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The Immense Cost of Japanese Dams and Dam-Related Landslides and Earthquakes [Chinese text available] ダムと地すべりに浪費される巨費 まさのあつこ

Atsuko Masano

The Immense Cost of Japanese Dams and Dam-Related Landslides and Earthquakes* [Chinese text available]

Masano Atsuko

Translated by Aaron Skabelund

It had been three months since the Iwate-Miyagi Nairiku Earthquake struck northern Honshu on 14 June 2008, triggering a huge landslide above Aratozawa Dam. The area hit by a landslide has been further carved by snow and rain, and trees and other vegetation are in disarray. The site looks like the day after a wretched barber had just given it a bad haircut. For the earth, this must be an embarrassing appearance.

According to the National Institute for Land and Infrastructure Management (Kokudou gijitsu sou-kenkyuusho; NILIM), the epicenter of the 7.2 magnitude quake was near Mt. Kurikoma on the border between three prefectures--Miyagi , Iwate, and Akita--and in the close vicinity of 15 dams (one which is still under construction) including Aratozawa to the southeast.

In this landscape carved by rivers, a landslide with an average depth of 55 meters, a width of 810 meters, and a length of 1400 meters slid as far as 140 meters off the side of the mastiff and into the back of the lake formed by the dam.

A few days after the earthquake, Tokyo University Professor Konagai Kazuo appeared on NHK television's "Close-up Gendai" special, "The Mountain that Disappeared: The Iwate-Miyagi Nairiku Earthquake," and explained that because ground water near the dam was high and because snowmelt had permeated the ground, the violent shaking of the earthquake had caused the massive landslide.

The Iwate-Miyagi Nairiku Earthquake

It has been a while since there was discussion of how there are no longer any sites appropriate to build dams, but as highlighted by the Aratozawa slide, it has become clear that many dams should never have been built where they were—in places where the volcanic character of the soil had caused huge landslides. In addition to Aratozawa Dam, constructed by the Agriculture Ministry, slides have occurred at the Japan Water Agency's Magio Dam in Nagano Prefecture, at the Ministry of Land, Infrastructure, Transport and Tourism's Ōtaki Dam in Nara prefecture, and at the Water Agency's Takizawa Dam in Saitama Prefecture while the reservoirs were being filled with water. Other landslides, which the government has not recognized as being caused by dams have occurred elsewhere, such as a slide of unparalleled size below the Water Agency's Shimokubo Dam in Gunma Prefecture.

What connects all of these landslides is the immense cost of dealing with them, which seems to never end. And what is even more amazing is that despite these many examples, the government seems intent on going ahead with other dam projects such as the Yamba Dam in Gunma Prefecture and the Asakawa

Dam in Nagano Prefecture.[1]

The Collapse of the Bottom of Mt. Kurikoma

About an hour by car from the city offices of Kurihara city, beyond golden rice fields, one can see patches of bare rock in the distance. Mt. Kurikoma, with an elevation of 1627 meters, looks gentle, but this ancient volcano erupted as recently as 1944.

According to Meteorological Agency documents, a series of earthquakes rocked the area in 1957, 1985, and 1986, and before the big quake in June, twenty-two tremors shook the mountain in May. Professor Kaneori Yuji, leader of a research team from Yamaguchi University and the Geological Society of Japan, explains that "when magma below volcano moves, earthquakes occur." On the earthquake archipelago of Japan, it is not surprising that tremors are frequent in the vicinity of volcanoes.

Mount Kurikoma

According to the Yamaguchi research team, "The soil of the mountain is mainly composed of tuff deposited there some 15 million years ago mixed with some volcanic rock. The peak is a volcanic heap and it is probable that it was susceptible to landslides before the earthquake occurred." Professor Kaneori explained that tuff, which is consolidated volcanic ash, collapsed easily because it contains many fissures that fill up with water. The geological composition, along with the tremor, led to the massive landslide.

