

# LAND AND WATER USE IN JAPAN

## —THE GENERAL SITUATION AND PROBLEMS OF ITS DEVELOPMENT—

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*Abstract* This report was originally prepared for the trainees from developing countries in 1965 to introduce the situation of land and water use in Japan. The contents of the original text consist of six chapters including Introduction, Multiple relationships between land, water, air and vegetation, Standpoints of the geographical studies on land and water use, Land and water use in Japan, Case studies on land and water use, and Techniques on land and water use studies. This report is the summary of Chapter 4 Land and Water use in Japan. Chapters 1 to 3 will soon be published in Special Volume on Land and water resources, Geoforum 1981.

In this paper, the author briefly summarized historical development of land and water use in Japan, change of distribution of population and negative effects related to land and water use from the geographical points of view.

### 1. Land and Water Use — the Outline of Its Development

Land use in Japan was closely associated with water since the early days of its history. Land use in Japan has been developed in a unique manner as compared to the rest of the world — the districts where rice fields are found are spread in regions of needle leaf trees that have plentiful supplies of water. A brief history of land use in Japan will be traced and problems connected with water use will be noted.

It is said that the first land use in Japan was carried out at the end of the Pleistocene. Therefore, it has a history of more than one hundred thousand years, but in the beginning the main land use was fishing and hunting. It was about two thousand years ago, in the Yayoi cultural period when people begun to cultivate rice and utilize water. However, the techniques of rice growing and methods of water use were primitive. A considerable length of time was required for rice to be accepted widely among the people of each class of the society. During that period the development of land progressed rapidly under the influence of nature — natural disasters of favorable occurrences. Farmers selected their sites of residence through experience, where it was easy to obtain water, but in places that were safe from floods. Moreover, those places had to be near alluvial plains that were convenient for rice cultivation. Soon villages were established and places of residence shifted from plateaus or the foot of mountains to lowlands.

The first stage of the residence of lowlands and land use was as follows: people left nature untouched and they utilized nature within the limits of their own techniques of

production. Nevertheless, they suffered great damages as times of inundation. Accompanied by the development of production techniques, the early forms of earthenwares were found. On the other hand, a few rulers and men of power assumed leadership and controlled the use of land.

The development of the techniques of earthenwares was certified by methods of old tombs and reservoir construction. The construction of reservoirs was significant because people could control water. Even if this was accomplished with the assistance of rulers, it had great value as the first step of planning land and water use. But it was necessary for a considerable length of time that people obtain water for irrigation from the rivers which often overflowed.

The utilization of reservoirs was developed in the Kinki district and in the regions along the Inland Sea of Japan. One of the reasons was that these regions were adjacent to the capitals of those days, and also the fact that rainfall amounts of these areas were sparse and fluctuations were large. Reservoirs were invented as a counter-measure against the damage of droughts. Even in the present it is one of the important means to secure water for agriculture to cultivate rice fields. This is accomplished by the construction of dikes or levees in the downstream reaches of small rivers which are high in river index.

The beginning of the land system took a step forward by the enforcement of rectangular allotment, the so called Jori system. In the following Manor era, reservoirs were important contributing factors in the development of rice fields, while the devastations of forest and damage because of inundation were already registered. In those days rivers and their adjacent areas were in danger of inundation. Of course a few examples of levees and utilization of river water were found, this practice was not yet widespread. The Katsura river near Kyoto was famous for utilization of river water. The method used was as follows people obtained water through bamboo pipes and removed them during the off season. This depended on the level of the techniques of water utility in those days and it was also associated with the natural phenomenon of rivers which often overflowed.

