally circulating knowledge with local engineering traditions.[11] They adapted development visions learned from the US to fit river engineering policy already well-established since the nineteenth century: 'water governance' (*chisui*), which involved building dams, straightening and deepening river channels and fortifying them with levees, and 'mountain governance' (*chisan*), which focused on afforestation and erosion control works upstream.

This chapter analyzes the role of bureaucratic experts as drivers in developing and shaping the environment in Japan, and looks at the part played by "domestic" and "foreign" knowledge and technology, thereby exploring the intricacies of global development in local contexts and traditions. While adopting science and technology developed in other places, it was crucial for engineering bureaucrats to contemplate the specificities of the given environment, adapting or rejecting knowledge to fit "Japanese" needs. This challenges the simplistic narrative that development was globally spread by the "West" and imposed on other parts of the world. Local actors did not only embrace development on their terms. They also adapted it to their own environment by drawing upon various sources of knowledge: Western "scientific" knowledge, "domestically" developed "scientific" knowledge, and local water control "traditions." While doing so, they were perfectly aware of the situatedness of knowledge in the environment and kept reflecting on it.

This chapter therefore not only sheds light on Japanese visions of development but also explores the role of science and technology in transforming the environment, or as Sverker Sörlin and Nina Wormbs have termed it, the "environing technologies" that were negotiated in Japan.[12] This chapter asks the following

11 Shōichi Ōyodo, *Gijutsu kanryō no seiji sankaku: Nihon no kagaku gijutsu gyōsei no makuaki* [The political participation of engineering bureaucrats: The beginning of Japan's technocratic administration] (Tokyo: Chūō Kōronsha, 1997).

12 Sverker Sörlin and Nina Wormbs, "Environing Technologies: A Theory of Making Environment," *History and Technology* 34, no.2 (2018): 101–25. See also the introduction to this volume.

questions: What was the perception of the Japanese environment and what were the expectations placed on development and technology? What knowledge was perceived as modern, foreign, or domestic? What kind of knowledge was deemed suitable for domestic needs? How was "foreign" knowledge adapted, and under what circumstances was vernacular knowledge incorporated? Section 2 of this chapter (following this introduction, section 1) discusses the background and specifics of Japanese development, highlighting the dominance of engineering bureaucrats, and is complemented by a literature review.

The next two sections (3 and 4) discuss debates fought over water control from a long-term perspective, spanning from the late nineteenth century to the postwar period, and situate these discussions in the context of contemporary global developments. In those debates, rivers and mountains were always viewed in conjunction with each other. This was seen as necessary given environmental conditions in Japan, which has a steep topography and a high erosion rate due to abundant rainfall.[13] As a result, it became established in modern Japan that both water control and erosion control were essential for controlling floods, and therefore, rivers had to be developed comprehensively. This entailed water control downstream to protect the lowlands and quickly discharge the water, and erosion control upstream to prevent sediments from filling up reservoirs and rivers, with forests planted to retain excess water and stabilize erosion.

The third section addresses a debate which took place towards the end of the nineteenth century, when the environmental effects of modernizing the economy and introducing Western knowledge to Japan first became visible. In the process, local stakeholders demanded federal funding, centralized water control, and the introduction of erosion control measures against flooding, which were both implemented at the turn of the twentieth century. The section contrasts the adaptation of Western knowledge in Japan by Dutch experts with the recurring reference to older traditions.

The fourth section focuses on the postwar debate introduced at the beginning, where the TVA was enthusiastically discussed as a model for comprehensively developing rivers and turning surplus water into resources. The section both traces continuities from the interwar efforts of imperial Japan to systematize water control through development projects, as well as bureaucratic implementation in the

13 The rainfall is approximately double the amount of central Europe, which was the point of reference for many Japanese engineers around 1900. Responsible for the most floods are heavy rains during the monsoon season and the annual typhoon season. For an overview to the Japanese climate, see Japan Meteorological Agency, "Overview of Japan's Climate," accessed July 22, 2025, https://www.data.jma.go.jp/cpd/longfcst/en/tourist_japan.html; Conrad D. Totman, *Japan: An Environmental History* (London: I.B. Tauris, 2014), 7–22.

postwar period, which involved the systematic construction of multipurpose dams and comprehensive river engineering. The chapter concludes with general observations about the formation and characteristics of the Japanese bureaucracy-dominated form of development.

2 Engineering bureaucrats, development, and rivers in Japan

This chapter seeks to elucidate the distinctive features of development in the Japanese case, which is characterized by practices of adapting Western science and technology, and the central role of engineering bureaucrats in shaping Japanese development and the relationship with the country's environment. These features can be traced back to the establishment of the modern Japanese state in the Meiji period (1868–1912), which adopted the strategy of introducing Western science and technology to compete in a world order dominated by Western imperialism. After a 250-year-long period of relative isolation from international relations in the Edo period (1603–1868), Japan was forced by Commodore Perry and his gunboat diplomacy into signing unequal treaties with the US in 1854. As a result, Japan entered into global trade and diplomatic relations, facing an economic and military imbalance with the Western powers. After a short civil war, a new government came into power in 1868, which mainly consisted of well-educated lower samurai, the warrior class that had occupied administrative positions in the former feudal government.

Out of fear of suffering the fate of its neighboring countries and ending up in colonial subjugation, the new Meiji government conducted a thorough reform program to "enrich the nation and strengthen the army." The reform aimed to thoroughly reshape the country according to Western models with the aim of being recognized as a "civilized" country by the West and accepted as an equal negotiating partner. The self-imposed development program encompassed government institutions, the military, the economy, society and culture, and lasted around thirty years, relying heavily on importing and adapting knowledge from the "West."[14] For the Japanese during the Meiji period, "civilization" signified the achievements of Western knowledge. Successfully incorporating Western knowledge was seen to

14 For an overview on the Meiji Restoration, see Andrew Gordon, *The Modern History of Japan: From Tokugawa Times to the Present* (New York, Oxford: Oxford University Press, 2003), 61–137.

lend Japan superiority in a Western-led civilizational world order, and to distinguish it from other Asian nations deemed "less civilized" or "barbaric".[15]

The Meiji reform program was orchestrated by the government and relied heavily on foreign experts and government bureaucrats acquiring Western knowledge. As river engineering had been part of the Japanese bureaucracy since the early modern period, the ministries employed trained engineers, who played a crucial role in adapting and disseminating foreign knowledge, which will be discussed in more detail in the following section. While policymaking was first dominated by members of the bureaucracy trained in law, engineering bureaucrats gained growing competence in shaping development policies since the late nineteenth century.[16] As such, it became established that engineering bureaucrats were both the group responsible for adapting knowledge and technology from abroad, and for molding that knowledge into policies.

Although the modern concept of development – the transformation of the environment with the goal of gaining economic benefits according to a comprehensive vision – was thus introduced to Japan via knowledge circulation processes involving engineering bureaucrats in the twentieth century, Japanese society was already no stranger to the idea of engineering the environment. As the premodern Japanese economy was based on rice, water control and river engineering had been important concerns for the Japanese state since ancient times. Being part of the Sinosphere, Japan initially learned river engineering technology from China in the ancient period, which was further adapted in local contexts and fully localized by the early modern period.[17] During a civil war, which lasted

15 The thought to "leave Asia" and become part of "Western civilization" propagated by thinker Fukuzawa Yukichi (1835–1901) was especially influential during the Meiji period. Yukichi Fukuzawa, "Good-bye Asia (1885)," in *Japan: A Documentary History: The Late Tokugawa Period to the Present*, ed. David J. Lu (Armonk, NY: M.E. Sharpe, 1997): 351–53. For an overview on Japanese cultural identity and nationalism since the Meiji period see Eika Tai, "Rethinking Culture, National Culture, and Japanese Culture," *Japanese Language and Literature* 37, no.1 (2003): 1–26.

16 Janis Mimura, *Planning for Empire: Reform Bureaucrats and the Japanese Wartime State* (Ithaca, NY: Cornell University Press, 2011); Tsuyoshi Wakatsuki, *Senzen Nihon no seitō naikaku to kanryōsei* [The changing structure of bureaucracy under the party cabinet system in prewar Japan] (Tokyo: Tōkyō Daigaku Shuppankai, 2014).

