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Preservation and management of a World Heritage site Tajima Yahei Sericulture Farm and its buffer zone

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Abstract

Tajima Yahei Sericulture Farm, one of the four components of the UNESCO World Heritage Site Tomioka Silk Mill and Related Sites inscribed in 2014, was the starting point for advancements in sericulture farmhouses, emphasizing the importance of ventilation. Through Yahei's experimentation surrounding the ideal space to breed silkworms, a new sericulture theory was invented, and a sericulture farmhouse architecture was formed. For the purpose of preserving this cultural heritage for future generations, it is important to understand the idea that led to the cultural and industrial advancement of the village of Shimamura and to revise the preservation plans prepared by stakeholders. This paper will discuss the development of the sericulture theory, *seiryō-iku* theory, and the formation of a sericulture farmhouse architecture; describe the adaptation of former sericulture farmhouses and the surrounding landscapes in terms of the industry and environment; outline the plans and efforts for the preservation and revitalization of Tajima Yahei Sericulture Farm, its surrounding area and its underlying issues; and propose a direction for future preservation plans.

Keywords: Preservation, Revitalization, Theory, Management, Planning, Sericulture, UNESCO world heritage, Heritage buildings

Introduction

Background

Tomioka Silk Mill, Tajima Yahei Sericulture Farm, Takayama-sha Sericulture School and Arafune Cold Storage located in Gunma Prefecture are four components inscribed as a UNESCO World Heritage Property in 2014. Inscribed as 'Tomioka Silk Mill and Related Sites', these components are part of the silk industry that created a technological interchange between Japan and the world. This mass production technology made silk available to the general public, modernising and enriching the lives and culture of people across the world.

Tajima Yahei Sericulture Farm was the starting point for advancements in sericulture farmhouses focusing on ventilation. Tajima Yahei's experiments in creating an ideal sericulture space led to the invention of a new sericulture theory and technique, the *seiryō-iku*. He concluded through experiments that sericulture can be best carried out in a space with efficient cross ventilation, which includes a roof system and openings on four walls. Yahei's sericulture theory later became a foundation for the *secchū-iku*[1] theorized by Takayama Chogoro, founder of Takayama-sha Sericulture School, which acted as a training centre and formal education institution for sericulture.

Yahei's sericulture guidebook, *New Theory of Sericulture,* written in 1872, illustrates his silkworm breeding

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[1] *Secchū* translates to eclectic. The silkworm breeding method combined *seiryō-iku* and *ondan-iku*.

method, its process, and experimental results relating to silkworm disease examinations (Tajima 1872). While pébrine disease[2] was spreading in Europe, silkworm species in Japan were improved and standardized through scientific experiments performed by Yahei. Silkworm eggs produced by farmers of Shimamura under the supervision of *Shimamura-kangyō-kaisha* company were standardized and exported to Europe. These silkworm eggs made up half of the export from the entire Gunma Prefecture. During Yahei's voyage to Europe, he learned foreign silkworm farming techniques, and suitable techniques that could be employed in Shimamura were brought back to the village, along with Christianity and seven microscopes used to observe diseases in silkworms. At one point, Shimamura became part of the imperial service of sericulture, and its farmers taught sericulture farmers all across the nation.

As technology advanced, the sericulture cycle could be carried out multiple times in a year by storing silkworm eggs in a natural refrigerator. Arafune Cold Storage, the largest wind cave in Gunma Prefecture, became the largest natural refrigerator for storing silkworm eggs in the early 1900s. Techniques and quality silkworm eggs produced by the Farm, education and technique dissemination by the school, and the storage of silkworm eggs to facilitate the development of multiple life cycles in a year led silkworm egg production to rapidly prosper in Gunma Prefecture. During the Meiji Revolution, foreign technologies were imported into the country, and industrialization took place. Steam engines and mechanical silk reeling machines were installed in Tomioka Silk Mill, which was established in 1872. The overwhelming amount of quality silkworm eggs produced in the prefecture and supplied to Tomioka Silk Mill allowed the country to produce raw silk and made silk fabric available to people at all levels of society.

Currently, the Tajima Yahei Sericulture Farm is the prototype farmhouse for the *seiryō-iku* sericulture theory and technique and symbolizes the contributions of Tajima Yahei to the advancement of modern sericulture in Gunma Prefecture and Japan. Recognized as part of the nation's industrialization heritage, Tajima Yahei Sericulture Farm was designated a National Historic Site in 2012 and later inscribed as a World Heritage Site in 2014. The Farm was originally not part of the tentative list during the nomination of the World Heritage Sites in 2003 and was later included in the revised tentative list (Gunma Prefecture 2006). Properties are first designated into the national protection system before being designated into the international protection system, and the Farm was the last to be designated nationally amongst all four properties. As a result, much work is still in needed even since its designation as a World Heritage Property. Located in a village, the Farm is surrounded by other former sericulture farmhouses and natural resources, creating a distinct scenery exclusive to the village. However, decay resulting in high repair and maintenance costs and lack of knowledge of the history and building itself are the main issues currently affecting the preservation of these farmhouses (Mizuno 2017).

This paper will discuss the idea behind the development of the *seiryō-iku* theory, which influenced the design of sericulture farmhouse architecture in Japan, review the literature, consider the current preservation status of the Farm and its buffer zone by discussing measures devised and conducted by local governmental and non-governmental organizations and propose ways for preserving the Farm and the village.

Methodology

To understand the values of the Farm, we will discuss the development of the *seiryō-iku* theory leading to the formation of a sericulture farmhouse architecture. The related literature and evidence collected from original manuscripts are cited and discussed. Manuscripts by Yahei titled 'New Theory of Sericulture' and 'New Theory of Sericulture Sequel', which document the results of his experiments in silkworm breeding and disease prevention and his thoughts and experience in constructing a suitable building for sericulture, will be studied and concluded.

To strengthen the concept of the functionality of the Farm and its effects on its surroundings, the structural transformation and adaptation of the Farm and surrounding farmhouses will be discussed. On-site observation survey reports and literature documents are cited to draw the relationship between the Farm and surrounding farmhouses. Due to overwhelming number of farmhouses still present in the village, the farmhouses located directly next to Farm are chosen and discussed in this paper. Natural and man-made elements in Shimamura that were significant in the formation of the site will be discussed to further highlight the relationship of these farmhouses with their surroundings. This discussion will bring to light distinctive features of the village that can be preserved for the succession of future generations.

Preservation plans and the implemented strategies will be discussed to grasp the current status of the Farm and its buffer zone, which can be used for monitoring, and then, the study will review, discuss ideas and propose a direction for a progressive preservation plan.

[2]pébrine disease is a disease of silkworms caused by parasites from flies. Silkworms contract this disease by ingesting eggs of flies laid on mulberry leaves. Pébrine was first recorded in France in 1845 and caused the collapse of the French and Italian silkworm industry in 1865.

Regional characteristics of the development of sericulture in Shimamura

The village of Shimamura is located southeast of Isesaki city in Gunma Prefecture on the floodplains of the midstream To-ne River, which confluences with the Hirose River. Locals engaged mainly in agriculture, sericulture, silkworm egg production and water transportation from the 1850s to the 1870s. The local average temperature is approximately 14.1 °C. Shimamura is affected by strong *Akagi-oroshi* winds, which bring extremely cold and dry winds from the northwest during winter. Yearly rainfall is approximately 1050 mm, and Shimamura is mainly affected by floods, followed by frost damage.

The above regional characteristics created an excellent environment for the cultivation of high-quality mulberry leaves. Mulberry cultivation is best carried out at an average temperature of approximately 13 °C, with an average rainfall of 100 mm to 150 mm, and in soil that is deep, fertile, well-drained and porous, with good moisture holding capacity and of weak acid. The yearly flood in Shimamura suppressed the breeding of Uzi flies by washing away eggs laid on mulberry leaves, which once ingested by silkworms become parasitic and eat through the silkworm and its cocoon.

Sericulture prospered in Shimamura with the breeding of healthy silkworms, and silkworm eggs were distributed through water transport. The golden years of sericulture exports were between 1867 and 1873, with 132 households engaged in sericulture and silkworm egg production in 1870. During these years, up to millions of cards with silkworm eggs were sold in a year (Aoki 2012).

The Shimamura brand established by the *Shimamura-kangyō-kaisha* company in 1872 accomplished a revolutionary achievement by exporting silkworm eggs directly to Europe. Amongst the silkworm eggs from Gunma Prefecture, eggs from Shimamura amounted to 50% of the total sold in Italy in 1880. During his voyage to the West, Tajima Yahei acquired knowledge on the prevention of pébrine disease through microscopic examinations. What he learned from Western cultures became a valuable foundation for the subsequent development of sericulture and cultural advancement in the late eighteenth century. Incorporating sericulture techniques learned from the advanced sericulture area of the Date region in Fukushima Prefecture in the early nineteenth century, Shimamura grew and became the core of silkworm egg production in Japan by the late nineteenth century.

Previous studies

Studies on sericulture farmhouses in Shimamura are scarce. Yahei's former residence was first mentioned in *Sakai-cho no minka to yōfū kenchiku* (Sakaichoshi hensanshitsu 1989), introducing characteristics of the *omoya* and buildings in the site. The book also introduced seven other sericulture farmhouses in Shimamura, but the character of the site of Shimamura was not mentioned.

