Modern Regional Development in Japan: From the Kiso River Improvement Project to the City Planning of Gifu

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Although modern Japanese cities are the products of an urban planning system, this system is itself rooted in the histories of towns and provincial areas, that had previously grown in the context of local economic needs and resources. However, in the early stages of urbanisation, the new infrastructure derived from the West did not necessarily complement the existing local urban environment. This was eventually reconciled by a series of infrastructure development projects, which were presented to local city planners for feedback. This study focuses on a typical example of this process in Gifu, Japan; it presents a description of the steps by which the region was gradually modernised by means of a river improvement project that led to the implementation of urban planning.

Keywords: sewage system in city planning, river improvement project, Johannis De Rijke, waterschappen, modern technocrat, irrigation/drainage improvement project, industrial contamination.

Introduction

Modern Japanese cities are the products of an urban planning system that reached its pinnacle in the 20th century, when the urbanisation process was controlled. However, the operation of this system is rooted in the histories of individual towns and provincial areas, that had previously developed in the context of local economic needs and resources as reported by Asano[1], Nakano[2] or Demura[3]. Indeed, cities develop on the foundations of the extant infrastructure, such as roads, water transportation networks, drainage systems, food and energy resources, and land improvement and disaster prevention programmes in the larger region in which they are situated. Benevolo[4] examined prominent examples of urban infrastructures, and Suzuki[5]'s reach encompassed water infrastructure as the basis of town formation. Tomory[6] demonstrated that the development of the sanitation industry in London represented continuity of economic and technological progress, leading to the formation of the urban infrastructure.

In the field of hydrology, a new interdisciplinary discipline combining technical hydrology and sociology, has explored the co-evolution and self-organisation of people in the landscape (Sivapalan et al.[7], and Seidl et al.[8]). Such linked approaches are also useful to examine themes related to planning history. It is important to investigate relationships between the growing regional infrastructure system and the urban planning process to understand the circumstances and conditions under which modern cities were established. For example, Arts et al.[9] presented a perspective separating different types of work, such as that of 'builders and planners'. As a subject that is arguably interdisciplinary like Art's study, the present study focuses on water management, which involves not only water and sewage in the context of city planning, but also irrigation and drainage in agriculture, soil erosion prevention, flood control, and water transportation as civil engineering application, in addition to other industries such as fishing, hydropower generation, and landscape creation.

Recently Vitiello[10] summarised studies that focused on planners' involvement in shaping critical infrastructure. According to his perspective, the sewers of Paris in the 1830s, New York's Croton water system that opened 1842, and the first major social and sanitary survey by Edwin Chadwick illustrate the concrete procedure for new water and waste systems. Vitiello also noted that a new cadre of municipal and consulting engineers designed urban infrastructure. He also noted that innovations in infrastructure technology often spread between cities bureaucratical route, and that infrastructure occupied a prominent position in the work of late 19th century and early 20th century planners. However, those studies tended to concentrate on urban areas as a reasonable consequence of their objectives to understand urban planning systems.

Several studies on critical regional infrastructure beyond the boundary of the urban area have been carried out by scholars in other fields, such as civil engineering and the industrial economy. Tasaki[11] focused on urban developments and their surrounding agricultural areas in modern Japan, and particularly on the difference between urban and rural economics, for example in terms of land prices, to explain the migration of populations to cities. Wilson[12] discussed the formation of Christchurch as an example of long-term drainage and sewage development, situated in that case on a vast swamp outside an urban area. Hoeksema[13] clarified how land area changed historically in the Netherlands through large-scale flood protection and land reclamation, including a description of management methods. Vast landscapes such as these are beyond the conventional urban area, and may be more

familiar in the context of regional planning, as a development of city planning. Such examples may be incorporated into this study as it seeks to understand the substructure of early city planning.

It is well known in the field of civil engineering that Japan's great rivers were modified by Dutch engineers many years before the urban infrastructure was constructed. Foreign engineers did not simply apply pre-existing techniques; instead, they developed new techniques while working with local engineers at the construction site (JSCE[14]). Moreover, local engineers also contributed their own techniques to this creative process. These modern river modification methods, which directly or indirectly support urban operations, were intended to support huge structures and generally have considerable impact. Therefore, it is not surprising that an entirely new structure would reflect and support local land-use patterns. However, at the beginning of urbanisation, the new river modification methods did not necessarily support the existing local urban environment. Indeed, studies on modern Japan's civil engineering history mentioned cities only in passing (Ohkuma[15]). These differing interests were eventually reconciled when a series of infrastructure development projects, initially derived from the West, were presented to local city planners for feedback. It is especially important to understand this process, as it became the prototype of the current urban planning system.

This study focuses on a typical example of this process in Gifu, Japan; it presents a description of the steps by which the region was gradually modernised by means of a river improvement project that led to the implementation of urban planning.

Early Gifu City Planning and Sanitation

The first city planning law was enacted in Gifu in 1923. Several roads extending out from the city centre and zones for residence, commerce, and industry were planned (Figure 1). The original purpose of this plan was the creation of conditions that would promote construction of industrial factories (Demura[16]). It was assumed that a rail network and abundant subterranean water would encourage the textile industry to build factories near the city centre.

Nevertheless, the early goals of Gifu city planning changed dramatically. Led by Mayor Kunimatsu Matsuo, who held office from 1925 to 1946, the land devoted to industrial development decreased by about 16% (from 557 ha to 470 ha), and that devoted to residential development increased by about 57% (from 1,095 ha to 1,718 ha). The new main agenda was to use local environmental resources to create favourable conditions for housing and tourism. The reasons behind this shift in the priorities of Gifu City were the decline of the textile industry after the great depression of 1920; the new concept of a 'Tourism City', a goal that conflicting actors could share; and the Mayor's commitment to public health, hygiene, and the construction of healthy residential areas. Regarding the latter, he insisted that 'drinking water, toilets, and bathtubs'[17] were necessary to prevent 'the fall of Gifu City' due to lack of sanitation, which leads to high mortality rates among infants. During the Matsuo administration, the Gifu City planning agenda included water supply projects and sewer facilities.