17 The Sinosphere is a term introduced by Joshua A. Fogel to denominate a cultural region in Asia that was shaped by Sinocentrism and deeply influenced by culture, thought, and technology from Ancient China. Joshua A. Fogel, *Articulating the Sinosphere: Sino-Japanese Relations in Space and Time* (Cambridge, MA: Harvard University Press, 2009). Reading Ancient Chinese scriptures were a fixture of intellectual learning (with a similar status to Latin in Europe) in the Sinosphere and only got contested with the arrival of Western knowledge in the nineteenth century, see Michael Facius, *China übersetzen: Globalisierung und chinesisches Wissen in Japan im 19. Jahrhundert* (Frankfurt am Main: Campus, 2017); Douglas Howland, *Translating the West:*

from the mid-fifteenth to the late sixteenth century, and the subsequent establishment of the feudal government of the Tokugawa in the early seventeenth century, river engineering gained importance, and technologies evolved. The Tokugawa shōgunate (1603–1868) and local domains established specialized bureaucratic positions for river engineering, as large-scale development projects were undertaken around 1700 to redirect major rivers to protect cities and gain new fields for mainly rice cultivation.[18] This early modern land reclamation project followed policy trends established in Ming-Qing China.[19]

This background is also reflected in the Japanese word for 'development,' *kaihatsu.* It derives from classical Chinese and has been in use since the seventeenth century to describe the process of clearing land for new rice fields, which usually implied constructing infrastructure for irrigation as well.[20] From the Meiji period onwards, *kaihatsu* became equivalent to the English word 'development.'[21] *Kaihatsu* then also became used in the context of "developing" colonies, first during the incorporation and agricultural colonization of Hokkaidō, which began in the

Language and Political Reason in Nineteenth-Century Japan (Honolulu: University of Hawai'i Press, 2002).

River engineering technologies such as, for example, bamboo nets filled with stones (similar to gabions) used to construct levees or to weigh down wooden devices for regulating river flow, can be traced to ancient Chinese ancestors but were locally adapted, which can be seen local variants with their own names. See Masakazu Ishizaki, "Jakago ni kansuru rekishiteki kōsatsu," [A Historical Study on Gabion] *Nihon Dobokushikenkyū Happyōkai Ronbunshū* 7 (1987): 253–58; Tadashi Miyamura, *Suigai: Chisui to suibō no chie* (Tokyo: Chūō Kōronsha, 1985), 60–64. For an overview on premodern Japanese river engineering, see for example Conrad Totman, "Preindustrial River Conservancy: Causes and Consequences," *Monumenta Nipponica* 47, no.1 (1992): 59–76; Kōchi Yamamoto, *Kasen teibō no gijutsushi* [The history of river embankment technology] (Tokyo: Gihōdō Shuppan, 2017), 5–93.

18 For an overview on early modern river control see Roderick I. Wilson, *Turbulent Streams: An Environmental History of Japan's Rivers, 1600–1920* (Leiden, Boston: Brill, 2021), 91–122; Yamamoto, *Kasen teibō no gijutsushi*, 33–43. For the ecological consequences of developing new rice fields see Kōichi Takei, *Edo Nihon no tenkanten: Suiden no gekizō wa nani o motarashita ka* [The turning point of Edo Japan: What did the dramatic increase of paddy fields cause] (Tōkyō: NHK shuppan, 2015).

19 For an overview on agricultural policies and development in Ming-Qing China see Shaohua Zhan, *The Land Question in China: Agrarian Capitalism, Industrious Revolution, and East Asian Development* (London, New York: Routledge, 2019), 19–35.

20 Zen'ichi Itō, "Kaihatsu," in *Nihon hyakka zensho (Nipponica)*, vol. 4, ed. Shōgakukan (Tokyo: Shōgakukan, 1984): 683–84.

21 F. Brinkley and Nanjō, F., Iwasaki, Y., eds., *An Unabridged Japanese-English Dictionary* (Tōkyō: Sanseidō, 1896), 532.

1870s.[22] As Japan established its colonial empire between the late nineteenth and early twentieth centuries, *kaihatsu* was also used to refer to imperial colonization in Taiwan, Korea, and Manchuria.[23] In the postwar period, the term gained a new layer of meaning as the concept of development, which was adapted from the US. *Kaihatsu* began to denominate a policy program driven by a comprehensive vision. This shift occurred when comprehensive regional development became integral to Japanese national policy planning. Since 1962, Japan has issued a national planning program approximately every ten years called the 'National Comprehensive Development Plan' (*zenkoku sōgō kaihatsu keikaku*), which outlines a future vision of the country's development, comprising infrastructure, regional economic planning, and environmental considerations.[24]

As is evident from the evolving meaning of *kaihatsu*, economic development and policy are closely entangled with the transformation of the environment in Japan, which in turn is strongly connected to technology. On the one hand, despite the romanticized and often nationalist notions and self-descriptions of "living in harmony with nature", Japan's relationship with nature has been characterized by historians of Japan as interventionist. Tessa Morris-Suzuki, for example, has argued that precisely because Japanese thinkers identified humans as the "crowning glory of a rich and benign natural order," it was the duty of humans to keep nature in order and unlock its riches. Natural beauty is thus strongly correlated with cultivation and management.[25] River engineering technology was a central means through which the Japanese interacted with their environment, mainly to obtain agricultural riches, especially since the early modern period, when the reclama-

22 Itō, "Kaihatsu," 4; Yoshinori Hisamatsu, *Hokkaidō shinsaku* [New strategies for Hokkaidō] (Sapporo: Maeno Chōhatsu, 1892), 67; Tetsuo Enami, *Hokkaidō kaitakuron gairyaku* [Summary of the theory of colonizing Hokkaidō] (Tokyo: Enami Tetsuo, 1882), 7.

23 For example, Katsutami Kobayashi, *Taiwan keieiron* [Theory on managing Taiwan] (Tokyo: Hori Usaburō, 1902), 34–42; Anonymous, "Chōsen kaihatsu no daiippo," [The first step of developing Korea] *Tōyō jihō*, no. 150 (1911); Noboru Harada, *Manshū kaihatsu 15 nenshi* [15 year account of developing Manchuria] (Tokyo: Kaigai Keizai Tsūshinsha Henshūbu, 1921).

24 Ministry of Land, Infrastructure, Transport and Tourism, "Zenkoku sōgō kaihatsu keikaku (gaiyō) no hikaku," [The comparison between the national comprehensive development plans (summary)], accessed April 3, 2025, https://www.mlit.go.jp/common/001116820.pdf. Japanese regional planning originally derived from the German *Landesplanung* during World War II, but it got adapted through the influence of the American TVA program, as will be discussed in more detail below. See also Yoshihito Honma, *Kokudo keikaku o kangaeru: Kaihatsu rosen no yukue* [Thinking of the national plan: The future route of development] (Tokyo: Chūō Kōron Shinsha), 1–8.

25 Tessa Morris–Suzuki, "The Environment in Japanese Economic History," *Asian Studies Review* 14, no.1 (1990): 80–87; Tessa Morris-Suzuki, "Concepts of Nature and Technology in Pre-Industrial Japan," *East Asian History* 1, no.1 (1991): 81–97.

tion of new rice fields required the construction and maintenance of many irrigation channels.

Conrad Totman argues that beginning around 1700, the cutting of forests and expansion of agriculture by land reclamation upstream significantly increased sediment intake into the rivers, forcing villagers into a constant fight against floods by maintaining and dredging rivers and canals.[26] In addition, in traditional water control, organic materials such as wood, bamboo, and reed were used to construct weirs, groins, and other technologies for controlling river flow. These were prone to decay and destruction by floods.[27] Thus, constant maintenance and care were necessary to keep early modern cultivated landscapes functioning. The introduction of modern Western technology, as Philip C. Brown has shown in his case study of the construction of a large-scale irrigation channel in Niigata, promised a level of river control not possible in earlier periods. Despite this, the vision of how to alter the river system remained the same: constructing a diversion channel to drain the lowland of the Shinano River. However, it was only with the advent of Western technology that the drilling of the Ōkozu Diversion Channel through a small mountain range and the distribution of the mighty Shinano River using large-scale weirs was realized. When it finally became operational in the 1930s, it turned the Niigata Plain into one of the most productive rice baskets in Japan.[28] Therefore, there is a continuity in thought that water control technology and its constant care are needed for agricultural gains.