The human costs were tremendous. The earthquake killed 13 people, left 10 missing, and injured 450. Damage to property was extensive, even if one limits its scope to the dam and reservoir. The holding capacity of Aratozawa Dam, which was completed in 1997, was to be 12,480,000 cubic meters. Twice as much soil—1,500,000 cubic meters—has slid into the basin as was to be removed. According to a spokesperson for the Tohoku office of the Land Ministry, officials have given up on removing all of the debris that flowed into the reservoir basin and opted to remove just 500,000 cubic meters. The official estimated that the cost of just removing soil on the front edge of the slide would total around 38 billion yen. It is unclear how much it will cost beyond that. In addition, the quake and slide damaged the metal gate of an intake tower that supplies water to some 3000 rice farmers in the valley below. Repairs should be completed by the end of the year.

Other than the Aratozawa Dam, there was considerable damage elsewhere in the area around Mt. Kurikoma. Another slope slid into a neighboring creek and buried a small valley, including where the Kurikoma Hotspring Resort once stood, resulting in a number of deaths. Cracks also appeared in over half of the fourteen surrounding dams.

The prospect of a complete recovery is dim. The projected cost of repairs of agricultural, forestry, and water resources alone climbs to 133 billion yen and is estimated to take at least 10 years.

The Magio Dam is suspected of causing the Nagano Seibu Earthquake

There are clear precedents for volcanic mountains collapsing because of earthquakes, leading to many casualties in areas around dams, and for dealing with these disasters to take many years and be hugely expensive. On 14 September 1984, the 6.8 magnitude Nagano Seibu Earthquake caused the collapse of the south face of Mt. Ontake, a peak made famous by the song "Kiso no Ontake-san." The earthquake's epicenter was near Ōtaki village in Nagano Prefecture, twelve kilometers to the northwest of the summit and four kilometers from the dam, which are connected by a ridge.

When the south face of Mt. Ontake collapsed, about 340,000,000 cubic feet of the mountain slid into the Ōtaki River, which runs from the west to the east at the foot of the peak, upstream from the Magio Dam. The slide created a natural dam and buried the Ontake River Dam, operated by Kansai Electric Power. In the direction of Magio Dam, a pine forested area slid into the reservoir, carrying with it a number of homes and tearing a road into two. Twenty-nine people died or were missing.

The amount of debris that slid into the reservoir totaled 23 million cubic meters. Subsequently material that had slid into the bottom of the river continued to flow downstream into the basin behind the dam adding 21 million cubic meters of debris by the next year and another 25 million cubic meters by the year after. By 1992, the total amount of debris climbed to 108 million cubic meters, and by 2000 it had increased by 1.5 times. To remove this debris to restore the water storage capacity of the dam, it cost no less than 30 billion yen from 1995 until 2006.

Many people believe that the Nagano Seibu Earthquake was a "dam-caused quake." It is understood elsewhere in the world that dams, such as the Hoover Dam in the United States and the Koyna Dam in India, have contributed to earthquakes, and researchers have investigated this possibility in Japan as well. In 1974, Ōtake Mazukasu of the Construction Ministry's Building Research Institute calculated the number of tremors in the area around Kurobe Dam and discovered that there was a correlation between the height of the water and earthquake activity. Later, as the chief earthquake researcher at the National Research Institute for Earth Science and Disaster Prevention, Ōtake conducted an experiment where he pumped 2000 tons of water into a well in the Matsushiro area of Nagano Prefecture, which had experienced a series of tremors and found a relationship between water pressure and the occurrence of earthquakes. Ōtake concluded that at eight dams, including at Magio, earthquakes had increased after reservoirs had been filled by conducting a study of Meteorological Center earthquake data at 42 dams from 1926 to 1983.

