Collisions of traditional Commons with the modernized institution of rice-paddy irrigation systems in Japan

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Abstract

The traditional Commons in water management, which have been called “irrigation Commons,” has operated rice-paddy irrigation systems in Japan. The systems (irrigation facilities and Water Users Organizations) are characterized by many farmers on a small scale. The feature leads farmers to the laborious task of collectively managing the long network of irrigation facilities through WUOs. In other words, the structure of irrigation facilities as a network of canals had an effect on the structure and functions of irrigation organizations. It is called the “stratified” structure and function, which is build up at each division works of a canal network.

The features of river water resources (fluctuation and gravity/natural-flow property) also had effects on the structure and function. The former (fluctuation) leads to privileged development of rice-paddy field as “First in time, first in right” upon a prior appropriation principle, whereas the latter (gravity/natural-flow property) does to an advantageous position of an up-stream diverter. These features provide the setting for traditional Commons and irrigation-water practices on rice-paddy field in Japan.

When the modernized river water management was introduced with 1896 River Act, the traditional rice-paddy irrigation systems were expected to totally shift from “under the local agreement” to “by legal permission for water rights”. However, since the river-administration authority regarded the prior-appropriation water rights as “deemed” permitted water rights in a legal system and verified the entitlement of prior-appropriation water right holders, the potential collisions and confusions were obviated. It was after the World War II when the potential collisions between traditional Commons and the modernized institutions occurred in response to the increase of demand in city and manufacturing water. The river-administration authority took several measures to prevent or reduce the impact of collisions such as construction of multi-purpose dams.

Key Words: irrigation Commons, Water Act, prior-appropriation water right, river-water use

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1. Introduction

The agricultural activities on rice-paddy field in Japan have been practiced through traditional rice-paddy irrigation systems which divert the river water resources since the mid-Edo period. The “systems” means both irrigation facilities and Water Users Organizations (WUOs): the former include water storage facilities (i.e. dams/reservoirs), water facilities (i.e. diversion facilities and division works/weirs), and canal facilities (i.e. a main canal, the secondary, the tertiary, the quaternary canals and so on)[4], while the latter mean the organizations for Operation and Maintenance (O/M). It implies that many “peasants” on a small scale in Japan had the laborious task of collectively managing the long network of irrigation facilities through WUOs. The collective management is characterized by: 1. its exclusively using diverted water from a river within one WUO and 2. fairly and impartially distributing the water inside. On the other hand among WUOs which divert water from the same river, the allocation of river water resources took place by the local agreements which were supported by the full authority. These features provide the setting for traditional Commons on rice-paddy field in Japan.

From the beginning of Meiji period, when the modernized river water management was introduced with River Act, the traditional rice-paddy irrigation systems was expected to shift from “under the local agreement” into “under the national control” by legal permission for water rights. The paper aims at clarifying how collisions between traditional commons and modernized institutions took place in terms of qualitative allocation of river water resources when: 1. modernized river administration was introduced in 1986 River Act, and 2. water demand for city and manufacture dramatically increased after World War II. This paper also states expressly how the traditional rice-paddy irrigation system in Japan is practically recognized as “Idealtypus (Ideal type)[5]” in previous study and hearing research.

2. What is Traditional rice-paddy irrigation system in Japan?

2-1 Difference in “irrigation”

“Irrigation” is one of the major Commons referred by social scientists[6] mentioning a daily water supply system, rotational irrigation in drought, and water organizations for management. However, little regard to the difference between a rice-paddy field and non rice-paddy field is often paid. In terms of water-requirement quantity per unit, rice-paddy field needs much water due to high water requirement rate such as

[4] Tsukuba International Center and Japan International Cooperation Agency (2012), *Contents of Technical Cooperation “Participatory Irrigation Management Organizations in Japan,”* Tokyo Japan.
http://jica-net.jica.go.jp/dspace/bitstream/10410/767/11/Text-English-Digest.pdf

[5] Max Weber(1969), *Basic Concepts in Sociology,* New York, Greenwood Press.