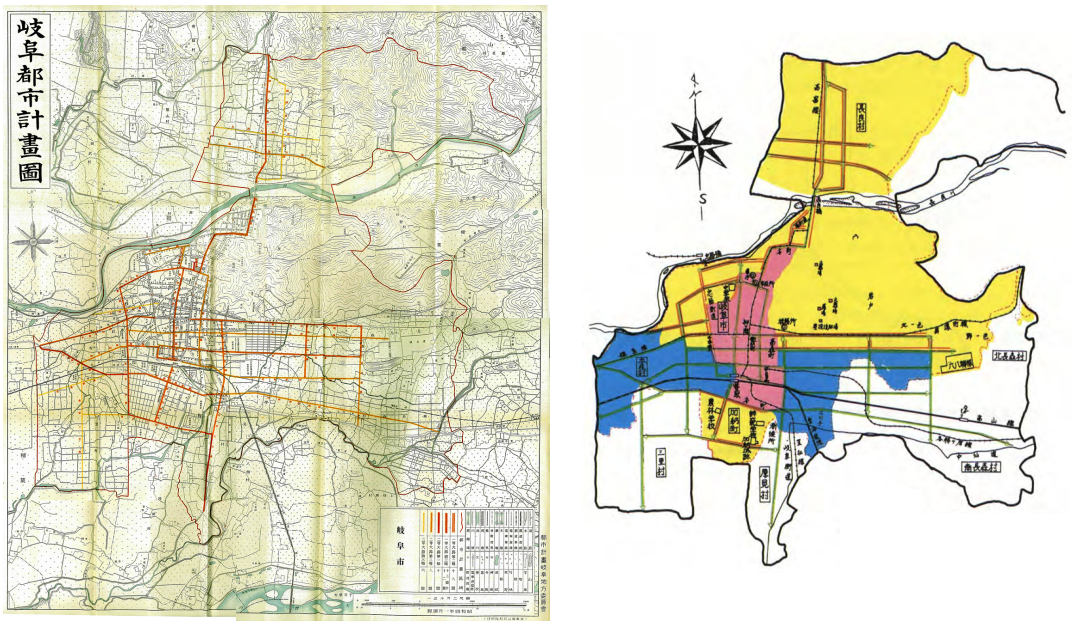

Figure 1: The Gifu City Planning Committee's *Street Network Plan of Gifu City*, issued in 1926 (left) and *Land Use Zones of Gifu City*, issued in 1927 (right). In the righthand figure, red, yellow, and blue areas indicate commercial zones, residential zones, and industrial zones, respectively.

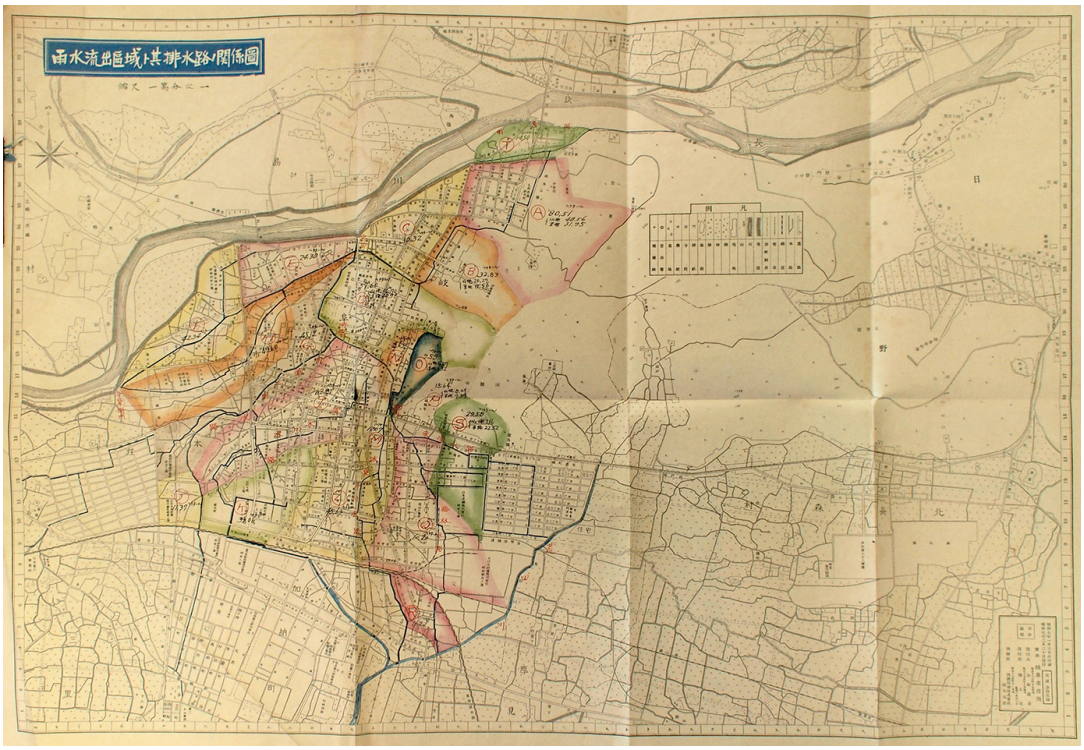

Figure 2: *The Relationship between Drainage Districts and Drainage Channels*. The same drawing was attached to a document submitted by the Home Ministry entitled *Map of the City Planning Sewage System: Drainage Districts,* together with another map, *The Sewage Plan and Trunk Pipes*. [included in Abe Nikko Kogyo Co., Ltd.]