In October 1984, after Ōtake presented his research at the Seismological Society of Japan, it was introduced to a wider audience by the *Nihon keizai* newspaper (on 9 October) and the *Chūnichi* newspaper (on 10 October). The Diet finally held a hearing in March 1995 when the issue was raised by the Lower House's Special Committee on the Environment. The Construction Ministry, however, did not agree with the idea of dam-induced earthquakes. An inquiry about this issue was met with the response that "in Japan a causal relationship between the level of water behind dams and earthquakes has not been clearly

confirmed." In regard to Ōtake's study, the Science and Technology Agency indicated that "since then, research on that topic has not been conducted."

Yet, even a Water Agency official acknowledged that in the case of the Magio Dam "as soon as it was completed, earthquakes began and when a big tremor occurred, part of the mountain collapsed and buried one dam." When I visited Ōtaki village, many residents found it appropriate that a landslide triggered by the earthquake buried a dam.

In 2004, Ōka Yukio, the director of Ōtaki Community Center, gave me a tour of the devastated slide area. "Previously earthquakes did not occur in Ōtaki," he reported, "Once Magio Dam was built, the earth began to shake." The dam was completed in 1961 and in 1976 a series of tremors occurred. Then, in October 1979, Mt. Otake, which had never exhibited any volcanic activity, erupted. "When smoke rose from the peak," recalled Oka, "many people thought that someone had accidently lit the hut on top on fire." Such a reaction illustrates how surprised local residents were by the eruptions and earthquakes. "Now every year when the snow melts, and the dam fills with water, there are earthquakes," said Ōka, "It sure seems like there is some sort of causal relationship."

Ōtaki Dam: Where the Government Recognized the Causal Relationship between Reservoirs and Landslides

In Japan, the government has only recently reached the point where it is finally willing to recognize the causal relationship between reservoirs and landslides. The Ōtaki Dam in Nara Prefecture was completed in 1977 after over two decades of construction, the expenditure of 23 billion yen, and the relocation of 475 households located mainly in the village of Kawakami. After years of extension, in March 2003, workers began to fill the reservoir up with water. The following month, a slope to the right of the dam in an area known as Shiroya began to creep downward. As the president of the neighborhood community association, 75-year old Isaka Kanshiro, recalls, "In the middle of the village, a crack appeared in the ground, and it was clear that it was very deep."

There was good reason that Isaka, who is not a geologist, came to this conclusion. "Before the dam was constructed," Isaka remembers, "The government had determined based on soil surveys that the areas of Shiroya and Hitochi (which sits below Shiroya next to the reservoir) were in danger of landslides." Researchers concluded that the slide was 70 meters deep and recommended that all the households in the village be moved to a safe location.

This did not happen, though. According to Isaka, "Government officials decided that the village did not need to be moved if certain measures were taken to prevent the land from sliding. But once they began to design the dam, they decided that because there was no evidence of sliding at the 70 meter level it would be okay and that taking measures so deep would cost a tremendous amount of money. So instead they drove some piles into the ground 20 meters deep. This was like beating the air. We did not agree with this, and when they started filling up the reservoir and the water level rose, of course the land slid."

Soon thereafter, the Construction Ministry "recognized that the damned water was the cause" of the landslide. In May 2003, the ministry created a committee to investigate the fissure in the Shiroya area, which cited other precedents of reservoirs triggering landslides such as Ōdo Dam in Kochi Prefecture in 1982, Hachisu Dam in Mei Prefecture in 1991, and Vaiont Dam in Italy. The Construction Ministry was clearly aware of the dam-caused landslides.

The government undoubtedly knew about the danger of landslides at Ōtaki Dam. There is evidence of this in Diet records. During a session of the Lower House Budget Committee in March 1990, questions were raised about sections of a Nara Prefecture Soil Survey Committee report that indicated there was a possibility of landslides as the layers below were submerged. In response, the chief of the River Bureau of the Construction Ministry, stated, "We received a request from local constituents and conducted research for five years. We concluded that the Shiroya area was in a latent landslide zone and that it was necessary to take construction measures to ensure that filling the dam did not induce a landslide." However, in March 2004, when asked if that "decision was incorrect," a bureau chief evaded taking responsibility by replying, "At the time, it was extremely difficult to predict that this sort of landslide would occur."