The priority research started only in the late 2000s when the Farm was nominated to the tentative list. *Kindai yōzan nōka chōsa hōkoku-sho* (2007) compiled measured drawings of distinctive sericulture farmhouses in Shimamura, but restorative investigation was not done prior to this. As a result, an investigation organized by the city council was carried out between 2007 and 2010 to formulate an overview of Shimamura's sericulture farmhouses, amongst them 17 sericulture farmhouses that played an important role from the end of the Edo era to the early Showa era, the regional environment and the characteristics of silkworm egg production, and the observations of the investigation were compiled in *Shimamura no tatemono* (Buildings of Shimamura). However, as the only work compiling basic factual information on historical, geographical, social, and architectural changes of Shimamura, this book acts as a reference for research in related fields, especially architecture. Sericulture farmhouses in Shimamura are introduced, but the relationship between farmhouses and their surroundings is still unclear and needs to be linked.

A survey (Mizuno 2017) regarding the awareness of Shimamura residents of the succession of farmhouses and the village townscape identified that only 12% of residents were undoubtedly convinced that the farmhouses must be passed down to future generations, 54% of the residents hoped to pass down farmhouses but believed that there were still issues to address, and up to 32% were reluctant to pass down the farmhouses. The decay of farmhouses and the high repair and maintenance costs are primary issues, and residents hoped to receive professional advice on the maintenance of farmhouses and designation into the national protection system in hopes of receiving financial aid. However, most residents believed that the village townscape, including the presence of farmhouses as a whole, should be passed down to future generations.

The survey also reported that 35% of residents had taken part in community events, 38% were interested in participating, and 23% were unwilling to participate in community events. Residents who had lived in a farmhouse, shared the ideology of the community organization, or were invited by other participants were part of the group that was keen on taking part in community events. Reasons for participation included wanting to understand more about the village buildings, national protection systems and financial aids and wanting to promote the charm of the village and the

hospitality of village residents. Residents who had not lived in a farmhouse, lived far away from the Farm, and lacked knowledge about the village buildings were part of the group that was reluctant to participate in community events. Residents would reconsider participating if family members or neighbours were keen in participating in community events or if they had spare time. Most residents hoped that the village would be preserved for future generations but were reluctant to take action themselves due to the lack of interest and understanding of the value of their surroundings. While some residents did not feel associated with the Farm and were reluctant towards the idea of preservation, this may be gradually resolved by raising residents' awareness of the significance and preservation of the village townscape as a whole for the preservation of the Farm. A closely linked community will be able to boost interest and promote the ideology of the community organization.

Development of a sericulture theory and architecture

Tajima Yahei's *Seiryō-iku* theory and experimentation with a sericulture space

Tajima Yahei (second generation) is one of the leading figures who developed the village of Shimamura through his achievement in sericulture. Yahei was born in 1822 as Tajima Kuniyasu and Yahei (the second). Since childhood, Yahei travelled to advanced sericulture areas with his father to gain skills and experience in silkworm breeding, production and sales, which led to his establishment of a sericulture theory and the design of a sericulture space.

'New Theory of Sericulture' was written by Yahei in 1872 to promote the use of *seiryō-iku* and the new sericulture farmhouse architecture (Tajima 1872). This guidebook, written as a compilation of tens of years of sericulture experience, includes 4 volumes with multiple sections on silkworm breeding and silkworm egg production. Yahei's first guidebook describes the process of silkworm breeding and egg production with the aid of hand-drawn sketches, emphasizing the circulation of cooled natural air.

According to the *dai-i-ron* (translates to summary section) of the guidebook, 'if cold air is stagnant, sickness will occur', and therefore, the breeder should 'make sure it is comfortable for a room full of silkworms'. The *shikyu-ron* (translates to first hibernation section) describes that '(silkworm breeding) has been carried out in natural climate for many years without the use of heat even during the end of seasons' but adds that farmers 'should use heat when the cold air is too strong'. The above description separates *seiryō-iku* from *shizen-iku,*[3] where the use of heat to regulate internal air temperature is encouraged while providing natural air circulation. However, it is also mentioned that 'the accumulated heat in the space will "hurt" the silkworms and should be circulated away from the space by adding small windows on the roof'. The emphasis of providing circulated natural air in the sericulture space is explained in the 'Cocoon section', 'Moth section', 'Egg Production section' and 'Silkworm Disease section', forming the idea behind Yahei's sericulture method.

The *seiryō-iku* theory's most significant characteristic is outlined in the 'Sericulture Space section', which explains how Yahei's father started touring other sericulture areas due to his failure in implementing the *ondan-iku*[4] method in Shimamura. By observing sericulture carried out in other areas, he found that 'garden trees aligned as fences prevents air circulation, resulting in the failure of sericulture'. He also understood that 'no matter the size of the farmhouse, ventilation is important' when practising sericulture. Therefore, it was noted that farmhouses should have windows in four walls and 'multiple small windows' that are adjustable in the roof, and the removal of all surrounding trees creates a suitable environment for sericulture.

'New Theory of Sericulture Sequel' was subsequently written by Yahei himself in 1879 (Tajima 1879). In the second volume of the sequel titled 'Reasons for the Improvement of Sericulture Buildings', Yahei recorded his thoughts and experience in constructing and renovating an experimental sericulture building. Yahei mentioned that it is commonly known that sericulture farmhouses function best under a thatch roof, and then under a plank roof. However, having experienced fire twice, Yahei desired to 'build his sericulture building with a tile roof for fire prevention purposes'. A tile roof is more fire resistant than thatch and plank roofs but is commonly deemed unsuitable for sericulture due to the severe heat accumulation under the roof space. Tile-roofed dwellings were a symbol of wealth at the time, as building materials reflect the status quo of the owner. The author believes that Yahei was determined to construct his farmhouse with a tile roof to fulfil this social desire.

Yahei constructed his experimental sericulture space on the upper floor of a storage house with a tile roof in 1856. He noted that 'sericulture was not successful that year' and believed that it was due to the heat that accumulated under the tile roof. This was resolved after two monitors were added onto the roof in 1857, which consequently produced healthy cocoons as a result of increased ventilation efficiency. Yahei explained that in 1858, he 'installed windows on all four walls to expand

[3] A silkworm breeding method using only the natural climate.

[4] A silkworm breeding method using heating appliances in an unventilated space.

the openings of the space to allow more airflow', and 'sericulture was even more successful' that year. In 1862, Yahei 'replaced (the) two monitors with an extended (or combined) monitor' and 'made the sericulture space into one large space'.

From the above, it is understood that Yahei started his research on a sericulture method focusing on ventilation in 1856 and successfully experimented with a sericulture building suitable for regional sericulture in 1862, which helped develop his sericulture theory more empirically. Based on his experiments, Yahei in his *seiryō-iku* theory believed that to nurture healthy silkworms and cocoons, it is vital to consider the ventilation of sericulture spaces through a roof ventilation system and window openings on four sides to regulate the indoor temperature and create an indoor environment suitable for sericulture in Shimamura. This became the form of sericulture farmhouse architecture that adopted the *seiryō-iku*. While sericulture was originally conducted on a small scale in thatched attic spaces, the author thinks it is important to know that large-scale sericulture and sericulture production were later carried out using the entire second floor of large buildings.

Technological and structural innovation of the new sericulture space

After the successful experimentation of a sericulture space in the storage house, Yahei officially built his two-storey farmhouse in 1863 with the living area on the lower floor and the sericulture space on the second floor. Existing until this day, the farmhouse known as *omoya*[5] is 25.4 m by 9.4 m, with openings located on all four walls. The 25.4 m-long tile roof was built with a 1.9 m-wide monitor with windows installed on both sides for ventilation purposes.

Currently commonly referred to as *sō-yagura*[6] (combined monitor) in Shimamura (Fig. 1), the windows are called *mado* as described in Yahei's second guidebook. The roof of the storage house Yahei experimented on was built with two monitors of 1.2 m by 0.9 m each and is commonly known as *futatsu-yagura* (two monitors). To maximize the efficiency of the ventilation system, Yahei expanded the monitors and built a *sō-yagura* on the roof of the farmhouse.

Based on his *seiryō-iku* theory, which prioritizes indoor ventilation, the 240 m^2 sericulture space on the second floor of the *omoya* has windows installed on four walls and a *sō-yagura* on the roof. This is to control the indoor temperature and the sunlight that enters the sericulture space through the opening and closing of windows in the sericulture space and *yagura*.

Fig. 1 Interior of the *sō-yagura* of the Tajima Yahei Sericulture Farm. (Source: Satoshi Ono)

Later, in 1873, another two-storey building similar to the *omoya* was built to the east. This building was known as *shin-sanshitsu* (New Sericulture Space) and was built specifically for sericulture activities. Aligned next to each other, the *omoya* and *shin-sanshitsu* were connected through a covered corridor on the second floor. The *shin-sanshitsu* was demolished in 1953, leaving only its stone foundation, and a part of the covered corridor connected to the *omoya* remains to this day.

While there is limited written evidence describing the features of the *shin-sanshitsu*, the façade was understood from old photographs in archives and illustrations found in Yahei's guidebooks. As the stone foundation remains until this day, the scale of the *shin-sanshitsu* is observed from pictures depicting the building on its stone foundation (Fig. 2). In Yahei's second guidebook, drawings are found portraying the *shin-sanshitsu* with a balcony-like porch located at the centre front. It is believed that the *shin-sanshitsu* was modified structurally and aesthetically multiple times due to the practice of various sericulture techniques throughout different eras (Ono 2012).