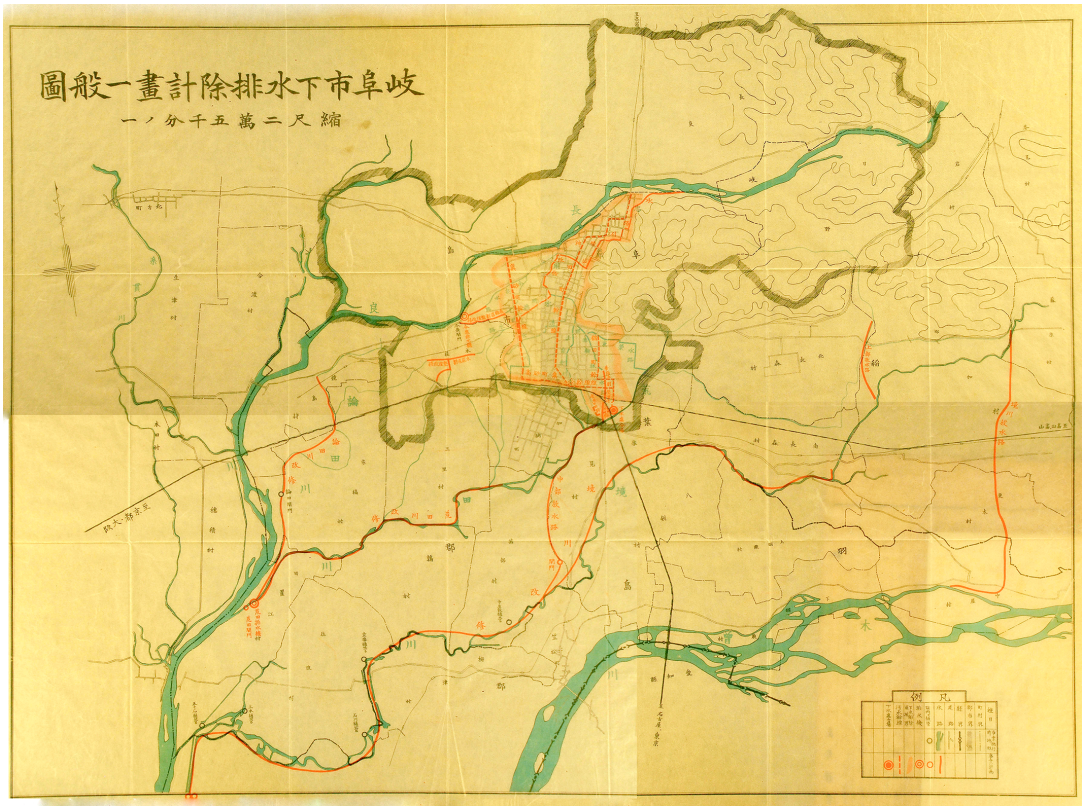

Figure 3: Genzaburo Abe. *General Map of the Gifu City Sewage System*. The area demarcated in Figure 2 is included in the centre of this large map. The boundary of the city is delineated by the grey hatched line. [Gifu City, 1935]

The sewage system was an especially huge project for the Gifu municipality. The cost of the initial plan was estimated to be 6 million yen in 1925, when the annual general budget of Gifu City was about 1 million yen. This system combined wastewater and rainwater in a large-diameter pipe[18]. However, the project could not be started due to insufficient funding and lack of technical ability. Then, in 1928, Mayor Matsuo announced a new plan at the Municipal Assembly in March: an unprecedented separate sewage system in which the sewage pipe was separate from the rainwater flow[19]. Improvements in the street gutters that collect rainwater and connect to trunk watercourses would start during the next budget year, decreasing costs.

At the same time, the mayor employed an expert engineer, Genzaburo Abe, who had been engaged in water supply construction in other areas, such as Maebashi and Takaoka. For the next 5 years, Abe was engaged to design and construct the water supply system using the subsoil water of the Nagara River as his first carrier in Gifu; at the same time, he studied and surveyed the location of the sewage system and insisted it would be possible to construct a complete, separate sewage system using existing water channels. Abe completed the design of the separate sewage system in 1932 for a cost of 2.5 million yen. His confident explanation of the project, which rested on his enthusiasm and engineering skill, facilitated its passage through the Municipal Assembly in August 1933 despite considerable opposition. The Home Minister endorsed this plan as an official Gifu City Planning project in January, 1934, and the sewage system was constructed between 1934 and 1943.

The plan that Abe and Gifu City Planning Committee submitted to the Home Ministry was drawn for a restricted area within the designated City Planning Area of 1923, as it conformed to the then-current norms, as Figure 2 shows. However, in practice, the actual plan was drawn differently. Figure 3 shows that the area went far beyond the boundary designated for city planning; indeed, the system for urban sewage was constructed as if it were situated in a huge water system. This raised questions regarding the planning of this urban water system and whether any blueprints could be found from the time before City Planning began.

Outline of the Kiso River Improvement –Johannis De Rijke's Idea

Gifu City is situated on the alluvial fan in the middle stream of the Nagara River, which was originally twinned with the flow of the Kiso and Ibi rivers. The downstream portions of the Kiso, Nagara, and Ibi rivers had been characterised by collective polders, areas surrounded by dikes in called Wajuu, during the Meiji Restoration (from 1867) (Figure 4). At that time, the town of Gifu was situated on relatively high ground within a broad field formed by polders that stretched 50 km to the sea. The most urgent problem facing the early Meiji government involved the transition from a feudal society to a new social, economic, and political structure. Indeed, it had to develop secure transportation routes for local industries and agricultural policies to prevent disasters such as floods. That is, the major rivers, including the Kiso River, which had been allowed to flow freely during the previous feudal epoch to discourage people from travelling, had to be safely controlled. The government tried to use Western technology to achieve this goal, hiring foreign engineers as no domestic engineer had managed such a major project.