According to Isaka, "As the water level rose to 305 meters on its way to the capacity of 320 meters, the fissure occurred. If the ground had shifted a month later (when the water level was higher), the entire village would have slipped into the reservoir."

Even though engineers were aware that there was a danger of a mountain collapsing into a newly created reservoir behind the Vaiont Dam, once the dam was completed and the reservoir filled, a massive landslide occurred, creating a tsunami that swept downstream and took the lives of 2000 people. Likewise, the damage at Shiroya resulted from the government ignoring survey results and the concerns of residents and placing priority on cutting costs while continuing to push forward the project.

The Construction Ministry has now emptied the reservoir and is continuing projects to prevent further landslides. In surveys conducted since 2004, two more areas in danger of landslides have been identified. Truly the criticism that public works projects are "born small but grow huge" aptly fits landslide prevention measures. In August 2008, the government amended the Special Multi-purpose Dam Law, extending construction projects to 2012, and allocating funds of 364 billion yen. Projects that were supposed to take 15 years will take a half century and costs are 16 times as much as were originally projected. Local governments, which are saddled with covering a percentage of these costs, continue to pay for landscape prevention measures related to dams that are useless. In August 2008, five years had elapsed without there being any reevaluation of the public works projects, which had all been decided on behind closed doors, by the Kinki Regional Development Agency, which oversees the Ōtaki Dam.

Takizawa Dam, Where Landslides Continue

Landslide prevention measures at the Water Agency's Takizawa Dam in Saitama Prefecture have continued for three years. The first landslide occurred on 2 November 2005. The previous month, while the reservoir was being filled, a slope 1.5 kilometers above the dam shifted 1 centimeter and fissures appeared in four separate spots. Landslide prevention procedures were conducted for nine months at the cost of 3 billion yen.

In August 2006, soon after those measures ended, workers began to fill the reservoir again. In May 2007, the slope right next to the one that had been strengthened collapsed when the water level was 16 meters away from being full. A half month later, the slope—now 90 meters wide, 90 feet deep, and 15 meters long—slid further. In response, Kurihara Yoshiharu, the assistant director of the agency announced, "We knew that this was an area susceptible to landslides and while keeping the water level down, we had taken preventive measures such as constructing an embankment." A visit to the area confirms evidence that the agency had taken all sorts of measures in no less than 40 different places. The agency had "combined the best construction techniques," said Kurihara, yet this was insufficient.

Takizawa Dam, second construction

Prevention measures continued and in August 2007 another attempt was made to fill the reservoir. This time, workers were able to fill it to capacity, but as they began to lower the water in April 2008, a crack was discovered in a city road near the reservoir bank. As the water continued to be lowered, other fissures appeared. On 7 May, a 40 centimeter diameter crack was found on Route 140 on the other side of the reservoir and six days later another was discovered in a concrete barrier. Even when the water level was maintained, the land continued to slump. On 13 June, a crack appeared in another city road as the slope dropped by .4 meters. When I visited Saitama, a worker put it bluntly: "A mountain is moving here." It was an obvious disaster.

Could have this all been avoided? A Water Agency official reported, "In November 2003, the Kanto Region Development Agency Public Works Review Committee evaluated the cost-benefit of the landslide prevention measures and recommended that we 'continue.' We did not arrive to this decision internally." But an investigation of the committee's minutes reveals that there was not a single geologist among its twelve members. No one takes responsibility and no one makes rational decisions; tax monies continue to be wasted.

The Takizawa Dam project, which began in 1965 with preliminary studies, was supposed to cost about 65 billion yen and be completed in 1982, but construction has been repeatedly prolonged and for the time being has been extended until 2010. By then, it will have cost 232 billion yen.

