4-2. Removal of the Arase Dam: Japan's First Attempt to Dismantle a Hydroelectric Dam and Restore the Original River Environment

Overview of Arase Dam


Arase Dam.

The Arase Dam, built exclusively for hydroelectric power generation, had an annual power output of 74.66 million kWh (kilowatt per hour). Completed in 1955, the dam is located about 15 km from the estuary of the Kuma River (mainstream length 115 km, watershed area 1,880 km^2) as it flows past Sakamoto Town (formerly Sakamoto Village), Yatsushiro City, in southern Kumamoto Prefecture. The Arase Dam is a concrete gravity dam consisting of eight gates, having a height of 25 m, a total length of 210.8 m, a total reservoir storage capacity of 10.14 million m^3, and a submerged area of 123 ha. It is the oldest of the prefecture-operated hydroelectric dams constructed according to Kumamoto Prefecture's Kuma River Comprehensive Development Plan.

The removal of the Arase Dam has been beset with twists and turns. The first decision for the removal was made by the Prefecture Council and the Prefectural Governor in 2003 due to lobbying from fisher-folks and local residents, only to have the decision frozen in 2008 when a new governor came into office. In 2010, however, when it became clear that the procedure to renew water rights could not be done without the agreement of the fishing co-op, the final decision to remove the dam was made and work to dismantle the dam began in 2012[1].

Changes in Environment and Lifestyle in the Kuma River Watershed Brought about by the Dam

Three dams have been constructed on the Kuma River mainstream, the construction of all three being pursued intensively over a period of a few years in the late 1950s. These are, in order from the estuary, the Arase Dam (completed in 1955), the Setoishi Dam (completed in 1958), and the Ichifusa Dam (completed in 1959). The construction of these dams had serious impacts on the Kuma River environment.

Prior to the construction of the Kuma River dams, catches of *ayu* fish (*Plecoglossus altivelis altivelis*) were extremely large. A river fish, the *ayu* is one of the most popular Japanese freshwater fish. The Kawabe River, a tributary of the Kuma River, was particularly well known for the "*shaku ayu*," a large *ayu* reaching over 30 cm in length, providing livelihoods for professional river fisher-folks and attracting large numbers of angling enthusiasts. The *ayu* made great contributions to the economy of the Kuma River watershed, including the inns and local restaurants that catered to the anglers. It is reported that at a time when the average salary for white collar workers in Japan was about 8,000 yen per month, 10,000 yen could be made in a day by catching and selling *ayu* fry.

At the construction site of the Arase Dam in Sakamoto Village, five to six tons of *ayu* could be harvested in the two months of the "*ochi ayu*"[2] season. This fishing was carried out by around 280 people in 30 households, but the number of people involved is reported to have fallen to just 16 in the five years following the completion of the Arase Dam, and to a mere two by 2000[3]. The *ayu* spawn in the river in the fall, and the eggs flow down the river to hatch in the vicinity of the estuary. The *ayu* fry then swim back up the river in the spring. Large structures that obstruct the flow of water, such as dams, become serious obstacles hindering the movement of the *ayu*.

In addition to *ayu*, eels, *donko* (a kind of fish, *Odontobutis obscura*) and *gane* (a kind of crab, *Eriocheir japonica*) could also be caught before the dam was constructed. The *donko* and *gane*, caught using handmade implements, were consumed by local families, and it is said that children would sell them to adults if they caught a lot of them[4]. It appears that these creatures also virtually disappeared within a few years following the construction of the dam.

Since the Kuma River is also the only major river flowing into the Yatsushiro Sea, the freshwater and nutrients from the river are vitally important for the ecology of this almost totally landlocked sea. The estuary of the Kuma River has tidal flats of about 1,000 hectares, and before the dam was constructed, the flats were so ecologically rich that even a child could fill a bucket with prawns[5].

After the construction of the dam, the biota of the flats changed. The return of the *ayu* to the upstream waters was obstructed, and the tidal flats became muddy and difficult to walk on due to a reduction in the amount of sand flowing down the river. Since the *ayu* were of significant importance to the local economy, the fishing co-op began a project to collect *ayu* fry taken from a fishway of a weir located in the lowest regions of the Kuma River, and then transported them by truck to release the fry in upstream areas. It cost them 50 million yen (approximately USD 500,000) per year to do this. While a fishway was constructed on the Arase Dam in 1998, only a very small number of *ayu* were able to pass it, and according to the observation of local fisher-folks, the dam reservoir at the top end of the fishway was almost completely still. Even if the *ayu* were able to swim up the fishway, they were not able to swim further upstream from there.

