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DEVELOPMENT OF LOCAL CULTURE AND THE
IRRIGATION SYSTEM OF THE AZUSA BASIN

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I. INTRODUCTION

The area selected as the object of study is the alluvial area of the Azusa River in the Matsumoto basin (also known as Nakanobudaira), Nagano Prefecture. An upper branch of the Shinano, one of Japan's largest rivers, the Azusa is a rapid stream running out of the northern Japan Alps.

The Matsumoto basin is a typical compound alluvial fan formed where several rivers meet, including the Azusa, the Narai and the Tokase. Alluvial terraces rise on both banks of the Azusa River fan. On the right bank, there are prominent terraces, especially along the foot of the mountains. The area studied here was selected for the following reasons:

- (1) The prominent feature of Japanese agriculture is wet-rice farming: the area under study contains extensive wet-rice paddies as well as dry fields cultivated on the upper levels of the riverbank terraces.
- (2) In Japan, field irrigation is typically achieved by channelling the river water into paddy areas, and the canal system is well developed in this area.
- (3) One of the remarkable features of canal irrigation systems in Japan is that they rely entirely on natural gravitation flow in sloping fanlike areas, as does the irrigation system in this area.
- (4) Most of Japan's irrigation systems were built before modernization, and have a long history. Those in this area are no exception, having been built in the medieval (1185-1568) or the early modern (1568-1868) period.

- (5) Several public works projects to modernize local irrigation systems were undertaken in this area in the early modern period, which brought about transformation of local agricultural practices.

Agricultural practice and the history of its development and change in this area have regional characteristics distinct from other farming areas. But among these features there is much that reflects the overall character of agricultural modernization in Japan.

In this report I have tried to analyze as objectively as possible the specific facts of agricultural development in this area, as well as to draw, from this particular example, some general conclusions about the significance of irrigation systems and their modernization in Japanese agriculture.

In reading this report it will be helpful to keep in mind several overall characteristics of Japanese agriculture and its irrigation systems. Situated as it is at the easternmost edge of Asia, Japan demonstrates agricultural patterns markedly different in history and structure from that of the non-Asian world. Yet at the same time, compared with agriculture in other parts of Asia, especially that of the Asiatic continent, Japanese agriculture has many distinctive features. Without some knowledge of such features, it is difficult to fully grasp the implications of the factual analysis of local agriculture discussed below.

- (1) Japanese agriculture consists of a combination of both wet- and dry-field cultivation.

The way these two techniques of farming are combined varies considerably from region to region, for the crucial condition is the availability of water sources and the degree of advancement of the irrigation system designed to exploit them.

- (2) In the early modern period wet-rice farming was extensively developed, for large-scale development and reclamation of new fields (shinden) had been carried out between the Sengoku (1467-1568) and early Edo periods (1600-1868).

New field development generally ceased by the period from 1688 to 1735, and it can even be said that development became excessive. By this I mean that the area of rice fields was too large for the quantity of river water available to irrigate it, even when the rivers were at their height. As a result, disputes over the water supply arose everywhere, making it necessary to regulate irrigation practices and to establish fixed rules for distribution of precious water resources, which inevitably reflected the inter-village balance of power.

- (3) Modern Japanese agriculture took over premodern irrigation systems and the rice fields that depended upon them.

An irrigation system is by nature closely connected with the land, and its physical facilities cannot be easily abandoned. Consequently, modern Japanese agriculture inherited a vast legacy of such irrigation systems, and had no alternative but to maintain the technology and social patterns established by those systems. This is one of the biggest reasons the traditional farming society has been so distinctly preserved in Japan. Even today the historic legacy of irrigation systems plays an important role in modern society.

- (4) Formation of irrigation systems, the scarcity of water resources and the establishment of irrigation practices created a society based on an elaborate pattern of customary law.

One of the basic qualities of these irrigation practices was that they reflected conflicts between the upper and lower areas of water distribution, as well as frequent conflicts which

arose over this issue between one village and another. The principle of water distribution established under the irrigation system was totally different from that which governs the allocation of resources in a market economy, in that it rested on a balance of power between villages and between groups of villages. Patterns established in a rural area dependent on water were rigid and could not be easily changed; they gave rise to a social order firmly rooted in customary law. Modern Japanese rural society inherited this social order along with the irrigation system.

The above sums up the historical factors behind the profound differences between modern Japanese rural society and its European counterpart. These factors also explain, in part, the ways Japanese rural society and agricultural practice differ from other Asian countries. It may be possible in some respects to find a close resemblance between Japan and the islands of Southeast Asia, but not with the Asian continent. Agricultural practice depends on the geographical characteristics of the environment but it also is the result of a historical process of developing the environment itself. The Japanese archipelago has a unique natural environment and in turn, a unique history of agricultural development.

II. CONFLICTS OVER WATER DISTRIBUTION AND THE EMERGENCE OF A SOCIAL ORDER

Agricultural development in the Azusa basin seems to have begun in ancient times. Judging from the remains of the jōri system rice fields (a system of land division adopted around the time of the Taika Reform [645]) in part of the Matsumoto Valley, it is estimated that people had already settled there in ancient times and rice cultivation had begun in some areas. However, it was during the medieval period, especially in the latter Muromachi period (1338-1573), that wet-rice farming was substantially developed in the Matsumoto basin. The Azusa is a rapid river and it must obviously have been difficult to stabilize its course. In any case, it is estimated that the beginning of systematic control of rivers and establishment of large-scale irrigation systems did not occur until the medieval period.

The major irrigation systems on the right bank of the Azusa River from the upper reaches downstream are the Kurokawa, Hata, Wada, Niimura, Kureki, and Shimauchi canals. With the exception of the Kurokawa and Hata canals, all have now been linked to a common intake point on the Azusa. Once each of these irrigation systems diverted water from the Azusa independently, except for the Kurokawa canal, which was fed not from the mainstream of the Azusa but from its branch, the Kurokawa River. Though the canals were built at different times and the exact dates are unknown, the Wada canal is the oldest, and the Hata the newest, having been completed in 1882 (Fig. 1).