In the early Meiji period, many samurai became unemployed due to the Meiji Restoration and had to acquire new occupations. The former *Shonai* clan originating from Tsuruoka City in Yamagata Prefecture reclaimed barren land and started to engage in sericulture. Two former samurai journeyed to Shimamura to master the *seiryō-iku* technique from Yahei and built ten similar buildings imitating the *shin-sanshitsu*. These two-storey tile roof sericulture buildings with *sō-yagura* are built in Matsugaoka Reclamation Land in Tsuruoka City (Fig. 3), five of which remain to this day (Yamagata Prefectural Government 2020).

[5]Translates to *main building* in Japanese.

[6]In Japanese, *sō* translates to combined; *futatsu* translates to two; *mitsu* translates to three. Roof monitors on sericulture farmhouses are known as *yagura*.

Fig. 2 Tajima Yahei Sericulture Farm in the early twentieth century. View from the east gate. Left: *Kōgetsu-ro*. Right: *Shin-sanshitsu* (Source: Agency for Cultural Affairs 2013)

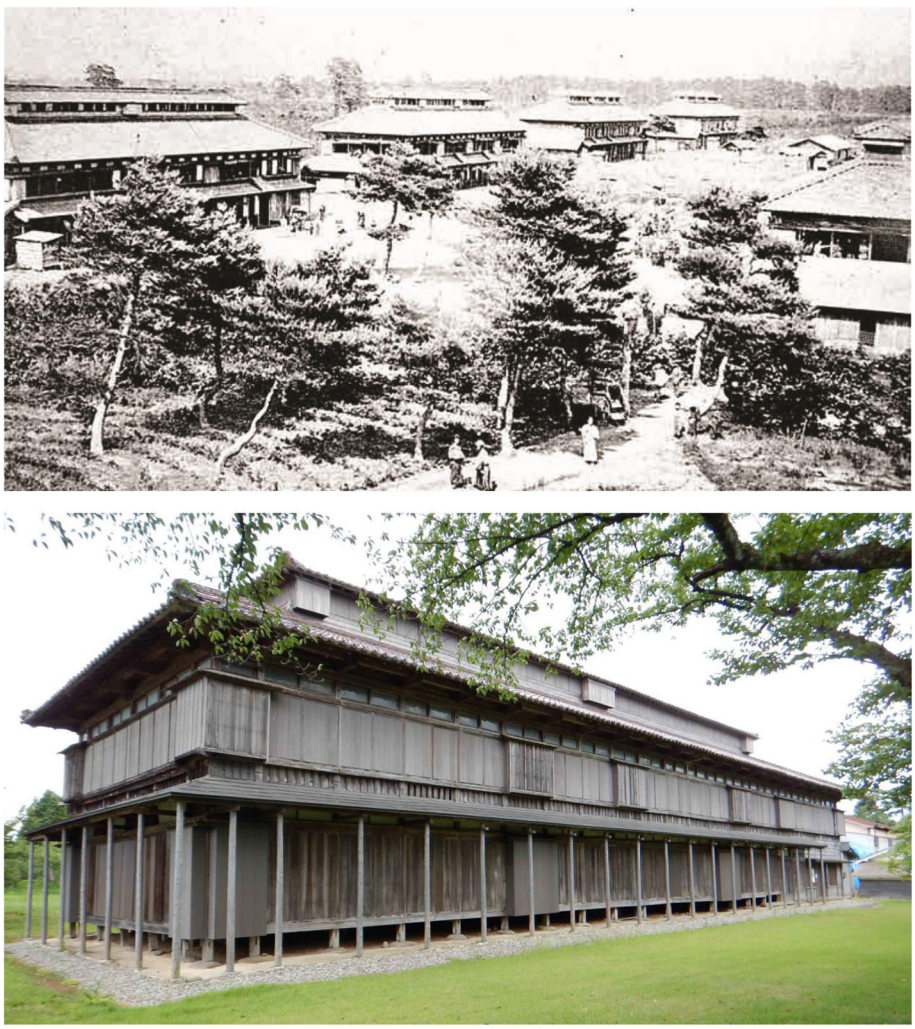

Fig. 3 Sericulture buildings at Matsugaoka Reclamation Land in Tsuruoka City, Yamagata Prefecture. Above: in the Meiji period (Source: Agency for Cultural Affairs 2013). Below: in the present (Source: Satoshi Ono)

Although the *shin-sanshitsu* was demolished with limited documentation, the author assumes that by observing the imitations in Tsuruoka City, the façade of the *shin-sanshitsu* can be strongly recreated, and the spaces of the *shin-sanshitsu* can be loosely inferred accordingly.

Adaptation of the Omoya sericulture space

The *omoya* sericulture space underwent multiple modifications. The installation of the connecting corridor bridging the *omoya* and *shin-sanshitsu* is considered the first modification made to the *omoya* sericulture space (Ono 2012). During the construction of the connecting corridor, the east-facing windows were enlarged, the rear windows were heightened and the windows on the front façade were modified into full-height openings. Looking at the ratio of openings to walls when it was originally built, the rear wall has a relatively low ratio compared to the front and side walls (Table 1). However, to further increase the efficiency of the sericulture space, the openings on the front and rear façade were increased, while the openings on the east side were reduced (Table 2).

Ranma, or transom windows, were installed above the front and rear windows to further improve east-west cross ventilation. With the installation of *ranma*, the lavishly patterned decorative rafters originally built were replaced with simple-patterned decorative rafters (Fig. 4). The column spacings on the front façade are 0.5 *ken* and *1 ken,*[7] and a column located on the west side of the front façade was removed to create a 1.5 *ken* window, which became the main entrance for transporting large tools directly in and out of the second floor. A balcony with handrails was installed on the front façade as a lever for transporting tools, as there are traces of friction on the handrail right in front of the 1.5 *ken* opening.

A microscope room was added on the rear east side of the sericulture space to receive maximum day lighting (Fig. 5). The microscope room spans 2.5 *ken* by *2 ken* (approximately 4.55 m by 3.64 m). Seven microscopes were purchased in the late 1870s during Yahei's voyage to Italy, and it is believed that microscopic examinations have been performed since then. The one-storey *shin-zashiki* or Japanese style drawing room spanning *3 ken* by 2.5 *ken* (approximately 5.45 m by 4.55 m) was built attached to the east side of the *omoya* around 1925, and the west-facing windows of the sericulture space were assumed to be left disused after construction of the *shin-zashiki.*

[7] *Ken* is a traditional Japanese measurement system used for column spacing. Generally, 1 *ken* is equivalent to 1.8182 m.

Table 1 Ratio of opening to walls of the sericulture space in the *omoya* when originally built. (Source: Sweet Yee Cheng)

	Length of wall (in *ken*)	Length of opening (in *ken*)	Ratio of opening to wall (Opening ÷ Total length)
Front	13.5	9.0	0.67
Rear	13.5	6.0	0.44
East	5.0	3.0	0.60
West	5.0	3.0	0.60

As written in Yahei's guidebook, the sericulture space was originally a single room. However, the space was later partitioned into smaller rooms with ceilings. It is assumed that a *1 ken* passageway was partitioned on the east, a 0.5 *ken* passageway was designed at the rear, and the remaining 12.5 *ken* by *4 ken* space was divided into 6 rooms. The frame, additional columns and duckboard ceiling are visible until this day, and it is assumed that *Shōji* (Japanese sliding doors) and *ranma Shōji* (patterned Japanese sliding doors) were used as partitions. Traces of weather-stripping sealants were found on the duckboard ceiling and *ranma* partition, and it is assumed that these rooms were divided and the temperature controlled using thermal power.

Even after Yahei had written his book on the know-how of *seiryō-iku*, he continued experimenting with various sericulture techniques and revising his ideas and technique. This can be clearly observed from modifications carried out to the *omoya* throughout its life in silkworm farming. The installation of a balcony and the expanded opening on the front façade largely contributed to improving the cross ventilation of the sericulture space and the efficiency of silkworm breeding. Although architecture style was sacrificed, this proved Yahei's devotion in improving the function of the sericulture space. The addition of the *shin-zashiki* and the closing off of the west-facing windows is assumed to be a correction to barricade the space from the hot western sun. The partitioning of spaces indicates that at a certain period, the *secchu-iku* developed later was carried out in these rooms, which proved Yahei's recognition of the *secchu-iku* and emphasizes temperature control. However, it is uncertain when the microscope room was added and whether the bracings installed on certain walls and roof trusses were due to the Kantō earthquake in 1923.

The formation of a Sericulture Village and significant elements of Shimamura as a buffer zone in modern days

The buffer zone of Tajima Yahei Sericulture Farm is made up of buildings and monuments related to the once prosperous sericulture and new residences of the locals still living in the village (Fig. 6). The buffer zone

Table 2 Ratio of opening to walls of the sericulture space in the omoya after modification. West wall openings do not appear, as they fell in disuse in 1925. (Source: Sweet Yee Cheng)

	Length of wall (in *ken*)	Length of opening (in *ken*)	Ratio of opening to wall (Opening ÷ Total length)
Front	13.5	10.5	0.78
Rear	11.5	6.0	0.52
East	5.0	2.0	0.40

was approximately 60.8 ha with 619 inhabitants during its inscription as a World Heritage Site. There are a total of 72 former sericulture farmhouses currently still standing in the village of Shimamura (Isesaki City Historical Building Research Committee 2011; Ono and Mizuno 2016). Amongst them, 38 farmhouses stand in the buffer zone of the UNESCO World Heritage Property Tajima Yahei Sericulture Farm. In fact, the Farm is surrounded by several farmhouses and is believed to be highly influenced by Yahei. This section will discuss the relationship between the Farm and its surrounding farmhouses by observing features and structural changes. These farmhouses are Tajima Nobutaka residence, Tajima Tatsuyuki residence, Tajima Shōji residence, Tajima Zenichi residence, Tajima Kameo residence and Kogure Shigeru residence.