[6] E., Ostrom (1990), *Governing the Commons*, Cambridge University Press, United Kingdom.

avoidable percolation: rice-paddy field needs 25mm-30mm whereas non rice-paddy field 5 mm on the average. A rice-paddy irrigation system falls into two types except rain-fed agriculture: by diverting river-water resources and by using a pond-fed irrigation. Since each management organization varies not only in infrastructures but also in locality such as custom and culture, it is difficult to generalize about "irrigation" as traditional Commons without regard to the various settings. Therefore, this paper specifically focuses on the period from 1945 (post WWII and Land Reform) to 1955 (before the Rapid Economic Growth) and aims at clarifying the characteristics of rice-paddy irrigation systems as Idealtypus which diverts river-water resources for irrigation.

2-2 Features of irrigation facilities and organizations

In terms of facilities and organizations, the small-scale farming and many farmers have been influential in managing the traditional rice-paddy irrigation system as saying by Iwata and Okamoto (2000)[7].

> For example, the beneficiaries' number of each irrigation organization is smaller in the case of large-scale faming like the United States, while the number is extremely big in the cases which the small-scale faming is popular such as Japan or some developing countries. Therefore, it appears typical in Asian monsoon area that myriads of farmers faced the task to operate and maintain one network of canals in cooperation.

After that, they point out that the structure of irrigation facilities as a network of canals had an effect on the structure and functions of irrigation organizations (i.e. WUOs). Iwata and Okamoto call it the "stratified" structure and function. JICA (2012) also mentions that the irrigation organizations have carried out irrigation management by creating "multilayered" organizations which are based on local communities (JICA, 2012). In order to understand the concept of a stratified irrigation organization, features of irrigation facilities and organization are overviewed below.

A paddy field is simply defined as a flat land surrounded with bunds to keep water stagnant, and is attached to ditches and drains. The water reaches each paddy field through a diversion point and an elaborate network of canals (Figure 1). The network of canals consists of division works, the main, the secondary, the tertiary, the quaternary canals, an so on. At the quaternary level, the water reaches a minimum unit of irrigation organization, i.e. a rural community called Mura (Iwata and Okamoto,

[7] Iwata, T. and Okamoto, M. (2000), "The structure and functions of stratified irrigation organization in Japan," *journal of the Association of Rural Planning* 19(2):181-186.

2000) (JICA, 2012)[8]. The irrigation organizations have done O/M (operation and maintenance) activities since the mid-Edo period. They are doing the same activities as Land Improvement Districts (LIDs) under the Land Improvement Act after World War II[9].

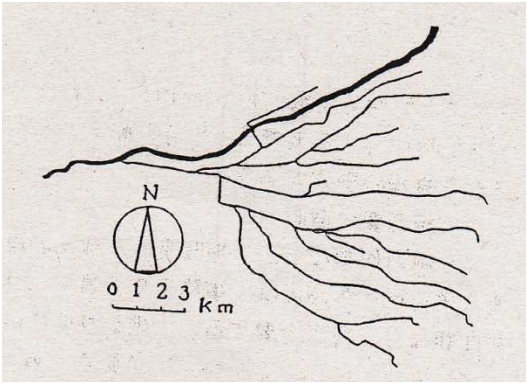

Figure 1: A typical layout of canal networks

At each level of canals, i.e. the main, the secondary, the tertiary, and the quarterly, the combination of irrigation facilities and organizations enable farmers to use the river water for rice paddy farming fairly and impartially. In other words, the "stratified" structure and function can be seen in both aspects of infrastructures and organizations[10].