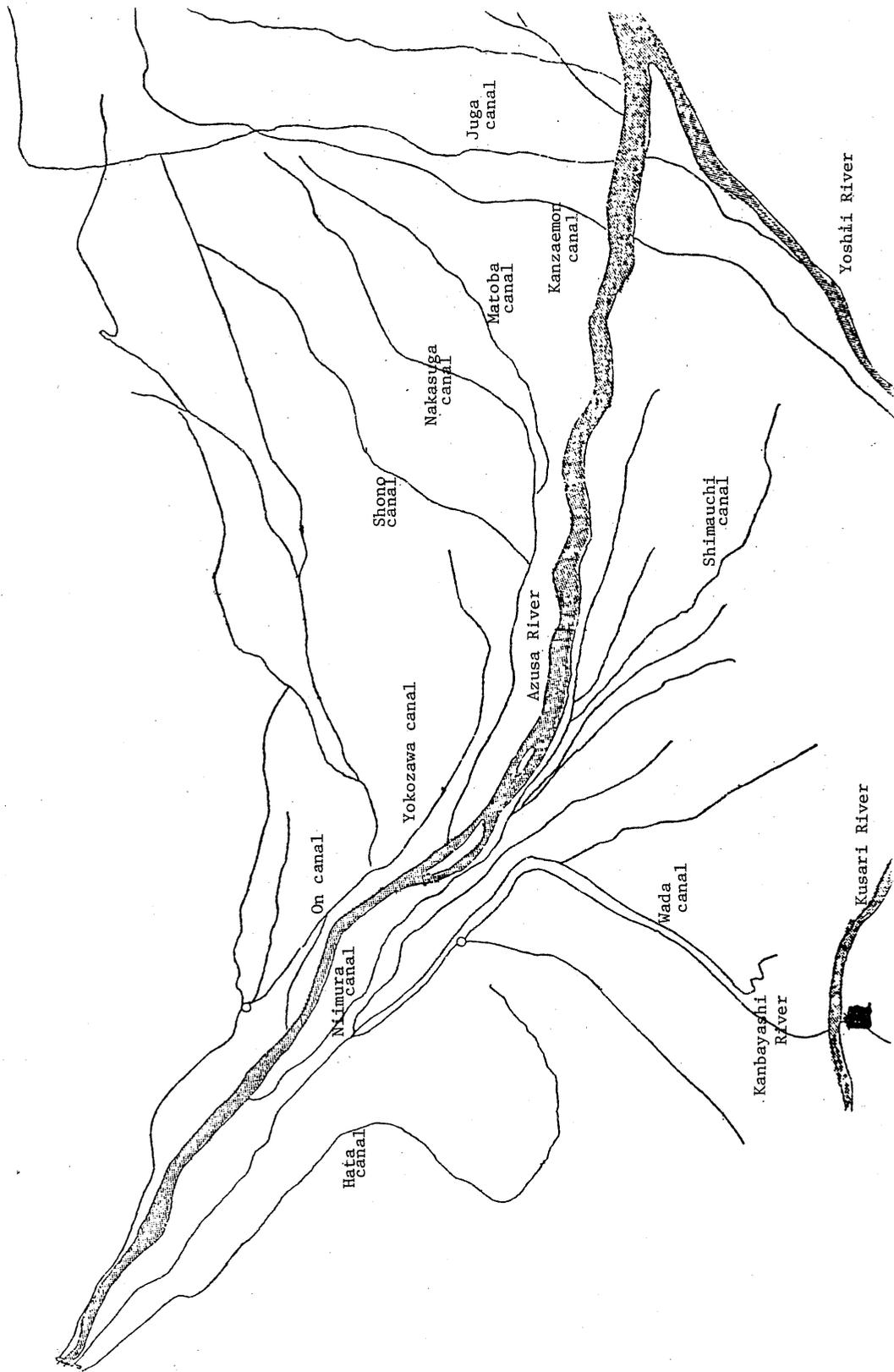


FIG. 1. Major Irrigation Systems in the Azusa Basin.

Brief histories of the three major canals are as follows.

1. Wada Canal

The Wada Canal is the most prominent of the water system in the Azusa basin, and it held a central role in maintaining the order of farm irrigation in the basin. Its intake point was at Kamiakamatsu, Hata village, at the pivot of the alluvial fan. When the canal was dug is not clear, but Wada village tradition says that Nakahara Kanetō, deputy governor of the province of Shinano, ordered his son, Imai Shirō Kanehira, to excavate it sometime in the Jishō period (1177-1180). Yet this legendary date seems far too old for such a large-scale canal to have been built, so it is very possible that the date may be somewhat exaggerated.

The Wada canal enjoyed privileges over the others and its exaggerated history may have been a way of reinforcing its status. If it had been excavated in the Tokugawa period, documents dating it would be more likely to exist. But there are none, suggesting that Wada canal goes back before the early modern period.

The canal does not seem to have been planned and built in its entirety from one original plan. The main waterway in the upper portion near where it leaves the Azusa runs parallel to the main stream of the river and follows a natural downhill course, apparently in an old riverbed (created during flooding) of the Azusa River.

As for the lower portion, the main waterway divides into three branches, two of which (the Wada and Kanbayashi waterways) turn south along the contour line, where they become more obviously man-made. Evidence leads us to believe that the existing water system was not completed all at once, but gradually through a process of construction and improvement. In fact, it may have been that the existing waterway took shape in the early modern period when paddy fields were expanding most rapidly.

One characteristic of the Wada canal is that it has many drainage outlets along its main waterway. There are five of these drainage routes between Akamatsu, at the water intake point, and Mitsumizo, where the canal divides.

Why were so many necessary? First, it is probable that a large quantity of surplus water flowed into the Wada canal, making it necessary to set up a large-scale drainage system to rid the area of excess water. There must have been an enormous volume of surplus water; otherwise the construction of five drains would have been quite unnecessary. We may thus conjecture that large quantities of water, far exceeding the usual level of water intake, occasionally flowed into the main waterway of the Wada canal.

Excess inflow could only have come from two sources, at the intake point on the Azusa River or midway along the waterway, although it is unlikely that the latter was possible in the upper portion of Wada canal. It seems inconceivable that such large quantities of surplus water could have come from anywhere but the Azusa River. The inflow of high waters from the Azusa River indicates that the Akamatsu intake point was situated favourably for the smooth intake of water and that the structure of the water intake dam of Wada canal was too simple to hold off flood waters by means of sluice gates or other control mechanisms. This advantageous intake point for Wada canal constituted one tangible factor in its supremacy over the other canals in the Azusa basin.

