

A Historical Overview of the Water Resource Development and the Establishment of the Water-Right of the Nojiri Lake, northern Nagano Prefecture

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Abstract: The Nojiri Lake located at Nagano Prefecture's northernmost section and lying near the administrative border between Nagano and Niigata. The Nojiri Lake has the largest volumes of water container (96 million cubic meters), surpassing that of the Suwa Lake (61 million cubic meters), the second largest one being famous for its resort areas located in central Nagano Prefecture. The Lake has its origin with volcanic activities of the near and surrounding Kurohime And Madarao mountains, dammed up by debris flows in Pleistocene 50 kilo years ago. The author will pay attention to the development process of the Nojiri Lake water resources. Discussed will be below in this paper are as follows. At first, brief geographical observation of the Seki river and within of its watershed Nojiri Lake will be made. That are followed by a historical review with water resource development and management of the Nojiri Lake, secondly. At third, emerging problems concerning water rights are presented.

In physical geography the Nojiri Lake is situated in the uppermost section of the Seki River drainage basin hydrologically connected to the Takada Plain and in human geography it is within the administrative area of the Nagano prefecture. Nojiri Lake is a sort of 'exotic' one for the people dwelling in the Takada Plain, but it has been physically and lawfully controlled and managed very successfully. It's 'double reversion' of physical and human, extending over two administrative districts, Nagano and Niigata, has been marked deeply in its development of the Lake water resources. This character also has been reflected in obtaining and ensuring process of the water right of the Nojiri Lake. Today almost all of the amount of waters are consumed in the side of the Seki river hydrographic areas, and the usage purposes of water are very diversified. On the opposite side small amounts are used for only Nagano City urban water. So, that to be included different river systems affects different amounts of waters are consumed for different purposes. It also can be said that the Lake water's potential has been properly developed and managed ever since the Lake Water Use Agreement of 1952 were signed and the Lake Water Sharing Schemes were started. Nojiri Lake water development has experienced so complex evolution process that following descriptions will be to some extent contributed to make clear for understanding its history.

Key Words: Water Right · Nojiri Lake · Irrigation and Power Purposes · Drainage Area · Landreclamation

I. Introduction

In summer season, Lake Nojiri and its surrounding areas exhibit the best landscapes, surrounding volcano mountains with rugged lava rocks and green covering forest vegetations mirror themselves in the Lake surface, appearing like beautiful picturesque scene. Altitude of the Lake are 654 meters and summer day's cool and comfortable temperatures are very attractive for

the urban people. The lakeside has become one of the famous resort areas with many second houses and summer cottages in the Nagano Prefecture. And lake water has been used not only for tourism but for agriculture, hydro-electric power, urban, industry and other purposes. But most of the water users are in the district along and downstream of Seki River, Niigata Prefecture. Similarly, most amounts of waters are consumed in the Seki River areas, not in Nagano Prefecture. The Nojiri Lake is within Nagano administrative border and the way of water uses seems curious for the people living in the Nagano administrative site. To the central portion of the Takada Plain, water was transferred not only from the Seki River but also from the Nojiri Lake facilitating as a reservoir, situated in the uppermost watershed of Seki River. This is the focus of the survey and the purpose of the author and circumstances of this affairs will be mentioned followingly.

This paper also try to make historical review the obtaining, keeping, and establishing process concerning the water right of the Nojiri Lake.

To show more clear the aspects of the subjects, following questions can be valid .

- 1)What is the geographical setting of the Nojiri Lake and it's surrounding area?
- 2)How the Nojiri lake water has been used for the many purposes?
- 3)How various factors or conditions influenced water resource apportionment between the two large administrative districts, Nagano and Niigata?
- 4)By what way the farmers along the Seki river in the Takada Plain obtained the water right of the Nojiri lake? How measures were taken by them in the steps approaching the Nojiri Lake water right ?
- 5)What were the evolution processes of the major canals, Nakae and Uwae, in the Takada Plain?

Followings are this paper's framework. Location and water resources of the Nojiri Lake will be described in II. Takada Plain's geographical settings will be presented in III. Next, in IV, agreement and collaboration between the farmers and the power company with the lake water management will be explained. Land reclamations and modernization of the irrigation systems in Takada Plain are the subject of V. In VI, water war between Nagano and Niigata in connection with the Nojiri Lake will be described along with various water conflicts within the Takada Plain. In VII, circumstances that tourism industry has grown to become a major water user and began to assert of their own water right will be mentioned.

II. Location and water resources of the Nojiri Lake

Concerning Nojiri Lake, in this section problems such as its location together with its hydrological characters, its water right jurisdiction, and its water use history will be outlined. At first, location and its hydrological circumstances about the Lake are as follows.

II-1. Outline of the Nojiri Lake, geographical features

The lake Nojiri is situated in the Nagano Prefecture's northernmost corner very near the

administrative margin between Nagano and Niigata Prefectures. Its Latitude is $36^{\circ} 49' N$ and Longitude is $138^{\circ} 14' E$. Its altitude are 654ms, surface are 4.4 square kms, surrounding length are 14kms. Distances From the outlet of the Nojiri lake toward rivermouth of the Seki on the Sea of Japan coast are approximately 50 kilo meters.

Seki River drainage basin receives heavy snowfall in winter season because of its windward position toward the Northwestern Monsoon originated from the Continental Asia, and it measures over 5 meters every winter. Peoples normal life are suffered from heavy snowfalls, but samely it has positive effects. The accumulated snow in the mountain areas especially above 500 meters altitude, melts in the spring and early summer provides affluent water for irrigation, electric power and urban consumption.

II—2. Lake's outlet, its river system, its administrative jurisdiction, and its water right

Nojiri Lake itself is included in the Seki River drainage basin. Its natural overflowed water via tributary Ikejiri river, on end pours into Seki River. The fact that Nojiri Lake's outlet is opened just only for the Seki river Basin had and has been the decisive factor of the jurisdiction which River Basin, Seki (Niigata) or Torii (Nagano), obtain the water right of the Nojiri Lake.

The administrative border between Nagano and Niigata takes from the east to the west course which does not coincide with natural hydro-dividing ridge but rather runs along the river flowing channel where the Seki and its tributaries incised deep gorge (see Fig. 2).

Nojiri Lake is situated at the northernmost part of Nagano Prefecture, standing closely to the distict border between Nagano and Niigata. It belongs to Seki River drainage basin, although is within the administrative area of Nagano Prefecture.

The Nojiri Lake also lies very closely to the opposite side Torii River drainage basin, and water competitions and frictions between both districts has been arisen repeatedly.

Almost of all the right of the Lake water are revert to Niigata District and only very small portions belongs to Nagano District. Nagano City is soley one water right holder of the lake within Nagano Prefecture.

How various factors or conditions influenced water resource apportionment between the two districts, Nagano and Niigata, will be seen later.

Some historians and local people said that the commencement of the approating for the Nojiri lake water for the Takada Plain irrigation dates from the beginning of 17th century, pre-Modern Age of Edo Era. To obtain the right of consuming Nojiri lake water had been the fundamental fact in the water development history. Water right assertion is the focal point of the present research subjects.

It also seems inevitable that peoples lived along the Seki River easily approached, obtained and ensured the water right of the Nojiri Lake. But the history of ensuring the water right of the Nojiri Lake is not so simple as an outward appearance. The process had and have been far highly complexed and troublesome ones.

In Takada Plain enough water had to be available throughout the padi growing season. Nojiri Lake had been able to provide the facility of a large reservoir.

II-3. Lake water use and its capacity expansions

In Nagano Prefecture today the Nojiri Lake has the largest storage capacity, water volume of 96million cubic meters, surpassing the Suwa lake of its storage capacity of 61million cubic meters.

Concerning the size the catchment areas, Suwa Lake has 531square kms, but Nojiri Lake has only 12.8 square kms. Nojiri Lake's water catchment area is very small when compared for its amount of volume, and the effective way of using Lake water has been the question of many years standing.

Throughout of the Takada Plain irrigation regions, seasonal variation in streamflows was heavily affected by the spring melt of the huge snowpack in the mountains within the drainage basin of the Seki River. It formed the amount of flowing water peak, during two months from April to May. Stream amount of water peak and irrigation water consumption peak did not simultaneously occur. The period of overlapping was short duration covering only two months.

On the other hand padi-growing season when irrigation water may be need extends over 6 months from April to September.

From the early times of the Feudal Age, following the padi field expansion, the necessity of flowing water quantitative adjustment had been arised and become more actute. And the function of the lake water so as to redress seasonal imbalance between periods of peak supply and peak demand had been expected.