Johannis De Rijke, one of the Dutch engineers hired for this purpose, investigated the Kiso River system in 1878 and 1879 and determined that sediment flowed out of the mountainous area. He reported to the government that the networked flows had to be organised into single streams to carry the large quantities of sand contained by the river water into offshore areas. At the same time, he argued that the supply of sand from the mountainous areas should be reduced by means of planting, management, and installation of dams on small streams[20]. Another of his reports insisted on the need to crack down on deforestation, which was a severe criticism of the then dominant Japanese tendency to act without considering consequences[21].

According to these reports, the government immediately began to construct sabo-dams, as soil-erosion control works, in the valleys that were the source of the Kiso River[22], based on designs created by De Rijke and six Japanese engineers in 1884. The river-improvement project in the lower streams, carried out from 1887 to 1911, was designed to prevent flooding, drain the fields within dikes, and improve shipping routes (Figure 4). De Rijke's vision of these projects, which included the entire basin of the Kiso River, went far beyond the aspirations of local residents, who had known only polders.

In 1891, De Rijke announced his understanding of the main causes of flooding in Japan: the deforestation of river water sources, the frailty of the sluices separating the water used for irrigation from the river flow, the failure of high-water protection methods, the lack of knowledge of local people, and the delays in making repairs after damage. He criticised people who waited passively for the government to draw on the public budget to respond, contrasting this pattern to the Dutch tradition of 'waterschappen', whereby landed individuals were responsible for flood control and drainage. Even after the river improvement work began, De Rijke continued to promote public organisation and cooperation[23].

The enactment of the Water Utilization Association (WUA) Law in 1908 allowed for the establishment of an association that could provide the financial basis for project development and maintenance. In 1909, the completely

revised version of the Land Arrangement Law centred on land improvement, including irrigation and drainage systems. Both policies were strongly promoted to improve agricultural productivity[24]. By 1911, many WUAs had been established in the area downstream of Gifu City. Although these were similar to the organisations proposed by De Rijke, each WUA had deep roots in the Wajuu community, rendering cooperation among them difficult (except for purposes of petitioning the government), leading to isolation.

Figure 4: *Kiso Nagara Ibi. Three Rivers Improvement Plan* (1900). North is to the left side; the rivers flow from left to right on this map. Gifu City is shown in the upper left corner. This map was drawn in 1/50,000 scale, based on the large map of Johannis De Rijke in 1/10,000. [housed in the Gifu Prefectural Historical Museum]

Overcoming the Scale of Wajuu – Union Integration

The drainage system was a primary problem even after completion of the Kiso River improvements in 1911. In Wajuu, polders in streams with an approximate bed slope of 1/5,000 reduced drainage efficiency, especially when the water surface of the river rose higher than the protected areas surrounded by dikes at the time of a flood. People living near polders downstream of Gifu expected the improvement project to improve the drainage in the upstream area of the Kiso River. However, the Kiso River Upstream Improvement Project did not include such improvements when it began in 1921. On the other hand, Kanichi Maekawa[25], a director of the Nagoya Civil Branch Office of the Home Ministry informed the aggrieved counties that, because the Home Ministry intended to improve the polders, they should discontinue their traditional practices and overcome the barriers between the people in the counties and the polders.

In December of 1924, Iwao Kira, the engineer at the Gifu Prefectural office, issued a comprehensive plan, which was framed as 'a personal proposal' [26] (Figure 5). Kira designed a system with new irrigation trunk channels and clearly distinguished drainage trunk channels that efficiently exchanged water within a wide area regardless of the traditional boundary of the Wajuu. This plan reduced the amount of water from the Sakai River, which had caused flooding as a result of collecting water from the hilly land, by constructing a discharge channel directly from the upper stream of the Sakai River to the Kiso River. He also modified the route of the Sakai River so that it could serve as the drainage trunk for the whole area and discharge its flow into the Nagara River at one downstream location. In terms of the irrigation channel, as all the water was taken from the Kiso River, an almost entirely new system that did not depend on the existing system involving the Nagara River had to be constructed.

Kira's plan proposed an approach to 'overcoming the barriers between counties and polders', which helped to expand the perspective of local people. Isamu Ohno, Director of Inaba County, agreed to the plan and gathered together neighbouring WUAs in January 1925. Although the design was declined by the technocrats of the Home Ministry and the Agriculture and Forest Ministry, Kira was able to improve the plan by the following year under the guidance of these technocrats to use conventional means to move water from the Nagara River, use existing water channels, and reorganise the system in a way that went beyond the purview of the small associations, to foster cooperation among the affected areas. At the same time, the affected people and organisations in the area on the left bank of the Nagara River organised a new, larger union in June of 1925. Finally, in January of 1926, Ohno and Matsuo, who had just been elected Mayor of Gifu City, established the Gifu City Inaba County

Irrigation/Drainage Water Utilization Association (Gifu/Inaba WUA), which included 25 towns and a city with five associations, to cover the entire area affected by this system[27].