It is said that in 1655 the area of land irrigated by the Wada canal was 589 chō 1 tan 2 se 26 bu (approx. 1443.95 acres), of which Wada village occupied 315 chō 2 se 3 bu (approx. 771 acres), Kanbayashi village 217 chō 7 tan 6 se (approx. 532 acres), and Niimura village 56 chō 3 tan 4 se 23 bu (approx. 137 acres). In addition, we are told that there was gratis intake of water for some 245 acres in Hata village at the upper portion of the waterway. The total yield from the irrigated land was 2,492 koku (12,757 bushels), broken down as

follows: Wada village, 1,371 koku 6 to (7,201 bushels); Kanbayashi village, 911 koku (4,663 bushels); Niimura village, 309 koku 4 to (1,584 bushels).

The water intake dam was of a type frequently used for rapid-running rivers in Japan, which dammed the Azusa River and shunted water into irrigation canals. These standard water intake facilities fitted with wooden sluice gates were maintained from early modern times all the way down to the Shōwa era, when the intake points were unified. Needless to say, these dams were easily destroyed by flood waters and needed frequent repairs. The villagers assigned to oversee the irrigation system for the year undertook construction work from 1 April to 30 September every year, a period known as the "summer irrigation season." However, according to Wada village farmers, the construction work was undertaken by the people of Hata village without compensation, and people of Wada village did nothing but oversee the work. This gratis service by the people of Hata village has been explained as being in return for the right of free irrigation from the Wada waterway running through Hata village, but it seems also to be related to the fact, discussed below, that Wada village was part of the lands under the direct control of the shogun.

Lumber to construct the sluice gates for the intake canal was in constant need, and the Wada canal co-operative has maintained forests specifically for the purpose of providing lumber in case of emergencies for centuries up to the present.

2. Niimura Canal

Like the Wada, the Niimura canal was fed by the Azusa River on its right side. Its intake point was located at Kamikawara, Fuchihigashi, Hata village, a little downstream from the Wada canal intake point. It irrigated Niimura village and part of Hata village, a total area of some 300 chōbu (735 acres). Unlike Wada canal, it irrigated a strip of land along the Azusa River and flowed parallel to it, in

what is believed to be an earlier riverbed.

The date of construction is not clear, but it is fairly certain that the Niimura canal was excavated in the early part of the Edo period, as there is mention of its establishment in 1645 among records concerning Wada canal. As the area closest to the Azusa River itself benefited from Niimura canal, it is quite likely that it was constructed at the same time as the new rice fields were being developed in the first half of the early modern period. At this time also, the course of the Azusa was finally brought under control through progress in river improvement works.

Since the Niimura canal drew water from the upper stream of the Azusa just a little below the Wada, it too was amply supplied with water, and never seems to have suffered from a shortage of irrigation water. Apparently its location on the upper reaches of the river was a great advantage, for it is said to have contributed water to other canals when asked to share water in times of drought. In addition, it seems to have had more than enough, allowing surplus water to flow down to Kureki canal by an interconnection of its waterways at the lower areas.

3. Kureki Canal

Locally called the "Kureki River," Kureki canal was clearly once a natural stream. In other words, the Azusa River originally flowed eastward somewhere near Yokomichi (Niimura, Matsumoto City) and joined the Narai River in the neighbourhood of Miyabuchi. The northern portion of the Kureki River today was the mainstream of the Azusa River, until the Matsumoto domain changed its course in the early modern period, making it into a branch of the Azusa. Gradually, its width was narrowed until it was finally reduced to a mere irrigation canal. In contrast to the northern Kureki River, the southern portion is an artificially excavated canal. The domain government apparently used the Kureki River to float timber downstream, so that

it was given special priority in water intake.

In the early modern period, regulation of water use was established among these irrigation systems. The Azusa River begins to run underground most markedly at the point where it fans out (in the vicinity of Hata village), and as a result, a shortage of irrigation water occurred as soon as drought set in. Severe conflicts frequently arose among the irrigation systems on both the right and left banks, and customs regulating water utilization were gradually established in the course of resolving these conflicts. Especially vehement conflict broke out several times in the Bunsei (1818-29) and Kōka periods (1844-47).

There were a total of eleven canals fed by the Azusa River; the Hata canal was built later, in the Meiji era. Six of these—the Wada, Tatsuta, Niimura, On, Yokosawa, and Shōno—were called the upper stream canals; five—the Kureki, Shima, Nakagaya, Matoba, and Takamatsu—were called the lower stream canals.

The upper six canals held the consistent advantage in drawing water from the Azusa, whereas the lower five canals often could not draw enough, partly because they were situated at points where the river went almost completely underground. Because of this, the Matsumoto domain government appointed co-ordinators at the magistrate's office who adjusted water distribution at times of drought. But these co-ordinators had no sway over Wada village since it was under the direct control of the shogun, thus preserving the supremacy of Wada canal.

Water distribution was adjusted according to the following procedures:

- (1) sharing of water by the five lower canals (beginning with the uppermost of the lower canals consecutively to the lowermost),
- (2) a second sharing of water by the five lower canals,
- (3) sharing of water by the six upper canals with the five lower canals,

- (4) a second sharing of water by the six upper canals with the five lower canals,
- (5) alternate use of water by lower canals,
- (6) alternate use of water by upper canals.

Of these procedures, it appears that the sharing of water by the five lower canals was relatively smooth, but sharing by the six upper canals was done in response to demands from the lower canals, and they did not always respond favourably to these demands. Wada canal, in particular, obstinately held to its advantageous position, and refused to comply with demands that it share its water. As a result, it became the target of severe criticism by residents of the lower canals at times of extreme water shortage.

The lawsuit which Nagamuro and 42 other villages on the left bank of the lower stream brought against Arai and 14 other villages connected with Wada canal in 1821 is one of the most outstanding. The complaint was that, while other villages shared water and took turns on a twenty-four-hour basis because of the severe water shortage that year, the Wada villages

dammed the Azusa River and stationed guards, and while drawing water freely for the Wada canal, they prevented other villages from obtaining any water and perpetrated great injustice. The guardsmen disregarded protests by the plaintiff villages, and were openly threatening. Upon investigation, it was found that the villages of Wada canal branches were channelling surplus water to other villages outside the Azusa watershed which were suffering from the drought. They even gave permission for a new canal to be constructed which would draw water for Futago village in the Chikuma district.

The main thrust of the suit was to force the villages connected with Wada canal to share water in proportion to their crop of rice. The defendant villages, however, countered that the area irrigated by Wada canal was on high ground, which made it difficult to draw water and the villages along branching canals often suffered from water shortages. They also argued that it was people from the lower villages who had provoked the guards and were far more to blame.

