

Investigation and analysis of the recently discovered sabo facilities built in Tateyama Caldera 100 years ago

EBATA Mitsuhiro ¹, ICHII Masahiko ², NOMURA Yasuhiro ³, IHARA Takashi ⁴, MAKINO Eizo ⁵
NORO Tomoyuki ⁶, MIYASHITA Masaru ⁷, KAMEE Koji ⁸, WATANABE Hisashi ⁹

1 Director-General, Public Works Department, Toyama Prefectural Government, Japan
3 Senior Director, Sabo-Sediment Control Division, Public Works Department, Toyama Prefectural Government, Japan
5 Assistant Manager, Sabo-Sediment Control Division, Public Works Department, Toyama Prefectural Government, Japan

7 Head of Rresearch Section, Tateyama Mountain Area Sabo Office,Hokuriku Regional Bureau,Ministry of Land,Infrastructure,Transport and Tourism(MLIT),Japan
9 Chief Researcher, Sabo Frontier Foundation,Japan

2 Deputy Director-General, Public Works Department, Toyama Prefectural Government, Japan
4 Assistant Director, Sabo-Sediment Control Division, Public Works Department, Toyama Prefectural Government, Japan
6 General Manager (Engineer), Tateyama Mountain Area Sabo Office,Hokuriku Regional Bureau,Ministry of Land,Infrastructure,Transport and Tourism(MLIT),Japan
8 President, Sabo Frontier Foundation,Japan



Introduction

Efforts have been made to protect people living on the Toyama Plain, Toyama Prefecture, from the potential flow of 200 × 10⁶ m³ of unstable sediment from Tateyama Caldera, which is situated over 1,000 m above sea level. Sabo works commenced over 100 years ago in the basin of the Joganji River, which is one of Japan’s steepest rivers, and activities continue to this day.

Among them, Shiraiwa sabo dam, Hongu sabo dam, and Dorodani sabo dams, which were built by the Ministry of Home Affairs of Japan from 1929 to 1939, were recently designated as important cultural properties by the Agency for Cultural Affairs of Japan.

In 2017, the Japan branch of the International Council on Monuments and Sites (ICOMOS) selected Tateyama Sabo facilities as one of the twenty 20th-century heritages of Japan, including these sabo dams.

The value of Tateyama Sabo facilities in Tateyama Caldera further evaluated in the “Toyama Declaration” at INTERPRAEVENT 2018 in the Pacific Rim.

In this report, we introduce the results of research into the Sabo Works built by Toyama Prefecture (Hereafter“SWTP”) in the early 1900s.

Shiraiwa sabo dam

Main Dam
Training dike
Counter Dam No.1
Counter Dam No.2
Training wall attached to the main dam

The tallest concrete gravity sabo dam in Japan
Height (Main dam) 63 m
Total drop (including 7 sub-structures) 108 m
Constructed in 1929–1939

An embankment dam covered with the concrete-bar square frames

Concrete-bar square frame

The core dam of the “Overall Joganji River Sabo Plan” created by Masao AKAGI who is well known in Japan as the “Father of Modern Sabo Works”
It was a main sabo dam constructed at the main part of the Yukawa River, the only location near the Tateyama Caldera outlet where bedrock was exposed. (The bedrock is called “Shiraiwa.”)
The Shiraiwa Sabo Dam has a special composite structure, combining a gravity dam, an embankment dam, a training dike and a training wall.

Hongu sabo dam

- ◆ Constructed in 1935–1936
- ◆ Completed in just 2 years
- ◆ The sediment trap capacity is the largest in Japan at 5 million m³.

◆ the core dam, constructed to accumulates and controls sediment at a narrow section of the midstream of the Joganji River

Dorodani sabo dams

1933
2007

Constructed in 1930–1938
The core dam to prevent debris and collapse of the mountain and the river
Mostly covered in trees
This is an excellent example of having achieved disaster prevention and nature recovery.

1. History to date

Tateyama Caldera is a large oval basin that is approximately 30 km southeast from Toyama city, Japan; it measures 6.5 km × 4.5 km, and 500–1,700m in elevation difference.

