Sustainability of the thatched house in Nadasyo village in Fukui prefecture, Japan

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ABSTRACT: The folk house named Syuraku-an is one of few existing thatched houses in Nadasyo village. The NPO group restored this abandoned house in 2008 with financial support. They now use it for nature experience programs for urban children. The traditional thatched house in use at the present time is quite valuable, whereas the maintenance, in particular for a thatched roof, requires a significant cost to outsource professionals and purchased materials, or a significant labor force raised from the community. The heavy work of re-thatching a whole roof is necessary in the future; however, it is difficult to repeatedly expect sufficient funds or to ask for community cooperation in a depopulated and aging village. The NPO group has a plan for the next re-thatching to establish a new community network with the help of participating members in the younger generation. The sustainability of the thatched house is a long-term challenge.

1 INTRODUCTION

A folk house named Syuraku-an (Fig. 1), which is over 100 years old, is one of few houses with a thatched roof in Nadasyo village, although nearly all houses were thatched until the early 1950s. Syuraku-an had been vacant because of the departure of the aged owner 10 years previously, in 1998. The NPO group Shinringakkou/Morinko (http://www.npo-morinko.com/index.html) rented the house for their activity base and renovated and re-thatched it in 2008 with financial support from the local government. After completion, the NPO group named the house Syuraku-an, which means “gather and enjoy” (syuraku) and “hermitage” (an), to be used as a base for nature experience programs.

Many activities are organized so that the depopulated and aged village can be revitalized and so that urban children can be invited to experience natural environments and rural life. Syuraku-an is quite valuable as a thatched house in use at the present time. Thus, the authors conducted a measurement survey for architectural records and analyzed the space layout and structure for evaluation in comparison with other houses in the surrounding areas. Additionally, an interview with the village historian allowed us to understand how villagers constructed their houses with community cooperation, in particular the cooperation involved in thatching. The NGO group is now studying sustainable methods for thatched housing in a modern context.

2 RESTORED THATCHED HOUSE

2.1 Thatched houses in Nadasyo village

Nadasyo village is located in the southwest part of Fukui prefecture neighboring Kyoto and was merged with the town of Ohi in 2006 (Fig. 2). The village had once been located along the main road for marine product transportation from Obama bay to the ancient capital city of Kyoto; thus, it was influenced by the culture of Kyoto. The village is 143.5 km², surrounded by deep mountains covering nearly 90% of the village area, and occupies small flatlands along rivers for settlements and agricultural lands. The main form of livelihood had previously been a small industry of wooden charcoal, forest industry, and subsistence agriculture (Nadasyo village, 1968). The population was 2500 people in 2010, compared with 3500 people in 1968. The villagers are mostly aged 50–60 years, with very few aged 20–30 years because of outflows to urban areas. Thatched houses have been gradually disappearing since the 1950s, and now five remain: one enshrinement hall (Yakushi-do) and one shrine (Kamo-jinja) are designated and conserved as cultural properties, one house was moved and converted to a hostel (Ryusei-kan) operated by the town management, and one temple was converted to a private house (Fig. 3), leaving Syuraku-an as the only original folk house in the village.

The reasons for disappearance of thatched houses are shown in (Fig. 4). Two major trends starting from the 1950s are the popularization...
The change in fuel material has led to a modernized life without *irori* fireplaces. This had a negative effect on smoking and drying thatched roofs with low durability, resulting in a conversion in roofing materials (Fig. 5) to an iron-sheet-covered roof or a tiled roof. Changes in the national industrial structure led to rapid urbanization in cities that imported large amounts of inexpensive wood, resulting in a decline in domestic charcoal and forest industries, which accelerated population outflows to urban areas as well as depopulation and overall aging in rural areas. These social changes have removed the opportunity to learn local thatching techniques (decay of intellectual resources), created difficulties in community cooperation (decay of human resources), and led to devastation of grass fields for thatching material (decay of natural resources). These three local resources are required for the sustainability of vernacular architecture such as thatched houses. According to interviews in the village, other reasons for the disappearance may be the change in lifestyle (desire for private rooms), a changing sense
of value (thatched houses look poor), the large cost of thatching, and the fear of fire accidents with thatched roofs. Additionally, in Nadasyo village, a large typhoon and flood in 1953 caused significant damage to many houses and triggered reconstruction of different types of houses.