This conflict was finally resolved by establishing a water-level marker in the Yanagi drainage outlet as the standard. It was determined that the normal level of water stood at a point 33 cm from the top of the marker. When the water in the Azusa River fell to seventy per cent of its normal level, water intake by Wada canal was to be reduced until its water level fell to a point 9 cm below its normal height. If the water of the Azusa River fell to sixty per cent of its normal level, Wada intake was to be reduced 15 cm from its normal height.

Apparently the method of regulating water intake not by sluice gates at water intake points but by measurement of the water level along the course of the canal was relatively rare in the early modern period. It is not yet known, however, how this practice was first established.

Despite these concessions on both sides, and perhaps because the conflict was not thoroughly settled, a violent dispute arose again in 1845. This dispute ensued from a complaint filed by 43 villages of the lower Azusa area against the villages of Wada canal. This dispute became prolonged and a case was ultimately brought to the commissioner of shrines and temples of the shogunal government, a man named Wakizaka Awajinokami.

It was finally settled in August 1847 with the following stipulations.

- (1) The water marker in Yanagi drainage outlet is to be solidly affixed and the canal thoroughly dredged.
- (2) Village officials of both sides are to inspect the Azusa River at times of drought to determine the degree of water shortage and the extent of mutual restrictions on water use from Wada canal. Control over water use will concur with the procedures stated in the 1821 agreement.
- (3) The same steps as the above are to be taken in the case of alternate water use.
- (4) At times of drought, inspectors are to meet at Yanagi to confer beginning at 3 a.m. Notification is to be made by 3 a.m. the previous day.
- (5) The surplus drainage outlets of Wada canal are to be reinforced to prevent any leakage of water.

The beneficiaries of Wada canal were probably responsible for such disputes by drawing water without complying with the provisions of the 1821 agreement on water sharing and alternate use.

Again, the conflict was not completely resolved by the settlement in 1847, and another dispute broke out in 1872. It seems that the beneficiaries of Wada canal continued to draw water as they pleased even after the settlement. The irrigation order in the Azusa River watershed was thus not entirely fixed; its premodern characteristics were preserved even after the Meiji era, and Wada canal continued to monopolize the most advantageous position.

The development of Hata canal at the uppermost reaches of the Azusa added a new element to the irrigation order in the river water system. Part of Hata village belonged to the lowlands along the Azusa River, where there had been rice fields from ancient times. Most of the village, however, was located on terraces above the river. Since paddy field development had not been carried out, it was used for dry fields. But the people of Hata village had long wanted to bring in water from the Azusa River to irrigate the land to use for wet-rice paddies.

In the latter part of the Tokugawa period, plans for a new irrigation system for Hata fields were made many times but could not be realized because those on the lower reaches of the river who were dependent on irrigation strongly opposed any new system that would draw water upstream from them. A de facto system of water rights that had been established by the lower canals effectively prevented development of new irrigation canals.

Only with the advent of the Meiji Restoration did the way open for Hata village to achieve its long-cherished goal. The fall of the Tokugawa bakufu destroyed the authority of the lands which had been controlled by the shogun. In the first year of the Meiji period, the Matsumoto domain (later Chikuma Prefecture, and then Nagano Prefec-

ture) accepted the petition of Hatakoshi Rokuza, the headman of Hata village, and gave permission for excavation of a new canal. The lower villages consented to the project on the condition that if water shortages arose during the period of irrigation, the water intake gates to the new canal would be completely shut.

Completed in 1882, Hata canal passed from the private management of Hatakoshi Rokuza to the control of Hata village in the following year, 1883. Subsequently, Hata canal was frequently forced to shut its sluices in accordance with this condition. The appearance of Hata canal gave the villages along the lower river a common target for their hostilities. When villagers of "the lower stream" detected a water shortage, they would first notify the villagers of "the upper stream." Then a delegation from "the upper stream" would inspect conditions, and delegations from both areas would gather at the intake sluice gate of the Wada canal on the Azusa River to investigate the flow. Next, they went to the Hata intake canal and shut and locked the sluices in the presence of representatives of Hata canal. This procedure was convenient for the villagers of "the upper stream" in that they could shift the responsibility for hardships suffered by villages of "the lower stream" to the shoulders of Hata canal beneficiaries. Using this technique to settle opposition between the upper villages and the lower villages, Wada residents speaking for the upper stream group were then able to dominate both groups. Conflict between Hata and Wada became quite serious as result, and there was frequent strife and formal complaints filed.

Under these disadvantageous conditions, the Hata canal had to establish strict control over water distribution for its 250-odd hectares of paddy fields. Hata village selected eight villagers to serve as irrigation overseers and delegated to them the full responsibility for regulating irrigation to paddy fields. Individual farmers were strictly forbidden to draw water arbitrarily from the canal. Methods of this kind were often found in the pond irrigation system in the Kinki districts, but it was a relatively rare case in canal irriga-

tion systems. A custom sprang up from this administrative system in which farmers made gifts to the irrigation overseers in order to obtain preferential treatment. For instance, they might bury a bottle of saké casually near the flume to their paddy field. However, the village collected a fixed quantity of unhulled rice per unit area of rice field which was used as formal compensation to the irrigation officers. This overseer system continues today, but the fees paid by the villagers have been collected in cash since 1969.

Another unique feature in connection with Hata canal was the emergence of water rights separate from landownership. When Hatakoshi Rokuza completed the canal as his private project, he decided to charge a membership fee to landowners of new rice paddies which were made possible by the new canal. Later when Hata village took over control of the canal, it perpetuated this practice. The practice, in turn, gave rise to the concept of "water rights" which could be bought and sold. Transfer of water rights was sometimes made by permission of the village assembly (or by the land improvement district after 1951). Such a customary practice is interesting for its close similarity to a practice (in which water rights are separate from landownership) widely observed in Kagawa Prefecture.

Thus, as a result of severe terms imposed upon it, Hata canal developed various unusual practices. The irrigation control pattern in Hata canal and the customary law which grew up within the order of the irrigation systems in the Azusa River took forms that are peculiar to the Matsumoto area, but they are by no means exceptional in Japan.