The Shimokubo Dam and Denials of the Relationship between the Reservoir and Landslides in Protected Areas

There may be nothing as contradictory as building a dam in an area that you know is susceptible to landslides. According to the Landslide Prevention Law, a landslide is defined as "land that slides because of underground water or another reason." This law places limits on "increasing, attracting, or retaining ground water" above areas that are designated to landslides. Dams constructed in such areas present a stark violation of this law. One example of this is the Water Agency's Shimokubo Dam, which required 310 households to be relocated when it was constructed on the Kanna River, the westernmost branch of the Tone River.

Just below the dam is an area that was designated as protected in 1962 because landslides occurred there in 1910, 1938, and 1947. Despite this, the Shimokubo Dam was constructed there in 1968.

According to a pamphlet about the protected area published by the Transportation Ministry's Tone River Riverine Sediment Control Office, the area is classified as a "fractured landslide zone." Parts of the geological composition of the area are a crystalline schist and are widely distributed throughout the Kanna River watershed. About two years after the dam was completed in 1991, a concentrated downpour triggered a huge landslide—40 hectares wide and 40 to 50 meters deep—which destroyed 40 homes. Cracks and bumps appeared in other houses and roads. Route 426 was completely closed for six days, and then one lane was closed for another 565 days hampering the passage of 55,000 vehicles. The following year, heavy rains intensified the landslide problems, and in 1995 the area was declared to be one of 12 "landslides under direct control of the central government."

These problems have transformed the area into one of the country's largest public works projects, currently expected to last until 2025 and cost 38 billion yen. Workers have constructed six catchment wells and conducted over 66 kilometers of boring. Even now, according to local residents, Route 426 regularly becomes a "river with gravel flowing down it and is often temporarily closed." Though the project is under central government control, the prefecture is expected to bear one-third of the cost.

Nearby a Protected Area Landslide Resource Center, which may be one of a kind, has been opened. On its panels and audiovisual presentations, the center explains that the landslides are caused by underground water. Nowhere is it mentioned that Shimokubo Dam has affected the water levels of underground water.

What is the relationship between the dam and the landslides? In regard to this issue, the Transportation Ministry's Sediment Control and Conservation Division claims there is no causal relationship between the dam and the landslides. Rather, officials assert, it is simply "heavy rains that are activating landslides." But there are "primary factors" and "contributing factors" to landslides. As a panel at the resource center explains, primary factors include geological formations that slide, bedrock that disintegrates easily, and other unstable geological features, and contributing factors include heavy rains and melting snow that cause groundwater to rise. In the protected area the geological formations are certainly a primary factor. The hypothesis that the reservoir, which seeps into the groundwater causing its level to rise, is a contributing factor to the landslides seems reasonable. However, officials are unwilling to even investigate the relationship between the dam and the landslides. Officials of the Kanto Region Development Agency's River Planning Division appear to have been unaware that a landslide under the direct control of the central government lay just below the Shimokubo Dam. Perhaps they would like to deny any relationship between the dam and landslides, but they should at least investigate that possibility and the risks involved.

The Yamba Dam Project Should be Stopped

Although there is overwhelming evidence that it ought to do so, the Transportation Ministry seems unwilling to be put a halt to building the Yamba Dam in Gunma Prefecture. This dam has been in the works for a half century.

Yamba Dam map

The Transportation Ministry has designated the slopes around the reservoir site as susceptible to landslides and determined that 22 locations are likely to weaken when the reservoir is filled. In the end, however, the ministry decided to take preventive measures in just six spots "where stored water is highly likely to lead to landslides." The region around the dam has been repeatedly subject to volcanic activity, and, as is even reported on the Transportation Ministry's website, it is the location of a hydrothermally-altered zone. Areas that have such a zone and experience other volcanic activity are particularly vulnerable to landslides.

According to a book published by the Naganohara Town Board of Education about the geology of the area, heavy rains in the 1980s caused landslides in forested areas, leading to subsidence and cracks on the Japan Railway Agatsuma Line. During construction to redirect Route 145 in November 2007, rocks falling in a tunnel killed one worker. In December, two different slopes collapsed. The fragility of the area's geology is increasingly obvious.