The dam also distressed local residents with its noises and vibrations, deterioration of water quality, and unpleasant smell. In the former Sakamoto Village, people were living in homes built close to the river to make it easy to fetch water for daily life. There were floods before the dam was built, but people coexisted with the floods by moving their household belongings to the upper floor before the floods arrived, and going out to catch *ayu* or collect river sand during flood times. However, the damage to these private houses was extremely severe after completion of the Arase Dam because the water level rose very rapidly when water was released. Silt that built up in the dam lake behind the dam flowed downstream when water was released. The houses that were flooded became inundated with silt, making it impossible for the people to coexist with the floods.

The Process up to the Decision to Remove the Dam

There were several twists and turns in the story up to the point when the final decision was made to remove the dam. In the former Sakamoto Village, where the dam is situated, the Sakamoto Village River Fisher-folks' Union began activities targeted at revitalization of the Kuma River in 2001, a couple years before the renewal of water rights was due in March 2003. An Association to Consider

the Arase Dam that encompassed a wider range of the local residents was established, thus giving organization to the calls for the removal of the dam as the consensus of the residents. In September 2002, the Sakamoto Village Council submitted a written opinion to Kumamoto Prefecture demanding suspension of the use of the dam. The prefecture then announced that it would limit the renewal of the water rights of the Arase Dam to seven years and begin the work of dismantling the dam in April 2010. This was the first time an official decision was made to dismantle a hydroelectric dam, not only in Japan but in the whole of Asia. The prefecture then continued deliberations on the methods and so on to be used to dismantle the dam by establishing an Arase Dam Measures Investigation Committee consisting of academic experts, related organizations and representatives of the local residents.

The process was proceeding smoothly until Governor Kabashima was inaugurated in 2008. It was announced that the plan to decommission the dam had been withdrawn for economic reasons, among which was the estimated 10 billion yen (approximately USD 100 million) cost to dismantle the dam. When in January 2010 it became clear that the procedure for the renewal of water rights, due to expire in March of that year, could not be completed on time[6], dam removal once again became the policy espoused by the prefecture. At the end of March 2010, power generation at the Arase Dam was terminated and all the gates were fully opened on April 1st.

The State of River Restoration in the First Year after Opening the Gates

A year and a half after the gates opened, the revival of the Kuma River had become apparent to the local people who had been continually observing the river. According to Ms. Shoko Tsuru, Vice Chairperson of the Kumamoto Nature Interpreter's Association, the changes seen thus far in the river can be described as follows:

1) Change in water quality: Water downstream from the dam that was turbid before the gates were opened, has shown a remarkable change, becoming clear and blue following the opening of the gates. Water turbidity after rain also clears more rapidly;
2) The appearance of rapids and pools: Before construction of the dam, there were rapids and pools in about 20 locations above and below the dam site, resulting in a self-purifying effect taking place through the creation of turbulence in the river flow. After the construction of the dam, these rapids and pools were lost due to inundation upstream and a reduction in the supply of earth and sand downstream. They have reappeared after the gates were opened;
3) Kuma River fish: It has not been possible to ascertain the state of restoration of fish thus far;
4) Kuma River estuary tidal flats: It is reported that after the gates were opened the amount of sand flowing down the river increased. The muddiness of the Yatsushiro Sea tidal flats was therefore reduced and they have become easier to walk on. The numbers of creatures that inhabit the sandy areas by digging holes in the sand, such as *anajako* (a kind of prawn, *Upogebia major*) and *hamaguri* (common orient clam, *Meretrix lusoria*), appear to have increased, but since the number of people collecting these has also increased it has not been possible to ascertain precise numbers;
5) Green laver (*aonori*) in the vicinity of the estuary: Although these grew to only about 50 cm in length before the gates were opened, they now extend to about two meters. The colors are now more vivid than before and fade less easily;
6) Fisheries in the Yatsushiro Sea: The seaweed bed in the vicinity of the Kuma River estuary has revived. Very soon after the gates were opened, large catches of the brachiopod *midorishamisengai* (*Lingula anatina*) became possible for the first time in 30 years, and veined rapa whelk (*akanishi*) and razor clam (*mategai*) have also increased. Eels, which no one had tried to catch for many years

due to their absence from the environment, reappeared after the gates were opened and found their way onto the market last year;

7) Removal of the dam and revival of the sea: Since the gates were opened, it appears that the water in the estuary and even the sea has become cleaner. The Kuma River has a great impact on the Yatsushiro Sea and removal of both the Arase and Setoishi dams will have a good effect on the revival of the sea and tidal flats environments. When a dam is present, accumulated silt flows downstream when water is released. Following the opening of the gates, the amount of wood flotsam and jetsam floating downstream increased, resulting in the negative impact of torn nets. This is probably because the mountain forests in the upstream areas are not being properly cared for. It is hoped that if the tidal flats are restored, more young people are able to make a living from fishing.