During irrigation season, lake outlet weir was open to release stored water for supplying additional irrigation waters. At the end of the padi-cultivation season, lake water surface were leveled down and must be replenished again till previous full surface level preparing for next irrigation season.

Then, during non-irrigating season, it was needed to close lake outlet weir and to withdraw water from small streams surrounding and near the Lake, similarly from outside the lake's catchment areas and reserved into the Lake. From the pre-Modern Era, farmers of the Takada Plain had took several trials and had mastered to some extent the lake water operation technology above mentioned. The modern history of the Lake warter use has been characterized by the repeated research and development of supplemental water supply.

II-4. Collaboration between Agriculture and Power Company with Lake water storage management

The lake surface water upperlimit was already given, because inundation by overflowed lakewater itself must be avoided and because building landscape damaging high dikes around lakeshore was, too, undesirable. The rational manipulation of the lake surface water level focused on to release larger amount during non-irrigation season and on to replenished again as rapid as possible. In fact, such artifical charge and recharge process of lake waters were very difficult task for agriculture sector alone. It was possible only after the combined agriculture and hydro-power project were planned and carried out from the early 1920s.

Today lake water can be released into the canals irrigating padi fields or diverted into

penstocks of power station generating electric energy. By using the lake water as a huge reservoir, irrigation can be done on more stable base and in more wider area or, electric generation can be done with full capacity in more longer time.

Snow melting water is typical seasonal surplus water. By pumping -up power plant operation, Seki river waters are diverted from and reserved into the lake. Since the pumping-up power plant completion of 1934, this reserving process has been carried out very smoothly.

During the non-irrigation season, Lake water is used for electric power generation. Reserved water is released for power generating purpose, and the reserved water dwindled and level of the lake surface fell downward.

Water surface manipulation ranges are following. Lake water standard level have set at altitude 653 meters. At the beginning of irrigation season, lake surface is at replenished fulfilled level of altitude 655.7meters. From the 1st of June till the 10th of September is set as the irrigation term. During this season lake water portion exceeding the standard level were released and used for irrigation as well as for power. Then, standard lake level are exhibiting the marginal 'bottom' to be kept during this season. From the 11th of September till the 14th of March water is entirely for powers. Maximum usable water level is 636 meters. At the 15th of March water release for power is ceased and via Ikejirigawa pumping up power station commence operation till the end day of May when lake water replenishment has completed.

III. Geographical setting of the Takada Plain, one of the Japanese typical Rice Growing Area

Water development and management in the Takada Plain has been shaped by the region's geography, legal and institutional arrangements, urban expansion, i.e. domestic water and snow melting water, the spread of irrigation water for padi-fields. In this part, geographical aspects will mainly be described.

In this section at first, Takada Plains climatic character and water resource conditions will be described. Secondly, several topographical features of the Plain will be mentioned. Finally, Hydrological environment is mentioned along with the transition of water use and development.

III—1. It's location and climatic character and water resource conditions of the Takada Plain

Being situated just in central portion, Honshu Island, Takada Plain belongs to one of the alluvial plains along the Sea of Japan Coast where single crop of rice has been prevailed over. Because there are plenty sunny days along with high and enough temperatures of above 20 °C monthly average degrees among the highest is 26 °C of August throughout the rice growing periods from June till September, although heavy snowfall and short sunshines during the winter season. So during summer season Takada Plain is blessed with high temperatures simultaneously have often experienced short rainfall.

In Takada Plain not only the short rainfall during summer season but also poor snowfall during the winter has made arisen water scarcity problems for irrigation, and the padi field

regions was frequently suffered from it. In dry years especially, the water deficit can spread to the four corners of the Takada Plain. It is easy to see that some water storage facilities were needed aimed at rectifying uneven seasonal water distributions.

Crops require varying amounts of water for growth time. As with amount of water consumption, needed water is not evenly arised. Its maximum water consumption shows two peaks. One is at the field preparing works at that time ploughning is done the ground must be watered with much amount of waters. Followingly transplanting is done. Other is the time when the young plants need plenty of water to grow well. Crop growing is very active with rapid evaporation and transpiration, the latter part of July and early in August, with the highest temperatures make loss of water the largest. For reliable water supplement, irrigation facilities such as large reservoirs are very effective.

Farmers usually depend on the rain to supply the water needed by the growing padi.

Unfortunately, rainfall cannot be controlled. Rainfall can be most unreliable. Thus, under such circumstances, flowing water controlling and irrigation water management by reservoirs and canals and other various methods are essential for agricultural development. It was natural that Nojiri Lake had attracted attentions of farmers as the major source of water resources.

III — 2. Landform features and Landuse conditions of the Takada Plain

Here, several topographical features of the Plain will be mentioned.

Takada plain occupies the southwest quadrant of the Niigata Prefecture on the Sea of Japan, forms one of the leading rice production district and has been refered to as the Japanese rice granary. Taking advantages of summer high temperature, most of the rice is of the early maturing variety, originated from seeking high prices by sharing off-season markets.

It also shows an outline figure seemingly like a large diamond-shaped rectangular. The coast line, Sea of Japan beach is overlapping the northern rectangular side extending from northeastern to southwestern direction, to which the southern side is paralleling. Both eastern and western sides of the plain are extending north-south direction and are showing an abreast shape. All four sides has its length of approximate 20kms (see Fig.1).

Almost whole of the plain is covered by alluvium with surrounding small portions fringed by dilluvium and has been formed by two major river systems and other four small tributaries jointed by the former ones.

Two major rivers flowing through the plain are the Seki and the Hokura. The former has its headwater area surrounded by Quaternary volcanic mountainland in the southwestern corner of the Joetu district (see Fig 2). The latter begins its channel within the Tertiary hilly mountainland watershed called Higashikubiki Hilly Land and follows downward from the east to the west direction, finally poured into the Seki river near its mouth and ended to the Sea of Japan. It can be refered that the Seki river limits the western margin and the Hokura river samely norhtern margin of the Takada Plain respectively (see Fig 1).

Takada Plain lies between in the Sea of Japan coast and the southern mountainland and as land surface has quite gentle slopes towards the sea, is suitable for growing of padi. Water from

the Seki has been used to irrigate the Takada Plain padi field for a long time. Across the Seki River many headworks had been built to obtain irrigation water.

In the southernmost portion of the Plain, the gentle sloping surface collides with the steep ends of Mts. Sekita that rise about 1100 meters high.

Landforms of the Takada Plain transforms gradually along the Seki River flowing, at first from the valley bottom of hilly mountainland with steep gradient being originated of the Tertiary Era, by way of Pleistocene terraces and finally end on the Holocene flood plains. Of the last one most of which are covered by top surfaces of several fans. The northern fan margins are marked off by the Hokura River flowing from the east to the west. Originally the Hokura river had heavily meandered and formed extending swampy land on the formerly delta areas, had often changed river course and made natural levees along its banks.

At the northernmost portion of the Takada Plain the land is barley 5 meters above sea level. There very poorly drained areas had been extended widely and farmlands were usually suffered from being inundated with flooded and stagnated water before modern land reclamation project has carried out.

Between Hokura River's northern bank and the Katamachi coastal Sand Dune extending along the Sea of Japan, there was a large lagoon called 'Oogata' surrounded by wide swampland from the ancient days till the end of the Pre-Modern Edo Era. Japanese '-gata' means lagoon (see Fig.1).

From near the end of the Pre-modern Era great efforts had been took to drain the lagoon Oogata and to reclaim the large swampy land, the purpose was to convert the swampy area suitable for padi cultivation.

Rare effort had been devoted to and continued till the year of 1953 when the building of the short-cutting waterway and large tidal control gate across the Katamachi Sand Dune was completed, that was to prevent the sea water from entering the reclaimed land(see Fig. 1).

III—3. Main rivers and water use transition of the Takada Plain

In this part, hydrological environment is mentioned along with the way of transition of water use and development.

The River of Seki originates in high mountainland areas over 2,000 meters altitude with rugged landforms. Those high mountains are such as Mt.Myoko, Mt.Kurohime and Mt.Hiuti and are forming Seki river's headwaters, supplying affluent snowmelting water every spring seasons.

In Takada Plain, Seki River stands out among other rivers forming natural stream flow for supplying ordinary discharge of the largest amount.