Sericulture farmhouses with openings on four walls are relatively rare in Shimamura, while openings on three walls, normally on the front, rear and east walls, are considered common. Nobutaka residence built in 1863 and Tatsuyuki residence built in 1866 belonged to families branched from Yahei's paternal grandfather and may have devotedly practised the *seiryō-iku* Yahei advocated. In terms of scale, Nobutaka residence is larger than the Farm and is the only example that persistently presented openings on four walls. The author believes that similar to the Farm, Tatsuyuki residence's west wall openings were disused after a shed was attached to that side. According to ink writings on the *munafuda*,[8] Tatsuyuki residence was constructed and the microscope room was added to the rear in 1928. Shōji residence built in 1861, Zenichi residence built around the end of the Edo period, Kameo residence built around 1868 and Shigeru residence built between 1874 and 1877 were originally built with openings on three walls. The west wall of the sericulture space in Kameo residence is an *ōkabe* (finished wall with no exposed columns) (Fig. 7) and is believed to avoid fire caused by cold, strong northwest winds in winter and temperature rise due to the western sun.

[8] *Munafuda* is a ridge tag, a narrow, wooden tag or marker on which pertinent information regarding a building's repairs or reconstruction is written with brush and ink. It is inscribed with dates, the buildings' names, the donors' names, and sometimes prayers, and attached to the ridge pole during a ridge-raising ceremony.

These sericulture farmhouses also differ from one another in roof ventilation. Observed from their façade, Tatsuyuki residence, Zenichi residence and Shigeru residence adopted the *sō-yagura*; Kameo residence and Shōji residence adopted a *mitsu-yagura*; and Nobutaka residence currently does not have a yagura. As observed from old photographs (Fig. 8), the roof of Nobutaka residence went through multiple modifications. The roof was originally built with plank roofing without a *yagura* in 1863, replaced with tile roofing and a *sō-yagura* in 1870, then renovated with six cylindrical vents around 1897, and finally replaced with *mitsu-yagura* around 1907.

Shōji residence and Zenichi residence added a balcony on the front façade, similar to that of the Farm, while Nobutaka residence and Tatsuyuki residence added a corridor on the ground floor whose roof acts as a balcony for the second floor (Fig. 9). The author believes the addition of balcony was highly influenced by the Farm.

Observed from the structures, the sericulture spaces of these former farmhouses are retrofits and were originally single rooms later partitioned into 5 to 8 rooms at a certain period. The author believes that the partitioning of spaces might be due to the adoption of *secchū-iku,* as was the case for the Farm. These farmhouses also had structural reinforcements, such as bracings, installed for extra strength against earthquakes, but it is uncertain when the installation or modification took place.

In addition to these farmhouses, sericulture-related buildings, including a large silkworm egg refrigerator and an incubator, and religious buildings, such as a church, a temple and a shrine, are present in the buffer zone. It is unknown when the refrigerator and incubator were built. The Hōshōji temple built in 1593 had been in the centre of Shimamura since ancient times. The Shimamura Church was built in 1897 when Christianity was brought in and spread across the village. In 1950, Shimamura Megumi Childcare was constructed at the site of the church.

The flooding of the To-ne River caused both disadvantages and advantages to the village in terms of flood damage but brought suitable soil for the growth of high-quality mulberry leaves. To combat yearly floods, stone walls and foundations were constructed

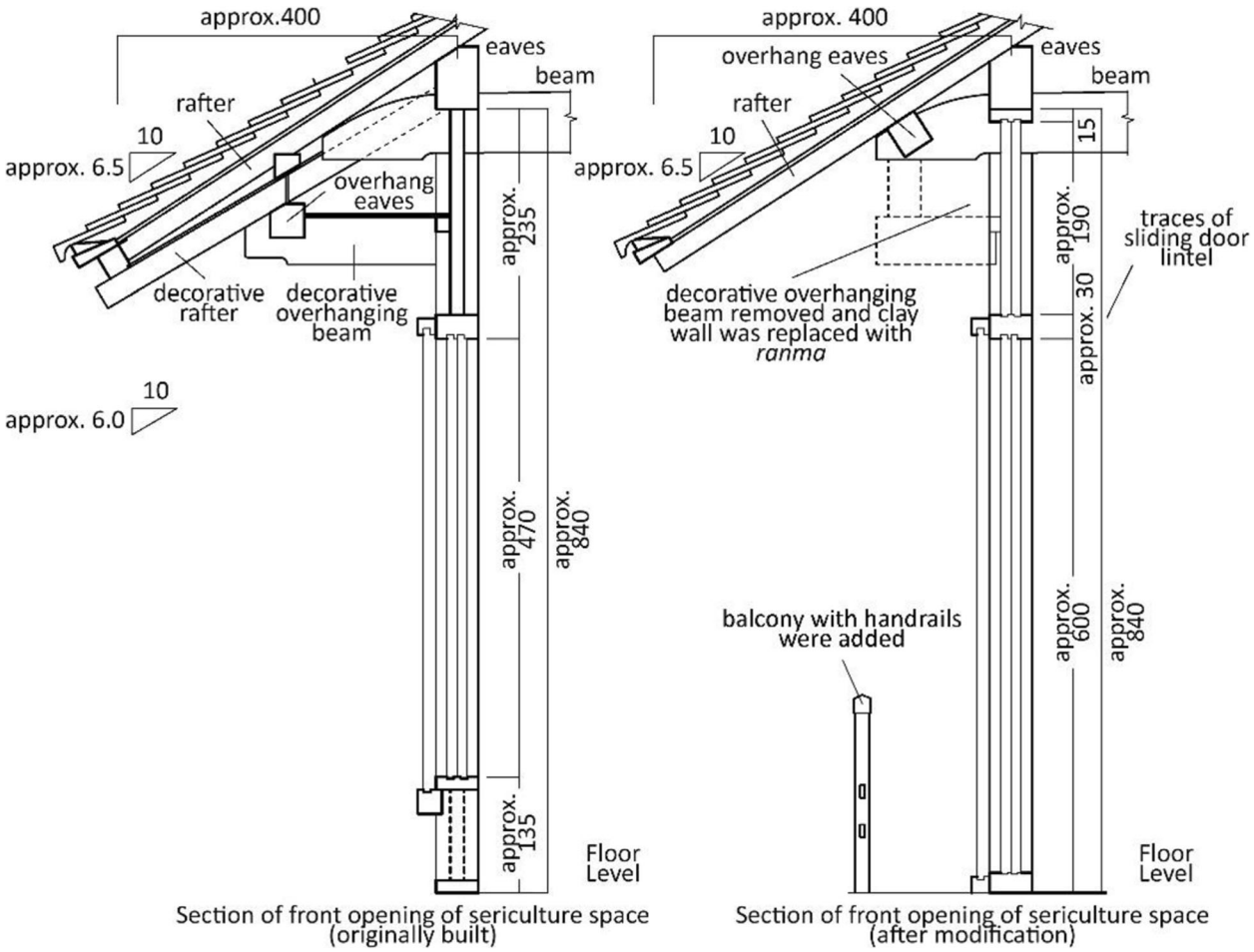

Fig. 4 Section of the front opening of the sericulture space as originally built and after modification. (Source: Satoshi Ono)

to lift and protect sericulture-related buildings. Soil was laid flat, and cobblestones were cut and stacked three-tiers to form a 1 m-high stone foundation to prevent moisture from entering the building. Amongst the 72 existing farmhouses, 50 are built on these stone foundations (Kurotsu 2012). On the lower floor, walls were built minimally with mostly sliding doors that are removable to reduce flood damage to the interior.

As sericulture in Shimamura declined, the riverbank as it is in the present was constructed in the Taisho period due to severe aftermath by a flood in 1910. The riverbank spans as long as 5 km and is 900 m wide from one bank to the other, creating the overwhelming presence of a horizontal landscape. While water transport was one of the main transportation means to and from the village during the Meiji period, the Shimamura Ferry River Crossing is still in use in the present.

Tall fencing trees known as *kashigune* are arranged in an L-shape to the west and north of the farmhouses to barricade against strong north winds and the western sun (Fig. 10). These fencing trees may span as long as 250 m and range from 1.2 m to 2 m in height, as tall as the eaves of the farmhouses, forming a captivating landscape widely seen in Shimamura. It is believed that this landscape was formed during the mid-Meiji period when the *secchū-iku* was widely practised in the village. However, fencing trees in the Farm are short, as Yahei believed that the sericulture space required sufficient dry air for ventilation.

Multiple monuments commemorating people, places, events and local folklore relating to sericulture of Shimamura remain in the vicinity of the village. Stone monuments were built between the late Meiji period and early Shōwa period, while the stone pagoda was built in the Edo period.[9] The family cemetery of the famous 'painter from the south', Kanai Ujyū, who was active in the late Edo period, is located just around the border of the buffer zone and is a Gunma Prefecture designated

[9]Edo period (1603–1968), Meiji period (1868–1912), Shōwa period (1926–1989).