On the other hand, the Japanese experienced numerous extreme natural phenomena, such as earthquakes, tsunamis, typhoons, floods, and landslides, which instilled a sense of fear and veneration of nature as an unpredictable force. This has also led to a strong preoccupation with how to avoid disasters, which in the modern period mainly involved enlisting the help of science and technology.[29] The "disastrous" nature of Japan was seen as exceptional compared to West-

26 Totman, "Preindustrial River Conservancy." Takei Kōichi also makes a similar argument. Takei, *Edo Nihon no tenkanten*, 226–62. Ōkuma Takashi argues that Edo period people closely monitored the river's flows and frequently adapted river engineering works accordingly (for example, they punctually destroyed levees to ease flood energy), Takashi Ōkuma, *Kōzui to chisui no kasenshi: Suigai no seiatsu kara juyō e* [The river history of floods and water governance: From the suppression of floods to acceptance] (Tokyo: Heibonsha, 2007), 103–14.

27 Takei, *Edo Nihon no tenkanten*, 247–254.

28 Philip C. Brown, "Floods, Drainage, and River Projects in Early Modern Japan: Civil Engineering and the Foundations of Resilience," in *Environment and Society in the Japanese Islands: From Prehistory to the Present*, ed. Bruce L. Batten and Philip C. Brown (Corvallis: Oregon State University Press, 2015): 96–113.

29 Julia Mariko Jacoby, "Disaster Prevention in Japan 1885–1978: Natural Disasters, Scientific Expertise, and Global Transfers of Knowledge," (unpublished manuscript, 2021); Itoko Kitahara,

ern countries. Knowledge and technology produced in contexts of disasters were thus seen as a niche where Japan, as a scientific nation, could compete.[30] New voices in the history of environment and technology, like Sara B. Pritchard and Carl A. Zimring, have emphasized the importance of attending to the close entanglement between environment and technology and treating them as an "envirotechnical" entity, instead of viewing technology as something that can be universalized and separated from its environmental context.[31] But in the case of analyzing development, the entanglement goes beyond environment and technology and includes questions about how policies are decided and implemented, as well as the role played by international economic and political trends. Following the ideas laid out in the writings of new materialism, especially in Jane Bennet's *Vibrant Matter*, I look at entanglements and assemblages of both material and immaterial things, including the environment, technology, bureaucracy, the generation of political decisions, and practices of knowledge production and adaptation.[32]

This chapter, therefore, brings together literature that has only recently started to intersect due to its disparate nature. The close relationship between engineering bureaucrats and the state, and their strong influence on policies, has drawn the attention of political historians. For example, describing Japan as a "construction state," Gavan McCormack unfolds the postwar connection between politics, bureaucracy and the construction industry, highlighting how this closeness has fueled the subsidizing of infrastructure projects, including those involving rivers.[33] Meanwhile, Patricia Sippel diagnoses the establishment of *chisui* as a "sacred domain" of the Japanese state since the early modern period, emphasizing its endurance and the seeming impossibility to challenge policies that heavily rely

ed., *Nihon saigaishi* [Disaster history of Japan] (Tokyo: Yoshikawa Kōbunkan, 2006); Tekunoba Saigai Kenkyū Project, *Kindai Nihon no saigai: Meiji, Taishō, Shōwa no shizen saigai* [Disasters of modern Japan: Natural disasters of the Meiji, Taishō, and Shōwa periods] (Tokyo: Tekunoba, 1993).

30 Julia Mariko Jacoby, "Learning from the Earthquake Nation: Japanese Science Diplomacy in the 20th Century," *Journal of Contemporary History* 56, no.3 (2021): 485–501; Kenji Itō, "The Question of Research in Prewar Japanese Physics," in *Science, Technology, and Medicine in the Modern Japanese Empire*, ed. David G. Wittner and Philip C. Brown (London: Taylor and Francis, 2016): 193–210.

31 Sara B. Pritchard and Carl A. Zimring, *Technology and the Environment in History*, Historical Perspectives on Technology, Society, and Culture (Baltimore: Johns Hopkins University Press, 2020).

32 Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, London: Duke University Press, 2010).

33 Gavan McCormack, "Growth, Construction, and the Environment: Japan's Construction State," *Japanese Studies* 15, no.1 (2008): 26–35.

on engineering, while also pointing to their exploitative nature and neglect of local interests.[34] Most literature, however, is limited to the realm of policy making and explores how water control shaped governance and bureaucracy.[35] There is also a body of literature on the fight of engineers for political influence in the interwar period, which has recently been contextualized within the global rise of technocrats and their contribution to World War II.[36] These studies usually do not engage with the specific technologies that the engineering bureaucrats used in policy designs. Instead, such discussions are mostly found in histories of technology written by engineers themselves or science journalists with engineering backgrounds. In Japan, these works are meticulously researched but are often written to support a political agenda or display an uncritical attitude towards technologies and their protagonists.[37] Only recently has river engineering in Japan been studied at the intersection of political history, the history of technology, and the environment, in works by Roderick I. Wilson, Eric Dinmore, and Aaron S. Moore, and in Japanese, Kajiwara Kenji and Nakamura Shin'ichirō.[38] However, their research has largely concentrated on the history of rivers and dams and mostly neglected the integral role of erosion control in river engineering in Japan.

34 Patricia Sippel, "Chisui: Creating a Sacred Domain in Early Modern and Modern Japan," in *Public spheres, private lives in modern Japan, 1600–1950: Essays in honor of Albert M. Craig*, ed. Albert M. Craig et al. (Cambridge, MA: Harvard University Asia Center, 2005): 153–184.

35 Ryōsuke Maeda, *Zenkoku seiji no shidō: Teikoku Gikai kaisetsugo no Meiji kokka* [The beginnings of national politics in modern Japan: The Meiji state reform under the parliamentary system, 1890–1898] (Tokyo: Tōkyō Daigaku Shuppankai, 2016); Takashi Mikuriya, *Seisaku no sōgō to kenryoku: Nihon seiji no senzen to sengo* [Comprehensiveness and power in policies: Prewar and postwar in Japanese politics] (Tokyo: Tōkyō Daigaku Shuppankai, 1996).

36 Ōyodo, *Gijutsu kanryō no seiji sankaku*; Wakatsuki, *Senzen Nihon no seitō naikaku to kanryōsei*; Mimura, *Planning for Empire*; Erich Pauer, "Die Mobilisierung der Ingenieure in der Zwischenkriegszeit: Von der Technokratie zum ‚wissenschaftsgeleiteten Industrialismus' (kagakushugi kôgyô)," *Nachrichten der Gesellschaft für Natur- und Völkerkunde Ostasiens* 175–176 (2004): 93–128.

37 Some well-written examples are Ōkuma, *Kōzui to chisui no kasenshi*; Shigeki Matsuura, *Senzen no kokudo seibi seisaku* (Tokyo: Nihon Keizai Hyōronsha, 2000).

38 Japanese names are given in their original order in this chapter, with the family name first, but kept in the "Western" order in the footnotes for uniformity. Moore, *Constructing East Asia*; Dinmore, "Concrete Results?"; Wilson, *Turbulent Streams*; Kenji Kajiwara, *Sengo kasen gyōsei to damu kaihatsu: Tonegawa suikei ni okeru chisui, risui no kōzōtenkan* [Postwar river governance and dams: The structural changes in the flood control and water use in the Tone River system] (Kyoto: Mineruva Shobō, 2014); Shin'ichiro Nakamura, *Floods and Probability: A Technological and Social History of Design Flood* (Tokyo: Tōkyō Daigaku Shuppankai, 2021).