Little by little the people were being concerned with inundation, so the development of land — its main objective was rice fields — and flood prevention works were required. The flood control of the Kamanashi river by Shingen Takeda and the reclamation work of the Ariake Sea by Kiyomasa Kato were known in the age of civil wars. The construction of castles, the development of mines and land surveying were examples of the progress of civil engineering. These progressive techniques were applied to land and water use. The development of rice fields was accomplished by feudal lords until the beginning of Edo era, meanwhile the people developed new rice fields by constructing water conduits. Some villages obtained water from the upper stream of small rivers and made newly cultivated rice fields on plateaus in cooperation with other villages. The enlargement of old reservoirs and the construction of new large reservoirs were also accomplished. The following examples were known; Hirose-Momonoki Yoosui (water channel), Bizenbori of the Tone river, Tamagawa Yoosui of the Tama river, the repair of the pond of Kawachi-sayama and Sanuki-Manno. The construction of water service as Tamagawa Yoosui started at this time. The reclamation works of the Ariake Sea was also continued by Hosokawa and the newly cultivated rice fields developed by merchants were also found. [As follows; Kawaguchi-Shinden of the Yodo river (Genroku era), Shinden of the Yamato river (Genroku era),

Shinden of the Yoshii river and the Asahikawa river (Kyoho era)].

The development of newly cultivated rice fields of the Yodo river was connected with the flood prevention works of the Yodo and the Yamato rivers, and it was accomplished by dredging. The development of newly cultivated rice fields not only accelerated commercial agriculture of the Osaka district but also developed into regions of cotton cultivation. It also aided the development of home industries. Osaka was formed as the central places of commercial products, accompanied by the development of commerce and industry.

New cultivated-rice fields in the Kinki district stimulated the development of downstream fields of the Shinano and the Agano rivers, that became good rice-producing regions. It also stimulated the new rice fields of the downstream areas of the Kiso river, the Okayama plain, and the development of land progressed rapidly throughout the land. The flood prevention works of wild rivers which built up the plains of inland areas and the construction of the facilities of water supplies and water channels and new rice fields were carried out. At the end of Edo era, the habitual practice of irrigation from rivers was regulated and it was fixed as habitual water rights by the establishment of the law of rivers.

Rice agriculture took a leading part in land use of Japan. However, villages which produced rice on upheaval plains or little basins of mountain, were established during the age of civil wars. On the other hand, dry field farming was developed when dry field crops were circulated as commercial products and the feudal lords protected them as special productions. As for cotton, it was cultivated widely as raw materials of clothes and kozo and mitsumata (paper mulberry and *Edgeworthia papyrifera*) as raw materials of Japanese paper. These products supported the development of home industries which occurred at that time. Mulberry fields combined with cocoons were cultivated in the waste lands where it was not possible to produce rice.

Land use was developed mainly by the cultivation of rice fields during the Meiji era, but the rapid development of industries made dry field farming attain a high position. The fields were increased because the rapid growth of population, and other phenomena promoted reclamation. Since foreign trade was initiated, mulberry fields and tea plantations increased because raw silk and tea were the main export items. On the other hand, the cultivation of cotton suffered great damages by importation of cheap cotton. The change of land use in Hokkaido where developments were carried out on a large scale was remarkable, especially the management of stock farms.

The rapid changes of land use made regional characteristic and specialization of land became obvious — mulberry fields, tea plantations, orchards, stock farms, potato fields and truck farms. Most of them are still in existence. Until the middle of Edo era most of these areas were waste land or forest, unused because of the difficulty in obtaining water as the technique of well drilling was not invented.

In the rice districts, low, wet areas were utilized as rice fields by drainage. The areas that suffered damage because of inundation spread widely and the amount of damage increased. Therefore, flood prevention works of lowlands was becoming important. In the early Meiji era great floods often occurred in the Niigata plain. Moreover there were many floods in the downstream areas of the Yodo and other rivers. Government decided to enforce flood prevention works on the Tone, the Yodo, the Kiso, the Shinano and the

Chikugo rivers. However, floods did not decrease, great inundation occurred throughout the country at the end of the Meiji era. The primary method to control flooding was to construct high dikes along rivers. This method was vulnerably to dike breakage, however, it increased the possibility of rice growing during ordinary times. Rice growing developed rapidly, because rice was more stable than other products and because the price of rice was kept high by governmental control, as illustrated by the expansion of rice growing to Hokkaido where it was thought too cool to cultivate rice.