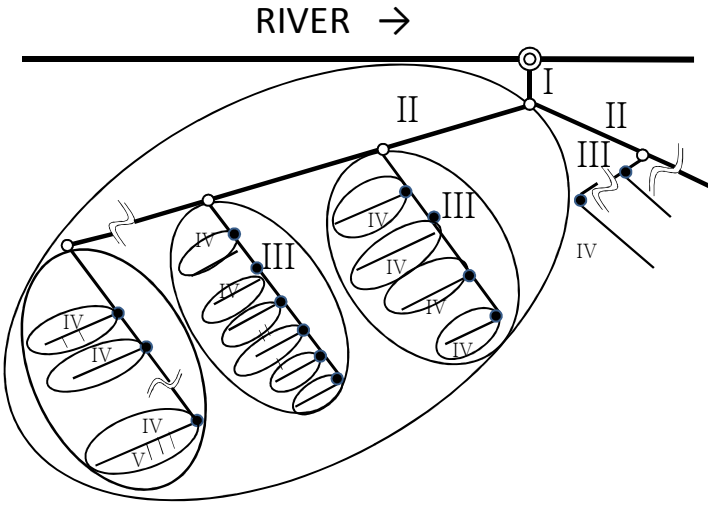

Figure 2: A schematic depiction of canal networks

[8] Beardsley, R., Hall, J., and Ward, R., *Village Japan* (1959) Chicago: University of Chicago Press is sometimes referred as one of references in terms of Mura.

[9] There are several differences between LIDs and the similar pre-war organizations (which called a land consolidation union and a common water supply union). As the Land Improvement Act aims at abolishing an absentee ownership, membership is preferentially offered to the famers who practically use the land (JICA, ibid).

[10] In terms of appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities, Ostrom mentions that CPRs are organized in multiple layers of nested enterprises (Ostrom, ibid pp.101-102).

Figure 2 shows the generalized model of a canal network in the rice-paddy irrigation system and emphasizes each stratified structure and function by adding circles. WUOs (LIDs in modern Japan) as Idealtypus are equivalent of the area that enjoy diverted water from a diversion facility (◎ in Figure 2) and delivered water through a network of canals. Water dividing procedure inside a WUO led to irrigation Commons. Since sustainable river-water use was particularly significant for beneficiaries in each WUO, though there sometimes were squabbles over irrigation water, critical conflicts could not occur inside. Sub-Commons such as WUOs at level III weakened their original exclusivity when they were included in Commons at level II. By contrast, between WUOs who diverted river water resources at different diversion facilities, each “Commons” experienced severe water conflicts (see *Takina River* case in 3-1).

The previous work and hearing research pointed out that the stratified structure and function of rice-paddy irrigation system by diverting river water resources is built up at each division works (○ and ● in Figure 2) It is because an organization is divided into sub organizations at each division work in terms of river-water use. Since the stratified structure and function can be seen in respective of managing a rice-paddy irrigation system, management and operation of irrigation organization including O/M activities are explained next.

2-3 management and operation of irrigation organization

There are O/M activities carried by irrigation organizations such as: 1. Weeding, removing sediments of canals, and minor repairing, 2. Operating irrigational facilities such as opening and closing water gates in order to deliver water fairly and impartially, 3. Collecting membership fees (including water charges), 4. Electing members’ representative. The members are qualified for a fair and impartial water right if they fulfill these obligations. The members always must be aware of their obligations to provide their services (labor) for carrying out the various O/M activities of irrigation management and water distribution (JICA, 2012).

The stratified structure is observed both in LID (the canal-covered area I in Figure 2) and a rural community as a minimum unit of irrigation organization (the canal-covered area IV in Figure 2) when a procedure for electing their representative and a way of operating/managing irrigation organizations are implemented. They choose their representatives or persons in charge of each level’s canal by a bottom-up way (i.e. by indirect and secret election in which every vote carries the same weight in the case of LIDs and by collegial in the case of a rural community). On the other hand, once their representatives or persons in charge are chosen, it is by a top-down way to implement daily O/M activities and to operate/manage irrigation organizations by

delegation of power.