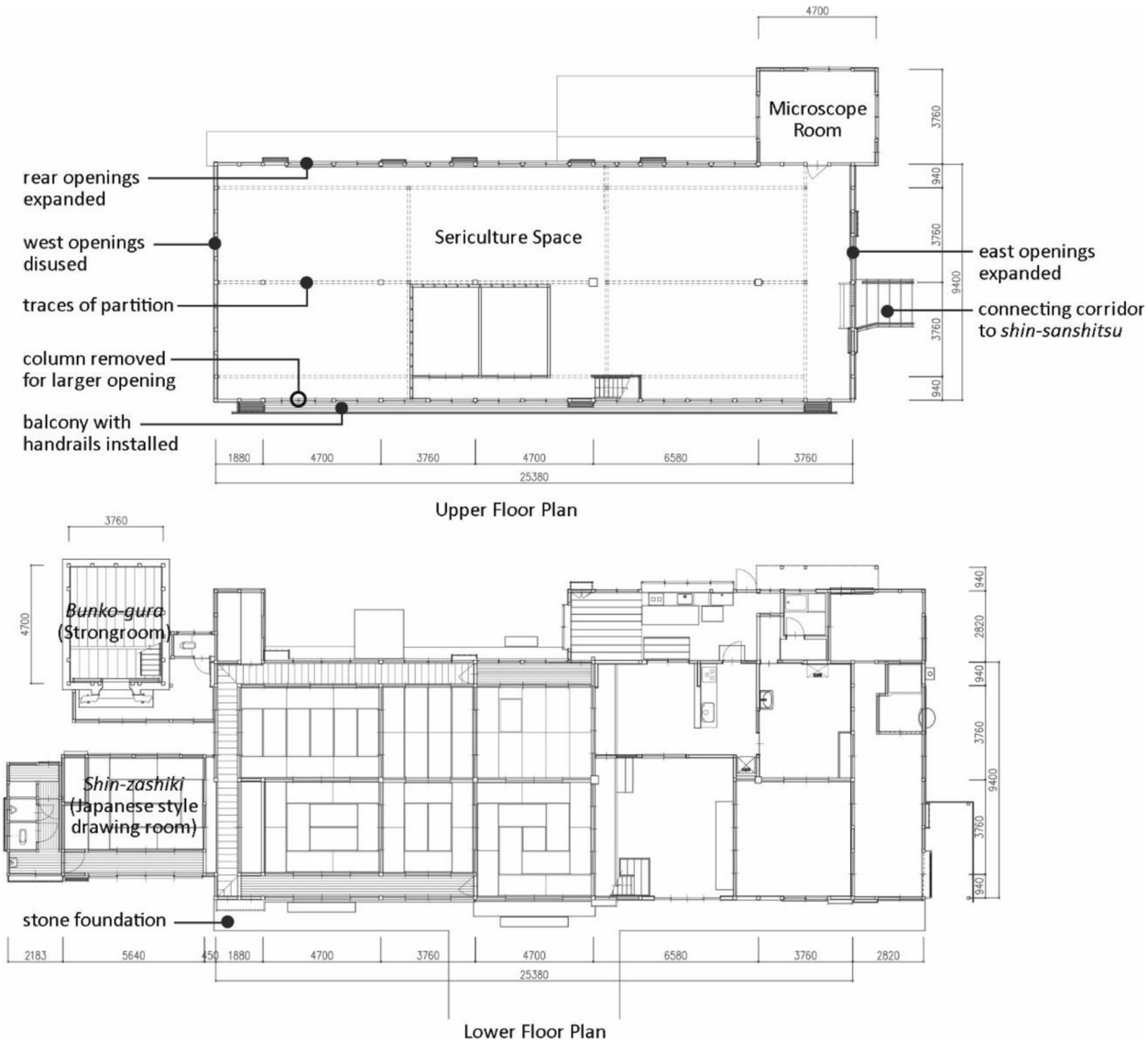

Fig. 5 Lower and upper floor plans of Tajima Yahei Sericulture Farm's *omoya*. (Source: Agency for Cultural Affairs 2013)

Historic Site. These monuments tell stories of history of the village of Shimamura.

The above concludes significant elements of Shimamura as a former sericulture village. Farmhouses in the village are believed to have practised the *seiryō-iku* at one point but have also been influenced by other techniques. Various features of the farmhouses show the aspiration of the owners to experiment on their own farmhouses and design an ideal sericulture space. The variety of roof structures also creates an eye-catching skyscape. Flooding mechanisms, such as stone walls and detachable doors, and the brilliant use of tall fencing trees to respond to the environment indicate the adaptation of the village towards its environment and industry. These elements are relatively significant, and the author believes that they should be preserved at their best.

Preservation plans and measures for the Tajima Yahei sericulture farm and its buffer zone

First preservation plan of Tajima Yahei sericulture farm

The first investigation in 2007 was performed by a group of researchers specializing in modern history, geography, agriculture, sericulture and architecture, with the second author in charge of on-site investigation of the structural changes of the Farm and the surrounding farmhouses in Shimamura. This investigation was carried out with the cooperation of Yahei's descendant, the fourth successor of the farmhouse, Tajima Kenichi, and a proposal was submitted to Isesaki City's Board of Education for the

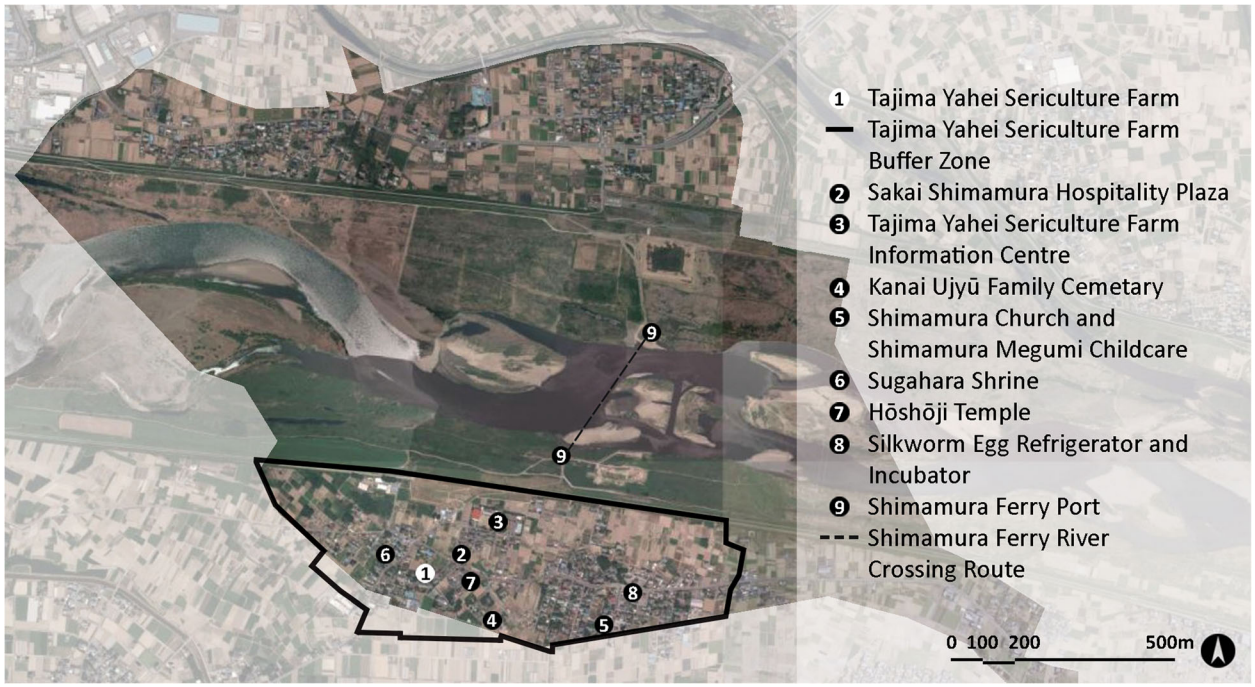

Fig. 6 Map of Shimamura, Tajima Yahei Sericulture Farm buffer zone and attraction points of Shimamura. (Source: Sweet Yee Cheng)

designation of the farmhouse as an important cultural property. The main objective of the preservation plan is to preserve the farmhouse, related buildings and landscapes, and the owner requested the inclusion of measures enabling him to maintain his current lifestyle.

The sericulture farmhouses of the Tajima family main branch, who are also members of the *Shimamura-kangyō-kaisha* company that ventured to Europe (Isesaki City Board of Education 2012), namely, Tajima Buhei's former residence (currently Nobutaka residence) and Tajima Shin's former residence, are proposed to be preserved conjointly with the Farm. Flood prevention mechanisms, such as stone foundations, and landscapes, such as fencing trees, stone monuments, family cemeteries and the riverbank, are also to be preserved because these elements have made up the captivating landscape of Shimamura since the end of the Edo period. Locals are encouraged to form an NGO that operates conjointly with governmental organizations to promote awareness, discuss and implement measures that are inclusive of the intentions of all residents.

The period of restoration is set between 1863 and 1940, as this was the golden period from when the *omoya* was built until its retirement from sericulture in 1940 (Fig. 11). The sericulture-related buildings and structures still remaining in the site are extensively surveyed and documented and then restored, reinforced and maintained for the safety of the public, while structures unrelated to sericulture and not in use are demolished. The *omoya,* including the sericulture space and microscope room, miso storehouse, granary and silkworm egg storehouse, are open to public once a month as they are currently still in use. While the *kōgetsu-ro* and *shin-sanshitsu* are demolished with only its stone foundation remaining on site, explanation signboards are placed at these locations to help visitors understand the buildings that once stood there. The mulberry-leaf barn is reinforced and used to exhibit sericulture-related displays, such as sericulture production processes and equipment, relics from Italy, manuscripts and records of silkworm egg exports. The surrounding landscape is also open for visitation.