The progress of flood prevention works promoted the reformation works of land and the development of new irrigation works. There were regional differences. Regional differences were the differences of the amount of rice crop and it was reflected in the annual change.

## 2. The Change of the Distribution of Population

It is necessary to refer to the change of the population distribution and its regional characteristic before the present problems of land and water use can be considered. Because water use developed in connection with agricultural land use in the changes of land use, the present problems of land and water use concerns the concentration of population in the cities and industrial areas and the increase of the demand of water.

Many studies were conducted regarding the presumption of population of Japan before the Meiji restoration. Generally, population increased slowly until the Edo era but it has increased rapidly after the Meiji restoration. During some periods, population growth was stagnant. Population migration was also minimal. Population distribution did not have the same pattern as the distribution of rice fields. Population density was high in low plateaus, Kinki district and its adjacent deltaic plains because of the level of engineering techniques. The increase of population density in the Hokuriku and the western Tohoku districts occurred until the middle of the Edo era, and it can be judged that the movement of population was from the Hokuriku district to northern places. The development of rice fields also took place in the same direction. The western Kanto district was higher in population density than the eastern Kanto, because the development of rice fields was carried out in relation to the development of flood prevention and irrigation works of the Tone river since the Edo era.

Population density also depended on increase of the value of commercial products especially the development of sericultural industries and silk spinning.

High population density in the western Sanyo district depended on the development of the reclamation works and the increase of salt farms or beds (evaporation bins) and rice fields.

Regional fluctuations of population since the Meiji were as follows: early in the Meiji era population increased in the Eastern Tohoku district and southern Kyushu, and from the end of the Meiji era to the middle of the Taisho era there was a slight decrease in the Hokuriku district, the Kii peninsula and the mountain districts of Chugoku, the hinterlands of Chukyo and Hanshin. On the other hand, rapid increase of population occurred in Osaka, Tokyo and northern Kyushu where urbanization and industrialization were the influences. From the end of the Taisho era to early in the Showa era, these tendencies were becoming

clear. Chukyo, Fukuoka and Sapporo increased their function as central regions of urbanization and industrialization. Before and after the Second World War, decrease of population occurred in the urban and industrial regions, because industrial and urban people were dispersed in the rural areas because of war damage and the delay of reconstruction. Since the war, the concentration of population to urban and industrial regions grew more intense. As the results, many problems concerning land use and water utility are now arising.

### 3. Problems Regarding Land and Water Use

Land use in Japan developed on the alluvial plains where water could easily be obtained for its main use which is rice growing. The present distribution of population is highest in the alluvial plains where rice fields are numerous. The development of diluvial plateaus where water is difficult to obtain developed comparatively late though it is topographically flat. Most of the planning areas of research institutes occupy diluvial plateaus where the densities of population are low as in the eastern part of Kanto. Most of the apartment-houses complexes and new towns are planned to be built on the diluvial plateaus and hilly lands where rice agriculture is difficult.

The development of the outskirts of plateaus and damp deltas are advanced because of the growth of cities and industries. Problems that are contrary between land and water use occur as a result of the development of cities and industries which need a great deal of water in the lowlands. Examples in common with Tokyo, Osaka and Nagoya can be noted. Attention must be directed to drainage of damp delta areas that often suffer flood damages. On the other hand, cities and industries demand a great deal of water which must be purified. Flood prevention works and urban and industrial land use progress, as a result, a great deal of water is required. The utilization of underground water which is abundant, pure and cheap progresses rapidly, therefore, subsidence of ground progresses, which becomes the paramount problem. As a natural course of events areas at sea level begin to sink. But other new problems arise – damages due to the flood tide. Damages due to the flood tide at the sacrifice of some urban and industrial function must be prevented. The utilization of underground water is limited and offer of substitute water is necessary. People are beginning to take a growing interest in water supply for the exclusive use of industry. The purification process progresses, but the demand of the reduced water does not actually grow. Industrial and urban areas of large cities developed from outskirts of plateaus and lowlands. As urban areas grow in population, residential areas and commercial districts develop widely on the plateaus. Many people pointed out that the distribution of population is becoming more extensive.