Other four small streams are originating from the southeastern hilly mountainland at most with altitude of 1,000 meters and flow toward northwesterly paralleling each other and ended into the Seki River. These small rivers arranging from the south to the north are, Ookuma, Bessho, Kushiike and Iida. Each of them are extending small fans at the valley outlet toward the central portion of the Takada Plain. Because of their controlable water volumes, from the early Pre-Modern Age, rice cultivation had already carried out along these small rivers prior to the

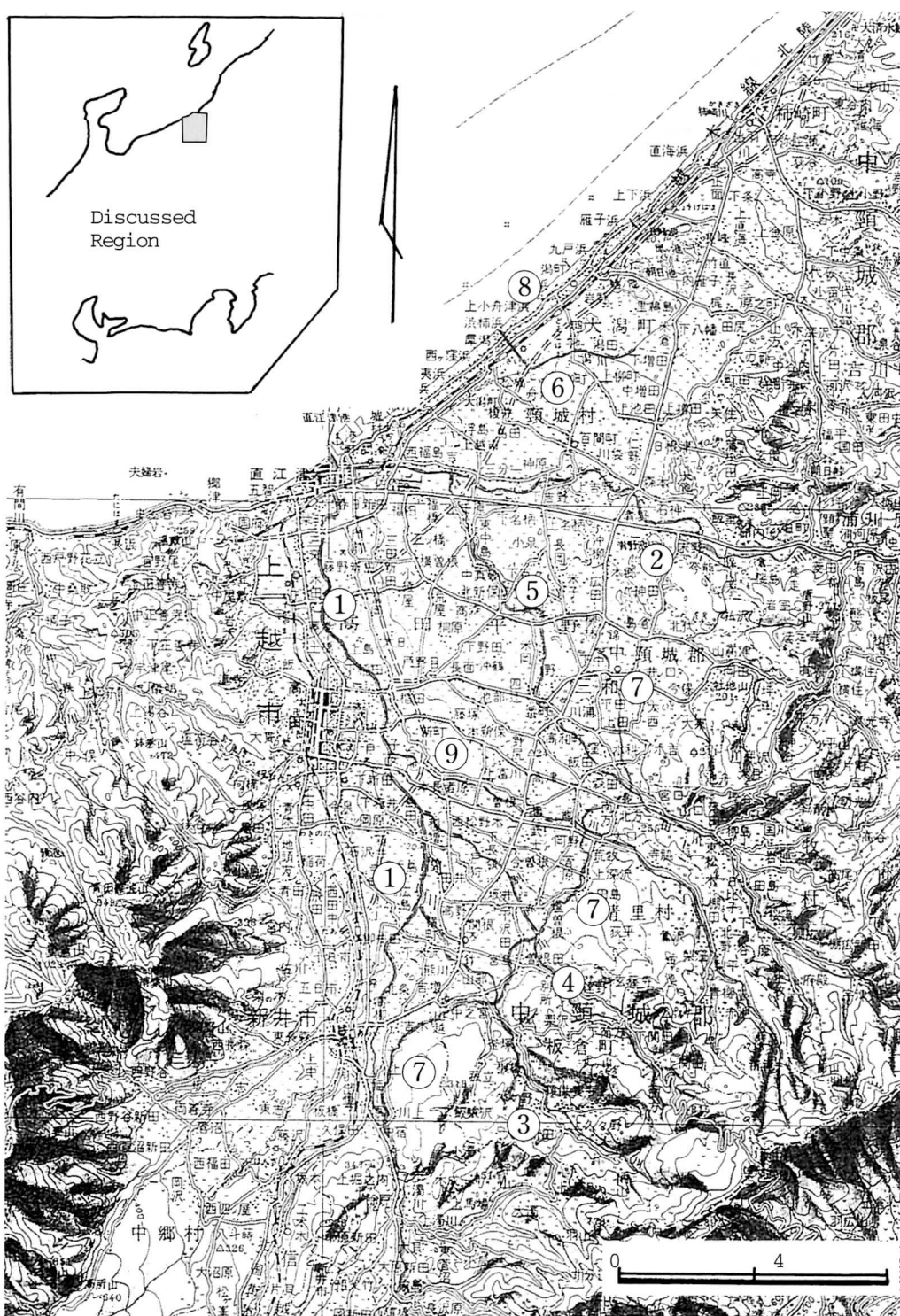


Fig. 1 River Mouth and Areas of Lower Reaches on the Seki River, with Location of Discussed Region. By Scale 1:200,000 「TAKADA」 topographical map of 1982.

Legend (Number): 1. Skeki River 2. Hokura River 3. Ookuma River 4. Bessho River 5. Iida River
6. Short-Cutting Water Way 7. Uwae Canal 8. Katamachi Dune 9. Kushiike River

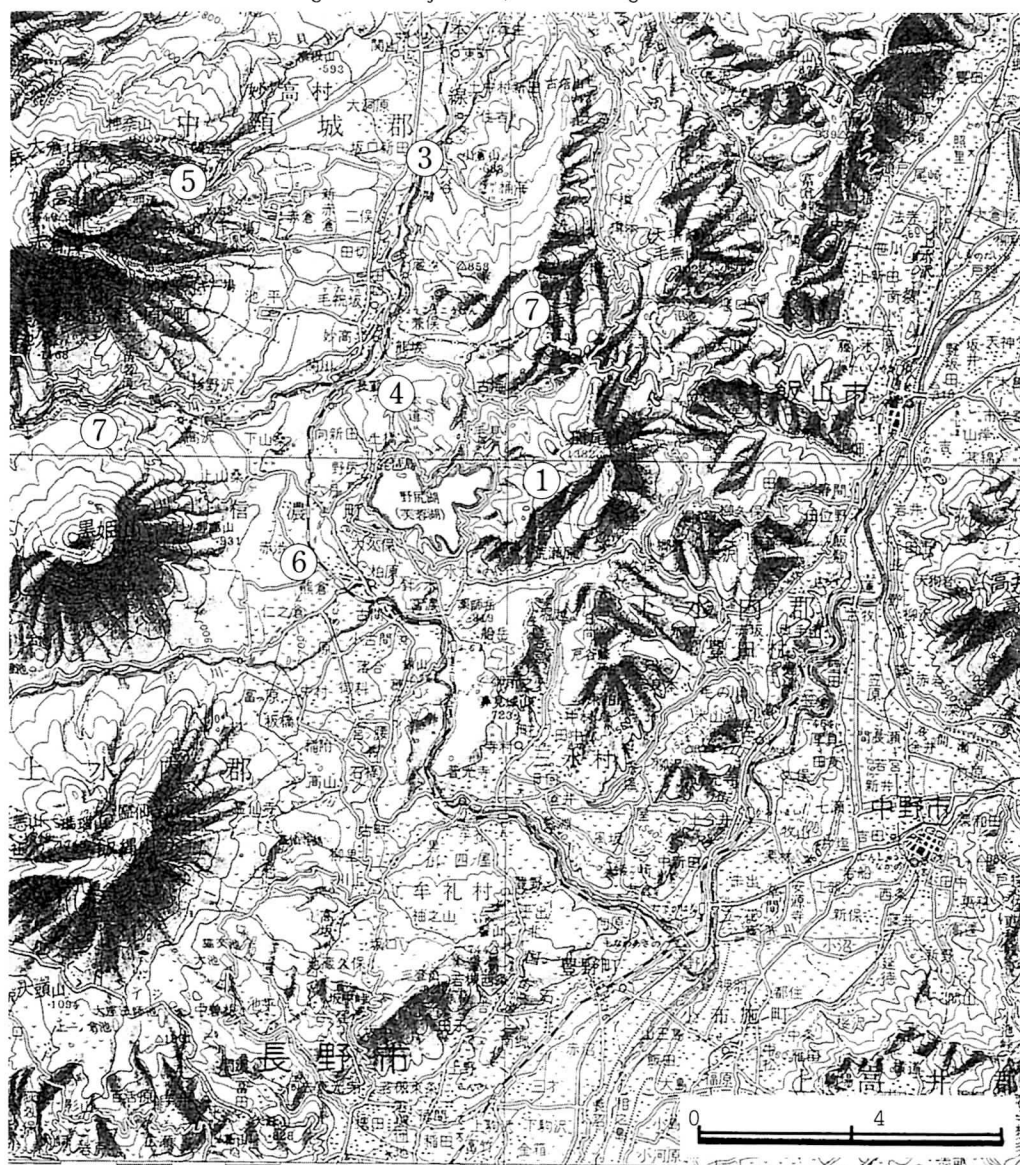


Fig. 2 Nojiri Lake and Seki River Upstream areas

By Scale 1:200,000 「TAKADA」 topographical map of 1982.