For example, when the river water resources get scarce and water-quantity coordination become necessary in an irrigation organization or among irrigation organizations, it is their representatives or persons in charge of each level's canal to discuss coordination. One of their alternatives in drought (of which frequency is once every five years at average) is a block rotation in an irrigation organization. A block rotation means a facility-operation shift from simultaneous and continuous (S.C.)-flow pattern to rotational and intermittent (R.I.)-flow pattern (Tajima, Ishii, and Miwa, 2009)[11] (Tajima, Ishii, and Miwa, 2009)[12]. When the water becomes as scarce as irrigation organizations at the level III cannot manage by itself, the representatives of III gather at the level II, of which canals cover the larger field, in order to coordinate irrigation water among irrigation organizations at level II. Whereas these decisions are implemented at both irrigational facilities and irrigation organizations in a top-down fashion, equality and accountability are thoroughly empathic even in drought in response to fluctuation of river water resources.

3. Collisions with the modernized institution

Although it generally maintains a stratified structure from its origin at the mid-Edo period, the traditional rice-paddy irrigation system had some collisions with the institutional changes for Japan's modernization. The collisions occurred especially between prior appropriation right holders and other water right holders who increased demand for water. Taking into account both: 1.features of river water resources, and 2. introduction and development of the legal system, collisions and solutions are clarified below.

3-1 features of river water resources and irrigation-water practices

Fluctuation

River water resources present two distinguishing features in comparison to other natural resources such as forest resources: fluctuation and gravity/natural-flow property. River water resources fluctuate in the volume of water by year, by season, by day, even by second (fluctuation). The water flow is from upstream to downstream (gravity/natural-flow property). The former leads to privileged development of rice-paddy field as "First come, first gain" ("First in time, first in right") upon a (prior) appropriation principle, whereas the latter does to an advantageous

[11] Tajima M., Ishii, A., Miwa, H., (2009), "Practice and Mechanism of Rotational Irrigation in the Rice-paddy," *journal of the Japanese Society of Irrigation, Drainage and Rural Engineering* 77(7) :559-562.

[12] Tajima, M., Ishii, A., Miwa, H. (2009), "Practices and principles of intermittent distribution in paddy fields for saving and promising water supply in Japan," *Tohoku-Chiiki-Saigai-Kagaku Kenkyu* (Japanese) vol.45:163-168.

position of an up-stream diverter. When the volume of river water is enough for all irrigation organizations, they all may enjoy the natural condition of watercourse. However, in the drought period when the volume of river water does not reach the total amount in demand, an irrigation organization who developed rice-paddy irrigation field first may be entitled to divert river-water resources as prior appropriation, undiminished in quantity by others. This is how the privilege of prior appropriation works in order to maintain an order among irrigation organizations in terms of fluctuation. Fluctuation is outstanding feature of river water resources, which differs from other traditional Commons in Japan such as *Iriai*.

Gravity/natural-flow property

Generally due to gravity/natural-flow property, since diverting at an up-stream point gives a direct impact on a down-stream irrigation organization, up-stream development of a new rice-paddy field is not intended. However, it can happen on the condition that an excellent arable field exists upstream and the authority to govern the watershed (i.e. the Edo government, or its local domains) encourages the up-stream development. Even in this case, despite of a contradiction between a privilege of prior appropriation and an advantageous position of an up-stream diverter, the prior-appropriation water right holders (irrigation organizations) may maintain a qualified right to the same extent and degree. In other words, it is necessary for up-stream development of a new rice-paddy field that: 1.the up-stream irrigation organizations honor the full agreement that they never infringe a prior appropriation water right, and 2.the authority endorses the agreement by its political enforcement. These procedures and agreements led to irrigation-water practices.