The caldera was formed at Midagahara Volcano area as a result of seismic activity occurring in the Atotsugawa fault, and subsequent erosion caused by heavy rain.

During the Hietzu Earthquake of 1858 (magnitude 7.1), a massive landslide (Mount Tonbi landslide) occurred that formed landslide dams at Tateyama Caldera. Following snowmelt, these landslide dams collapsed on April 22 and June 7 of the same year, and large-scale debris flows damaged areas downstream on the Toyama Plain. In total, 1,600 houses were swept away, causing 140 deaths and damage to the property of approximately 7,000 people.

Sediment produced by degradation of the bed of the Joganji River near Tateyama Caldera or other upstream areas continued to flow into the alluvial fan. Thus, the Joganji River became a typical raised-bed river and prone to further sediment-related disasters. In response, Toyama Prefecture started sabo works in 1906, which was taken over by the central government from 1926.

Records of the sabo work carried out by Toyama Prefecture in the early 1900s were lost due to burnt prefectural office, so the details of the sabo work performed by Toyama Prefecture are lacking.

During the era of sabo works by Toyama Prefecture, the Joganji River basin was more devastated than in the era of sabo works by later central government, and sediment production was more active. The construction site in the early 1900s was located upstream of the site of central government, and because of the severe environment (high altitude, riverbed gradient of 30 degrees or more, difficult access and slow snow melting), the time available for construction of sabo facilities was much less than now.

For these reasons, it was thought that the sabo facilities built at this location did not exist anywhere.

From 2007 to 2009, a survey about the SWTP during the Meiji and Taisho eras was conducted in several valleys near the location of the Mount Tonbi landslide. The survey revealed some of the SWTP.

However, due to safety concerns regarding the rugged terrain and severe weather conditions, the scope of the field survey was limited and it was not possible to survey all of the valleys.