Legend : 1. Nojiri Lake 2. Torii River 3. Seki River 4. Ikejirigawa Pumping-up Power Station 5. Mt. Myoko
6. Ninokura-Denkuro Connecting Canal 7. Nagano · Niigata Administrative Border

opening and operation of the major canals such as Nakae and Uwae of latter days. Those along small rivers early cultivated padi went ahead than the areas of Takada Plain central portions tapping more large Seki river, in where flood controls were still impossible. For heavy water using crop as rice, waters are essential. Great cares had been taken to obtain and ensure stably sufficient waters.

To understand the way of making use of the Seki river water resources, we can divide the river into two sections. One is of the upper reach area and of the downstream is the other one. With very steep gradient in the upstream areas the Seki river flows with high velocity and whole of the waters are used for electric power generations. On the downstream section with altitude less than 100 meters river gradient become gentle and water flows slowly with much affluent volumes. In there most of the waters are resources for padi-irrigation. At the beginning portion of this slow flowing zone several headworks situated, from where start some major canals of their conveyance to deliver waters for those minor and numerous short distributing ditches.

Of above major canals location point of the intakes are very significant because a headworks helps to raise the water level of the river to the height of the canals so that the river water can be channelled into the padi-fields. So major canals of the Takada Plain has their intakes concentrated at the altitude between from 140 ms to 120ms of the Seki river.

At Ooe-kuchi headworks (see Himegawara settlement in Fig. 1 and Fig. 4), the water of the River Seki is led into two main canals, Uwae and Nakae, and running through the central portion of the Plain. As presented in Fig.1, from its headworks Uwae canal extends northeasterly and crosses 4 small rivers. Those small rivers are tributaries of the Seki and are, Okuma, Bessho, Kushiike, Iida and others. Farmers formerly had organized on each of the tributaries small irrigation districts respectively. Today Uwae canal is supplementing waters one by one above small river irrigation areas, to overcome their own water shortages. Uwae canal has its course of 20 kilometers length and are irrigating amount 7,200 hectares till the ending of Sanwa Village. The other major one, Nakae canal, runs northward direction approximately parallel to the Seki river and its irrigating total padi fields amount to 2,300ha. Originally Nakae and Uwae canals had crossed over those branch Ookuma, Bessho and other small rivers by wooden structure bridges. During 1920s and 30s those bridges were rebuilt from the wooden to more reliable modern concrete siphon structure. Then they had been free from frequent repairing and reinforcement.

On the up-and middle stream areas of those small tributaries such as Ookuma, Bessho, Kushiike and others, development of 'terracing' had preceded than the padi-openings of Takada Plain's central portion.

Terracing was one way to open new padi-field on the relative steep hill slopes, on where mud walls are built along the edges of the flattened fields to retain the water and the soil. Terracing was done by levelling steep slopes to make flat terraces so that crops can be easily cultivated. In above small river areas, every little improvement of short canals induced small but quick padi-expansion, as much as reliable water supply seems possible, and as inevitably, water shortages

soonly arised in the downstream areas.

Preceded research contribution as of Takeuti (Takeuti, 1963) has suggested that in the upstream areas of those small rivers water shortages had arised because of preceded padi-cultivation than the small river ending areas, central portion of Takada Plain and that had make accerelate demands to supply of additional water from the major Seki River, with more affluent streams but then rather uncontrollable.

Those small branch rivers had in early Pre-Modern Times very important roles although today they have minor consequence in the overall surface water supply for irrigation in the Takada Plain.

It is easy to recognize the significance of the Seki river's scale and facility by refering next figures representing the acreages of drainage area those of each tributaries such as, Ookuma river 41.7km^2 , Bessho river 36.1km^2 , Kushiike river 36.0 km^2 , Iida river 112.8 km^2 . Compare with next figures $1,143.4\text{km}^2$ that of the Seki river itself.

Takada Plain contains a large area that is often refered as to be suitable for the cultivation of padi. But the land suitable for rice production is man-made one rather than the physical environmentally blessed with one because critical water for farming is come from obtaining, reserving, distributing through the building waterways that are the results of working of the man.

In Takada Plain, opening the new padi-field had been continued step by step for long times and had being put under following yokes. At the every phases of the extensions or improvements of any major waterways completion, under the primitive and low level engineering technology, within the small amount of added available waters, the upperlimit of the padi-expansion was arrived soon after. It had been felt repeatedly that the farmlands of the Takada Plain would still have precious little hedge against a prolonged drought. This has been true almost since the time padi-opening started in Takada Plain. Farmers had seeked water again and again, finally found their way to the Nojiri Lake, at the beginning of the Pre-Modern Age. Those local peoples closely examined the Lakes concerning water storage capacity and hydrological characters. They find that the great care must be taken to ensure so that the available using water can be obtained annually through lake surface water level management by careful outlet gate operation.

IV. Agreement and Collaboration between the Nakae Irrigation District and Chuou Electric Power Company, its Commencement and Accomplishment with Nojiri Lake Water Storage Management

Nakae Irrigation District had secured Lake water right in one hand, and Chuou Power Company had carried out several construction works aiming expand the Lake water's capacity virtually 'water right' make more larger in other hand. Both party's intimate collaboration had strongly characterized the Lake water use histry. Details of the Lake water use history are as follows.

IV-1. They were commonly situated in the same drainage area, Seki river Basin

Since the early 1910s, hydro-electric power companies entered into the Lake water competition as new water seekers. Soon after Nakae Water District decided to select the Chuou Electric Company as the partner to alliance with among several water seekers. Chuou Electric Company, one of the local firm had been originated 1906 in Takada City and had searched for power station sites with the plan to develop Nojiri Lake water. Nakae accepted power company's plan and agreed with Lake water use and storage management. They had begun to develop and to establish the system that could effectively manage the Lake water together with. They, Nakae and Chuou Electric Company, were commonly included in the Seki River drainage basin and had also common interests surrounding the Lake water use. This was the main reason why they had cooperated without difficulty.

IV - 2. The commencement of the joint use facilities of the Lake water

Their cooperation commenced from 1910 was noteworthy.

It could be conceived as a sort of combined project both of agriculture and electric power company. After some adjustment and remedies of water use and management planning were done, Nojiri Lake water usage had finally set as follows,

- 1) From Jun to September, then irrigation season, waters for padi and for power are used together. Water surface hights of the Nojiri lake were to kept at standard level.
- 2) During non-irrigation season from October to March water is used for electric power alone. Lake water surface fallen downwards largely to the limited lowest level at the season end.
- 3) From the latter half of the March to the end of May, by driving turbin of the Ikejirigawa Pumping Power Plant, Lake waters was recovered and storaged up to the fulfilled surface making ready for the irrigation season to be begun.

With such operations, the lake waters could be used relatively inexpensively and without heavy outlays of capital. By carrying out joint works the amount of usable water of the Nojiri Lake had increased remarkably and water consumption had become more effective.

The Chuou Power Company had made large financial contributions toward the capital costs of the aqueduct and other water facilities including for irrigation purposes. The aquisitoin of lands with appurtenant rights to lake water was accomplished almost completely by the power company as the compensation for inundation damaged land of the lakeside areas.

Adding obtained physical water use merits, the important purpose of their alliance was to guard and to ensure lake water right and preventing from the encroachment by others. And the holding and the defencing of their water right was attained sccessfully.

IV - 3. Measures to increase the capacity of the Lake water

To increase the usable amount of Lake water storage, following two measures were adopted. The first was the water transfers from the two small rivers surrounding the lake area by converting of their flows toward the Lake formerly poured to outside areas. Those small rivers were Denkurou Canal and Huruumi-Gawa. Denkurou Canal was a small waterway that had already existed at the beginning of the Edo Ear. Huruumi-Gawa streamed in the northern area of the Lake and poured directly into the Seki River. Those improvements were attained in 1925

and in 1929 respectively. After this improvement, whole the non-irrigation season waters were caught. With the adoption of more high and advanced technology, the second measure was as follows.

At the junction point of Seki and Ikejiri river, Ikejirigawa Station, a pumping power plant was constructed in 1934. The purpose of the Ikejirigawa Power station, the first Japanese pumping-up power plant, was to fulfill the lake water and recover the lake surface water level more smoothly by withdrawal from the far downward larger Seki river through reverse driven turbines of the power plant, in place of several natural rivers flowing into the Lake which cannot supply enough water and cannot recover rapidly the lake surface water level.