3 Between knowledge adaptation and inventing tradition: Establishing water control in modern Japan

When the new modern Japanese state implemented its fundamental reform program in the late nineteenth century to "enrich the nation and strengthen the army," river engineering also played an important part, mainly because of its role in transportation and trade. As a consequence, the early Meiji state heavily invested in river engineering with the goal of facilitating navigation.[39] In these projects, the government relied on Western expertise, which was expensive at that time, highlighting the importance of river engineering.[40] In contrast, river engineering for flood control and agricultural purposes was, in continuation of early modern practices, at first left to local governments and village communities.[41] Importing knowledge from the West was achieved in two ways: Hiring foreign experts (*oyatoi*) or sending Japanese students abroad, which was both sponsored mainly by the government because of the high cost. The government hired foreign experts from various Western countries to build up projects and to teach Japanese on the spot. The selection process was carefully conducted: the criteria used were a blend of identifying the most prolific nation in a given field, ensuring compatibility with Japanese needs, and balancing the influence exerted by the Western powers.[42] The Home Ministry, which oversaw river engineering, hired mainly Bri-

39 Fumi Ashina, "Meijiki no kasen seisaku to gijutsu mondai: 'Teisui kōji kara kōsui kōji e' zushiki o megutte," [The river engineering policy and technology problem of the Meiji period: On the schema "from low water construction to high water construction"] *Shigaku zasshi* 115, no.11 (2006): 1831–1863.

40 Construction in Western style in the 1870s and 80s did not only require experts in Western knowledge but also the use of modern materials, which were acquired via the networks of the Western experts and provided profit to their home countries. See for example Kazumasa Iwamoto, "Orandajin dobokugishi Mulder no sekkei rinen: Oranda de hakken shita shinshiryō o chūshin to shite," [The design philosophy of Dutch engineer Mulder: Concentrating on new sources discovered in the Netherlands] *Dobokushi kenkyū kōenshū* (2019): 173–78; Kristin Meißner, "Responsivity within the Context of Informal Imperialism: Oyatoi in Meiji Japan," *Journal of Modern European History* 14, no.2 (2016): 268–289.

41 Maeda, *Zenkoku seiji no shidō*, 102; Takumi Yamashita, "Tenryū gawa karyū chi'iki ni okeru suibō kumiai katsudō to sono keizaiteki kiban: Meiji kara Shōwa senzenki o chūshin to shite," [The activities and the economic base of the water defense associations: With emphasis from the Meiji to the prewar part of the Shōwa period] *Rekishi chirigaku* 42, no.1 (2000): 64–83.

42 Ardath W. Burks, ed., *The Modernizers: Overseas Students, Foreign Employees, and Meiji Japan* (Boulder: Westview Press, 1985); Edward R. Beauchamp and Akira Iriye, *Foreign Employees in*

tish engineers because of their expertise in railroad construction. River engineering, however, was dominated by Dutch engineers.[43] The choice to hire Dutch has been debated in the literature. During a government expedition in the 1870s, the Japanese chronicler Kume Kunitake (1839–1931) remarked on the flat Dutch topography and considered it unsuitable as a model for Japan, characterized by steep mountains. However, it is understandable that the Meiji government turned to the Dutch, as they at first prioritized building harbors and engineering rivers for transportation.[44] The Dutch, long renowned for their expertise in civil engineering and water control, had a solid education system in place for water engineers and were internationally sought-after experts in the field.[45] In addition, the Netherlands was a minor imperial power compared to Britain, which enabled the Japanese administration to exert control over the direction and budget of infrastructure projects.[46]

Nevertheless, it was a priority for the Japanese government to quickly replace foreign hires with domestic experts. Thus, an education system was introduced. Foreign experts taught higher engineering education first at the Kobu Daigakko, which in 1886 became part of the Imperial University of Tokyo. Tokyo University became the elite institution for teaching Japanese bureaucrats, and later, the tight-knit community of Tokyo University graduate engineers came to dominate water control policies.[47] When engineers entered the Home Ministry, they could gain the opportunity to be sent abroad for studies. Later influential engineering bureaucrats in river engineering, such as Okino Tadao (1854–1921) and Furuichi Kōi (1854–1934), studied in France.[48]

Nineteenth Century Japan (Boulder: Westview Press, 1990); Meißner, "Responsivity within the Context of Informal Imperialism."

43 Kiyoko Toda, "Kōbushō ni okeru oyatoi gaikokujin: Meiji zenki Nihon no gijyutsu dōnyū o megutte," [The foreign experts at the Ministry of Public Works: On the import of technology in early Meiji Japan] *Nara Kenritsu Daigaku Kenkyū Kihō* 13, no.4 (2003): 27–36.

44 Kunitake Kume, *Tokumei zenken taishi beiō kairan jikki* [A true account of the ambassador extraordinary and plenipotentiary's journey of observation through the United States of America and Europe] (Tokyo: Hakubunsha, 1878), 235–290.

45 Karel Davids, ed., *The Rise and Decline of Dutch Technological Leadership: Technology, Economy and Culture in the Netherlands, 1350–1800,* History of Science and Medicine Library, Knowledge Infrastructure and Knowledge Economy 7, vol. 1 (Leiden: Brill, 2008).

46 Iwamoto, "Orandajin dobokugishi Mulder no sekkei rinen"; Shigeki Matsuura and Yoshiyuki Kamibayashi, "Orandajin gijutsusha to igirisujin gijuchusha no kakushitsu: De Rēke (Johannis de Rijke) to Pāmā (Henry Spencer Palmer) o chūshin ni," [The feud between Dutch engineers and British engineers: Concentrating on de Rijke (Johannis de Rijke) and Palmer (Henry Spencer Palmer)] *Suiri Kagaku* 37, no.4 (1993): 25–51.

47 Ōyodo, *Gijutsu kanryō no seiji sankaku,* 22–27.

48 Wilson, *Turbulent Streams,* 150–55.

The decisions on infrastructure projects, however, lay with the bureaucrats of the Home Ministry who were graduates of law, and not engineering. Japanese historian Ōyodo Shōichi argues that this served to keep the decisions on water infrastructure in the hands of the government and limit foreign influence.[49] Dutch expert Johannis de Rijke (1842–1913), who worked in Japan from 1873 to 1903, staying longer than his compatriots, often complained in his letters about the difficulties of dealing with the Japanese bureaucrats.[50] In the 1870s and 1880s, trade ports and transport channels were built all over Japan. The most popular technology learned from the Dutch were 'groins' (in Dutch *kribben*, and in Japanese *kereppu*), structures built into the riverbed to stabilize the flow and deepen the channels for navigation. Similar structures had already existed in the Edo period, albeit made with less durable organic materials. *Kereppu* were built all over Japan, including in unsuitable places, which might have contributed to later attacks of local stakeholders on the government's prioritization of 'low water' (*teisui*) construction downstream.[51] To manage flood control, diversion channels were built to eliminate the excess water. This was in continuation of Edo-period practices, as historian Philip C. Brown describes in the case of the aforementioned Ōkozu Diversion Channel, which was initially planned in the Edo period but was only realized with modern technology, against warnings by Dutch engineers.[52]

This does not mean that the Dutch engineers only concentrated on "low" construction downstream. Johannis de Rijke also lobbied for erosion control for his river projects and acquired knowledge from Dutch books that he asked friends to obtain, thus learning from knowledge generated in the Dutch Indies.[53] As he spent most of his professional career in Japan, he also gained and generated new knowledge on-site. Often facing budgetary constraints, he incorporated existing knowledge and practices, creating pidgin knowledge.[54] For example, he worked with Ichikawa Yoshikata, who had served as an engineer for erosion control for Kyoto prefecture and later authored a treatise on water control.[55] They

49 Ōyodo, *Gijutsu kanryō no seiji sankaku*, 26–27.

50 A collection of de Rijke's letters can be found in Louis van Gasteren, *In een Japanse stroomversnelling: Berichten van Nederlandse watermannen rijswerkers, ingenieurs, werkbazen 1872–1903* (Amsterdam, Zutphen: Euro Book; Walburg Pers, 2000), 473–516.