Diluvial plateaus have difficulty in obtaining water, therefore, the development of new rice fields did not advance until the technique of well drilling progressed. The progress of urbanization increased population, but it depended on well water and not on municipal water. Not only waterworks but sewage works developed slowly, and these are the areas where the problems of “water” are concentrated. The problems of water in this respect are to complete waterworks and prevent the pollution and depletion of ground water.

Urbanization progresses from diluvial plateaus to hilly lands. Another new problem of land and water will become apparent. The increase of residences in hilly districts will occur and traffic problems will arise. Faulty construction of building sites may cause landslides. There is no danger of the subsidence of the ground by the utilizing groundwater in hilly districts.

The demand of water in cities necessitates the regulation of habitual water rights regarding the utilization of river water that is used for irrigation purposes. The amount used for industrial purposes is said to increase fourfold as much as the present use of 10 – 12 billion cu. meters. An essential solution cannot be obtained by investigation of agricultural water. It is necessary to obtain the source by regulation of water rights and to endeavor to secure new sources. The demand for electric power is being supplied with stream-power and atomic generators. The development of water resources should be re-examined for utilization for agriculture, industry and municipal supply. Of course, water utility to generate electricity will not decline soon. The future of the problem of “water” whose center is river conservancy will be slow in being solved, and it will be necessary to promote the development of industrial and urban water, instead of agricultural water.

Another difficult problem that will occur is with regional development. More industries will develop, more water for cities and industries will be needed. As a result, they must repay the demand of regions by the diversion of irrigation water or the development of new sources.

For these reasons, the value of water increases even in the country and it will become difficult to offer water to local towns and cities where the problem of water scarcity already exists or may occur in the future. The movement of population from the heart of the city to the outskirts of large cities is becoming obvious as in Tokyo. Population that require water are decreasing in areas of completely equipped waterworks. On the other hand, population is increasing rapidly in the outskirts of cities where waterworks is delayed. The problem of shortage of water will occur in urban areas. Because the value of water increases and the social and economic circumstances make it difficult to obtain water in the near future, problem of regional differences of water allotment for cities must be considered.

The shortage of water is increasing rapidly in cities and its neighborhood, on the other hand accompanied by urbanization and chronic floods – increase not only in lowlands but also in other areas. The solution of the problem of “drainage” is urgent.

#### **4. Remarks**

This report was originally prepared for the trainees from developing countries in 1965 to introduce the situation of land and water use in Japan. Since then, regional development works have been developed in various places in Japan. Due to remarkable changes of land and water use, environmental pollution and destruction became apparent. On the other hand, heavy damages due to such natural hazards as flood and earthquake have not occurred in and around large cities. Without checking the influences of land and water development, more than 15 years have passed.