In the irrigation season, water from the Lake flows down normally in the penstock and used for driving electric generator. Its power amounts 2,300kw.

In the non-irrigation term during winter and early spring, when the Lake must be filled up with water preparing for next irrigation season, at the Ikejiri Power Station, turbine is driven reversely by electric power from other station and water is driven backward from the downward Seki river into the upper Lake and reserved.

It can be said that the Seki River and the Lake Nojiri were connected via Ikejiri Power Station in the northwestern corner of the Nojiri Lake.

The completion of the Ikejirigawa Power station in 1934 exhibited the highlight scene of the Lake water usage history.

IV-4. Beginning to tap on the Torii river water, the final stage

As the final stage affair, Denkurou Canal was improved and reinforced its facility once again.

Partial interbasin water transfer from the Torii River Basin to the Seki River Basin was realized in 1942 under enforced order by the central government aimed to increase hydro-electric power production for munition. Non-irrigation season waters were diverted from the Torii river and transported by improved Denkurou Canal and stored in the Lake. It released for power plants along Seki River after reserved in the Nojiri Lake.

After those facility completions, lake waters were virtually connected to both Seki and Torii Rivers and Lake facility as the reservoir was largely expanded.

In modern 1930s this waterway connection was reinforced its facility to make expand the ability of the Lakes reservoir, for the purpose of hydro-electric generation.

IV-5. Industrialization enhancement blessed with affluent power

As the by-product results of the two sector's cooperation, easy accesses for generated-power fostered and encouraged the growth of local originated manufacturing activities.

Along the Seki river today twelve hydro-electric stations are located and are under operation, generated total powers of maximum capacity amount to 91,827kw.

Seki river were favoured with steep graient and with affluent spring and early summer snow melting water, and during the 1930s to 50s, electric-chemical manufacturings were rised and prosperous in areas along the river side and downstream river mouth towns and cities such as Taguti (today's Myoko Kogen), Arai, Naoetu and Kuroi. Above all, east bank at the river mouth

of the Seki, industrial complex composed of stainless steel, and synthetic chemical products has been formed. Those manufactured products were for munitions and after World War II, chemical products were converted to fertilizers for agricultural production.

V. Land Reclamations and Modernization of the Irrigation Systems in Takada Plain

In this section, at first, summarizing technological evolution of the irrigation facilities will be done. Secondly, descriptions concerning persuasive policies of land reclamations paralleling Agrarian Land Reforms of 1949 will be followed. Outcomes and meanings of the carried out land reclamation project will be discussed finally.

V-1. Outline of the irrigation evolution

In Takada Plain the irrigation schemes has been successively designated mostly for growing padi. Water resource development and management were advanced in degrees Pre-Modern Age, through 16-19th centuries. More land had been developed to meet the increasing needs of rice production. From the early 20th century, along with legal and institutional arrangements, the primitive and traditional methods of irrigation became a hindrance to the more advanced methods of padi-cultivation.

Many types of irrigation methods have evolved from early times to modern days. Some traditional methods were simple and cheap cost and were able to irrigate small areas of lands next to or near small rivers. By this method, irrigation could only take place with limited amount of water.

Adequate water supply was fundamental for the cycle of rice farming activities.

It is not just the supply of water that was important, but that it was essential for the supply to be adequate and regulated. The beginning to tap the Nojiri lake water for the irrigation of Seki river's downstream areas at early Pre-Modern days was the biggest epoch-making affair. The time when the transplantings are started, as irrigation water from the river stream alone becomes insufficient, additional supply comes from the stored water in the Nojiri Lake. Nojiri Lake had began to facilitate as a large reservoir.

Together with the released waters from the lake, much of the needed water from the Seki river was effectively diverted into the center of the Takada plain throughout the growing season.

As well as to realize tapping Nojiri Lake water, in Takada Plain from the outset Pre-Modern Era, several trials for large scale irrigation were commenced. This process were accelerated from the second half of 19th centuries. A more modern and expensive way such as the building of a concrete headworks across the river or concrete waterway or other facilities had been promoted. The structures of various irrigation equipments had developed from simple ones made of brushwood, mud, stones to the more highly complexed ones made of large concreted structure with water volume controlling weirs. Simultaneously canals were renewed and were extended more longer and concrete lining has done as a protection measure for water leakage. It was

noteworthy that electric-power pumps were installed for irrigation and drainage purposes. More extensive area of land has been able to be irrigated by using those ways. They had greatly supported following land reclamation projects.

In the Takada Plain at the outset of 1950s, along with above mentioned investment, reclamation and orderly rearrangement of padi-fields were also undertaken and fields were planned to divide into rectangular of 30 ares units. Agricultural mechanization were intended under such designs.

Recently extensive rice fields were connected with each other under integrated single water delivery system. In place of single action, the era of independency with respect to government policies, economics, and engineering had arrived.

V-2. Agrarian Land Reform and Land Reclamation Project

Agrarian Reform (Land Reform) of 1949 was very meaningful affairs for the war defeated economy reconstruction process. Before the reform most of the farmers were tenants had to pay rent to the landowners for the use of the land. Paid rents were generally high sometimes above half of the harvested rice and it was the main hinderance to the more production expansion.

Great many farmers has experienced and been favoured with Agrarian Reforms enacted shortly after World War II. Under these reforms, tenancy was greatly reduced and farmers income were increased. Their wills toward production expansions were also stimulated. The reforms also helped to rise the living standard of farmers.

Adjusting the partitions of farmland was done very smoothly. Farmers who became landowners as a result of the land reforms following World War II did their best to promote rice cultivation.

Government control of rice production has helped farmers in many ways.

At the same time farmers have received positively large scale land reclamation project promoted national and municipal government and conducted many planning.

After World War II, to overcome then serious foods shortages, along with Agrarian Land Reform, the national government protected rice growers by purchasing products at a prescribed price. Adding above price-supporting policy, government eagerly conducted improvement in land conditions refered as land reclamations. Finally it make possible wide spreading of agricultural machines and realized great labour savings.

In 1952 the National Diet involved central government directly in the construction and management of land reclamation projects through passage of the Land Reclamation Act.

The Reclamation Act of 1952 can be recognized as the beginning of many decades of central government involvements in financial supporting and constructing great many projects. Under this law, technological advancements and high productivities of agriculture were greatly realized.

The Bureau of Reclamation, one of the major department of the Ministry of Agriculture, Forestry and Fishery of the central government had charge of land reclamation project.

In Takada plain reclamation and orderly rearrangement of rice fields were also undertaken and carried out under the Land Reclamation Act.

Central government had and has initiated preparing various long term planning and has financially permanent role and carried out many projects in the work of land reclamation. Great portion of the government investment were also shared by land reclamations.

Administrative investment for the improvement of farming land was planned, financed, and carried out by the central and local government, most of them are central government-sponsored project. Thus, much of the water supplied to padi-cultivating farmers originates financially in prefectural or central government various water projects.

In Takada Plain, water management and development have also shifted from small local private institutions at the early times of the Modern Era, i.e., Nakae and Uwae Irrigation Water Party, to predominantly large public agencies such as the Incorporated Land Reclamation Association of Niigata Prefecture of the present times.

After Meiji Restoration reorganization for modernization must be done. Previous simple irrigation district under feudal authority grew to farmers organization of mutual water delivery corporation or agencies based on landowners.

Water delivering corporative agencies (Water Distribution Agency) of each farmers were established suitable for more highly systematic and complex society.

Land Reclamation Act (1952) also provided for formation of land reclamation district. The new legislation districts were more democratically organized, each land owners had one vote, and finally, large scale irrigation and drainage works containing land consolidation works has been carried out corporatively by many farmers agreement.

From 1950s, people began to change farming methods and to undertake the land reclamation together in larger groups so that higher yields may be obtained and to receive continuous water service, a number of water districts had to be banded together.

Before conducting of the land consolidation project, the farming unit had been made up of one small unit or several small plots and in spontaneous or irregular shapes.

To solve the problems of land fragmentation and farming inefficiency, land consolidation must be conducted so that efficient farming can be carried out. Large scale farm consolidating projects were undertaken. Those projects were also financed by the national and local government because road rearrangement, modern irrigation and drainage schemes were very expensive to conduct privately.

Under the rational land allotment planning, roads and irrigation canals were also arranged according to the land division which generally followed the cardinal direction with the smallest 30a rectangular unit. Waterways were divided for inlet and outlet, the former for divert water from the main canal and the latter for drainage.