Economy and community creation

The two most vital plans devised and carried out are the Second Isesaki City Comprehensive Plan (2015–2025) and the Sakai Shimamura Community Creation Vision (2015–2024). The first plan is the most significant plan designed to address declining birth rates and the ageing population, to promote awareness of large-scale disasters, such as the Great East Japan Earthquake, to convert lifestyles to cause less impact on the environment and to create a safe and healthy city. The second plan is devised to understand the intentions of local residents and produce guidelines for promoting citizen cooperation in community creation due to the increase in visitors accompanying the World Heritage designation.

The city encourages the development of local food products and tourism, such as walking, cycling and

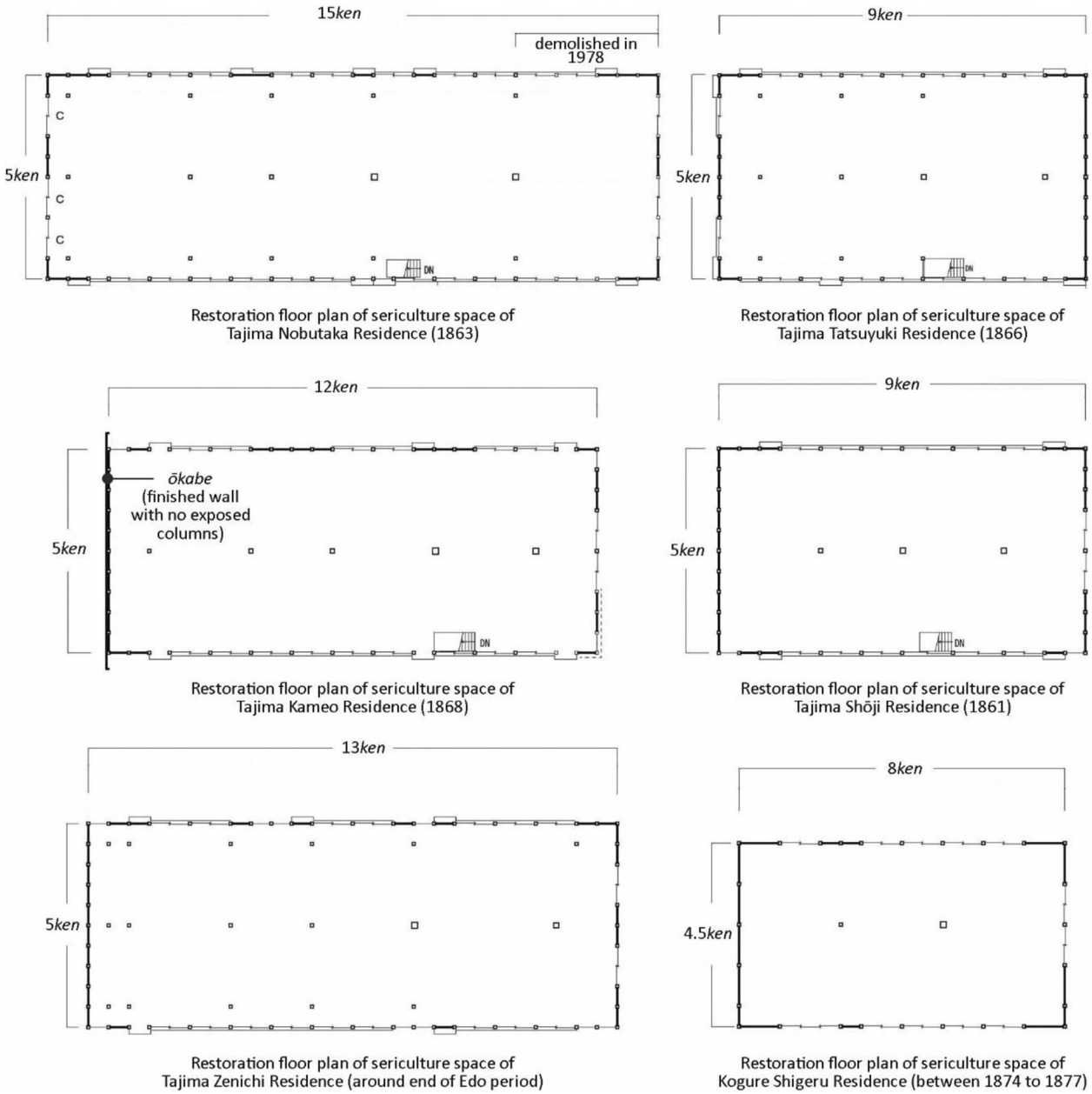

Fig. 7 Restoration floor plans of the sericulture space (upper floor) of former sericulture farmhouses located near Tajima Yahei Sericulture Farm. (Source: Gunma Prefecture 2007; Satoshi Ono)

Fig. 8 Transformation of the roof ventilation system of Tajima Nobutaka residence in 1870 (left), 1897 (centre) and 1907 (right). (Source: Sakai Shimamura Committee of Photo Journal Publication, 2007)

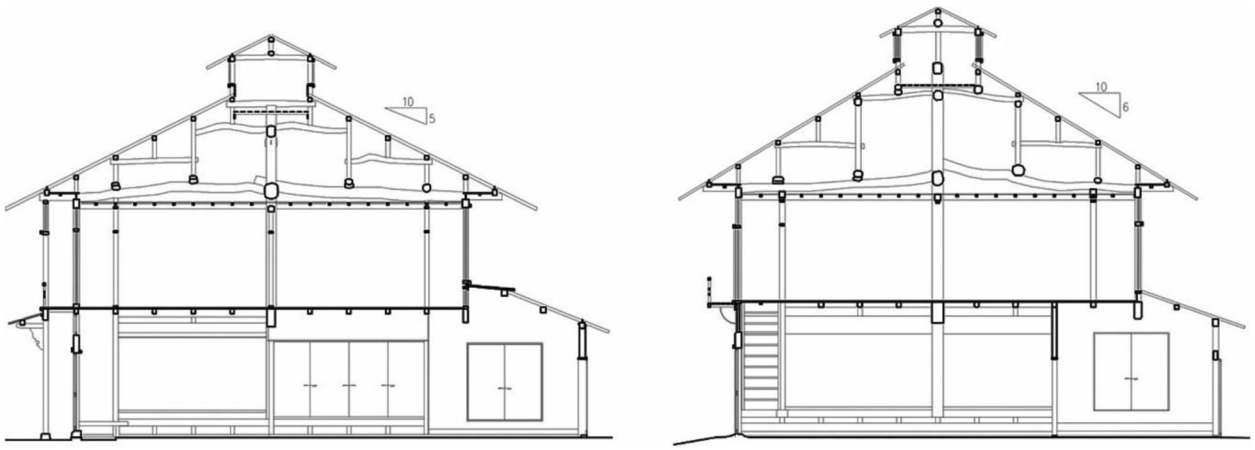

Fig. 9 Front-rear section of Tajima Tatsuyuki residence (left) and Tajima Zenichi residence (right). (Source: Isesaki City Historical Building Research Committee, 2011)

hiking tours, to link a network of local cultural properties around the vicinity. The Sakai Shimamura Hospitality Plaza is set up on weekends to sell local produce, provide a rest area for visitors to taste local mulberry tea leaves, and serve as an information centre for the Farm and its buffer zone (Cheng and Ono 2019a; Cheng et al. 2020). During the annual Shimamura Boat Fiesta, a carnival is set up on both sides of the riverbank selling local produce, and visitors may enjoy folk performances, play games and enrol in handicraft workshops.

The *Sakai Shimamura Sanshū no Kai* and *Shimamura Kaiko No Furusato Kai* are local organizations formed by former sericulture farmhouse owners and residents. The former, formed before the nomination of the Farm as a World Heritage Property organized study groups to discuss history, culture and silkworm egg production in Shimamura and published research and guidebooks on the village. The latter was formed after the successful designation of the Farm and is led by Tajima Kameo, who is also an owner of a former sericulture farmhouse.