Toward a Revival of the Entire Watershed

As noted above, the decommissioning of the Arase Dam is the first case of its kind in Asia. The impacts of decommissioning on the Kuma River and the Yatsushiro Sea, however, will remain limited as long as the Setoishi Dam, located 10km upstream of the Arase Dam, continues operation. When both of these dams are removed, the Kuma River will become a Class A river with no large-scale dam all the way upstream to the Ichifusa Dam, close to the border with Miyazaki Prefecture, and a magnificent revival of the ecology and environment of the river and sea, as well as biological resources, is anticipated.

The 50-year term of the Setoishi Dam water rights will also expire in 2014. The local fishing co-op has refused to recognize the renewal of water rights and a resolution aimed at removal of the dam has made the dam's decommissioning a possibility. However, since the Setoishi Dam is located on the outskirts of both Ashikita Town and Kuma Village, there is no resident community that suffers direct damage from the dam, as in the former Sakamoto Village, and because 70% of the *ayu* caught downstream are released upstream of the Setoishi Dam, the number of *ayu* harvested from the river has been maintained. For these reasons, the intense activities by residents to demand the removal of the dam as seen at the Arase Dam have not occurred in the case of the Setoishi Dam. Nevertheless, up to now, when water was released from the Setoishi Dam, the Arase Dam played the role of a supplementary dam, adjusting the water volume. The Setoishi Dam has thus relied on the Arase Dam to some extent, creating a necessity for the operation of the Setoishi Dam to be reviewed when the Arase Dam is removed.

Even though the removal of the Setoishi Dam may not come about, if hydroelectric power generation is suspended and the gates opened, albeit temporarily, the flow will be restored and sand and earth will be supplied to the lower reaches. Thus it is said that by altering the operation of the Setoishi Dam to give increased consideration to ecology and nature, revival of the Kuma River and the Yatsushiro Sea can be enhanced[7]. From now onwards, the focus of the revival of the Kuma River and the Yatsushiro Sea will move to the Setoishi Dam and whether or not it is possible to remove the Setoishi Dam or alter its mode of operation.

Recommendations: Multifaceted Monitoring Should be Conducted

The removal of the Arase Dam is an extremely important case when considering methods for the future revival of the natural environment of Japan's rivers, on which a large number of dilapidated

dams exist. To really understand the environmental impacts of decommissioning the Arase Dam, it is necessary to carefully monitor the environment prior to, during, and after dismantling the dam. Precise monitoring also provides valuable information regarding necessary conditions to enable a smooth environmental revival. However, the Arase Dam is the property of Kumamoto Prefecture, and there is very little nationwide interest in its removal. Multifaceted monitoring surveys by specialists have not been carried out. Inquiries to the official responsible for biodiversity-related matters at the Ministry of the Environment revealed that the Ministry is simply not aware of the Arase Dam.

Kumamoto Prefecture has set up a Specialist Follow-up Committee on the Arase Dam Removal, which is proceeding with deliberations to "implement the dam removal safely and with consideration for the environment while evaluating and verifying the results of monitoring surveys on water control and the environment with respect to the removal of the Arase Dam." The scope of this committee however, is limited to monitoring in the Arase Dam removal impact assessment zone, downstream only as far as the Yohai Weir, which does not include the estuary tidal flats or the Yatsushiro Sea. If this situation remains unchanged, the only comprehensive survey will be the observations that have been continuously conducted by local citizens' organizations active in opposing the Kawabe River Dam and demanding the removal of the Arase Dam.

As noted above, the removal of the Arase Dam will have a huge impact on the ecology of the tidal flats and the Yatsushiro Sea, and the fisher-folks who depend on the marine resources. Considering the importance of the Arase Dam removal as a case of natural restoration and Asia's first dam removal, we feel strongly that a monitoring survey that includes the Yatsushiro Sea should be conducted and the results made public.

References

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1. To view pictures of the project site, visit: http://www.arase-dam.jp/shinchoku/index.html
2. *Ayu* that swim downstream to spawn in the fall
3. According to the morning edition of *the Kumamoto Nichinichi Shimbun Newspaper* of October 27, 2002
4. From a hearing with Mr. Seiko Kimoto (Chairman of the Sakamoto Village River Fisher-folks' Union) conducted on October 23, 2011
5. From a hearing with Ms. Shoko Tsuru on October 23, 2011
6. Since water cannot be used for power generation unless the water rights are renewed, the continued existence of the dam became untenable.
7. From a hearing with Ms. Shoko Tsuru on October 23, 2011