Along with the land condition improvements, to make water use more efficient was undertaken by installing taps in each unit of padi controlling irrigation water.

Also waterways improvements and being equipped with more complete facilities were actively carried out.

Waterways were divided for intakes and drains purposes which will contribute savings of

water resources to be carried out. Excess water draining from the field will contribute to improve soil conditions.

V — 3. The outcomes of land reclamation projects in Takada plain

In Takada plain, the extent of land reclamation completed areas has been covering almost the whole cultivated areas amount to approximate 10,300 ha. That had achieved mainly through the decades of 1960s and 70s. In many cases, each land reclamation units and irrigation districts coincided and has been overlapped, that had supported projects to be conducted smoothly.

Under the central and local government schemes, land adjustment and improvements of the irrigation and drainage of the cropland were done.

The whole irrigation network will be quite rational and efficient if a waterway and a road were constructed parallel to the direction of the incline, and waterways and roads has been organized into grid-pattern networks for the best possible use of irrigation water (see Fig. 4).

Along the waterway concrete lining has done as a protection measure for water leakages, and a tap was installed in each unit of padi to control irrigation water and water conservancy was realized.

Land reclamation projects of the Takada Plain had been carried out successfully all those aspects like other rice production dominant districts.

The land reclamation had also greatly contributed to realize the wholly mechanization of agricultural works such as transplanting, harvesting, field preparation and ploughing, those were highly depending on the degrees how much land reclamations were progressed.

Because of these improvements and realignment of fields, such mechanized implements as large combine machines has able to be used.

Execution outcome of the Takada Plain's land reclamation is shown in the values as recent yields of rice per 10 ares equal to or above 650kg.

Landscape transformation can be recognized clearly by comparing the topographical map of two different times. Fig.3 had been prepared in 1930. In this map we can find the canals and roads are taking the irregular courses throughout the Takada Plain. It exhibits the land reclamation and land consolidation had not still started. We can also find the canal inlet with "Nakae Yosui" letters on the Seki River's right bank at east side of the railway, southwestern corner of this map.

Fig.4 had been prepared in 1989. Schemes of land reclamations and land consolidations have already realized. The reclaimed land is served by a good road system which can be used by commuting cars of part-time farmers who are engaged in non-agricultural works in the weekdays.

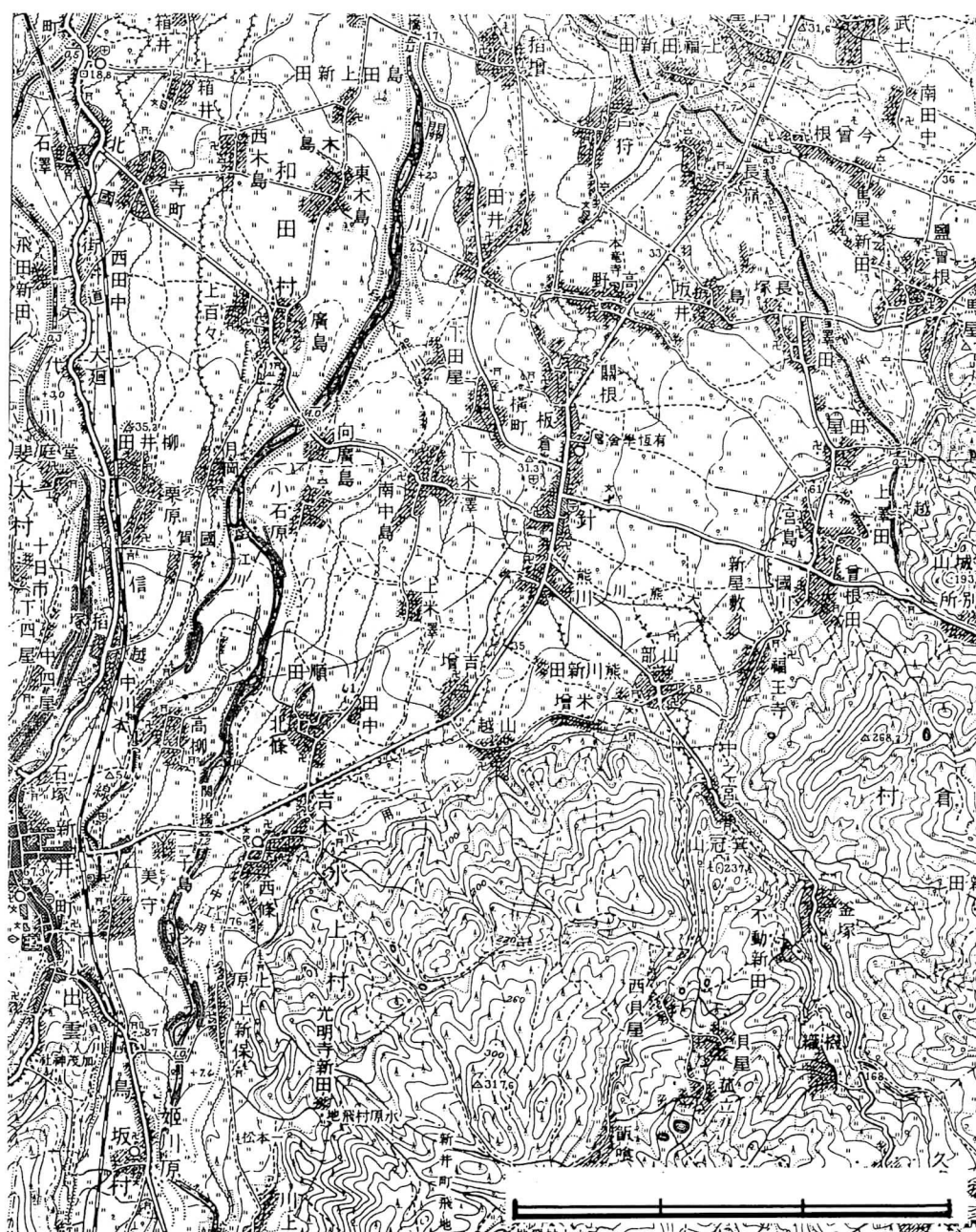


Fig. 3 Scale 1:50,000 Topographical Map 「TAKADA EAST」 of 1930.

Legend : Both Nakae and Uwae Canal's inlets can be seen in southern portion on the right bank, Seki River.



Fig. 4 Scale 1:50,000 Topographical Map 「TAKADA EAST」 of 1989.

Legend (Number): Nakae Canal's Siphons. 1. crossing Okuma River 2. crossing Bessho river

VI. Water right conflicts and disputes among water users between different drainage basin Nagano and Niigata and within the Takada Plain, surrounding Nojiri lake water

Water resources of the Nojiri Lake had been shared with inside communities, water irrigation districts, within Takada Plain and outside Torii river basin, Nagano District. There had been arisen many conflicts, disputes and political battles and those had strongly characterized the Nojiri Lake water use history.

In this section, at first, affairs accompanying water right as general and common problems will be described. Next, water right disputes within Takada Plain will be commented. Finally, water right disputes, lawsuits, litigation, legal and political battle between Nagano and Niigata around Nojiri Lake water will be described.

VI-1. Water right disputes, water conflicts, and legal and political battles among water users and seekers in Japan

It is occasionally referred that Japanese water "law" is the typical one of the traditional custom-law. Its traditional items of rules reflects Japanese natural hydrological environment and are rather well-founded, although often commented as are outdated. From the early times, whenever the opening of padi-fields, a primitive body of water law had adopted and in degrees, received and recognized widely.

The 'first in time, first in right' tenets also had seemingly been born in traditional Japan. That priority system afforded security of supply in times of drought to those with early claims. The priority of early developed padi in water use based on assumption that any change in point of diversion or type of use may affect and give some damages on downstream water users.

This priority right has often been explained as one of the typical model of the feudal society system but, the priority of old padi, should be understood as one of the clever way to prevent from being fallen together by the drought damage. Under this prior rule, the procedures by which water divert claims were gradually established and had ruled water allocation. The right to use water was exclusive, absolute, and established by the fact of diversion activities.

Farmers engaged in rice production had to divert water from the natural river streams with artificial headworks although in early times unmatured construction technology such as using brushwood and stones allowed much amount of water passed and flowed away and uncaptured. In degrees irrigation systems had grown and spatial expansion resulted some integrations between irrigated regions proceeded. Each of them had common headworks and frictions and struggle for limited amount of water had become more and more serious. Before the Meiji Restoration, those struggles among irrigated areas were judged and settled by feudal government authority.