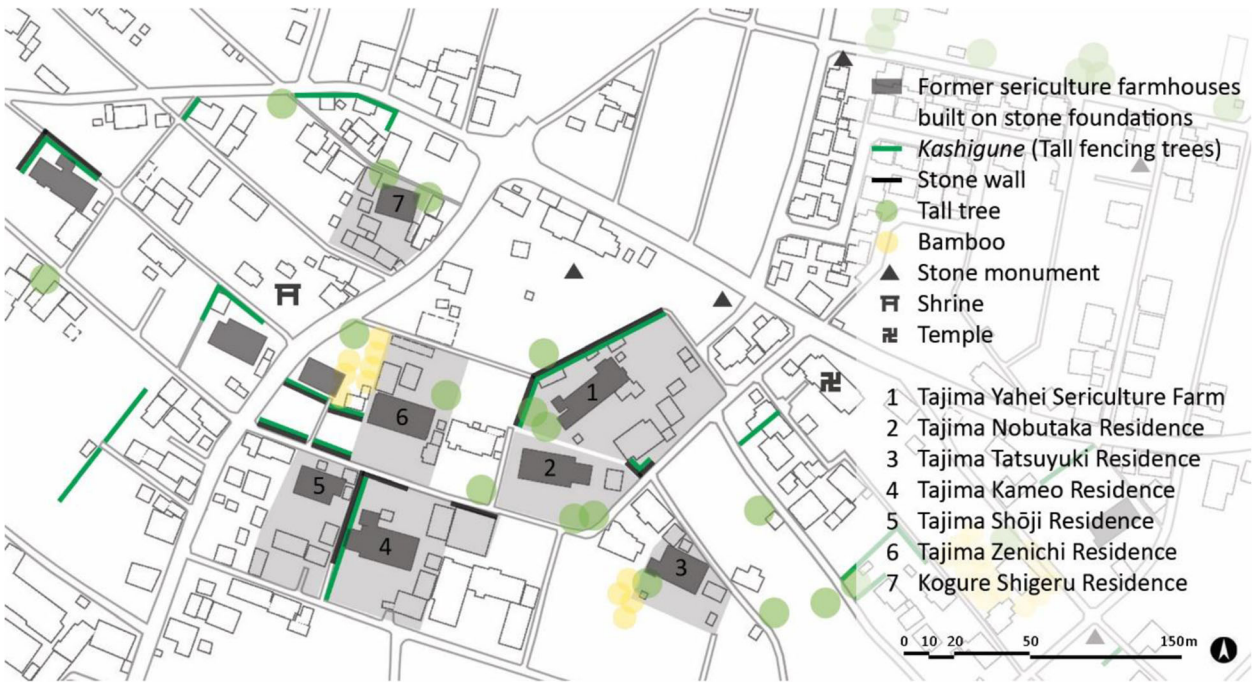

Fig. 10 Tajima Yahei Sericulture Farm and its vicinity. (Source: Sweet Yee Cheng)

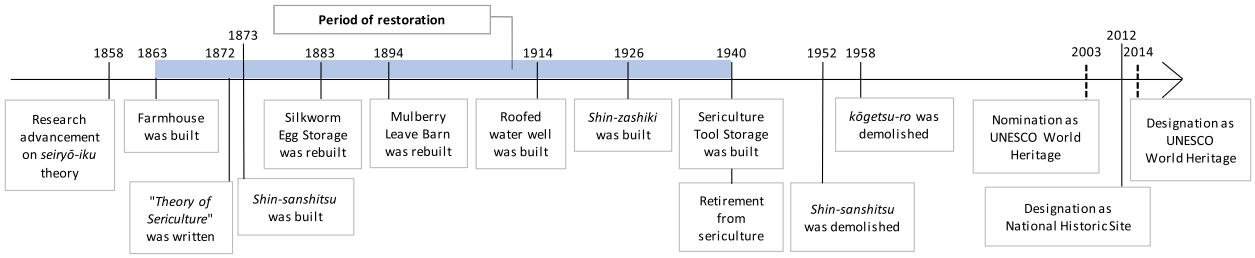

Fig. 11 Event timeline of the Tajima Yahei Sericulture Farm and its period of restoration. (Source: Cheng 2018)

Members of both organizations volunteer daily as tour guides at the Tajima Yahei Sericulture Farm and at the hospitality plaza.

In February 2016, a symposium was co-organized by *Sakai Shimamura Sanshū no Kai* and the academic researchers, including Ono Satoshi, Professor Murata Keiichi, Professor Kurotsu Takayuki and Professor Fujii Keisuke, to promote understanding of the values of large-scale sericulture farmhouses in Shimamura; the first author was one of the 90 participants. As a result, the '*Shimamura (Isesaki-shi) no sanshu seizō minka kenchikugun*' booklet introducing important sericulture farmhouses built between the end of Edo era and the Showa era was published for the *Gunma Shimamura no Yōsan Nōka Kenchikugun o Kangaeru* symposium.

International and regional networking

International and regional networking policies were also proposed to encourage local sericulture organizations, residents and universities to organize academic and industrial exchanges. An international symposium was conducted in October 2015 as the first anniversary celebration of the inscription of *Tomioka Silk Mill and Related Sites*. The vice-director of the China National Silk Museum, Zhang Yi, and the Associate Professor of National Tsing Hua University (Taiwan), Mao Chuanhui, were amongst the foreign scholars and professionals who presented on the protection of silk industry-related heritage and the effects of sericulture advancement in Japan on China and France (Gunma Prefecture Planning Department World Heritage Division 2015).

As a part of the curriculum, students from the Graduate School of Urban Innovation of Yokohama National University were involved in yearly on-site visits led by Professor Ono Satoshi. In 2018, the Shimamura Harvest Festival was proposed by students to promote the experience of village life and local produce harvested year-round. The first harvest event was held in July 2019 as students experienced harvesting sweetcorn from the corn field of Kurihara Tomohiko, who is also an owner of a former sericulture farmhouse that is believed to have been the first farmhouse to engage in sericulture (Cheng and Ono 2019b). Tajima Kameo, a former sericulture farmhouse owner, had requested help, as his sericulture building was under the effects of decay and was planned for demolition due to vacancies. A site survey was carried out, and multiple proposals on reutilization ideas were presented by the students, including reusing the sericulture building as a community space for locals and tourists, a local produce processing factory and a site for club activities.

A seminar on three-storey sericulture farmhouses located in Hyōgo Prefecture was conducted in October 2018. The speaker Wada Hiroyuki, a researcher at the Akenobe Mine Research Centre and a building conservationist, spoke about the conservation and reuse of dormant three-storey sericulture farmhouses as a community space. Measures for the revitalization of the village's local culture were also addressed. The session provided the residents of Shimamura insight into how other areas preserve sericulture buildings and sparked new ideas on the preservation of local sericulture farmhouses in Shimamura.

Enriching culture and education

The education-related policies proposed by governmental plans encourage raising townspeople's awareness of local history and culture. In response, the *omoya* of the Farm is open to the public once a month for visitation, as it is currently inhabited for daily living. The mulberry-leaf barn of the Farm is currently reused as a gallery to showcase information regarding the origin and invention of the *seiryō-iku* technique. In celebration of the annual chrysanthemum exhibition organized by the city, the Farm has been used as a location to house workshops and events, such as for handcrafting cocoon straps, pin badges and a 1:125 scale paper model of the *omoya*. Through these workshops, participants are educated on the history and distinctive structures of the Farm.

Much has also been done by residents in the buffer zone. Zenichi Residence is open for visitors to explore the internal space of its *so-yagura*. Visitors who conquer their fear of heights and successfully experience the *yagura* space are awarded a certificate of commendation. Tajima Tatsuyuki, also an owner of a

former sericulture farmhouse and a ventriloquism enthusiast, occasionally provides free tours to his residence while ventriloquizing.

The Tajima Yahei Sericulture Farm Information Centre currently provides interactive media and exhibits manuscripts and diaries written by Yahei and people who have contributed to the advancement of sericulture in Shimamura. A special site is set up with tools and equipment that allow visitors to experience the traditional method of plastering a wall. Volunteering professionals are on site to explain the structure of a wall of a traditional farmhouse and the materials and tools used for plastering.

The local primary and secondary schools also incorporate sericulture and history studies in the school curriculum. Primary school students are allowed to breed silkworms and harvest their silk to be made into a school flag to be exhibited in an interschool exhibition, and secondary school students are able to experience threading silk from cocoons as a part of their school curriculum to educate and preserve the technique.

A project group was led by Professor Ono Satoshi to designate three sericulture farmhouses, Zenichi residence, Takayuki residence and Kanai Yoshiaki residence, as Registered National Important Property. In June 2020, nomination dossiers were submitted to the Isesaki city government. This became the first stepping stone to strengthen the value of important buildings in Shimamura as registered cultural properties.

Reutilization and landscaping

A large emphasis is placed on incorporating transportation and the reutilization of buildings and facilities. To reduce carbon emissions by vehicles, walking and cycling routes were designed along the south riverbank of the To-ne River and the south riverbank of the Hirose River. While two main bridges, Bando-ohashi Bridge and Jōbu-ohashi Bridge, connect both riverbanks of the To-ne River, free boat rides are set up for visitors to enjoy the scenic view of Shimamura by speed boat or canoe. The Shimamura Ferry Boat Fiesta is organized to revive this fading method of transportation, which was once the main method to and from the village of Shimamura in the Taisho period.

Dormant buildings are also fully utilized. The Tajima Yahei Residence Information Centre was renovated from the 143-year-old Shimamura Primary School, which closed down in 2016 due to the lack of students. Currently, the information centre is the first stop for visitors exploring the village, where exhibitions, video screening on the sericulture history of Shimamura and free guided tours are available. The Senior Citizen Welfare Centre, also located at the site of the information centre, is currently used to hold local seminars and discussion sessions.

Discussion and conclusion

First, while it is assumed that at a certain period, other sericulture techniques were carried out in the sericulture space of the *omoya*, there is an urgent need to conduct historical research as to when the other sericulture techniques were practised and their relation to the partitioning of the sericulture space. Many of the manuscripts and archives are preserved and are able to be referenced. However, information is still missing regarding some aspects, such as the social and architectural transformation of the demolished buildings *shin-sanshitsu, kōgetsu-ro* and *inkyo* and the year of construction of the microscope room. Generally, groups of buildings from the same area might have influenced one another. The Tajima Yahei Sericulture Farm may have influenced its surroundings; likewise, the surroundings may have also influenced the Farm. Therefore, it is wise to examine the social and architectural transformation of other sericulture farmhouses located in the buffer zone, as we may thereby trace back and gain deeper insight into the transformation of Tajima Yahei's former residence. Looking from a macro perspective, the link between *shin-sanshitsu* and the imitation sericulture buildings in Tsuruoka City should also be investigated. Dormant buildings in Shimamura are utilized as facilities to promote the Farm; however, the silkworm egg refrigerator and incubator was originally renovated and reused as a local post office but has been again left vacant. Designated as an Important Cultural Property, the building could also be utilized as a pit stop for visitors when travelling to Shimamura or a community space for locals to gather for activities.