51 Ashina, "Meijiki no kasen seisaku to gijutsu mondai."

52 Brown, "Floods, Drainage, and River Projects in Early Modern Japan."

53 van Gasteren, *In een Japanse stroomversnelling*, 344–345.

54 Pidgin knowledge denominates knowledge amalgamated from various sources. The term was coined by historian Harald Fischer-Tiné for colonial contexts, see Harald Fischer-Tiné, *Pidgin-Knowledge: Wissen und Kolonialismus* (Zurich: Diaphanes, 2013).

55 Yoshikata Ichikawa, *Suiri shinpō* [The real treasure of hydrology] (Tokyo: Suirikan, 1896). In this treatise, Ichikawa criticizes Dutch erosion control dams as not stable enough.

collaborated to build erosion control dams, structures meant to retain sediment and prevent it from blocking the rivers, which were already common in the Edo period.[56] In de Rijke's works conducted at the Jōganji River, the river with the steepest gradient in Japan, he incorporated existing open levees, so-called *kasumitei*, into his reconstruction plans after a devastating flood in 1891. *Kasumitei* were discontinuous levees that allowed overflowing water in regular intervals to flow backwards, thereby reducing its destructive energy and utilizing the deposits brought by flooding.[57] De Rijke also published a Dutch treatise on this river project, where he described the incorporation of traditional woven baskets made from bamboo or willow branches, filled with stones, into the design of his levees.[58] These *jakago*, which derived from Chinese flood control technology, were widely used in early modern water control.[59] De Rijke likely created these pidgin designs through conversations with local officials and workers from the rural prefecture of Toyama.

Paradoxically, this incorporation of vernacular knowledge did not quell the rhetoric that, because of the Netherlands' flat topography, Dutch engineers were ill-equipped to deal with Japan's steep and fast rivers. This opinion was also echoed by leading engineering bureaucrats, who had gained influence over water control policies by the 1880s and 1890s.[60] Rather, the situation further fueled the Japanese engineers' argument that Dutch engineers were not skilled enough in modern technology.[61] In the first large-scale river construction endeavor undertaken by the government as a response to a devastating flood in 1885, de Rijke's design was discarded in favor of Okino Tadao's. Okino's design was similar to de Rijke's in many ways, with one notable exception. Whereas de Rijke had proposed to use an existing wetland lake as an overflow reservoir, Okino proposed to construct a large weir on the Biwa Lake, which was the main source of the Yodo

56 Wilson, *Turbulent Streams*, 146–148. In local administrations, practices from the Edo period were carried over to the Meiji period. In the Edo period, there were already bureaucrats tasked with erosion control, who oversaw afforestation and the construction of erosion control dams. Kunihiko Mizumoto, *Doshadome bugyō: Kasen saigai kara chiiki o mamoru* [The gravel stopping magistrates: Protecting the countryside from river disasters] (Tokyo: Yoshikawa Kōbunkan, 2022).
57 Norikazu Ichikawa, "De Rijke no Jōganjigawa kaishū kōji ni okeru gijutsu," [De Rijke's technologies used at the Jōganji River improvement construction] *Dobokushi kenkyū*, no.20 (2000): 117–128.
58 Johannis de Rijke, "Banjirs en vloeden in Japan," *De Ingenieur* 15, no.36 (1900): 544–548.
59 Ishizaki, "Jakago ni kansuru rekishiteki kōsatsu."
60 Yasuo Itō, "Ranjin yōkōshi to sono chisui shisō," [The hired Dutch engineers and their water control thought] *Kyōto rekishi saigai kenkyū*, no.2 (2004): 1–5, here 4.
61 Iwamoto, "Orandajin dobokugishi Mulder no sekkei rinen."

River.[62] Okino's choice not only demonstrated that his design relied more heavily on modern technology, but also indicated that Japanese engineers were beginning to address the growing demand for solutions that would not only stabilize canals downstream, but also retain water upstream to prevent it from overflowing downstream.

Despite de Rijke's efforts to promote erosion control, Dutch technology became a popular target of criticism during a debate advocating for flood control measures upstream through afforestation and erosion control instead of through fortifying channels downstream. This debate unfolded as a result of floods in the 1880s and was part of the larger struggle of the local educated elite seeking political participation.[63] As there was no national system of water control regulation and funding in place, and the responsibility for water control construction was shouldered by local governments and communities, the debate about water control became an important vehicle to bring local concerns into the political arena.[64] This included requests for central government funding for larger flood works and criticism of the water construction policies of the government, which concentrated on building navigable channels and constructing levees.[65] This critique was partly focused on the reliance on foreign technologies. For example, Nishi Moromoto, a local journalist in Toyama prefecture, reacting to the aforementioned Jōganji River construction, criticized officials for using the technology of de Rijke despite the fact that his levees were not sufficiently strong. [66] According to him, foreigners' inexperience with Japanese nature led them to overlook the real problem of sediment overload. This problem had been exacerbated by deforestation in the nearby mountains in recent years, which occurred as forestry regulations

62 Wilson, *Turbulent Streams*, 172–183; Shigeki Matsuura, "Meiji no Yodogawa kaishū keikaku: De Rijke kara Okino Tadao e," [Yodo River improvement project for flood prevention in the Meiji era: From de Rijke to Okino Tadao] *Doboku gakkai ronbunshū*, no.425 (1991): 213–220.

63 Ashina, "Meijiki no kasen seisaku to gijutsu mondai"; Michael Lewis, *Becoming Apart: National Power and Local Politics in Toyama, 1868–1954* (Cambridge, MA: Harvard University Press, 2000), 74–117. For the Freedom and People's Rights Movement, see Gordon, *The Modern History of Japan*, 80–85; Yūsaku Matsuzawa, *Jiyū minken undō: Demokurashī no yume to zasetsu* [The Freedom and People's Rights Movement: A dream of "democracy" and its failure] (Tokyo: Iwanami Shoten, 2016).

64 Maeda, *Zenkoku seiji no shidō*, 100–114; Lewis, *Becoming Apart*, 75–76.

65 Ashina, "Meijiki no kasen seisaku to gijutsu mondai."

66 Ichirō Kaibara, "Chisan chisui – suiri no koten kaisetsu: Nishi Moromoto cho 'Chisuiron' ni tsuite," [Commentary on classic literature on mountain and water governance – water use: On the 'Treatise on water governance' by Nishi Moromoto] *Suiri Kagaku* 1, no. 2 (1957): 76–86.

were disrupted when the regime changed. Pointing to forestry regulations in Europe, Nishi demanded their reform in Japan.[67]

As in the case of the Toyama journalist, local intellectuals and stakeholders involved in water construction joined the debate to advocate for prioritizing flood control at the national level. The Imperial Diet, the Japanese parliament introduced in 1890 to appease the demands for political participation, became the main forum for these discussions. While figuring out how to navigate the parliamentary system, local delegates from flood-stricken regions formed a political alliance during the 1890s. They submitted petitions to the government and established an association with a magazine that aimed to promote knowledge about water control. Leading engineering bureaucrats also supported the group.[68] The knowledge promoted in the magazine included information on recently conducted water construction works and treatises by Dutch experts, but also reprinted Edo-period knowledge about water control and erosion control.[69] The group's lobbying led to the implementation of river engineering projects for the six major rivers under the central government's control. Following a major flood in 1910, this was later expanded to include fifty-six rivers, although not all of these projects were carried out.[70] The importance of controlling floods upstream in the mountains was acknowledged in the passing of the so-called "three water control laws," which consisted not only of the Water Control Law (1896) but also the Forest Law and the Erosion Control Law (both 1897).