During the Shogunate, rice played a dominant role in the economy. Central and local feudal government eagerly promoted the construction of long waterways, headworks, and huge irrigation ponds and other irrigation facilities forming agricultural common base. Under the

feudal government controls those irrigation facilities were financed, managed and maintained directly. In Japan, for long times, water for agricultural purpose had priority over any other consumption. This priority itself had experienced little transformation under modern Law systems following the Meiji Restroration. On the Nojiri Lake, situation was the same.

As the result of the Meiji Restoration feudal authority and ruling systems had given way to the modern civil law systems. Water resource management system in the civil law had experienced transformations to some extent. Along with the establishment the Riparian Act of 1896(original KASEN Act, in 1964 revisioned), water users other than agricultural sector had to require permission for the central or local government to obtain appropriated water rights. On the other hand, farmers as water users could no longer be depended on the traditional feudal authorities. They might establish themselves in the modern law systems and obtain water rights through the process of water appropriation, 'first user could to file first right'. Under this rule, water divert claim was allowed priority over any later claimants. Then farmers had to consolidate cooperation or parties of water users to solve various troubles, most of them were arised from water allocation and diversion. Water users' corporations or parties were not a natunal person but were incorporated firms as farmers agency that were aimed to occupay more favorable position in the law court. Since the beginning of the 20th Century, they claimed and appealed positively toward whatever seemed to be feared that would invade and threaten their own vested interest or privilege, and bring the matter before the court to ensure their own water right.

The fact that the first accessor had the prior position over any other water users, was some degrees similar to those circumstunces such as the principle of the "first in time, first in right" priority system arised and grew in the modern western U.S. arid regions.

Although at first, far early times, water rights were recognized as a exclusive, absolute one. But, in practice, used waters exhibit a sort of circulation forms such as one users return flows to the river were at once another's source of supply. So, reasonable use or beneficial use for others has become in degrees some obligation of all the water users. Of course, the Nakae, the most prominent water party in Takada Plain then, could not be an exceptional existence.

Among the water users the conception of water use efficiency has been accepted widely, although very slowly, and efficiency criteria are not still expressly defined. Rather, custom and traditon dictated the quantity of water considered reasonable.

Each farmers that use surface water in appearance own water right, but they are more likely to be a part of an irrigation district or a mutual water cooperation that holds such right in fact. So farmers hold and exercise the water right only through the 'umbrella organization'.

Under modernization process previous primitive water user's party had to transfer from the old style simple one to modern mutual water cooperation more suitable for complex economic and social law systems. Irrigation districts originated in a sort of land-fixed(bind) community under feudal authority. They had evolved to collective organization of law-person with modern economic and social facilities. But the members were limited with land owners only.

Since the Meiji Restoration and during the pre-Agrarian Reform times, the landowners were

not always persuasive for the promotion of land reclamation project.

Following the big affair of Agrarian Reform 1949, the former water districts under the initiation of land owners had transformed to the land reclamation corporation composed of new workingpeople-landowning farmers. Under the new organisation, land productivity were improved remarkably. As the result of land-reform farmers saw high yields could be realized and sustained by land improvement schemes under the land reclamation project. New land-owner farmers had persued to make rice yield be high. Previous primitive irrigation district inevitably evolved to new land reclamation cooperation.

VI — 2. The transition of water right disputes among the Nojiri Lake from the Pre-Modern to Modern Era

Nakae Irrigation Water District had its origine one of the irrigation district collective organization of water using farmer's party at the beginning of Pre-Modern Era in the Takada Plain, patronaged by Takada Clan.

In the early times of the Edo Era, several Shoya Class farmers, were the members of the ancestral Nakae Irrigation Water District, together with some warriors of the Takada Clan, researched the headwaters of the Seki River and the Nojiri Lake. They undertook to develop water resource of the Nojiri Lake soon after. The fact that Nakae had been the first seeker for Nojiri Lake and Seki River's headwater area had given them the well-founded base of their holding water right assertion in the Japanese traditional custom-law.

Adding to the monopolistic using right of the normal overflowing Lake water, Nakae had been given the priviledge of the Lake water 'special release' dropping below the normal level surface water as emergency means in case of severe drought year.

During the Pre-Modern Era, Nakae had again and again opposed to the Uwae's all opening new padi schemes. Uwae, another major water district that had more later origine but grown as the rival of Nakae and had competed with Seki River, because most of thir plans were based on extention the existing Uwae Waterway of which water inlet situated more upstream position than of the Nakae and its accomplishment opening-padi might affect harmful effects on the downstream Nakae. The new opened padi-fields had constantly surpassed available amount of irrigation waters, competition among the irrigation water users inside the Takada Plain had arisen and become severe in degrees, despite the availability of substantial quantities of released Nojiri Lake waters.

Water right conflicts and disputes were continued and carried over to the Modern Era, and litigation in 1920s between Uwae and Nakae, was the most acute case. Those water competitions and strained circumstances had been derived from the padi-opening and water scarcity showing dilemma, had eventually overcome by the alliance with and carrying out jointing works with electric power company. That made possible and realized to increase amount of useable water of the Nojiri Lake remarkably. That has been mentioned details in the previous chapter IV.

In 1901, Nakae, in Feudal Age Nakae Irrigation District, had reorganized as the Nakae Irrigation Cooperation, a farmers agency, and had adopted themselves positively in the modern

civil law systems, firmly established and strengthen their lawful authority through many lawsuits and judgements resolving water right conflicts. It grappled with confronted severe competition and, above all, successively achieved to obtain the water right of the Nojiri Lake over the opposite Torii River basin, Nagano District.

VI — 3. Nagano against Niigata Water War, its outbreak and ending

Today almost all the Nojiri lake waters are bound for irrigation and waterpower in Takada Plain and Seki River drainage area. Today people in the Takada Plain in fact hold the Nojiri lake with their own lake water right, beyond their administrative border but physically within their same drainage area. Pre-Modern and Modern Era, all of the new application for the water rights of the Nojiri Lake, were required from the Torii River drainage basin within Nagano District border. And all of them were rejected.

Throughout the history, water seekers of the Torii river drainage basin, of Nagano side, had and has been always shut out of sharing of the Nojiri Lake water right with the Seki River basin, Niigata side users. Farmers of the Niigata side, had deneyed to give alienate their share from the early days till today. They, Niigata side people, had and has protected the lake waters toward almost all water plans of the opposite Nagano side. Today only exceptionally Nagano City on her for domestic and urban use has its water right in the Nagano Prefecture. This claim limited only within the non-irrigation season. During the limited times from 11, September to 31, May, Nagano City can divert from the Lake water 9,600 cubic meters per day.

For waterseekers or proposers of the water use alteration in the Nagano side, all of given court judges were unfavorable. Because lawyers recognized in the court that planned or proposed alteration of water use especially in the Torii River drainage basin would threaten existing water users along and downstream of the Seki River including Nakae Water District. Fundamentally, new water seekers or even the present water right holders themselves had to prove that a proposed alteration of water use would not damage the right of downstream preceded users. This is the needed justification for the additional development or diversion of the Lake water then.

In 1913, aiming to guard their Nojiri Lake water right going on, Noriji and Nakae had established one body of water users party named “Nojiri Lake and Ikejiri River Waterway Management Corporation”, and formed an alliance with each other. They had been situated upstream and downstream on the Seki River respectively and were, formerly independent two irrigation water district. Soon after the annexation of two water district, commencement of teaming up with irrigation water corporation and the hydro-electric company in 1917 was followed. It marked the new era in the sequence of the lake water resource development.

It had seemed impossible to maintain holding water right of the Nojiri Lake by farmer's water corporation alone or by electric company alone, to quarrel with others and to survive among severe water competitions. Only intimate partnership between with the electric company and the Nakae farmers made it possible to establish their lawful water right.

The established water right of the Nojiri Lake had to provide for two factors. The one was the water right for irrigation seasons and the other was the right for power generations during non-

irrigation seasons. To control lake water perfectly, this was the major premise to use and to manage the lake water as the prolific resource, both water rights, for irrigation season and for non irrigation season, might be owned and appropriated. It had become lawfully complete water right only after two factors were provided. By having made support mutually, both, farmers and electric company, had succeeded in acquiring right and managing the lake water in their hands.

Farmers and electric company had adopted themselves to civil laws very skilful by keeping their claim of holding the lake water right and, they had expanded their quantity of usable amount of water substantially. In the works of increasing lake water storage capacity, the commencement of withdrawal from the Torii River on the opposite watershed of Seki River in 1942 was another noteworthy epoch making affair, and also was the final determinant factor of the present water budgeting balance of the lake water. And that has remained its effects still present days.