III. MODERNIZATION OF THE IRRIGATION SYSTEM

The Azusa River is an extremely rapid stream, and its riverbed is lined with boulders all the way down to where it joins the Narai River. Thus, until the twentieth century it was impossible to construct a levee that cut across the river at right angles. For more than three hundred years until the early Shōwa period (1926-), all the irrigation canals in the Azusa River water system relied on intake facilities first developed in early modern times. This was a method whereby a wooden sluice gate was set up on the riverbed and a waterway channelled through the bank. This method was adopted because structures that cut into the river at right angles were easily destroyed by boulders that were dislodged and carried along by flood waters. Such flooding was another reason for making facilities for siphoning off river water easily reconstructable.

Examples of this type of intake facility were not confined to the Azusa River irrigation system. Many of Japan's rivers are rapid streams and in the most rapid, a similar technique of water intake as used in the Azusa River irrigation system was practised. In the case of the Kinu River, a branch of the Tone, water intake facilities of major irrigation systems up until the end of 1960s were no more than sluices in the embankment, with water conduits on the riverbed and panels to protect them.

Among the Azusa River canals, the intake facility of Wada canal was a relatively strong structure and secured a stable inflow of water. It is said to have cut straight across the Azusa River at Akamatsu,

Hata village, near the pivot of the Azusa River fan where the course of the river was the most stable. In this, of all the canals in the Azusa River irrigation system, Wada canal enjoyed the most favourable conditions for obtaining water.

A full-scale project to modernize the irrigation systems fed by the Azusa River was undertaken in 1926 and completed in 1930. Called the Azusa River Basin Irrigation Improvement Project and sponsored by Nagano Prefecture, this project was part of a new policy adopted in 1923 by the government, the so-called General Plan for Assistance to Irrigation-Drainage Improvement Projects. Government subsidies covering 50 per cent of project costs were given to irrigation-drainage facilities serving an area of over 1,225 acres, selected for the prefecture-sponsored improvement project. The plan was under the direction of the Ministry of Agriculture and Commerce and the Nagano prefectural government, but was also actively supported by the users of lower stream canals. By contrast, the users of upper stream canals, especially the Wada, opposed the project and declared themselves against it from the outset. Wada canal obviously enjoyed the most advantageous position for taking in water, and suffered little even in the low water season. Eventually, however, Wada canal was persuaded to support the project.

The chief goal of the project was to unify all the water intake facilities of the irrigation system at one point on the river. The work of unification consisted of constructing sluices and a concrete embankment across the Azusa River in the vicinity of the old intake point for Wada canal near Akamatsu, Hata village. All the major canals were then tied to this main intake area with waterways on both banks of the Azusa River. In all the construction, traditional methods were replaced by modern civil engineering techniques long since introduced from the West. Traditional technology was not sufficiently developed to be able to design a dam that could cut transversely across the rapid stream of the Azusa River.

When unification of intakes was completed under the Azusa River Basin Irrigation Improvement Project, the irrigation order established within the Azusa River water system was of course profoundly affected. Conflict over water distribution in the Azusa River irrigation system was, at least superficially, resolved because the ten irrigation canals no longer drew water independently, but had to share one common facility. As a result, the social order and customs established on the basis of the traditional water distribution system in the Azusa River basin gradually disappeared. On the other hand, this is not to say that the system of water distribution was completely rationalized. In fact, the traditional order based on old customs was preserved in changed form within the new organization created by unification. It was modified and preserved in even more established forms.

The most important aspect of this new order was that the quantity of water available to all the canals became fixed. Water was distributed at a ratio of 54.5 per cent for the right bank and 45.5 per cent for the left bank canals. This ratio was not necessarily determined by need, but by a basic policy of "preserving the established pattern of distribution to each waterway, and making available surplus water from upper stream canals to lower stream canals."

As is apparent from the quantity of water distributed to each canal (see Table 1), the quantity normally used was not necessarily proportionate to land area irrigated. For instance, the area of land irrigated by one cubic meter per second of water was, respectively: Wada, 338 acres; Niimura, 495 acres; Kureki, 296 acres; Shimauchi, 370 acres; Tatsuta, 490 acres; On, 473 acres; Yokosawa, 502 acres; Shōno, 542 acres; and Nakagaya, 238 acres. Matoba canal was a rather special case in that its quota of water was determined on the basis of its total area of irrigation, 510 acres, plus part of the land irrigated by Kanzaemon canal. As the result, Wada and Kureki canals obtained relatively more water, whereas the Niimura, Tatsuta, Yokosawa, and Shōno canals received 40 per cent less. Water consumption is, of course, not determined by area of land alone; it differs

TABLE 1. Share of Irrigation Water after Unification of Water Intakes.

Name of canal	Quantity of allotted water		Area of irrigation (in acres)
	Volume of water per second (m ³ /sec)	Units of volume	
Right bank			
Wada	6.95	250	2,353
Niimura	1.86	67	922
Kureki	4.03	145	1,199
Shimauchi	3.86	139	1,426
Total	16.70	601	5,900
Left bank			
Tatsuta	1.50	54	735
On	5.79	208	2,745
Yokosawa	0.75	27	377
Shono	1.55	56	841
Nakagaya	2.22	80	890
Matoba	2.14	77	510
Total	13.95	502	6,098
Grand Total	30.65	1,103	11,998

according to soil and topographical conditions, as well as to factors related to irrigation works themselves, such as loss of water from the waterway. Thus, it may be that the imbalance of water distribution was actually caused by inequity of distribution. On the other hand, it is improbable that there was a marked discrepancy in the required quantity of irrigation water in this district.

Apparently the quantity of water distributed to each canal was determined not by calculating required quantities for all rice fields in the given area but by referring to past records of intake. The imbalance among them is very noticeable. Clearly, the fixing of new quotas was not so much based on rational, objective standards as it was a reflection of traditional relations based on customary regulations. The users of Wada canal, who adamantly opposed the project, managed to uphold their advantage in return for their participation in the project. Ultimately, the customary order of water distri-