Two of the three officials who made the decision to proceed with the project and only remedy six spots were also members of the committee that decided to continue the endless (and fruitless) landslide prevention measures at the Takizawa Dam. One of those was also the chair of the committee that made the decisions about what measures to take in the Shiroya area near Ōtaki Dam.

Okunishi Kazuo, a retired professor of Kyoto University, has prominently raised his voice against the construction of Yamba Dam. Okunishi, who has testified as an expert witness for an alliance of citizen groups from six prefectures who have sued to stop construction of the dam, has prepared a report detailing the danger of landslides on the banks of the reservoir. From his investigations the Ōtaki and Asakawa dams, Okunishi argues that, "it is clear that building dams in areas where the possibility of landslides is high will result in extremely costly prevention measures." Okunishi asserts that in the case of the Yamba Dam, the danger extends beyond that of landslides on the reservoir's slopes.

Okunishi has criticized the Transportation Ministry for its decision to locate the dam's body on the rock that includes a hydrothermally-altered zone and is highly permeable. "They are implementing seepage control measures," Okunishi contends, "but it is wrong to believe that these methods ensure safety in this area." The method that is being is used is called "milk" because it involves infusing milk-colored cement into the rock to strengthen it. Dam builders often comment that, "You can never be sure if things will work out, until you build the dam. There are limits to what you can determine even from boring samples of the rock." Workers "infuse as much 'milk' as they can to fill up the gaps in the rock until no more will go in." Okunishi sees a danger in the attitude that, "if we proceed with this construction method something will work out." In addition, such practices are one of the primary reasons why the costs of dams always bloat beyond what is originally projected. Officials contend that "because they don't know how much it will cost," they cannot come up with a precise budgetary request so they start with smaller requests for funding.

Mountains and community at the Yamba dam site

Three days after the Iwate-Miyagi Nairiku Earthquake, Toyooku Yukio, a Democratic Party Representative of the Upper House elected from Gunma Prefecture presented the government with the following questions in a memo about the strengthening of the dam and the surrounding area: 1) Will the dam be able to withstand an earthquake the strength of the Iwate-Miyagi earthquake? 2) If such an earthquake occurs, can you ensure that residents who have been relocated because of the dam will be able to avoid the suffering that citizens in Iwate and Miyagi have endured? 3) Can you guarantee that no landslides will occur in the area? 4) Is there any possibility that the body of the dam will not sustain any damage? In response, the government replied that because the earthquake's "dynamics were not adequately understood, the possibility of damage to the dam and relocation sites, and the prospect of landslides, were difficult to determine." Furthermore, the government continued, "Because we are ensuring that the rock at the planned dam site conforms to government regulations concerning the construction of structures in riverine areas, there should not be any problems."

But the problem is whether the government really wants to understand the dynamics or not. When asked when an investigation of the Aratozawa Dam landslides will be conducted, the Tohoku Regional Agricultural Administration Office replied that any inquires should be directed to the "Forestry Administration Office which manages the watershed above the dam." Because the Yamba site is located at the headwaters of the volcanic Mt. Asama and Mt. Satsu-

shirane, the only risk inviting disaster is not from earthquakes alone.

The Asakawa Dam, in the middle of the Zenkoji Earthquake and the Mt. Chizuki Landslide

There is another dam project that is moving forward even as questions about the possibility of landslides go unanswered. This project is the Asakawa Dam, a Nagano Prefecture venture which was once canceled. The site of the project is on the southwest side of the one-time volcano, Mt. Iizuna. The site is located between the epicenter of the 7.4 magnitude Zenkoji Earthquake, which rocked the area in 1847, and the Mt. Chizuki Landslide, that occurred in July 1985. All three locations lie on the western edge of the Nagano Basin, where volcanic tuff is widely distributed. The three lie within a radius of about 15 kilometers.

The Zenkoji Earthquake and the many landslides which it triggered are estimated to have killed 10,000 people. The Mt. Chizuki Landslide, which began at Togakushi Toll Road, constructed in 1964 by the prefecture, engulfed an elderly care facility killing 26 bedridden residents.