The construction on the major rivers included building continuous levees and creating a distinction between the riverbanks, which were designated public land, and settlements.[71] Only a few critics spoke out against levees as potentially harmful. Odaka Atsutada (1830–1901), an entrepreneur without engineering training, criticized the reliance on levees. He argued that building levees would only lead to a race to build even taller ones and eventually render the river more dangerous by increasing the river's velocity. Quoting a classic Chinese text from the Western Han Dynasty (202 BCE- CE 9), the *Three methods of Jia Rang*, he stated that rivers needed space to meander.[72] In this context, Odaka presented an Eastern tradition

67 Moromoto Nishi, *Chisuiron* [Treatise on water governance] (Toyama: Seimeidō, 1891).

68 Wilson, *Turbulent Streams*, 206–212; Maeda, *Zenkoku seiji no shidō*, 104.

69 A full reprint of the magazine can be found in Tadashi Miyamura and Masakazu Ishizaki, eds., *Nōgyō doboku koten senshū Meiji – Taishōki 8 kan: Chisuiron* [Selected classics of irrigation engineering Meiji – Taishō period vol. 8: Treatises on water governance] (Tokyo: Nihon Keizai Hyōronsha, 1989–1991).

70 Wilson, *Turbulent Streams*, 212–216, 225.

71 Wilson, *Turbulent Streams*, 225–38.

72 Atsutada Odaka, *Chisui shinsaku* [New policy in water governance] (Tokyo: Odaka Jirō, 1891).

of river engineering, although he does not refer to water engineering during the Edo period, which already made heavy use of levees. His analysis, however, points to a growing trend in the 1880s to reappraise "traditional" knowledge based on Chinese learning as the core of Japanese identity.[73]

In the case of erosion control and forestry, continuities from the Edo period were explicitly drawn. Towards the end of the seventeenth century, silviculture had developed in Japan, after heavy extraction during the civil war period, and the development of new fields, which had both taken a heavy toll on forests.[74] Deforestation, sediment input into the rivers and flooding were recognized as interconnected issues early on in Japan, in the middle of the seventeenth century, especially in the heavily logged mountains around the Seto Inland Sea, where the rivers are short and the granite bedrock is prone to erosion.[75] In response, the shōgunate and local domains enacted logging bans, initiated afforestation and built erosion control dams.[76] Kumazawa Banzan, a neo-Confucian thinker who also advised on the policies of the Okayama domain at the Seto Inland Sea, wrote treatises about the necessity to protect the forests for water control. These treatises were rediscovered and promoted by Okayama Prefecture erosion control specialist Uno Enzaburō (1834–1911). Uno petitioned and worked to reintroduce erosion control in Okayama in 1882, which had been neglected in the early Meiji period, and thus became an influential figure for erosion control in Japan.[77] As a consequence, erosion control became established and seen as a Japanese tradition.

Forestry was learned in Japan from German *oyatoi.* However, they were invited in the mid-1880s, later than the river engineers, presumably because agricul-

73 Especially in education, Confucian moral education was deemed as providing necessary values which could not be replaced by Western education. Western individualism was constantly criticized as harmful to Japanese society. See Howland, *Translating the West*, 55–60; Harry D. Harootunian, *Overcome by Modernity: History, Culture, and Community in Interwar Japan* (Princeton, N.J.: Princeton University Press, 2002), 53–54.

74 Totman, *The Green Archipelago.*

75 Tokuji Chiba, *Hageyama no kenkyū* [The research on denuded mountains] (Tokyo: Soshiete, 1991), 41–55.

76 Totman, *The Green Archipelago*, 81–115, 130–148; Mizumoto, *Doshadome bugyō.*

77 Okayamaken Nōrin Suisanbu Chisanka, "Okayama ken chisanjigyō no ayumi: Hageyama taisaku," [The development of the mountain governance project in Okayama Prefecture: Measures against mountain denudation] *Sabō gakkaishi* 53, no. 2 (2000): 66–69. Uno republished Kumazawa's writings on mountain governance by erosion control: Banzan Kumazawa, *Chisui shokurin hongenron* [Water control afforestation: The treatise on fountains], ed. Enzaburō Uno (Okayama: Nozaki Mataroku, 1904).

ture was less prioritized by the Meiji state.[78] The interest in forestry for erosion control clearly guided the adaptation of knowledge afterwards. Most notably, the German forester Karl Hefele (1863–1904) was dismissed due to his lack of knowledge of erosion control, and Austrian Amerigo Hofmann (1875–1945) was invited instead between 1904 and 1909. He conducted experiments on afforestation and erosion control, and later, applied the knowledge he acquired to Italy. The reasoning was that Germany did not have enough high mountains prone to erosion. Thus, the Japanese turned to experts from the Austro-Hungarian Empire instead.[79] Notable pioneers of erosion control technology (*sabō*) who studied in Vienna included, for example, Akagi Masao (1887–1972), who lobbied for erosion control in the interwar and postwar periods.[80] Although knowledge was adapted from Europe, erosion control was perceived as a technology with a strong national tradition that was acknowledged by their European peers. "Mountain governance" was built into the overall idea to manage river systems in a comprehensive manner. The Forestry Law stipulated the establishment of flood protection forests. From the early twentieth century, the government promoted science-backed afforestation campaigns.[81] Erosion control became an increasingly important aspect of flood control during the twentieth century because of the constant lobbying by engineering bureaucrats, especially Akagi Masao.[82]

78 The Meiji state had mostly invested in infrastructure and a few key industries such as heavy industry or silk and cotton production, but failed to address local demand for research in agriculture and manufacture. This only shifted in the 1880s with the growing demand for political participation from rural intellectuals. See Gordon, *The Modern History of Japan*, 71–72, 83 and Tessa Morris-Suzuki, *The Technological Transformation of Japan: From the Seventeenth to the Twenty-First Century* (Cambridge: Cambridge University Press, 1994), 98–103. For the development of forestry in Japan, see Jun'ichi Iwamoto, "The Development of Forestry in Japan," in *Forestry and the Forest Industry in Japan*, ed. Yoshiya Iwai (Vancouver B.C.: UBC Press, 2002): 3–9.

79 Haruo Nishimoto, "Tokyō teikoku daigaku sabō kōya gaikokujin kyōshi, Amerigo Hofmann no gyōseki ni tsuiteno ichi kōsatsu," [A consideration on footprint of Amerigo HOFMANN, foreign professor of SABO laboratory, the Imperial University of Tokyo] *Sabō gakkaishi* 70, no. 5 (2018): 24–33; Hiroshi Koide, Takeo Satō and Ichirō Kaibara, *Nihon no suigai: Tensai ka jinsai ka* [Flood disasters in Japan: Heaven-sent or man-made disasters?] (Tokyo: Tōyō Keizai Shinpōsha, 1954), 187–190, 197–198.

80 Masao Akagi, *Sabō ichiro* [One way to erosion control] (Tokyo: Zenkoku Chisui Sabō Kyōkai, 1963), 32–33.

81 Tarō Takemoto, "A History of Tree Planting in Modern Japan: Resource Utilization and Environment Conservation," in *Handbook of Environmental History in Japan*, ed. Tatsushi Fujihara (Amsterdam: Amsterdam University Press, 2023): 233–251, here 242–244.

82 Akagi, *Sabō ichiro.*

4 Adapting developmental visions to Japan in the prewar and postwar periods

As a result of the campaigning for river engineering for flood control, the major rivers were subjected to significant readjustments and construction projects, which Wilson refers to as the introduction of the "modern river regime."[83] The river construction works, however, did not proceed as swiftly as the authorities wanted. Historian Mikuriya Takashi blames the dysfunctions of the early twentieth-century water control regime on administrative "sectionalism," which resulted in competing responsibilities and a lack of coordination. For example, while river construction and water control were mainly under the control of the Home Ministry, irrigation ponds and channels were the responsibility of the Ministry of Agriculture. According to Mikuriya, the comprehensive vision of development planning facilitated the coordination of administrative tasks and a pacification of rivalries.[84] These centrally coordinated grand development visions also empowered technically skilled bureaucrats to shape policies.[85] As such, the Japanese engineering bureaucrats also joined the technocratic visions of engineers around the world during that period, who presented large-scale technological projects as solutions for social problems.[86] During the interwar period, Japanese engineering bureaucrats were repeatedly sent abroad by the government to study such projects, especially dam construction.[87] This overseas experience not only shaped ideas about water control policies in Japan, but also especially influenced efforts to build dams to develop the Japanese colonies of Taiwan, Korea, Manchuria, as well as in occupied Chinese territories during World War II after 1937.[88]

The most influential advocate for policies coordinating dam construction projects was the engineering bureaucrat Mononobe Nagaho, who was sent to the US and Europe to study concrete dams in the 1920s.[89] In 1926, he put forward a plan to

83 Wilson, *Turbulent Streams*, 225.

84 Mikuriya, *Seisaku no sōgō to kenryoku*, 97–158.

85 Hiromi Mizuno, *Science for the Empire: Scientific Nationalism in Modern Japan* (Stanford, CA: Stanford University Press, 2009), 43–52.