In 1945, just before the defeat of the World War II under the militarism government policy, enforced allocation were ready to adopt to the Nojiri Lake water. With back of military power, the Nagano Prefectural Government had expected then that their water demand could easily be met by reallocating the Nojiri lake water. At that time Nagano City herself was faced with urban water scarcity along with the proceeded military population dispersals.

The irony of the fate, the same militarism central government had required to supply additional amount of lake water for expanding power generation for munition and for foods production increase, and that might more easily and effectively realized within Seki River drainage basin and Takada Plain in the Niigata District.

Immediately after the War Defeat, controversies surrounding Nojiri Lake water development were revived and repeated again among Nagano and Niigata District. From the outset they were unable to negotiate a mutually satisfactory allocation and finally a compromise was reached between them that were resulted in The 1952 Nojiri Lake Water Use Compact.

According to the 1952 Agreement with the two district, to adjust and to settle the competition for lake water that had repeated on the past long times, the author hold that the Lake-water's allocation were carried out under logical and orderly way provided justification rather than were seemingly skewed in favour of the side of the Seki River drainage basin. It could be referred as the latest round of the water war between Nagano and Niigata. It was hammered out after many controversies. This apportionment assigned 2,545,051 cubic meters per year to Nagano City. And it limited the diversion only 263 days during non- and quasi-irrigation season from October to March, averaged amount 9,677 cubic meters per day. Comparing the volume of water permitted in the Niigata District side totally amounted to 132,451,200m³, one can easily see that apportioned Nagano City's shares show only 1.9 per cent, very small portions of the lake water.

It takes skewed as if it would be in favour of the side of the Seki River drainage basin. But we can find and can recognize its adequate justification under closely examination of the lake water use history. Farmers of the Niigata prefecture attained the reaffirmation of priority over the Lake waters after the conflict resolution. Those traditional institutions that had governed water use in

Nojiri Lake dominated by irrigation and electric power tend to discourage such as above mentioned enforced reallocation under militarism. And it had been likely that Nakae Water District's centuries-old legal right to the Nojiri lake water made perpetuate their holding and assertions in the negotiations. Adversely for the peoples who had resided on the side of the Torii River basin, on the Seki River's opposite, the amount of water seemingly available over the long time now appears to be less than was assumed a half-century ago.

The term of the Compact validity was set for 50 years from 1945 till 1995 at first. Then, from the year of 1995, the Compact should be reviewed every 10 years cycle on the meeting.

After the review of 1952 Compact in 1995 to Nojiri lake water, among both Niigata and Nagano districts, anew appropriation has not allowed yet for the people of Nagano district side. Within Takada Plain, domination for irrigation and power has inherited and has none been allowed anew adding appropriations to the Seki river's stream flow.

VI - 4. Irrigation Water Significance, a typical recycling resource

In the following section, the significance of the irrigation water for paddy cultivation will be examined. Although the existence of various and different views, the author believe that the irrigation waters are facilitating very effectively.

In Joetu, major urban area of Takada plain, newly arised section's demands amount of waters other than agricultural use are by degrees surpassing the latter. Although agriculture's water has been guaranteed, other economic sectors demanding water grew rapidly especially from the 1970's. Those of the major one is for industrial use, and the other is urban or municipal use, containing for snow melting. The last one is the proper of this heavy snowfall area and has become more significant in degrees. So it is often referred to that traditional means of augmenting the Seki river basin's water supplies may be less viable than they once were.

In Takada plain that waters for agricultural use shares 80 per cent of the whole consumption indicating dominant position of agriculture, of the other 20 per cent so strictly nonagricultural use of water, residential and industrial purposes shares most of it. And waters for agricultural purpose has not only quantitative but also has qualitative important function, as facilitating and forming recycling, reusing system.

In the padi field water flows slowly by means of gravity and later back into the river at the places further down the river. Water is cycling between the river and the padi field, and movement is so slow, that paddies are facilitating a sort of reservoir. Then, in the Takada plain almost amount of waters finally flow back into the Seki river in its lower reaches and are resulted in ordinary discharge, forming stable river surface flowing. Skillful and excellent farmers make padi field reserved water frequently increase and decrease for water management that prompt smooth growing the rice plant and result good harvest.

Irrigation also helps to improve the aeration of the soil. The oxygen in the irrigation water helps to provide additional supply of oxygen that is much needed by the soil.

Silt from flood water is a valuable source of plant food. Bringing the silt into the fields by irrigation helps to further enrich the soil.

The irrigation water that enter the padi field will move and pass on the ground surface, and some of them will move downward by percolation, resultedly become groundwater. In the excellent quality padi, groundwater is produced about 10mm depths per 10mm squares per day through this percolation process. For example, 1 square meter padi-field will raise 10l/day and 1 ha padi-field will raise 100t/day groundwaters respectively. So padi-cultivation can be recognized as the one process of producing groundwater. Such groundwaters raised in the paddy fields are being pumped up near Joetu urban area for the urban water consumption. In urban areas groundwaters are also consumed for melting-snow purposes during the heavy snowfall season. Downward moved water also supplys water mixed oxygen to the roots of rice plant demanding them in the growing. Near the river mouth of the Seki, draining excess waters after irrigation are cached with weirs and reused for the industrial purposes. Then, even though a reduction in irrigated share hectares of farmland continued over last 30 years, irrigation waters are recycled and reused for many purposes intensively and effectively.

VII. Conclusion

In the lakewater management and usage, in every season lake water has been released for irrigation purpose between the fulfilled surface level(altitude 656 meters) and base level(altitude 653ms).

So, during the irrigation season, fluctuation of the surface water is kept within minimum range.

This situation have favoured tourism on the Nojiri Lake side over the years because stable water surface near at fulfilled level is indispensable for swimming, rowing boat, pleasure shipping, yacht playing and other water plays. Irrigation season coincide with tourism season. And stable lake water surface level keeping has become the sound business basement of the tourism surrounding lakeside area.

Summer of 1994 was never experienced heavy drought season. Takada plain's agricultural sector had to release lake water for 20 centimeters depths below the fixed lake base level. Depths of 20 centimeters means 650,000 cubic meters in Nojiri Lake. Moreover, simultaneously, they had to negotiate with the lakeside tourism businesses so that tourism might approve of the reducing lake water level in farmer's interest. After severe disputes between them, tourism conceded farmer's requirement finally.

This affair exhibited suggestive matter. By excessive releasing the lake water will not only be threat for irrigation purpose but also for tourism. To keep the lake water level to be stable has become already a one ruled custom, like of the custom-law. Tourism business has begun to insist their 'right' assertion for their business to be sustained. Today, tourism has arised itself as a new water seeker, adding themselves to previous water right holders of the lake water.

Acknowledgement

交通論の専門分野ではごくごく基礎的な知識だが、この場を借りて少しこだわってみる。

1. 都市が空間の節（ノード。関節の節）、あちこちの節を互いに結ぶのが、リンクである。
2. 分母に節の数、分子にリンクの数をとる。 3. いま、四辺形を考え、四つの節があり、リンクも四つなら、その地域の空間の結合度は 1 と評価される。4. 節が四つのまま四辺形に対角線二本が加われば、空間の結合度は $6/4 = 1.5$ となる。これだけなら、何でもない。

ところで我が学部で立ち上がった内陸文化研究交流（室）を考える。節をそれぞれの研究・教育の単位、リンクを相互交流や理解、さらに結合の深さの度合い、としよう。目下の大学をめぐる厳しい状況では、ノード・節を増やすことは極めて困難だが、リンクの数を増やすことは可能である。ここに、我々の未来につながる一つの鍵がある。リンクの数を増やすにはいろいろな方法があるが、紀要なども、数ある方法の内の、一つにはなるであろう。

節を大学内に限ることはないが、リンクは大学の内でも外でも、数が多ければそれだけよいのだから、あらゆる方法が模索されることが望ましい。研究発表など、各自（節）が、それぞれの所属する学会ですればよいではないか、と、筆者もまた思う。だが、リンクの数を増やすには、それだけではすまなくなっている。難しい時代が来たと感じる。

拙稿をまとめるきっかけは、1999年刊行の、『長野県土地改良史』の編集作業であった。編集作業の中核を担われた滝澤公男氏（長野県地理学会会員）、県職員の滝澤嘉市氏、土地改良連合会職員の清沢友幸氏ほか多くの方々に心からお礼申し上げる。

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