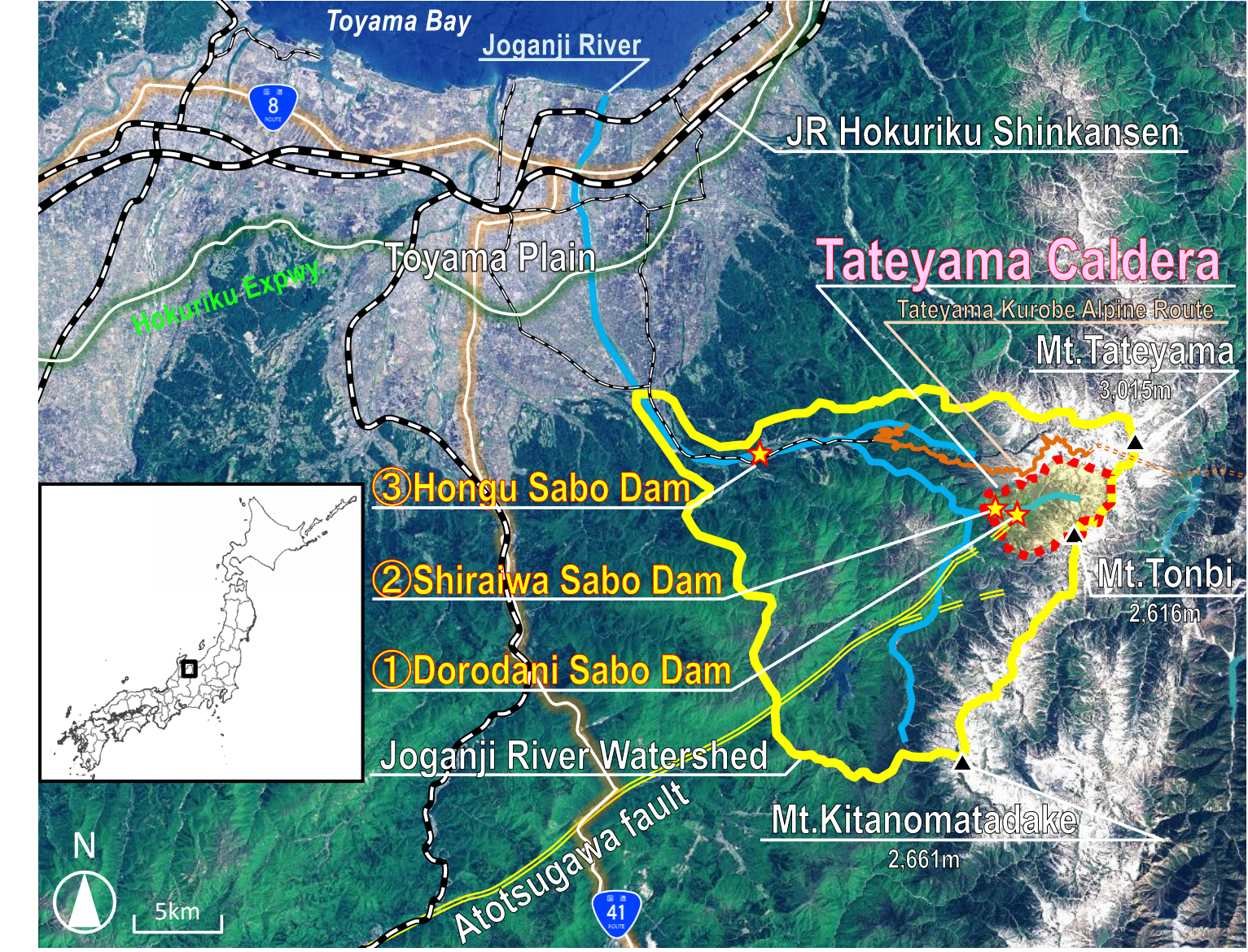


Fig.1 The Joganji River basin



Fig.2 Tateyama Caldera