Case of Takina River

The water use of *Takina River*, located in Iwate prefecture of Japan, is an example of an irrigation-water practice. *Takina River* is a small-sized river, and is included in the *Kitakami River* system. Since alluvial funs are created by the streams of *Takina* and other tributaries, underflow water is available partly in the irrigated areas. Since the catchment basin was relatively narrow in comparison with the total developed rice-paddy field, most of which were developed in pre-Edo period, irrigation water conflict often occurred in the area between WUOs depending on *Takina River*. The water conflict is widely known as “Water Fight in Shiwa” (*Shiwa-no-mizugenka*). The conflict was so severe that not a few peasants were killed or injured. Along *Takina River* over a distance of 10km, twenty-seven division works/weirs were built and delivered irrigation water for rice-paddy field such as about 822ha in 1672. Due to an advantageous position of up-stream diverter, all surface stream water was divided

among the up-stream nine WUOs (up-to ⑤ in Figure 3), while the down-stream remaining WUOs depended on underflow water of the alluvial fan seeping into canals. The irrigation water conflict often occurred until 1952 when *Sannokai Dam* was constructed upstream of *Takina River*. Figure 3 shows where the division work/weirs were, what they were composed of, and how they divided natural flow with the work/weirs[13].

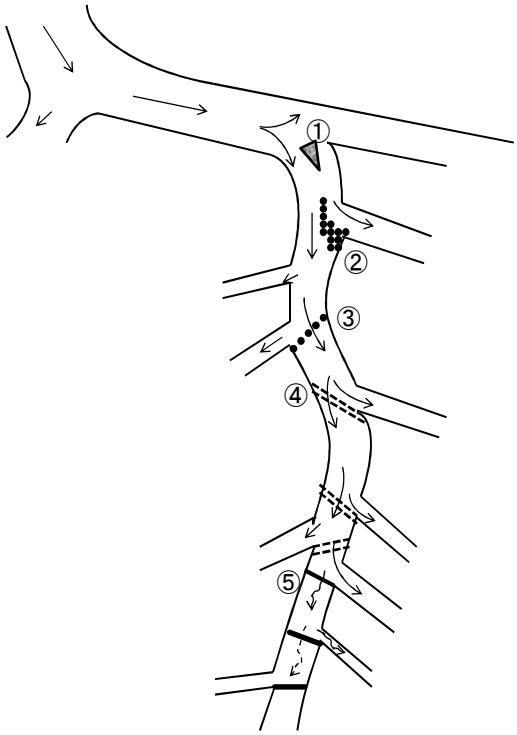

Figure 3: A layout of diversion works in *Takina River*

The characteristics of water division through weirs along *Takina River* are explained as follows: 1. The division work/weirs (division facilities) were made of big rocks (① in Figure 3), stones (③ in Figure 3), gravel (④ in Figure 3), and mixed materials of them (② in Figure 3). 2. River water flowed through each work/weir which was agreed between WUOs, and was divided consequently in accordance with their agreement (e.g. ④ intended to halve a river width, not the volume itself), taking into account features of river water resources: fluctuation and gravity/natural flow property. The agreement about O/M of division facilities bound all related WUOs. 3. the most advantageous WUOs could use irrigation water as much as they needed. The point is that irrigation water conflicts occurred per water work/weir. It means that "peasants" who shared irrigation water by one water work/weirs formed irrigation Commons. The relationships between Commons, which were often expressed as

[13] Sato, M.(1978) *People along Takina Rive, Morioka:* Kumagaya Printing Co.

irrigation water conflicts, were formed per division “point” as division work/weirs. The irrigation water practices at *Takina River* bear several empirically-derived implications: 1. Since the relationship among WUOs in terms of river-water usage is different by a division point such as a division work/weir, which means also the characteristic stratified structure, it is a division “point” to determine how rice-paddy irrigation system using river water resources was built up, whereas other Commons such as *Iriai* based on “face” like land and forest. 2. Division ratios and O/M of division facilities were considered the most critical in continuing irrigation water practices. 3. The available volume of river water resources in accordance with irrigation water practices was indefinite in a practical meaning. It is because water facilities at that time could only divide in accordance with the agreed ratio. In a severe drought period, when the agreement of division rations and O/M division facilities was at risk for breach in irrigation water conflicts among WUOs as Commons, the authority to govern the water shed (i.e. the Edo government or its local domains) was expected to intervene for final settlement.