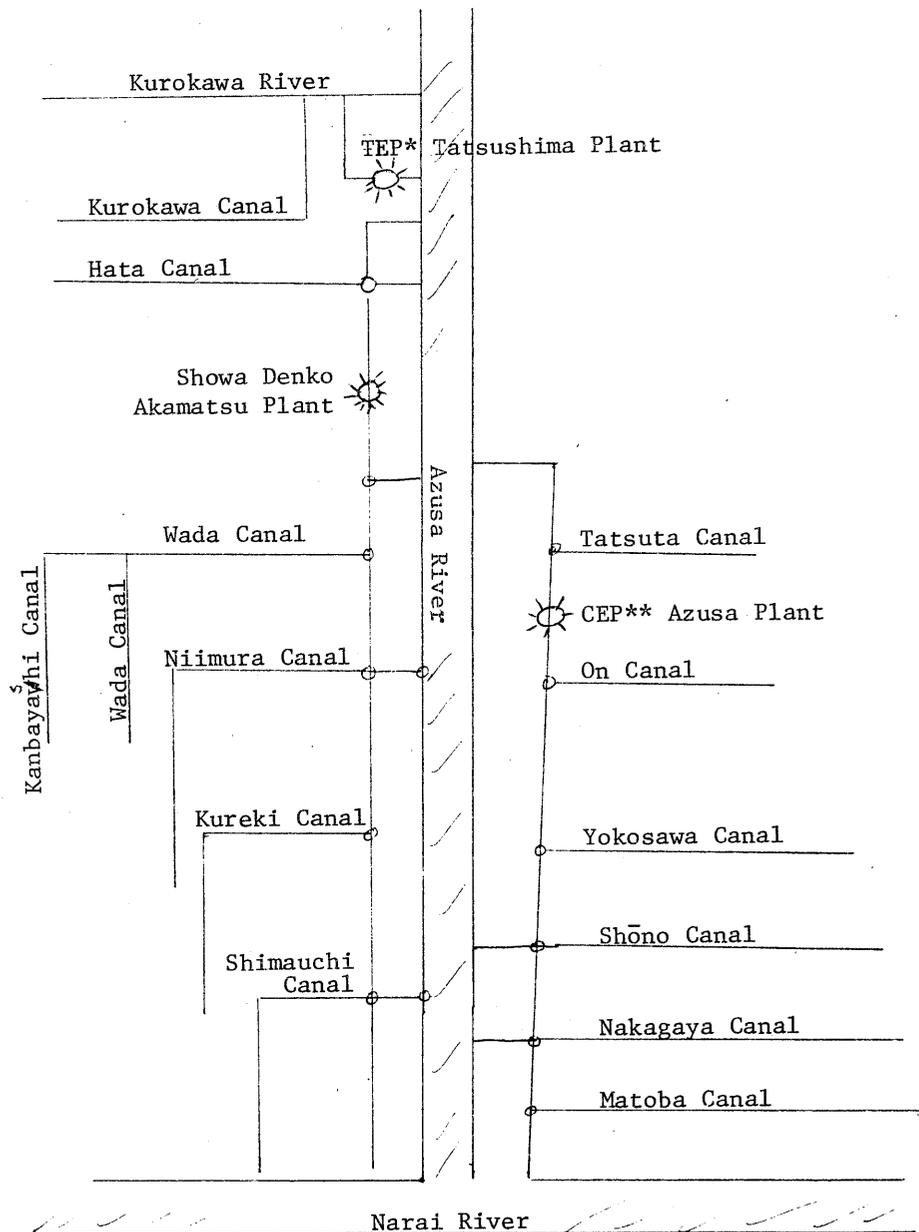


FIG. 2. The Azusa River Irrigation System.

(Source: Records of Higashi-Chikuma County, Matsumoto City and Shiojiri City, Vol. 3, Part 1, P. 834, edited and published by the Association for Compilation of the Records of Higashi-Chikuma County, Matsumoto City and Shiojiri City, 1962.)

- * Tokyo Electric Power Co., Inc.
- ** Chubu Electric Power Co., Inc.

bution in the Azusa River basin was merely fixed in the form of new quotas. Unification, therefore, was not able to provide rational solutions to the problems inherent in the customary order; only outward conflict disappeared.

The second most important aspect of the new organization was that the customary order was internalized and preserved both in allotment of operational expenses and the organization of beneficiary groups. The two major irrigation associations of the right bank and the left bank of the Azusa River were established in 1931, but the individual canal co-operatives retained their autonomy and independence. As indicated by the continuation of virtually independent accounting for each canal and unequal allotment of operational expenses, it is obvious that the autonomy of these canals continues even today, despite establishment of land improvement districts and the formal dissolution of the canal associations after the war.

Regional subdivision and proportions of operational expenses borne by the right bank of the Azusa River land improvement district are shown in Table 2.

The figures in the table were determined by dividing major waterway and water distribution facilities into four sections and calculating the cost of maintenance, management, and construction borne by each district. As the chart shows, Wada canal, which branches off the upper part of the main waterway, had to bear only the expenses up to where it branches, whereas Shimauchi canal, the lowermost canal, had to shoulder the cost of the entire length of its connecting waterway. There was great inequity in the burden of costs borne by the upper and lower stream canals because the main waterways were not treated as an integrated whole; each canal was required to pay for the section to which it was directly related. The lowermost canals thus carried the greatest burden, reflecting the traditional advantages enjoyed by the upper stream canals in actual apportionment of the financial burden.

TABLE 2. Defrayment of Maintenance Costs.

	By area of land	By quantity of water
Section No. 1 (between Kuzureiwa drainage outlet and the point where Wada canal branches off)		
a. Wada canal subsection (all of Wada village and Kanbayashi village, part of Niimura village)	31.1264%	7.7816%
b. Niimura canal first subsection (part of Niimura village)	10.4568%	2.6142%
c. Kureki canal first subsection (all of Shimanaka)	17.8136%	4.4554%
d. Shimauchi canal first subsection (part of Shimauchi village)	20.6032%	5.1508%
Section No. 2 (between Wada canal and where Niimura canal branches off)		
a. Niimura canal second subsection (part of Niimura village)	17.0408%	4.2602%
b. Kureki canal second subsection (all of Shimanaka)	29.1872%	7.2968%
c. Shimauchi canal second subsection (all of Shimauchi village)	33.7720%	8.4430%
Section No. 3 (between Niimura canal and where Kureki canal branches off)		
a. Kureki canal third subsection (all of Shimanaka)	37.0936%	9.2734%
b. Shimauchi canal third subsection (part of Shimauchi village)	42.9064%	10.7266%
Section No. 4 (between Kureki canal and where Shimauchi canal branches off)		
Shimauchi canal fourth subsection (all of Shimauchi canal)		100%

Hata canal was not part of the unification project. This was partly because its irrigation area was on a higher elevation than the new dam head, and water could not be naturally channelled to it. Reconstruction of water intake facilities for the canal was undertaken

when the Central Electric Power Company began to construct a hydroelectric power plant in the Azusa River in 1937. The power plant decided to build its intake dam near the Hata water intake point, and Hata canal took advantage of that location by making use of the water from the plant's reservoir. As a result, in an agreement reached between the Azusa River Irrigation Association (an organization formed among all the canals party to the unification of water intake points) and Hata village, Hata canal was no longer forced to shut its sluice gates during times of drought. The main terms of the agreement were that the maximum quantity of water intake in early spring was to be seventy-seven units (equal to about $2.1 \text{ m}^3/\text{sec}$), and that when the Azusa River water level fell, Hata canal was to decrease its volume of intake in accordance with the situation and to place a watch along the waterway. However, the facilities of the Hata canal were constructed in such a way that they left Hata at a disadvantage compared to the power plant in the intake of water from the settling reservoir.