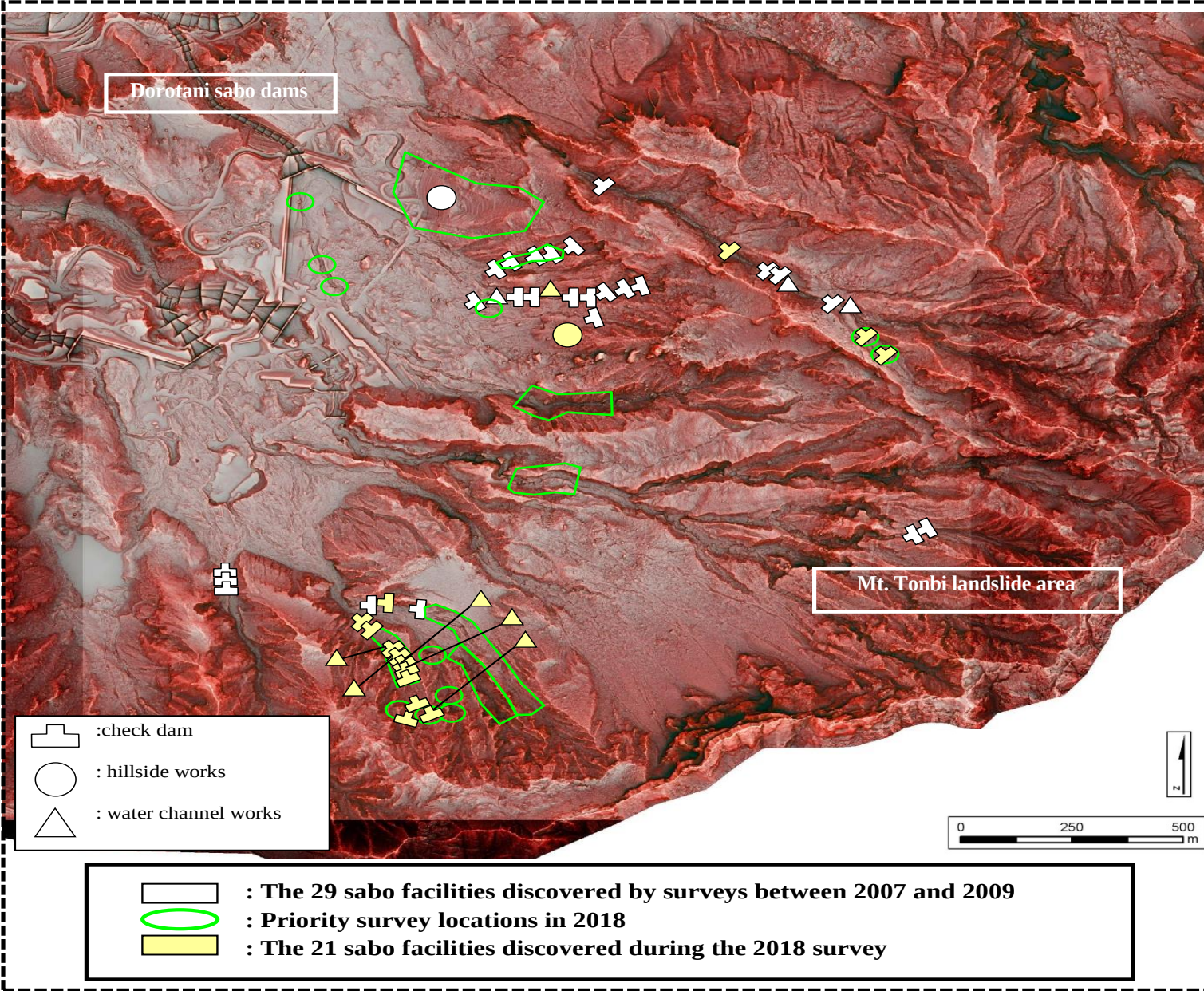


Fig. 4 Locations surveyed in 2018 and the sabo facilities discovered therein.