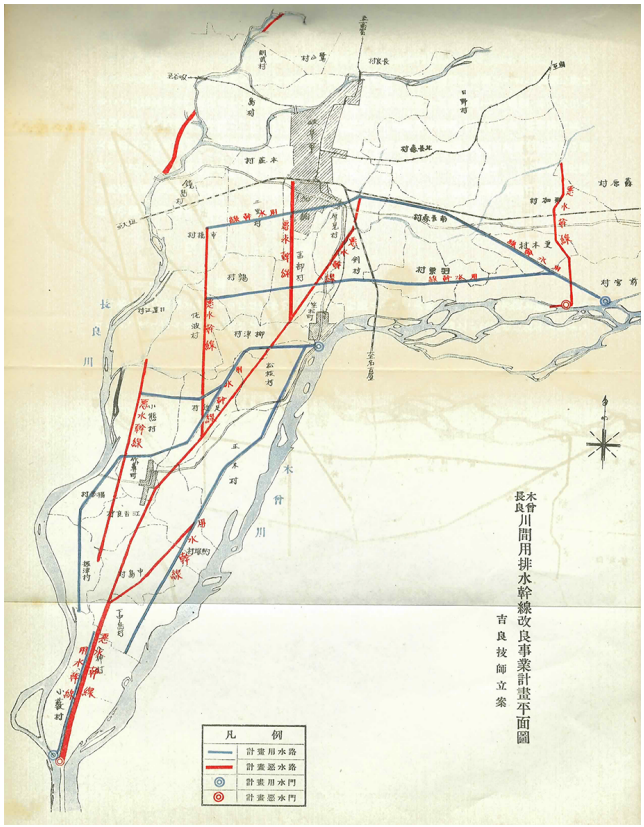

Figure 5: Akira Kira. *Irrigation/Drainage Trunk Channel Improvement Plan for the Area between the Kiso and Nagara Rivers* (1924). Blue and red lines indicate irrigation and drainage channels respectively. The streams are of Nagara River (upper) and of Kiso River (lower). The upper hatched area is downtown Gifu City. [Ohno, 1933]

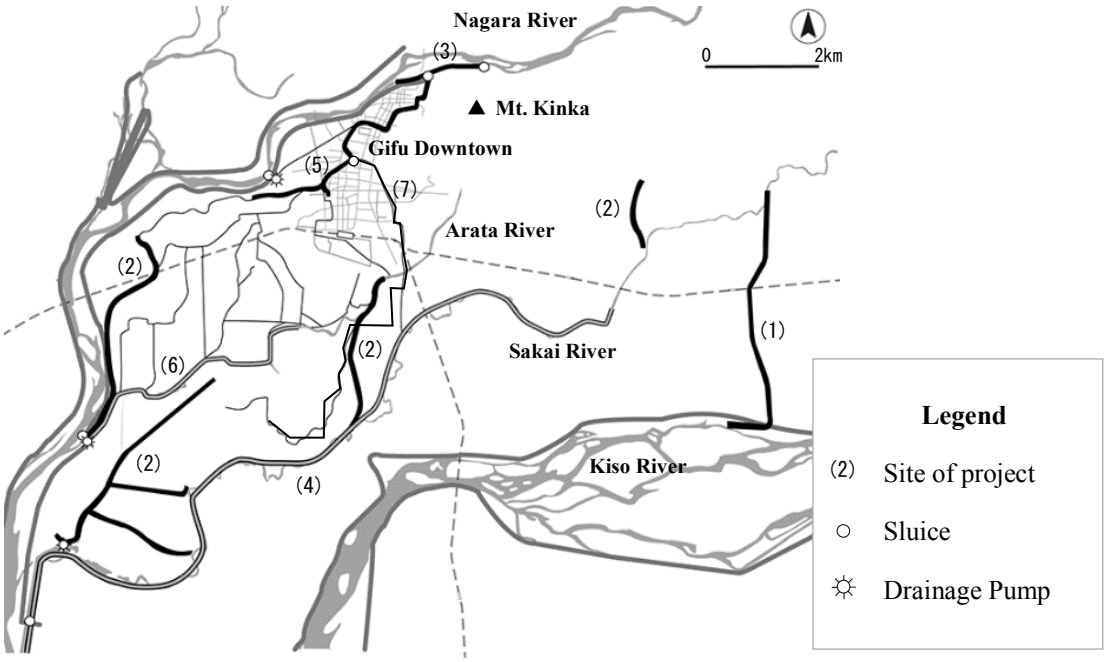

Figure 6: The series of water system improvement projects being conducted around Gifu City and the downstream area. This clarifies Figure 3.

Table 1: The series of water system improvement projects being conducted around Gifu City and the downstream area. The monetary unit is Yen in total expenses, government subsidy, prefectural subsidy, and local contribution columns. (A) and (H) are the subsidies provided by the Agriculture and Forest Ministry and the Home Ministry, respectively. This table was included in a previous study. [Demura, 2017]

	Period	Project Name	Objective	Contents	Expenses	Sub. by Gov.	Sub. by Pre.	Local
(1)	1926 1931	Sakai River Drainage Improvement Project (the first stage)	Drainage Improvement	Discherge channel	1,100,000	(A) 400,000 (H) 200,000	250,000	250,000
(2)	1928 1933	The Second Stage of Sakai River Drainage Improvement Project	Drainage Improvement	Drainage Pump・Drainage Channel・Sluice	1,180,000	(A) 590,000	177,000	413,000
(3)	1931 1933	Replacement Project of Chusetsu Water Channel	Irrigation Improvement	Irrigation Channel・Sluice	251,500	under the direct control of the Home Ministry		
(4)	1932 1933	Sakai River Improvement Project	Tributary Improvement	Channel・Shorter Flow	567,000	(H) 283,500	155,925	127,575
(5)	1932 1934	Chusetsu Water Channel Improvement Project	Irrigation Improvement	Irrigation Channel	135,000	(A) 67,500	20,250	47,250
(6)	1933 1934	Arata River Improvement Project	Tributary Improvement	Channel	82,000	(H) 41,000	29,038	11,962
(7)	1935 1937	Shobo Temple Water Channel Improvement Project	Drainage Improvement	Irrigation Channel	160,000	(A) 80,000	24,000	56,000

The water system improvement projects in this area were reasonable and functional. Their results are presented in Figure 6, and Table 1 outlines the schedule and budget for each part of the project. The scale of the entire project and the discharge channel from the area upstream of the Sakai River were the same as in Kira's plan. This system first removed the excess water using the discharge channel, calculated the capacity of the drainage downstream, distributed the necessary water, and drained into the Nagara River by the mechanical force of pumps at its most downstream points. This series of construction projects was based on an understanding of the function of drainage; the irrigation plan (mainly (3), (5) and (7) in Figure 6) was not clearly outlined in the plan at the first stage of implementation. That is, intentionally or otherwise, the blueprint for the vast water-management plan for the urban water supply and drainage system in upstream areas had not yet been completed. According to the shared flexible blueprint, appropriate irrigation arrangements could be planned after the drastic improvements designed to protect against flood damage due to drainage failure had been achieved.