Table 1. Major events related to land and water use in Japan

Japanese year period		Events
BC 7500±	Jomon	
2500±		Shell mounds
	Late Jomon	Settlements on lowlands
300	Yayoi	Rice cultivation
		Migration of rice cultivation to east and north-east direction and introduction of continental and Korean culture
323	Nintoku 11	Manda-zutsumi Dyke (Osaka)
AD ca 600		Surveying technics introduced from China
607	Suiko 15	Irrigation ponds in various places
702	Taiho 2	Jori system
710	Wado 3	Heijokyo Castle (Nara)
794	Enryaku 13	Heiankyo Castle (Kyoto)
1542	Tenmon 11	Flood and construction of Shingen Zutsumi
1589	Tensho 17-	Cadastral survey and Bunroku Kuniezu-map
-1595	Bunroku 4	(Bunroku National map)
1574	Tensho 2-	Nagahama Castle town Construction of more 100 castle towns
-1624	Kanei 1	Aomori castle town, final Azuchi castle by Nobunaga Oda (1576 Tensho 4), Edo Castle town (1603 Keicho 8)
1588-	Tensho 16-	Land reclamation works by Kiyomasa Kato (Kumamoto)
1594	Bunroku 3	Reconstruction of River Yodo's dykes by Hideyoshi Toyotomi
1603-	Keicho 8-	Edo, capital; flood in Edo and flood control of River Tone by Tadatsugu Ina Bizen-no-Kami
1610	Keicho 15	Ashio copper mine
1653-54	Sho-o 2-3	Tamagawa water channel
1657	Meireki 3	Furisode fire in Edo
1661	Kanmon 1	Town planning of Edo
1688-1704	Genroku	Development of copper mines of Ashio, Kosaka, Besshi etc.
1716-1736	Kyoho	Various administrative improvements by Yoshimune Tokugawa
1855	Ansei 2	Sanbongi Town planning by Inazo Nitobe
1859	Ansei 6	Port of Yokohama
1869	Meiji 2	Kaitaku-shi of Hokkaido (Sapporo), Town planning by Giyu Shima
1872-	Meiji 5-	Modern engineering technology applied to Rivers Yodo and Tone
		Construction of railway between Shinbashi and Yokohama
		Fire and reconstruction of Ginza district
		San Francisco Earthquake in 1906
1910	Meiji 43	Flood disasters (Tokyo) - Construction of Arakawa discharge channel
1917	Taisho 6	High tide disasters (Tokyo)
1919	Taisho 8	Town Planning Law
1923	Taisho 12	Great Kanto Earthquake Development of suburban areas of Tokyo
		Reconstruction of Tokyo
		Abnormal land subsidence (Tokyo)
1934	Showa 9	Muroto Typhoon disasters (Osaka) - Increase of flood disasters in urban land subsidence areas
1945	Showa 20	War damaged cities including Hiroshima and Nagasaki
1947-	Showa 22-	Flood disasters (Tokyo, Osaka etc.)
1950	Showa 25	Korean war Rapid recovery of industry and economic growth
1953	Showa 28	Acute land subsidence due to pumping up natural gas in Niigata area
		Minamata disease (Kumamoto)
1955	Showa 30	Itai-itai disease (Toyama) Yokkaichi disease (Mie)

Table 1. Major events related to land and water use in Japan (continued)

Japanese year period		Events
1958–1964	Showa 33–39	Flood disasters due to typhoons in and around large cities including Tokyo, Nagoya, Osaka, Yokohama etc.
1969	Showa 44	First White Paper on “KOGAI” New Development Plan (SHINZENSO)
1975	Showa 50	1,168 square km (Land below sea level) Most of prefectural capitals are now in land subsiding areas
1978	Showa 53	Miyagiken-Oki Earthquake and characteristic damages occurred in newly developed areas since 1950

However, characteristic damages due to Miyagiken-Oki Earthquake in 1978 occurred in and around Sendai City where one of the typical regional development project has been executed. Simply speaking, such example will also be reported from various places after great natural hazards in near future.

Major events related to land and water use are shown in Table 1.

## References

Most of references useful for these studies are published in Japanese. Among them, following two books will be recommendable for general understanding on the situation of land and water use and their historical development.

Association of Civil Engineering (Dobokugakkai) (1975): *Nippon no Doboku-gijutsu – Kindai Doboku Hatten no Nagare (Civil Engineering of Japan – Progress of Modern Civil Engineering)*. Dobokugakkai, Tokyo, 507p.

Ministry of Construction (Kensetsu-cho) (1978): *Nippon no Kasen (Japanese Rivers)*. Kensetsu Koho Kyokai, Tokyo, 513p.