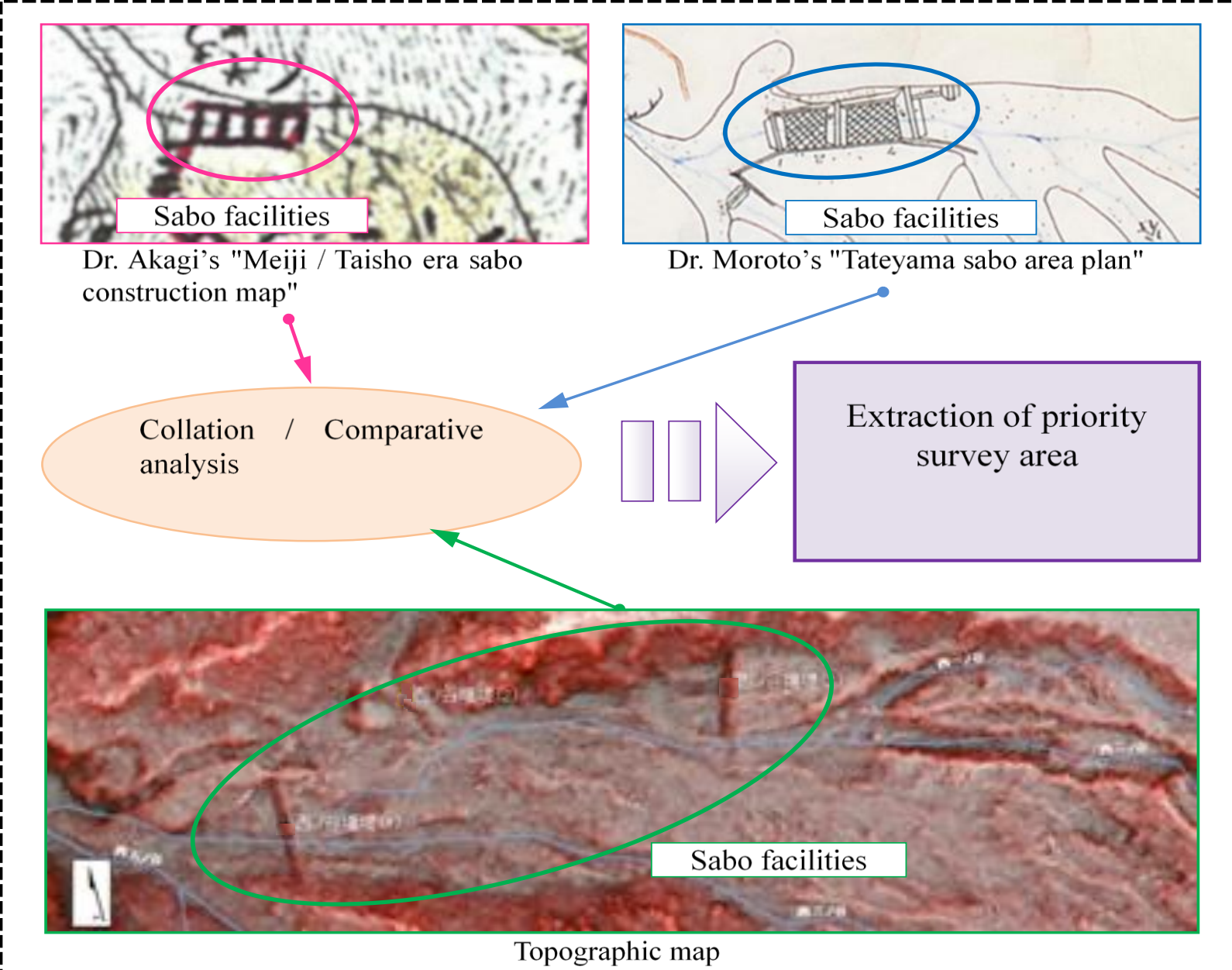


Fig. 3 Collation and comparative analysis of historical drawings and topographic maps.