Conflict and Cooperation between Rural areas and the Town

Following the initial urbanisation plan, many industrial factories were built just outside the Gifu City area after World War I (Figure 7). These factories were involved mainly in textile manufacturing, including spinning, dyeing, and scouring. Although they were built just after enactment of a law regulating factories in Japan, the factories discharged their wastewater directly into the nearest water channels. This soon caused water pollution in the area downstream of the Arata River, and 'clear water changed into black water, even animals could not drink, fish disappeared except for a few which were too foul to eat'. The Fishery Society and Arata River Sluice WUA started to take action in 1923, negotiating with the prefectural government and other governmental agencies for the regulation of factory wastewater.

In June 1928, the Arata River Sluice WUA invited Shozo Toda, a Kyoto University professor of hygiene, to perform a detailed investigation of the discharge practices of factories insofar as they affected the Arata River. In September, Toda presented the results to the relevant actors, including members of the police and prefectural government officials; workers at the Agricultural Experiment Station; WUAs; industrial, civil, and sanitary engineers; village, town, and county leaders; and Mayor Matsuo of Gifu City. Toda proposed a two-pronged plan: the first initiative involved a regulation requiring cooperation from factories, and the second involved improving the water-related infrastructure in a vast area that extended to downstream areas of the Arata River[28].

The second part entailed additional construction to ensure a stable and sufficient volume of water. However, the intake of the 'Chusetsu Water Channel' and the only watercourse reaching the urban area from the Nagara River was almost non-functional at this time because, due to the Kiso River Improvement Project, the surface of the Nagara River became too low to flow into the channel without intervention.

In April 1930, the Gifu/Inaba WUA decided to improve the irrigation system by replacing the intake sluice of the Chusetsu Water Channel. The leaders of the municipalities and various WUAs that belonged to the Gifu/Inaba WUA reached agreement over the share that would be accorded to each municipality if the improvement project

were approved by the prefectural government as a public works project[29]. According to this agreement, Gifu City was given the largest share, 65.8 %. (Figure 8) The aggressiveness with which Gifu City officials pursued their interests seems to have stemmed from their intention to reduce the pollution caused by industrial wastewater, as Toda had suggested. However, they should have aimed for more.

The final version of the project to improve the Chusetsu Water Channel consisted of two parts (Figure 9). The first was to widen and partially reorganise existing downstream irrigation courses; half of this project was subsidised by the Ministry of Agriculture and Forestry. The second part was to replace the intake sluice and the connection to the existing system; this proceeded as a part of the Kiso River Upstream Improvement Project, directly controlled by the Ministry of Home Affairs, which had provided compensation to the area that had suffered from the drawdown of the Nagara River. The objectives of both parts required the dilution of the industrial effluent and the need to consider the resulting surplus water; the amount of effluent from each factory was measured to determine the volume of water that would travel downstream.

The main portion of the upper part of this system was devoted to the control of flooding at the entrance to the main sluice, which was situated before water from Nagara River was taken up. This system enabled the movement of abundant water for the dilution of industrial pollution, in addition to satisfying the demands from agriculture. Additionally, the irrigation water could be stopped by the main sluice when it rained heavily; the system was also designed to collect rainwater efficiently using the capacity reserved for irrigation water. The improvements to this irrigation system were completed in May 1934.

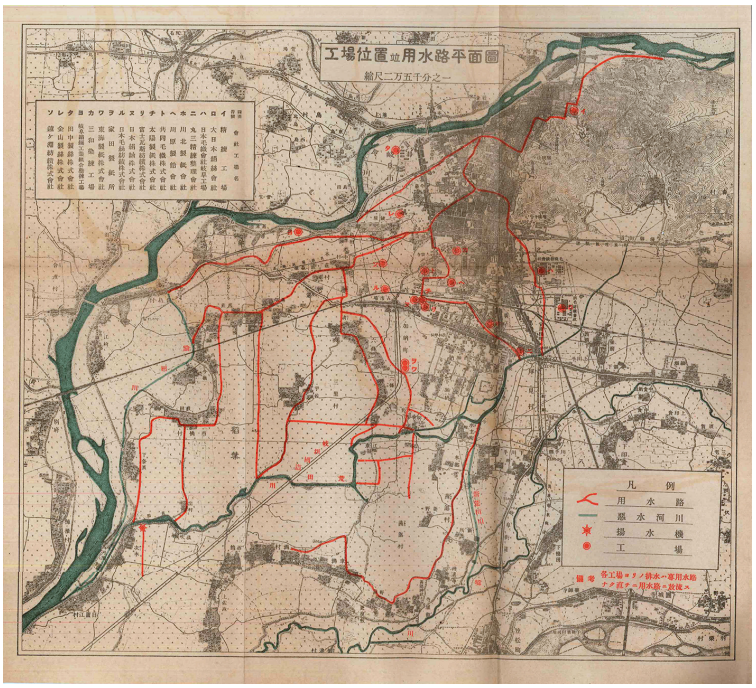

Figure 7: Arata River Sluice Water Utility Association, *Irrigation Channels and Location of Factories*. Red circles are the sites of factories, which show a strong correlation with the water course. Their location also correlates with the planned arrangement of streets, as can be seen by reference to Figure 1. [Arata River Sluice WUA, 1938]