As stated in the Operational Guidelines for the Implementation of the World Heritage Convention (WHC 2019), the buffer zone of a nominated property should have 'restrictions placed on its use and development in order to give an added layer of protection to the property' and should include 'attributes that are functionally important as a support to the property and its protection'. The World Heritage and National Heritage Tajima Yahei Sericulture Farm has received much attention from governmental and non-governmental bodies and foreign and local visitors. From the results of the survey by Mizuno, it is apparent that residents in the buffer zone, especially those who reside further away from the Farm, may not entirely feel connected to the Farm. While they are part of the buffer zone, the lack of interconnectedness and awareness causes former farmhouse owners to feel pressured to obey governmental guidelines that they think do not benefit them. Unfortunately, most farmhouses and sericulture buildings in Shimamura are under the crisis of natural deterioration and natural hazards and pose a physical threat to the families living in them and to the beautiful skyscape of the

village. High maintenance cost becomes a common pressure shared by all farmhouse owners, and being located in the buffer zone of a World Heritage Property does not automatically entitle them to national financial assistance. One way to counter this could be to designate the village of Shimamura as a Preservation District for Groups of Historic Buildings, as this would allow farmhouses to be preserved together as a whole with their surroundings with the aid of the national government in terms of technical and financial support. Historic buildings of an area should possess 'designs of especially high value', have an 'original state [that] is well preserved' or include 'buildings and environs which noticeably show local characteristics' (Agency for Cultural Affairs 2019). The author feels that the village well meets criteria no. 3 because of the characteristic farmhouses with distinctive sericulture architecture style, the stone monuments scattered throughout the village to tell its local folklore and celebrate the village's achievement in sericulture, and the ideal landscape for mulberry plantations.

However, since only limited investigations have been carried out, much is still unknown about the components of the village, including the structural adaptation of farmhouses in relation to the sericulture technique adopted and the formation of certain landscape components in the village. The authors are working towards investigating individual sericulture buildings around the Farm for designation as National Cultural Properties to receive professional guidance and financial assistance. As investigation continues, the character of the village will slowly and concretely form, promising a successful designation as a Preservation District for Groups of Historic Buildings. Then, when their farmhouses are recognized as a cultural property and a part of a larger group of historic buildings, owners will feel more connected to the village and the Farm, which will encourage them to become more involved in the preservation of the Farm and the village and strengthen their efforts to preserve their culture.

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Authors' contributions
Sweet-Yee Cheng (S.Y.C.), Satoshi Ono (S.O.). S.O. studied the archives, original manuscripts and old photographs in Japanese to justify the *Seiryō-iku* theory. S.O. also carried out technical investigation of the Farm and the surrounding farmhouses on their structural changes, and organize site visits which require participants (university students) to propose ideas for the revitalization of the village. S.O. is the author of Chapter 2.1, 2.2, 2.3 and parts of 2.4 which was drafted in Japanese. S.Y.C. studied and discussed the preservation and management plans of the UNESCO World Heritage Property and implemented efforts by stakeholders in preserving, managing, and revitalizing the property and its surroundings, participated in site visits organized by S.O. in the past 5 years and was involved in proposing revitalization ideas, and is the author for Chapter 3 and 4. S.Y.C. drafted the manuscript, translated the draft for Chapter 2.1, 2.2, 2.3 and 2.4 into English and combined it with other Chapters originally written in English. Translated draft was reviewed by S.O. and rectified by S.Y.C. The author(s) read and approved the final manuscript.

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References

Agency for Cultural Affairs. 2013. Justification of inscription. In *Tomioka Silk Mill and Related Sites: World Heritage Nomination*, 13–164.
Agency for Cultural Affairs. 2019. *Information on Preservation District for groups of historic buildings policy: Town making through living history [Dentōtekikenzōbutsugunhozonchiku seido no go annai: Rekishi o ikashita machi-dzukuri]*. Tokyo: Agency for Cultural Affairs.
Aoki, Hiroshi. 2012. "Dai 2 shō: Shimamura no jizen to shakai." [Chapter 2: Landscape and society of Shimamura.]. In *Tajima Yahei kyūtaku chōsa hōkokusho [Tajima Yahei Former Residence Survey Report], 3–12*. Isesaki: Isesaki City Board of Education Cultural Property Protection Division.
Cheng, S.Y., and S. Ono. 2019a. Preservation and Revitalization of Sericulture-related Heritage Buildings in Gunma – In the case of Tajima Yahei Sericulture Farm and Takayama-sha Sericulture School. In *Proceedings of The Second International Conference on Built Heritage Studies: Built Heritage Conservation in Rural Vitalization*, 409–424.
Cheng, S.Y., and S. Ono. 2019b. Value of Cultural Inheritance of World Heritage Site Tajima Yahei Sericulture Farm. In *Proceedings of ICOMOS-CIAV 2019 Joint Annual Meeting & International Conference on Vernacular & Earthen Architecture towards Local Development*, 76–83.
Cheng, S.Y., S. Ono, M. Morita, and Y. Sugeno. 2020. Evaluation Of Management Plans Related To World Heritage Tomioka Silk Mill And The Silk Industry Heritage Group. In *2019 (90th) Japan Architectural Institute Kanto Branch Research Report II*, 527–530.
Cheng, Sweet Yee. 2018. *Evaluation of management plans related to world heritage Tomioka silk mill and the silk industry heritage group*. Master thesis, Yokohama National University.
Gunma Prefecture. 2006. "*Proposal on the Properties Nominated for the World Heritage Tentative List*." Accessed 27 May 2020 https://worldheritage.pref.gunma.jp/pdf/The_World_Heritage_Tentative_List%20.pdf
Gunma Prefecture. 2007. Kindai yōsan nōka chōsa hōkoku-sho. In *Survey Report of Modern Sericulture Farmer*. Gunma: n.p.
Gunma Prefecture Planning Department World Heritage Division. 2015. *Heisei 27nendo「tomioka seishijō to kinu sangyō isan-gun」nenpō [Tomioka Silk Mill and Related Sites Annual Report 2015]*. Gunma: Gunma Prefecture Planning Department World Heritage Division.
Isesaki City Board of Education. 2012. *Tajima Yahei kyūtaku chōsa hōkokusho [Tajima Yahei Former Residence Survey Report]*, 83–85. Isesaki: Isesaki City Board of Education Cultural Property Protection Division.
Isesaki City Historical Building Research Committee. 2011. *Shimamura no tatemono [buildings of Shimamura]*. Isesaki: Isesaki City Board of Education.
Kurotsu, Takayuki. 2012. "*Shimamura no shūraku keikan.*" *[Village landscape of Shimamura.]*. In *Tajima Yahei kyūtaku chōsa hōkokusho [Tajima Yahei Former Residence Survey Report]*, 64–71. Isesaki: Isesaki City Board of Education Cultural Property Protection Division.
Mizuno, Takahiro. 2017. *Chiiki no rekishi-teki shisan ni taisuru jūmin ishiki no kiso-teki kenkyū: Gunmaken isesakishi sakaishimamura chiku o taishō to shite [a basic study on residents' awareness about regional historic property]*. Master thesis, Yokohama National University.
Ono, S., and T. Mizuno. 2016. *Shimamura (Isesaki-shi) no sanshu seizō minka kenchikugun [groups of sericulture farmhouses in Shimamura (Isesaki City)]*. Yokohama: Yokohama National University Ono Satoshi Laboratory.
Ono, Satoshi. 2012. "Dai 4 shō: shiiku shisetsu toshite no tajimake jyūtaku." [Chapter 4: Tajima Residence as a Breeding Facility]. In *Tajima Yahei kyūtaku*

chōsa hōkokusho [Tajima Yahei Former Residence Survey Report], 44–49. Isesaki: Isesaki City Board of Education Cultural Property Protection Division.
Sakai Shimamura Committee of Photo Journal Publication. 2007. *Me de miru shimamura no ayumi: kōsei ni tsutaetau konjaku fūkei [a look into the development of Shimamura: Past and present scenes to pass down to future generations]*. Isesaki: Sakai Shimamura Committee of Photo Journal Publication.
Sakaichoshi hensanshitsu. 1989. *Sakaicho no minka to yōfū kenchiku [Sakai Town's private houses and Western-style buildings]*. Sakai: n.p.
Tajima, Yahei. 1872. *Yōsan shinron [new theory of sericulture]*. Tokyo: Izumoji Manjirō.
Tajima, Yahei. 1879. *Tsuzuke yōsan shinron [new theory of sericulture sequel]*. Tokyo: Izumoji Manjirō.
WHC (World Heritage Centre). 2019. *"Buffer zones." Operational Guidelines for the Implementation of World Heritage Convention*, 30.
Yamagata Prefectural Government. 2020. "*Matsugaoka Kaikanjo*." Accessed 27 May 2020. https://www.pref.yamagata.jp/ou/shokokanko/110001/him/him_03.html

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