86 For a global context of large-scale development visions of the 1930s, see David Ekbladh, *The Great American Mission: Modernization and the Construction of an American World Order* (Princeton, NJ: Princeton University Press, 2011), 40–76.

87 Matsuura, *Senzen no kokudo seibi seisaku*, 73, 274.

88 For dam construction of Japan in its colonies, see Moore, *Constructing East Asia.*

89 For a biography of Mononobe, see Kōichi Kawamura, *Mononobe Nagaho: Doboku kōgakkai no kyosei* [Mononobe Nagaho: The great star of the civil engineering world] (Akita: Mumyō Shuppan, 1996).

systematically dam Japanese rivers for flood control, hydroelectricity, water supply, and irrigation.[90] Japan was subjected to much greater rainfall than the Western countries he visited, and had much narrower river valleys. As a result, according to Mononobe, plans for using concrete dams had to be modified from what he had observed in the West. He suggested building several smaller reservoirs on the rivers in a row.[91] Mononobe's vision for development involving concrete high dams was not realized in the interwar period, although dams gained popularity for development in both the colonies and domestically. After a large typhoon in 1934, another river construction program was launched that was expanded to all Japanese rivers. In this context, the TVA, established in 1933, was already a subject of study. The Home Ministry praised the comprehensive river development approach, which consisted of building dams, implementing erosion control and promoting agricultural development, viewing it as a model for Japan. As a result, a development program was implemented in Northeast Japan, which was poor and had recently suffered major crop failures.[92] Many of the plans, including development plans for occupied China after 1937, were not finished or put into practice because of wartime shortages. However, the continuities of the personnel in the administration during the postwar period meant engineering bureaucrats were already experienced with comprehensive river development designs and the use of high dams when they were proposed as a solution to address energy shortages after 1945.[93]

In order to rebuild Japan after the war, the US occupation authorities sent a group of experts, many of them New Dealers, including Edward A. Ackerman (1911–1973), who later served as vice director of the TVA. They cooperated with engineering bureaucrats from Japanese ministries to design development schemes. Ackerman founded the Resources Council, an advisory organ for the Japanese government, which included representatives of engineering bureaucrats from various fields. The council enabled free discussions between US and Japanese experts and fostered knowledge exchange. The TVA was among one the

90 Matsuura, *Senzen no kokudo seibi seisaku.*

91 Nagaho Mononobe, "Chosuiyō jūryoku entei no tokusei narabini sono gōriteki sekkeihō," [The special properties of gravity dams for water control and its technological construction method] *Doboku gakkai zasshi* 11, no. 5 (1925): 995–1157.

92 Naimushō Dobokukyoku, *Kasui tōsei no teishō* [Advocacy for the comprehensive river and water control project] (Tokyo: Naimushō Dobokukyoku, 1935); Tomohiro Okada, "Saigai to kaihatsu kara mita Tōhokushi," in *"Seizon" no Tōhokushi: Rekishi kara tou 3.11*, ed. Masakatsu Okado et al. (Tokyo: Ōtsuki Shoten, 2013): 2–52.

93 Dinmore, "Concrete Results?"

most popular subjects of discussion.[94] Water was one of the few resources that mainland Japan had in abundance.[95] Using dams, the surplus water of the typhoon floods that plagued postwar Japan could be turned into "useful" water that provided a valuable resource. Another reason why the TVA aligned with the Japanese agenda was that it incorporated forestry practices upstream, which aided in flood control and provided wood resources.[96] In 1950, the National Planning Law was enacted, and since then, Japan has issued national planning visions roughly every ten years.[97] In the meantime, ten-year construction programs for "water governance" and "mountain governance" were issued in the ministries to manage the actual work of water control.[98]

The comprehensive vision of the TVA was divided according to the ministries' competencies. Accordingly, the water control visions provided by the TVA were translated into the existing patterns of water control and erosion control that had been established since the Meiji period. They were divided and fragmented according to the engineering bureaucrats' education and ministerial affiliation. Water control and river engineering were primarily the responsibility of civil engineers, while "mountain governance" and erosion control were taught at the faculty of agriculture, creating separate personal networks for "water governance" and "mountain governance." River construction had fallen under the administration of the Home Ministry in the prewar period and the Ministry of Construction in the postwar period. "Mountain governance" through afforestation was under the administration of foresters at the Ministry of Agriculture. Erosion control responsibilities were divided between the Ministry of Construction, which mainly took care of check dams (small dams designed to slow down rivers upstream and catch sediment), and the Ministry of Agriculture, which oversaw hillside works to prevent mountain slides.[99] The administrative "sectionalism" of the prewar period thus continued into the postwar period, meaning in practice that the comprehensive development vision was translated into a multitude of construction projects alongside river systems and afforestation campaigns, allocated across different administrative sections. The construction of dams, the most cru-

94 Satō, *"Motazaru kuni" no shigenron*, 77–93.

95 Robert Y. Grant, *Report of the Natural Resources Section no. 149: River Control and Utilization in Japan* (Tokyo: General Headquarters, Supreme Commander for the Allied Powers, Natural Resources Section, 1951).

96 Aki, *Nihon no suigai*, 124–127, 140–141.

97 Honma, *Kokudo keikaku o kangaeru.*

98 Nakamura, *Floods and Probability*, 81–82.

99 Masao Akagi, Ushimaro Hayao, and Hirotada Gotō, "Zadankai: Sabō to chisan (ge)," [Roundtable: Erosion control and mountain governance 2] *Suiri Kagaku* 4, no. 1 (1960): 121–136, here 125.

cial element of the TVA vision, experienced a boom in the 1960s and 1970s and came under central regulation by the Multipurpose Dam Law in 1957.[100]

The most prominent proponent of the multipurpose dam was Aki Kōichi (1902–1985), who served as vice president of the Resources Council. He was a student of Mononobe Nagaho's and had served as a civil engineer in the Home Ministry. During the war, he had been sent to occupied China and later played an important role in propagating dams for regional development in Southeast Asia.[101] In popular science books, he promoted the idea that postwar floods were caused by overlogging and a lack of investment in river construction.[102] As a solution, he argued that repairing and building levees downstream was necessary for flood prevention, but they could not be built high enough to entirely block out floods. Water also had to be retained upstream in dam reservoirs.[103] The stored water could be used for hydroelectricity, industrial production and irrigation, as Japan was desperate for energy and resources after losing its colonies.[104] Japan had difficulties in the past in building dams because its soil was prone to erosion and as a consequence, the reservoirs would fill up too quickly. To prevent erosion, he assigned afforestation and erosion control an important role.[105] Ultimately, Aki acknowledged the TVA as a model for the comprehensive development of river systems.[106]

Not all engineering bureaucrats supported the vision of engineering rivers from the mountains to their outlets, a topic that was also discussed in public. Geologist Koide Hiroshi (1907–1990), who also served as a member of the Resources Council representing the Ministry of Agriculture, criticized many of the water control measures implemented by the Ministry of Construction. He especially opposed the use of continuous levees and dams, pointing to Japanese traditions of living with river overflow. In a book on *Floods in Japan*, which he co-wrote with Marxist economist Satō Takeo and forest scientist Kai Gen'ichirō, he claimed that blaming deforestation for the floods masked the failures of modern engineering.[107] According to him, Japanese river engineers wrongly adapted Western

100 Kajiwara, *Sengo kasen gyōsei to damu kaihatsu*, 30–48.

101 For a rather uncritical biography of Aki, see Tetsurō Takasaki, *Gekkō wa taiga ni haete: Gekidō no shōwa o ikita mizu no kagakusha Aki Kōichi* [The moonlight is reflecting on the great river: Aki Kōichi, the water scientist who lived through the turbulent Shōwa period] (Tokyo: Kajima Shuppankai, 2005).