Finally, a plan for improvement of the Azusa River irrigation system as a whole was made in the late fifties, in the form of the government-sponsored Nakanobudaira Irrigation Project. This project, designed in anticipation of development in the Azusa River basin, was influenced by the fact that the Tokyo Electric Power Company, Inc. had built three dams, Nakawado, Midono and Inekoki, in the Azusa River water system. The area which benefited from the project was some ten thousand hectares on both banks of the Azusa River, and the project aimed at securing irrigation water for already-existing wet-rice fields, as well as irrigation for some four thousand hectares of dry fields.

Water was to be drawn from the reinforced Azusa River unified water intake head and from the newly-built water intakes attached to the pressure control tanks of Shintatsushima power plant constructed for the new hydroelectric dams. The maximum quantity of water intake was to be $55.35 \text{ m}^3/\text{sec}$ in all.

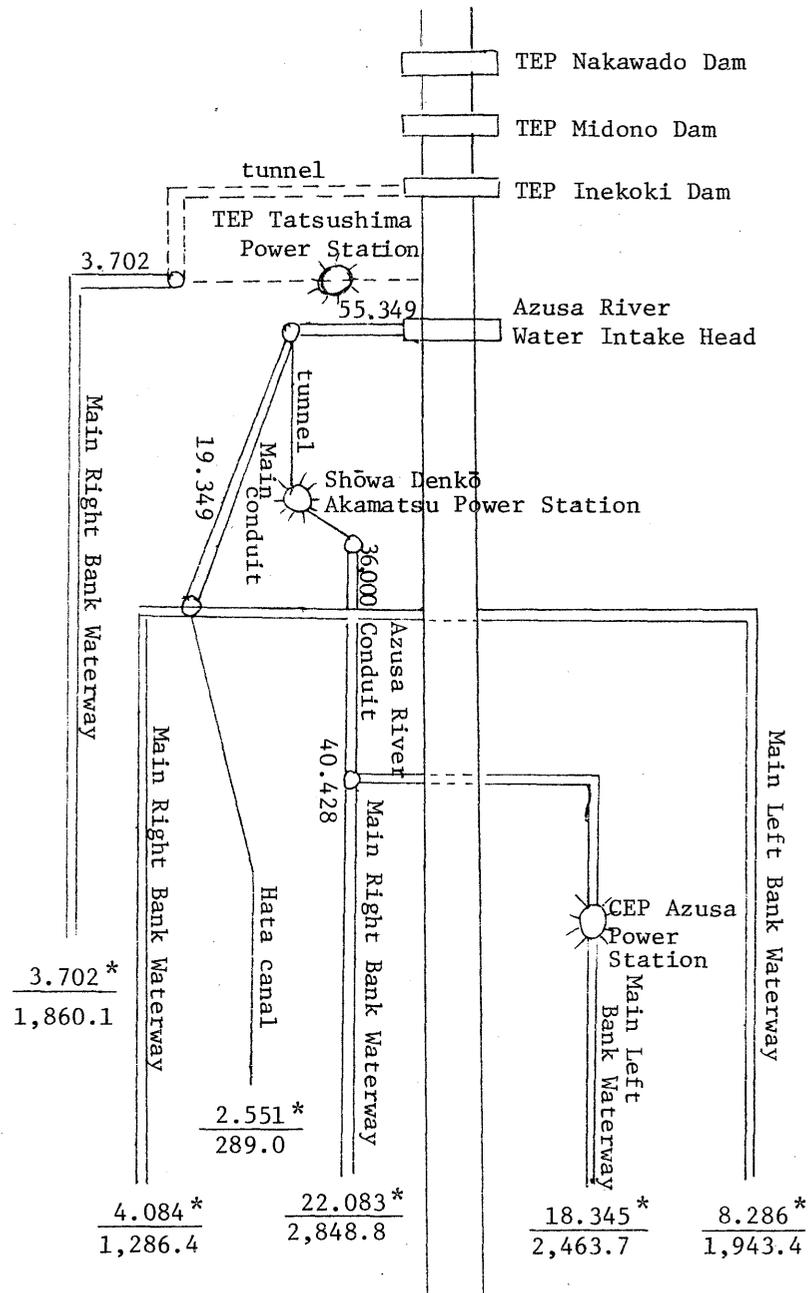


FIG. 3. Diagram of Waterways in the Nakanobudaira Irrigation Project. Asterisked figures are cubic meters of water per hectare of irrigated land. Other figures denote volume of water intake by cubic meters per second.

(Source: Outline of Nakanobudaira Irrigation Project, Kantō Regional Office of the Ministry of Agriculture and Forestry.)

The decision was also made to construct 48,234 meters of main waterway and to repair 21,705 meters. The project was begun in 1965 and completed in 1978 at a total cost of ¥13 billion. A Nakanobudaira District Irrigation-Drainage Project sponsored by Nagano Prefecture was planned simultaneously to construct or repair subsidiary waterways and drains which were not covered by the government project. This project is still underway.

The irrigation system of the Azusa River was thus completely unified and brought under the uniform operation of the newly formed Nakanobudaira Land Improvement Association. This federation is made up of the Azusa River Basin Land Improvement District, the Nakanobudaira Right Bank Land Improvement District, and the Hata Canal Land Improvement District. It maintains and manages facilities for the common use of each land improvement project.

Despite these changes, however, the autonomy of individual canals was not completely lost. For instance, in the Azusa River Basin Land Improvement District, although old canals were unified for land improvement, even now each calculates its accounts separately, and the expenses per ten ares of irrigated land vary from canal to canal. In distribution of water to subsidiary waterways, areas still rely on traditional practices observed since the Tokugawa period. This shows how firmly the customary laws of the traditional order are rooted, and indicates that conditions for utilization of land and water for wet-rice fields still retain many premodern characteristics.