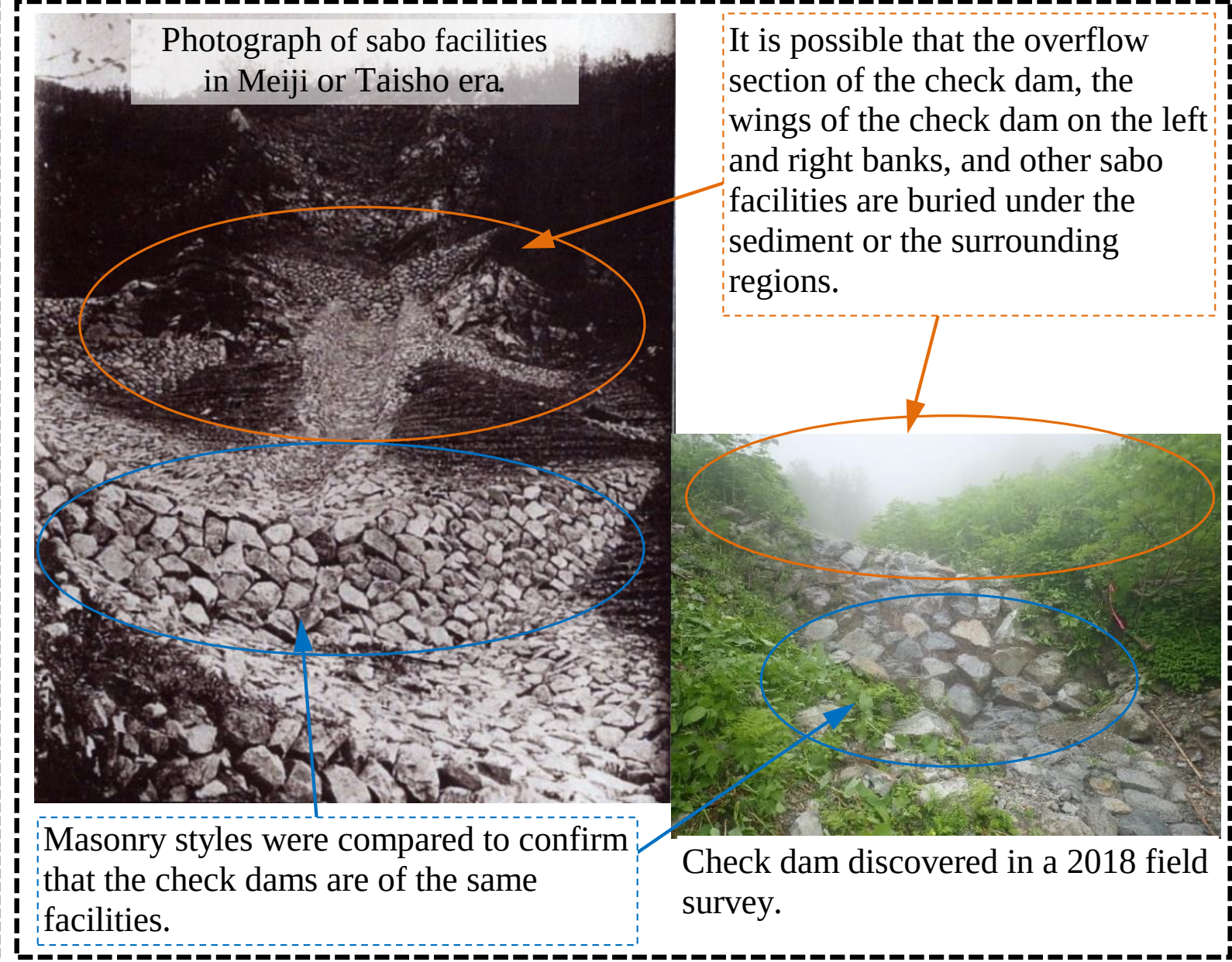


Fig. 5 An example of the 2018 survey and analysis.

3. Conclusions

In 2019, Toyama Prefecture began conducting detailed field surveys and analyses, based on surveys conducted previously (up to 2018).

In the Tateyama Mountain area, the governmental sabo works that created three facilities designated as important cultural properties has been attracted attention.

However, our survey revealed that many SWTP still exist over 100 years in the steep mountainous upstream region of the Joganji River.

The SWTP of around 100 years ago are still effective, and it is thought that they formed the foundation of the sabo works subsequently carried out by the Japanese Government, such as the construction of the Shiraiwa sabo dam.

Detailed investigation of these sabo facilities, verification of their effects, and evaluation of their historical value are future challenges. We intend to continue our investigation and analysis, and aim to explore the further achievement of the SWTP.

Moreover, we will continue to make efforts to register for World Heritage so that the value of Tateyama Sabo will be shared throughout the world and will be handed over to the next generation as a treasure of mankind.

References

- 1) Taku, O. et al. (2014): Universal Value of Tateyama Sabo from the Viewpoint of National Resilience, INTERPRAEVENT 2014, pp. 182–183.
- 2) Hitoshi, M. et al. (2018): The Features of Tateyama Sabo and Their Value, INTERPRAEVENT 2018, pp. 242–243.

«Reference information» Outstanding Universal Value of Tateyama Sabo «INTERPRAEVENT 2018»

The collective wisdom and accumulated efforts of our predecessors realized a holistic watershed approach to fighting natural disasters by means of modern technologies. The historic sabo facilities built in the Tateyama Caldera and the downstream area have cultural value as a common heritage of humankind that has protected people’s safety and security. We have been working toward the inscription of this site on the World Heritage List with the objective of conserving it and passing it on to future generations.

At INTERPRAEVENT 2018 (in Toyama), to effectively promote technology development and its application for further prevention of landslide disasters, and to further promote global sharing of experience, knowledge and technology, INTERPRAEVENT 2018 “Toyama Declaration” was adopted as a summary and a recommendation.

In the Toyama Declaration, Tateyama Sabo received high praise as follows, and its remarkable universal value was transmitted to the world.

“Toyama Declaration” (excerpt)

- i) Noble example of holistic approach to disaster management which was developed in Japan with many natural disasters
- ii) One of the best masterpieces of integrated basin-scale sediment management in modern times under the most difficult natural conditions
- iii) Universal technique of disaster reduction which can be applied to mountainous regions all over the world

Important Cultural Property “Joganji River Sabo Facilities”

These historic sabo facilities were built in the 1930s.

On November 28, 2017: Designated as Important Cultural Property
On December 8, 2017: Selected in “20 20th century heritage sites of Japan”
(Japan ICOMOS National Committee)