### 2.2 Restoration of Syuraku-an

*Syuraku-an* is located in Oisako settlement in Nadasyo village, a small settlement with five houses along a small river, but no one lives there at present. Currently, some families living outside of the village sometimes visit to maintain their family grave near the settlement. *Syuraku-an* is estimated to have been constructed more than 100 years ago. An elderly couple had lived in *Syuraku-an* as the last villagers in the settlement but finally moved out to the city in 1998 due to the difficulties of self-supporting life. In the aftermath, the NPO group offered to rent *Syuraku-an* from the owner for a lower rate and restored it, as they luckily obtained special funds from the local government focusing on the promotion of rural resources. *Syuraku-an* has been restored to its original state to the greatest extent possible (Fig. 6/1, 6/2). The decayed parts of the wooden pillars on the ground and weakened joists were renewed to adjust the horizontal floor. In the *heya* (sleeping room) and *daidoko* (living and dining room), tatami mats were placed on the original wooden floor with an *iori* (fireplace).

![Figure 4. Disappearance of thatched houses.](image)

![Figure 5. Change in roof materials (Authors).](image)

![Figure 6. Comparison of space layout.](image)

![Figure 7. Comparison of roof structure.](image)
The additional ceiling in the daidoko was removed to recreate an opening for the smoke on the original ceiling. Meanwhile, the modern kitchen, originally a part of the niwa, was retained as a useful utility. A significant amount of the restoration cost was used for rethatching on three surfaces of the roof (Table 1). The roof style is mostly same as in Yakushi-do (Fig. 3), and the details of thatched roof is shown in Figure 8 (Ohi Town Board of Education, 2012).

3 ARCHITECTURAL CHARACTERISTICS

The authors evaluated the architectural characteristics of Syuraku-an by a measurement survey and analysis of the space layout and structure. It was found that Syuraku-an has a traditional housing style that is typical of the surrounding area, and the original structure and materials are well maintained.

Table 1. Cost of re-thatching on 3 surfaces (Other parts cost: 2 million JPY (19,400 USD)).

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material cost of main components (rice straw, Japanese silver grass)</td>
<td>2,600,000 JPY (25,200 USD)</td>
</tr>
<tr>
<td>Material cost of subcomponents (bamboo rafter, straw rope)</td>
<td>400,000 JPY (3,900 USD)</td>
</tr>
<tr>
<td>Labor cost for removal and rethatching, setting cost of scaffold</td>
<td>3,690,000 JPY (35,800 USD)</td>
</tr>
<tr>
<td>Total cost</td>
<td>6,690,000 JPY (64,900 USD)</td>
</tr>
</tbody>
</table>

3.1 Space layout

Syuraku-an has a traditional space layout, and all partitions between rooms are sliding doors (Fig. 6–2). The function of each room is as follows:

![Figure 8. Thatched roof.](image)

Eaves of roof

Top of roof

![Figure 9. Timber frames in the daidoko.](image)

Table 2. Conventional construction process.

<table>
<thead>
<tr>
<th>Construction process</th>
<th>Description</th>
<th>Owner</th>
<th>Community</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village meeting</td>
<td>Request of construction: An owner requests community cooperation and asks for permission to log trees in the community forest.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Timber collection</td>
<td>Selection: Following the directions of the carpenter, villagers select trees in the forest of the owner and the community forest.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Logging: Lumber professional fells trees and leave them on site for drying. Sometimes the villagers do logging by themselves.</td>
<td>(O)</td>
<td>(O)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Transport: Villagers cooperate to carry down logged wood to construction site.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Preparation for construction</td>
<td>Hut construction: An owner constructs temporary hut for carpenters.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Lumber sawing: Lumber professional saws logged wood to make wooden frame components.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Finishing: A carpenter planes components and chisels joints.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Erection of main structure</td>
<td>Ceremony: All related persons join the ceremony for safe construction.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Erection: Carpenters erect main structure assisted by the carrying tasks of villagers, and an owner and carpenters celebrate the completion of the structure.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Thatching</td>
<td>Collection: Villagers every year collect thatching materials on private and public fields and stockpile them in the loft space, contributing the material for new construction and repair.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Thatching: Thatching professionals direct the roofing with the cooperation of villagers.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Plastering</td>
<td>Base works: Villagers set bamboo laths for the base of plastering (work mainly done women).</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Material: Villagers prepare for plastering materials for rough, second, and final coats.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Plastering: Villagers carry materials to a plasterer to work for rough, second and final coats.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Finishing</td>
<td>Carpentry: A carpenter finishes the interior work.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Completion</td>
<td>Return: An owner gives straw ropes to neighbors in thanks for cooperation.</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Figures (Figs. 7/3, 7/4). Many posts stand on the cross Iwasa and Ishida houses have different roof structure on the front and back sides (Figs. 7/1, 7/2). The beams (B) on lateral sides, and two roof beams (C) on the edge of the ridged pole, six roof posts (A) on the cornerstones. This leads to an expansion of the space in the circle observed in Syuraku-an in the surrounding areas. The roof structure of northern Kyoto, including Nadasyo village, where many thatched houses are conserved as in the preservation districts for a group of historic buildings. The Iwasa house has a different space layout, adding the nakano-ma between the shimono-ma and zashiki. This house has no connection between the daidoko and zashiki, whereas the Syuraku-an and Ishida house create a connection by the displacement of partitions. The connecting layout between the daidoko and zashiki is popular around northern Kyoto, including Nadasyo village. Syuraku-an and Ishida have mirror-image layouts, which depend on the site location obtained in the interview of the village historian in Nadasyo village. Additionally, the entrance from the front and side of the niwa in Syuraku-an and the Ishida house is reported to have developed in the late 18th to early 19th century (Kyoto Prefectural Board of Education, 1997).