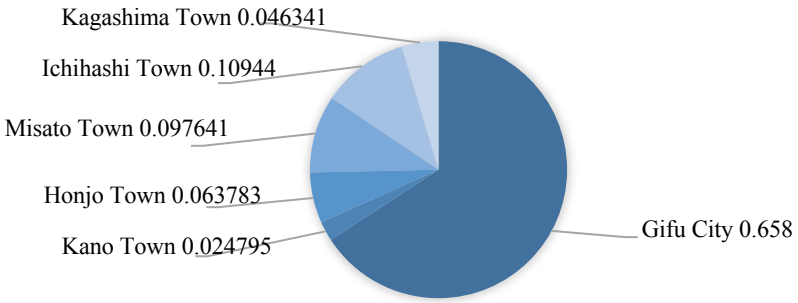

Figure 8: Share of Contributions for the Chusetsu Water Channel Improvement. The municipal leaders reached an agreement regarding the distribution of the budget on 18 June, 1930, on the assumption that the project would be approved by the prefectural government as a public works project. [Ohno, 1933]

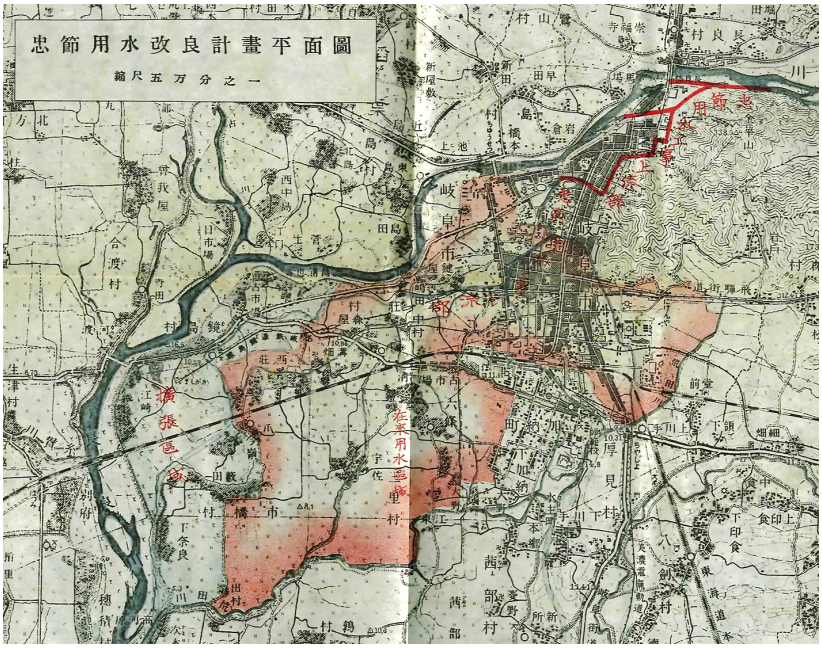

Figure 9: *Plan for Improving the Chusetsu Water Channel*. This map is drawn to a scale of 1:50,000. Red bold lines in the upper part of the figure indicate part of the Kiso River Upstream Improvement Project (dnoted by as (3) in Table 1). The faint blue line indicates the lower part of the project, subsidised by the Ministry of Agriculture and Forestry (denoted by as (5) in Table 1). [Ohno, 1933]

Conclusion

Kunimatsu Matsuo articulated his concept of a separate sewage system in early 1928. He knew it was possible to establish a drainage system located downstream of the urban area because, as a mayor of Gifu City, he occupied a central position in the Gifu/Inaba WUA, founded in 1926. The engineer, Genzaburo Abe, performed research in preparation for the design of the sewage system. Matsuo was also among the most important founders of the Chusetsu Water Channel Improvement Project in 1930. At that time, it is likely that Matsuo and Abe clarified the plan for urban drainage. They would have noticed that the ability to manage rainwater could be secured, even in heavy rain, if the inflow from the Nagara River could occasionally be stopped. Moreover, the amount of water was reduced by the collection of the industrial wastewater from each factory outlet pipe. Finally, the aforementioned comprehensive vision of all the systems emerged. (Figure 10)

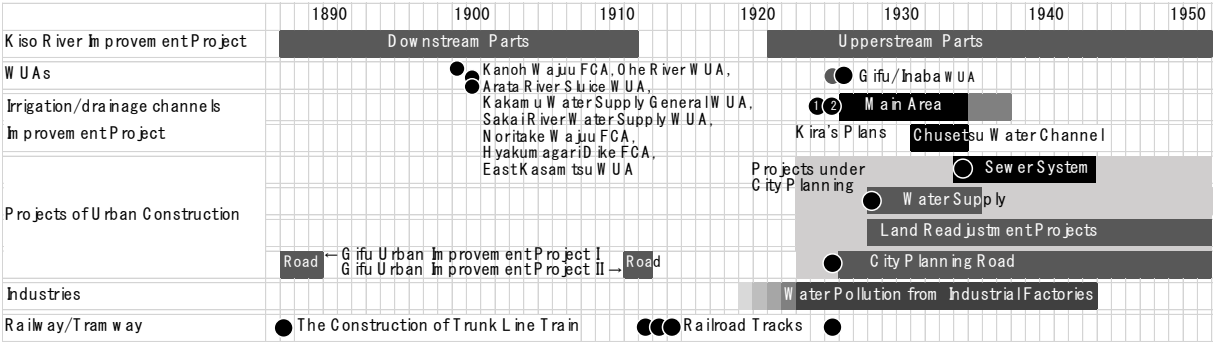

Figure 10: Modern Construction Projects in Gifu and its Downstream Area in Chronological Order. Gifu Urban Improvement Project I, and II are beyond the scope of this paper to describe; these were urban construction projects in downtown Gifu City initiated by townspeople based on a business strategy. For more information, see Demura 2012 and 2015.