102 Aki, *Nihon no suigai*; Kōichi Aki, *Kōzui no hanashi* (Tokyo: Iwanami Shoten, 1952).

103 Aki, *Nihon no suigai*, 133–137.

104 Aki, *Nihon no suigai*, 117–126.

105 Aki, *Nihon no suigai*, 129.

106 Aki, *Nihon no suigai*, 155–160.

107 Koide, Satō and Kaibara, *Nihon no suigai*, 45–50.

knowledge. Continuous levees would lead to fast-flowing rivers with a lot of sediment accumulation in riverbeds and "ceiling rivers" that were more elevated than the surrounding land. These would make breaches and flooding more devastating, because of their high speed and the difficulty in draining the floods afterwards.[108] Adding more dams would only increase the risk of "man-made" disasters, as the results of breached dams were devastating.[109] Vernacular water control strategies, according to Koide, were better equipped to reduce floods and deal with sedimentation. Protection forests at riverbanks protected levees and reduced flood speed. *Kasumitei*, the discontinuous levees that allowed an overflow backwards, which Johannis de Rijke also used, also slowed down flooding and made the water retreat again faster.[110] When a certain amount of overflow was allowed, the fertile sediment could also be used in agriculture. Afforestation was not a universal solution, since the afforestation favored conifer monocultures because of commercial reasons, but these were not ideal for retaining floods.[111] Finally, Koide also argued against the construction of dams, since the fast sedimentation in Japan would quickly render dams useless.[112] Koide concluded that Japan should not treat floods as a problem only to be solved by engineering, but should also address the social and economic problems caused by flooding.[113]

Although some river engineers, especially Ōkuma Takashi (*1942), continued to argue for allowing a certain amount of overflow and living with floods, drawing on traditional flood management practices, the reality was different.[114] Postwar growth and urbanization meant that space in the plains was needed for settlement. It became desirable to keep river channels narrow and to allow less overflow. Engineering historian Nakamura Shin'ichirō has pointed out that the flood protection standards were tied to the national budget in the postwar period to save on levee costs, but the subsequent economic miracle enabled flood protection standards – and levees – to become higher.[115] The problem of sedimentation in dam reservoirs was engineered away, by installing sediment discharge gates, dredging, and especially by promoting "mountain governance" and erosion con-

108 Koide, Satō and Kaibara, *Nihon no suigai*, 71–74, 220–222.
109 Koide, Satō and Kaibara, *Nihon no suigai*, 52–56.
110 Koide, Satō and Kaibara, *Nihon no suigai*, 167–170.
111 Koide, Satō and Kaibara, *Nihon no suigai*, 213–217.
112 Koide, Satō and Kaibara, *Nihon no suigai*, 268–269.
113 Koide, Satō and Kaibara, *Nihon no suigai*, 276–277.
114 Ōkuma, *Kōzui to chisui no kasenshi*.
115 Nakamura, *Floods and Probability*, 173–180.

trol.[116] These were introduced based on Aki Kōichi's and erosion control pioneer Akagi Masao's claims that the problem of sedimentation in dams would be solved by the systematic implementation of afforestation and erosion controls, which were both energetically pursued in the 1950s and 1960s.[117] Erosion control also became an international export for Japan. In 1951, while still under US occupation, soil conservationist Walter C. Lowdermilk (1888–1974) came to observe Japanese erosion control and suggested the use of the Japanese term, *sabō* as an internationalism. It has been employed internationally as a technical term since then.[118]

5 Conclusion

Examining water control in Japan reveals not only complex entanglements between environment, society, and development, but also between globally circulating knowledge on development and vernacular environmental understanding. Contrary to their image of living "in harmony with nature," the Japanese of the modern era have persistently argued for the engineering and control of nature, attributing natural disasters to the neglect of river engineering or the "devastation" of mountain forests. Care of the environment was strongly tied to technology, which had to be adapted to the Japanese environment. Engineering bureaucrats in Japan never tired of emphasizing how different (and more difficult) the Japanese environment was compared to Western environments – steeper topography, and more rain and erosion – meaning that technology had to be tailored to the Japanese environment. What was considered "suitable for the Japanese environment" was complex and varied according to the arguments being presented. For example, in the case of nineteenth-century civil engineers, water control technology had to be even more modern and engineered than suggested by the Dutch advisor de Rijke, who was more open to integrating Japanese vernacular knowledge. Erosion control was perceived as a neglected Japanese tradition overlooked by Western technology that was crucial for flood control, while many practices were also learned from Austria. Finally, the argument that Japanese vernacular practices were more suitable for dealing with floods gained traction in light of

116 Damu kōgakukai Kinki-Chūbu wākingu gurūpu, *Damu no kagaku: Shirarezaru chōkyodai kenzōbutsu no himitsu ni semaru* [The science of dams: Close in on the secrets of unknown megastructures] (Tokyo: Sofutobanku Kurieitibu, 2012), 186–197; Ministry of Land, Infrastructure, Transport and Tourism, "Omo na taisha taisaku," [The main strategies to get rid of sedimentation], accessed April 4, 2025, https://www.mlit.go.jp/river/dam/taisa/taisa3.pdf.

117 Aki, *Nihon no suigai*, 141; Akagi, Hayao and Gotō, "Zadankai," 129.

118 Akagi, *Sabō ichiro*, 2–3.

a comprehensive development scheme that subjected entire rivers to development, inspired by the TVA, an American development program.

In this way, Japan actively participated in the global movement towards comprehensive development in the nineteenth and twentieth centuries while continually connecting it back to its own traditions and structures. This resulted in a process of development dominated by engineering bureaucrats who, since the reforms of the Meiji period, had overseen the search for and adaptation of knowledge from abroad. In the case of comprehensive river development, the dualism in the perception of the Japanese environment, between plains and steep mountains, became a defining and structuring element. Starting with the debate over "low" and "high" water construction in the late nineteenth century, which brought the necessity of erosion control onto the political agenda, the dualism was present in the education of engineering bureaucrats and the division of responsibilities between the ministries. The adaptation of technological and developmental visions from abroad was tailored to fit the existing dualism in river development. The bureaucratic approach to development led to the standardization of water control practices, narrowing them down to a few universally applied measures, and resulted in straightened rivers fortified by levees and controlled by thousands of dams. As a key power in Asia, Japan also played a role in propagating technologies like dams and erosion control in the second half of the twentieth century. Although vernacular flood control practices have been repeatedly revisited as environmentally friendly alternatives to "standard" flood control measures, it must be noted that these are limited to a few methods that do not require much overflowing space and can easily be integrated into modern bureaucratic catalogs of river engineering. Examples include the planting of protection forests and the use of discontinuous levees like *kasumitei.*

The case of Japan is a reminder that the development and engineering of the environment is not necessarily something brought to the world by the "West," but also something embraced by a culture such as Japan's, which tied technology to the belief in the necessity of constantly cultivating the environment. Since the nineteenth century, the adaptation of Western technology has enabled the engineering of the Japanese environment on an unprecedented scale. The embedding of development into bureaucratic structures was spearheaded by a small group of engineers educated at the University of Tokyo, resulting in a narrow understanding of what development should entail. The bureaucratic structures have led to a central national coordination of development on the one hand and a fragmented approach to execution on the other hand. This has facilitated the establishment of routines and path dependencies in river development that seem almost impossi-

ble to challenge, that Patricia Sippel has referred to as a "sacred domain."[119] Even if the necessity of river engineering measures like dams have been questioned more in recent decades with the rise of environmentalism, the Japanese state has continued to double down on its established practices of river development.[120]

119 Sippel, "Chisui."

120 A good example for this is the "National Resilience" program of the Japanese government, which is Japan's response to the UN's Sustainable Development Goals, including climate action. This program continues the traditional river development programs aimed at flood prevention. Cabinet Secretariat, "Building National Resilience," accessed April 2, 2025, https://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/index_en.html.