One of the first people to realize the danger of the reservoir that would be created by the Asakawa Dam was Uchiyama Takurō, who had been forced to relocate his house by the Chizuki Landslide from a hill on the right side of the Asakawa River to one on the left side (and through those experiences became a writer). After relocating, Uchiyama decided to construct a pond on his property, but was told that he could not because the area was susceptible to landslides. Why then, Uchiyama wondered, is a dam being planned in this area? Thus began his investigation. Uchiyama discovered that the plan for a dam was a "phantom project." Workers had been drilling bore samples for twenty years and had failed to find a site that was appropriate for a dam. This was in 1990.

Suddenly, however, the project began to accelerate soon thereafter. In preparation for the 1998 Nagano Olympics, the prefecture decided that it needed a road to replace the Togakushi Toll Road, which had been devastated by the Chizuki Landslide, to Iizuna Mountain, where ski races were to be held. The prefecture, which was short on money, combined the road with the Asakawa dam project as a last ditch measure to obtain additional funding. In this way, the dam project was restarted.

In 2000, Uchiyama led newly elected prefectural governor Tanaka Yasuo on a tour of the dam site. He informed him that the current site was the fourth or fifth proposed location and that it had initially been abandoned as inadequate. By the end of the day, Tanaka decided to pull the plug on the project.

Since Tanaka left office, the empty dam has been combined with other river development projects, and it is necessary, as with other dams, to periodically fill the dam partially, so the possibility of landslides has not disappeared completely.

Using a 1998 map of the Asakawa Dam project created by Uchiyama, who deployed freedom-of-information requests to conduct his research, I confirmed with the prefecture that 296 hectares in six zones around the dam had been designated as landslide prevention zones.

In June 2007, a number of prefectural assembly members suggested that another investigation be conducted about the geology of the proposed site. In response, the director of the construction department declared that "sufficient surveys had been conducted" and that the prefecture would proceed "using the best designs and workmanship." Such statements have been heard before in the cases of Ōtaki Dam and Takizawa Dam.

When dams are constructed in areas with a volcanic geology or in areas that have been designated as landslide prevention areas, they often lead to serious human and economic costs. When will the government learn from all these examples that "using the best designs" will not be enough? It is puzzling to try to figure out what it will take for officials to cancel the Yamba and Asakawa dam projects.

Masano Atsuko is a journalist specializing in environmental issues.

Aaron Skabelund translated this article for The Asia-Pacific Journal.

Aaron Skabelund teaches in the history department since 2006 at Brigham Young University after completing a Ph.D. in modern Japanese history at Columbia University and a postdoctoral fellowship with the Japan Society for the Promotion of Science at Hokkaido University. His first book project examines the social and cultural history of Western and Japanese empires by analyzing the actual and metaphorical deployment of dogs. In a second project, he explores the history of the Japan's post-Second World War military, commonly known as the Self-Defense Force. Skabelund's publications include Inu no teikoku: Bakumatsu Nippon kara gendai made *(Empire[s] of Dogs: From Bakumatsu Nippon to the Present), trans. Motohashi Tetsuya (Tokyo: Iwanami Shoten); "Fascism's Furry Friends: Dogs, National Identity, and Racial Purity in 1930s Japan," in* The Culture of Japanese Fascism*, (Durham NC: Duke University Press, 2009); "Breeding Racism: The Imperial Battlefields of the 'German' Shepherd," Society & Animals 16, no. 4 (Winter 2008), and "Can a Subaltern Bark?" Imperialism, Civilization, and Canine Cultures in Nineteenth-Century Japan," in* JAPANimals: History and Culture in Japan's Animal Life *(Ann Arbor: Center for Japanese Studies, University of Michigan, 2005). He is a Japan Focus associate.*

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Notes

[1] The newly elected Democratic Party government announced a freeze on dam construction and canceled the Yamba dam in September, 2009. This article provides some of the compelling reasons for that decision.