The early city planning in Gifu involved a remodelling project aimed at establishing a healthy, liveable city that would complement the extant infrastructure, which had been developed based on an economic strategy. Indeed, a highly organised, modern infrastructure was needed. It was clear that the last city planner who brought sophisticated skills to these projects, which were based on the ambitious vision of Mayor Matsuo, was Genzaburou

Abe[30]. However, they had only just finished the long process of improving the vast water system that had started in 1887. Initially, there was no comprehensive plan, and the final system emerged from the social relationships among various actors, perhaps ensuing from a new equilibrium. The vast vision was elaborated by De Rijke, the prefectural engineer Kira contributed his systematic perspective, and the technocrats of the Ministry of Home Affairs cooperated with those of the Ministry of Agriculture and Forestry to provide guidance derived from Western or Westernised engineering practices. These efforts facilitated cooperation among relevant actors, all of whom benefited from the large scale of the system; this system brought a new state of equilibrium to the wider society, and the urban planning discussed here was constituted on the vast infrastructure system that was developed for this area.

The expansion of technological and social frameworks should be more or less homogeneous across cities in Japan, and in any country whose modern history is founded on the legacy of a previous epoch that had to create a framework to resolve inherent problems. Generally, the boundaries between rural and urban areas were contested as cities started to expand. In the case of Gifu, urban construction and regional improvement had started in late 19th century. Subsequently, the process of creating a water system to serve both urban and rural areas functioned simultaneously as the process for applying modern engineering methods from the West to the local environment. The focused examination of a typical city conducted herein found that an expanded framework that considered the construction of water infrastructure amid the upheaval in linked domains, such as inter-Waju or urban-rural relations, resembled regional planning, which historically was distinct from city planning. Fluvial systems may be a relevant topic for cities located on fluvial fans, and their relevance to regional planning should be pursued as a new perspective on planning history.

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Figure 1: Gifu City Planning Committee, *Summary of Gifu City Planning* (1929), appendix (left).

Gifu City, *Reference Materials used to Designate Land Use Zones for Gifu City Planning* (1927 estimated), appendix (right).

Figure 2: Abe Nikko Kogyo Co., Ltd.

Figure 3: Genzaburo Abe, *Summary of the Gifu City Sewage Plan* (Gifu; Seinoh Insatsu, 1933), appendix.

Figure 4: Gifu Prefectural Historical Museum

Figure 5: Isamu Ohno, *Summary of the Gifu City/Inaba County Irrigation and Drainage Improvement Project and Related Projects* (Gifu; Seinoh Publish, 1933), 12.

Figure 7: Isamu Ohno, *Summary of Arata River Sluice Water Utility Association* 荒田川閘門普通水利組合誌 (Gifu; Seinoh Insatsu, 1938), appendix.

Figure 8: Isamu Ohno, *Application for the Chusetsu Water Channel Improvement Project (by municipal leaders to the administrators of Gifu City/Inaba County WUA)*, in Summary of the Gifu City/Inaba County Irrigation and Drainage Improvement Project and Related Projects (Gifu; Seinoh Publish, 1933), 496-498.

Figure 9: Isamu Ohno, *The Chusetsu Water Channel Improvement Project* in Summary of the Gifu City/Inaba County Irrigation and Drainage Improvement Project and Related Projects (Gifu; Seinoh Publish, 1933), appendix.

Endnotes

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[18] Although the engineers were aware of the (then) popular system in which the sewage pipe was separated from the rainwater flow, they considered this system to be uneconomical. After outlining the advantages and disadvantages of both approaches in '*The History of Water Supply*' (1927), the local authorities insisted that a separate system was inappropriate for Japanese cities because it cost almost twice as much as the combined system, and they would have to construct both pipes from scratch. Indeed, a separate system was constructed in only a small part of Tokyo, Shimonoseki, and Qingdao (under Japanese rule at this time). (The three cities mentioned were not able to build complete systems, but only limited systems; a complete system had not been built in Japan at this time.) (Chujirou Moniwa, *The History of Water Supply*, Society of the Memorial Project for Doctor of Engineering Nakajima, Tokyo, 1927).

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[20] Johannis De Rijke, *A General Condition of Kiso, Ibi, Nagara, and Shonai Basin*, the report to Secretary Shoichirou Ishii, April 1, 1878.

[21] Johannis De Rijke, *A Matter of Forests to the North of Gifu in Kiso Basin*, the report to Secretary Shoichirou Ishii, November 27, 1879.

[22] However, the government soon suspended this sabo project because it needed more money for the downstream improvements planned by De Rijke.

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[25] He was the father of Kunio Maekawa, who was a disciple of Le Corbusier.

[26] The epoch after World War I was characterised by food shortages and occasional heavy floods, and the Cabinet, which was supported by rural landowners, strongly promoted efforts to increase food production by improving irrigation, drainage, and flood control measures. The Emergency Water Control Committee, formed in 1921, developed the National Flood Control Plan, which proposed improvements in agricultural water use, in addition to raising the subsidy rate of the National Treasury. Communications regarding river administration matters concerned with water management were divided into river issues, under the directive of the Home Ministry, and irrigation/ drainage, under the Ministry of Agriculture and Forestry. This national effort led directly to the unprecedented 50% subsidy for the Irrigation/Drainage Trunk Channel Improvement Project, issued by the Food Director in 1923, which affected 500 cho-bu (495.9 ha) of agricultural land. This plan, which was developed by Kira, was designed to distribute the subsidy. (Yoshifumi Demura: *Repair Work at the Branches of Kisogawa River and Land Improvements - the Process of Building Cooperation to Acquire a Modern Water System* -, Journal of Japan Society of Civil Engineers, Ser. D2, JSPS, 73(1), 54-62, 2017; see also Tokai Agricultural Administration, The History of Kisogawa Basin Agricultural Water Use, Nagoya, 1980).

[27] The petitions to the Home Ministry organised by a committee of the Gifu/Inaba WUA finally led to the development of a clear plan that requested the Diet to allot another unprecedented 50% subsidy to the Repair Work Project at the tributaries of the Kiso River in 1928. Added to the Irrigation/Drainage Trunk Channel Improvement Project, this area received a substantial budgetary allocation and became widely known due to its dependence on the authority of both the Agriculture and Forestry Ministry and the Home Ministry (Demura, 2017).

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