3-2 Introduction of the modernized river administration and establishment of permitted water right

The River Act was enacted as part of modernized legal development in 1896. The permitted water-right system was introduced. All water rights including prior-appropriation water rights for irrigation need to be legally authorized after each concerned water-right holder voluntarily apply to a river-administration authority.

It is noteworthy that the permitted water-right system requires holders to clarify a purpose of use, beneficiaries, and a maximum volume of watercourse which a holder diverts at a division work whereas it does not require specifying how to operate and maintain the division work itself (Okamoto 2011)[14]. The latter was one of the main points in irrigation-water practices. Names of right holders, division points and division works were also continuously required. In other words, when river water resources get scarce, by honoring an agreement about operation and maintenance of diversion facilities, fair and impartial water distribution had been fulfilled among irrigation organizations (or in an irrigation organization itself). In the place of the agreement, the maximum volume of watercourse in the permitted water-right system ensures the right holders to divert river-water resources.

It was highly anticipated that some collisions might occur between prior-appropriation water rights of traditional rice-paddy irrigation systems and the new permitted water rights. However, the river-administration authority regarded the prior-appropriation

[14] *Brief Introduction of River-water Use in Modern Japan* (2011), Reference issued by Kanto Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism.

water rights as “deemed” permitted water rights in a legal system and verified the entitlement of prior-appropriation water right holders. Therefore the potential collisions and confusions were obviated. Technically speaking, the river-administration authority put restriction on prior-appropriation water rights by requiring each “specific facility capacity”, whereas the authority practically accepted the existing facilities with the “specific facility capacity” at the same time. As a result, there were not big changes in despite of much possibility of collisions at that stage.

3-3 Increase in water demand and the next collisions after World War II

As water demand in Mega City Tokyo (Greater Tokyo) drastically increased due to city water and manufacturing water after World War II, new sources of water were the absolute essentials for fulfilling the demand. Although the Tone River was regarded as the only possible source of water, since many prior-appropriation water rights were already entitled along the Tone River, there occurred the collision between the modernized legal institution and the traditional rice-paddy irrigation systems. Therefore the river-administration authority took several measures to prevent or reduce the impact of collisions. First, construction of many multi-purpose dams was designed. It made it physically possible to increase available storage capacity and supplementary discharge from multipurpose dams in drought, which led to both guarantee of existing water rights and permission for new permitted water rights by the river-administration authority. Additionally the low-flow management based on multi-purpose dams required more elaborate methodology. The water right discharge for rice-paddy irrigation, which consume a large amount of river water, became to be represented not by the maximum quantity of water intake based on facility capacities (i.e. before WWII) but by the more precisely calculated/accumulated volume: 1. The total irrigation period was divided into several growing stages of wet-paddy rice, and at each stage different volume of water was required (left of Figure 4). More severe condition of water needs more elaborated diversion requirements against growing stage (right of Figure 4). 2. Adding to the stage-specific discharges, the total annual volume of water that can be diverted from a river is also calculated as the second restriction (JICA, 2012). Consequently the possibility of collisions happening was remarkably reduced while a rice-paddy irrigation system as traditional commons came to be restricted in a practical meaning. 3. Furthermore, “effective rainfall” is required to be considered in an irrigation-water diversion plan. Effective rainfall is the component of total rainfall, which is neither deep percolation water nor run-off water over the soil surface[15]. Since effective

[15] FAO (1986) *Irrigation Water Management: Irrigation Water Needs (Chapter 3)*, FAO Natural Resources Management and Environment Department.