IV. SIGNS OF CHANGE IN FARM MANAGEMENT

The area discussed above is representative of labour-intensive agricultural areas in Japan. As it is surrounded by high, steep mountains, outward expansion of agriculture reached its limit early in history, forcing the area to concentrate on inward development, or more correctly, on intensive cultivation.

Before World War II, wet-rice farming and sericulture were the major activities of the agricultural sector. Nagano Prefecture was, together with Gunma and Yamanashi prefectures, one of the most important silkworm-raising districts. After Japan opened its doors to the West in the mid-nineteenth century, it gradually became one of the major suppliers of raw silk and silk fibre for foreign trade. In Nakanobudaira, mulberry trees were widely grown along river terraces and in the foothill areas. During World War II, however, mulberry plantations decreased sharply, and sericulture dwindled because of suspension of raw silk export and the necessity to increase food production.

After World War II, fruit trees (mainly apple), various vegetables, and in some places tobacco gradually replaced mulberry trees as the established farm products. Especially on the river terraces of such villages on the right bank of the Azusa as Yamagata and Hata, a variety of dry-field crops were introduced, and Yamagata village is even said to grow the greatest variety of farm products of any region in the country.

Wet-rice farming in this part of Nagano Prefecture has a relatively high yield per ten ares of cultivated land. This is partly due to the marked differences of temperature between night and day, which are conducive to a high rate of deposition of starch. The heavy use of chemical fertilizers and pesticides in the 1960s also contributed to increased, stable yields. The average yield is roughly six hundred kilograms of hulled rice per ten ares.

Despite this abundance, however, there were considerable limitations to modernization of wet-rice farming, most notably land and irrigation. The following is a general summary of these conditions (see Fig. 4).

- (1) Individual rice paddies were very small and irregularly shaped; and the fields of a single farmer were often scattered over a wide area.
- (2) The subdivision of canals was not sufficient and many rice fields which shared boundaries were forced to irrigate with water from neighbouring fields. Consequently, the autonomy of individual fields was impaired, and free use of the land became difficult.
- (3) The network of farm roads was not well developed. As a result, a farmer's fields seldom abutted on a road, making it necessary to pass through another farmer's fields.

These irrigation conditions were typical of most such fan-shaped riverbasin regions, and the above problems were especially remarkable in the area under study. All the above limitations acted to inhibit reform of cultivation techniques, including wider use of mechanized agricultural equipment, and to restrict freedom of choice in farm crops. They also served as the strongest factor upholding the customary laws of water distribution. The overall shortage in the water supply and the persistence of traditional relationships between the old canals inhibited improvement of irrigation conditions for these rice fields.

The Nakanobudaira Irrigation Project sponsored by the government was



FIG. 4. Configuration of Paddy Fields Prior to Consolidation Project.
Shaded lines are irrigation ditches.

premised on the need to institute fundamental innovations in rice field irrigation in the area. Accordingly, a series of regional groups planned large-scale rice field reform projects which are still underway today. These projects are intended to unify fields into regular rectangular shapes of an area approximately thirty ares in size and to see that all rice fields border directly on irrigation canals, drainage ditches, and farm roads, thereby removing traditional obstacles to irrigation of rice fields.

Hata village has already completed a reform project, and in the process several new agricultural developments emerged. For instance, agricultural machinery corporations (for shared use of farm machinery) were organized by each settlement, and efforts were made to economize on labour and to reduce the burden of equipment investment for each family through common use of large agricultural machines (e.g., farm tractors and combines). Surplus working time produced by mechanization is devoted to dry-field farming, and large profits are made on crops of watermelons grown in the summer. In addition, the Hata Canal Land Improvement District continued the traditional practice of controlling irrigation by overseers appointed to the task, even after implementation of the rice field reform project, and this has freed individual farmers from water control duties. In a period of ten years, then, it may be said that agriculture activities in this village were completely transformed. Agricultural activities in the entire Matsumoto basin are beginning to take on a remarkably different character.

V. CONCLUSION

Rice cultivation, the core of agriculture in this area, developed through an ancient heritage of irrigation facilities and customary regulatory practices. In the late Tokugawa period the development of sericulture became a powerful impetus for change in the agriculture of the area, and land was mainly utilized for rice paddies and mulberry fields. Building on experience accumulated from their sericulture work, farmers eventually became adept at business and sensitive to market trends.

Another impetus for change was central government intervention in the early 1930s in the modernization of the irrigation system. The Azusa River Basin Irrigation Improvement Project, sponsored by the government, helped to alleviate shortages of irrigation water and to transform the irrigation order based on customary law and practices, opening the way for greater stability and intensity of rice crop farming.

The technically interesting point in this project is that it built the unified intake head and reconstructed the main waterways with modern technology, but left the existing canals or the shape of rice fields or network of farm roads as they were. The project introduced modern civil engineering technology and combined it with traditional irrigation techniques.

Formation of regional agricultural capital under government initiative was continued and expanded after World War II, mainly through the

Nakanobudaira Irrigation Project. This project totally modernized central irrigation facilities; repair or construction of all irrigation canals was undertaken through concurrent prefecture-sponsored projects. These projects made possible improvements and new building of irrigation facilities, as well as rice field reform.

The most advanced civil engineering technology has been used in these projects; the unified intake head and the siphons are both of reinforced concrete. All the major canals were lined with concrete. Modern heavy construction equipment was used throughout.

Under the influence of this project, agriculture in the area is now undergoing substantial change. Accumulation of agricultural capital such as farm machinery has progressed, and the labour-intensive agriculture of former days has been converted to capital-intensive agriculture. The social order based on customary law, exemplified by irrigation practices, and intraregional rivalries are gradually disappearing. There is no denying, however, that the impact of Japan's rapid industrialization has accelerated modernization of this area almost too much. The result of this rapid growth is responsible for the marked increase of farmers with side-jobs and the overdevelopment of farm mechanization.

The existence of a kind of intermediate rural organization formed an important social basis for agricultural development. Irrigation associations before 1950, and land improvement districts afterward, were instrumental in this process. These organizations helped to integrate farmers in the area and facilitated smooth progress of regional capital formation and the building of the rural infrastructure, including irrigation projects and paddy field reform. In addition, they served as the nuclei of autonomous control in each community, performing functions beyond that of mere irrigation associations. These phenomena are common to many agricultural areas in Japan, and they demonstrate unique qualities that cannot be found in the rice cultures of other countries.