rainfall is considered as technically useful water in irrigated agriculture, the volume of irrigation water is less than before, which produced another restriction to prior-appropriation rights. Second, an emergency system known as “drought coordination” was practically implemented when scarcity of river water resources becomes too severe for water right holders to divert from a river in accordance with the water right system. While the river-administration authority prepared the discussion table for all users (saying more precisely, representatives of city water, agriculture water, manufacturing water, and water for power generation), it does not participate in the discussion of the drought coordination. The river-administration authority only focuses on the operation of dam facilities in accordance with the decision of emergent restriction rate. This means that collisions do exist, but the drought coordination system prevents them from emerging in reality. The drought coordination takes place once every four years at average. As emergent restriction rates are decided at each table targeting a specific local area, they vary area by area. For example, in the case of the Tone River the maximum restriction rate is thirty percent regardless of prior-appropriation water rights or not. In comparison in the Yahagi River, city water is prioritized over manufacturing and agriculture water: an emergent restriction rate of city water is twenty percent while manufacturing and agriculture water’s rate is fifty percent.

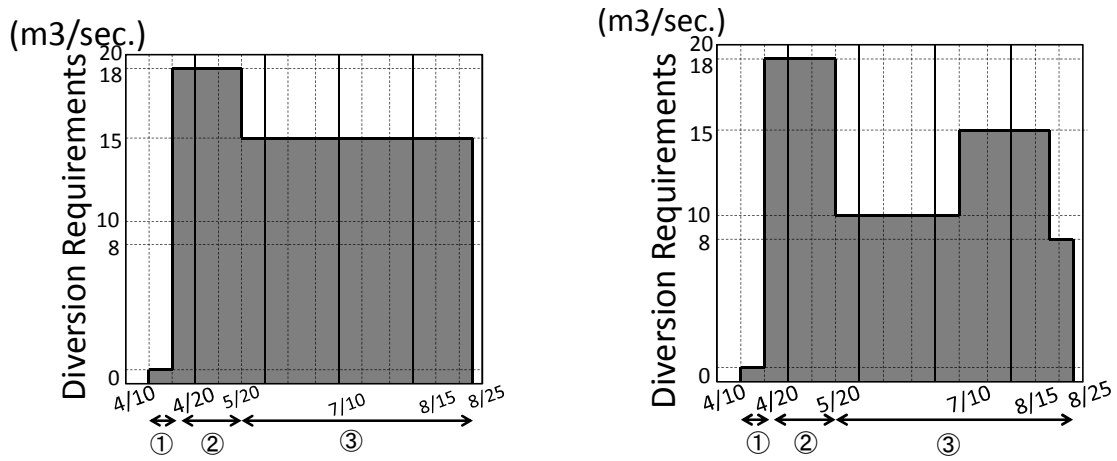

Figure 4: Diversion requirements against growing stage

Each growing stage of wet-paddy rice:
① Rice nursery stage
② Paddling and transplanting stage
③ Normal season stage called *Futsu-ki*

Conclusion

The traditional rice-paddy irrigation system is characterizes by collective management by many farmers on a small scale, which is due to O/M activities of irrigation facilities with a network of canals. The collective management means: 1.exclusively using diverted water from a river, and 2. fairly and impartially distributing the water in an irrigation organization. At each diversion point and division works the stratified structure of rice-paddy irrigation system was built up, and the characteristic feature has been maintained up until the present.

Although it was highly conceivable that the distinctive rice-paddy irrigation system might have collisions with the modernized institutions, the probability was obviated or diminished through several river-administration measures: 1. the river-administration authority verified the entitlement of prior-appropriation water right holders even after introduction of the modernized institutions. It regarded the prior-appropriation water rights as “deemed” permitted water rights, which resulted in obviating the potential collisions and confusions. 2. in response to the increase of demand in city and manufacturing water, construction of multi-purpose dams and drought coordination consequently prevented the collisions and confusions from getting apparent. The traditional rice-paddy irrigation systems still practically maintain the stratified structure, whereas various administrative adjustments to the modernized institutions were made especially after World War II against a background of increasing water demand.