3.2 Structural system
The main structure of Syuraku-an consists of typical wooden frames, one characteristic being the removal of the pillar located in the daidoko as in the circle observed in Fig. 6–2 (Nadasyo village, 1968). This leads to an expansion of the space in the daidoko to the eaves and maintains a wide opening connected to the niwa space. Thus, the beam at that position should be longer and larger to bear the load (Fig. 9). The Iwasa and Ishida houses are also reported to have the same characteristics observed in the surrounding areas. The roof structure of Syuraku-an, in which the roof is supported by two posts (A) on the edge of the ridged pole, six roof beams (B) on lateral sides, and two roof beams (C) on the front and back sides (Figs. 7/1, 7/2). The Iwasa and Ishida houses have different roof structures (Figs. 7/3, 7/4). Many posts stand on the cross beams and are connected by tie-beams, which is common in these areas. The style of Syuraku-an is sometimes observed in the houses constructed after the 19th century, particularly in small houses, as a result of the usability of the loft space (Kyoto Prefectural Board of Education, 1997).

4 SUSTAINABILITY OF THE THATCHED HOUSE
4.1 Conventional construction process
The construction of thatched houses was originally completed with the cooperation of the family of the owner, members of the community, and professionals. This word is used for any cooperative activities, not only construction but also rice planting, road cleaning, funeral ceremonies, and so on. Housing construction involves a long process of community cooperation, as shown in Table 2, the information for which was discovered in an interview with the village historian. The villagers in his settlement of Nadasyo village hold an annual meeting to worship a mountain god on December 9, a time when they do no work in the mountains. Villagers who plan to build a new house require agreement and cooperation from others in the meeting.

Logging works are usually performed between late November and February, as logs in those months have no risk of insect infestation. Fallen trees are left on site for approximately two weeks to dry them to be light. A lumber professional cuts fallen trees to the necessary length, according to the specifications of the components of the planned house, and then removes tree bark to smooth the surface for easy transportation to the construction site. Villagers cooperate to rope and haul logs via human power without horses or cows.

For building materials in the area, Japanese chestnut is used for the bedding, and Japanese chestnut or Japanese cypress is used for the pillars. Japanese cedar can be used in their absence. The beams are created from Japanese pine. The central pillar uses large Japanese zelkova or Japanese pine. The flooring board is mainly created from Japanese pine.

A lumber professional saws logs to make rough-sawn lumber and boards, and a carpenter planes them and chisels joints in preparation for all of the building components. Before starting construction, a ground-breaking ceremony is conducted to purify the building site for safe construction, and then villagers place gravel at the positions of the pillars and pack the ground with weights for laying the cornerstones.
After the ceremony, a carpenter asks other carpenters to help with the erection of the main structure and asks villagers to assist by carrying lumber, which continues for two days. On completion of the main structure, carpenters and the family of the owner wear a formal costume and celebrate by scattering rice cakes to gathering villagers from the top of the structure.

The main thatching material is Japanese silver grass, and rice straw is also used on the edges of the eaves. The grasses usually grow in clusters, often on mountainsides. Some settlements prepare private or public lands to grow grasses. Villagers constantly collect grasses and straws and stockpile them on the loft space of a house, at times borrowing or lending materials if necessary. They can also give materials in the construction of a new house as presents. In thatching projects, several thatching professionals are usually engaged simultaneously, and villagers join them to carry materials and assist in thatching. Skilled villagers can direct the work instead of professionals at times. In plastering work, villagers first cooperate to create bamboo laths for the plastering base, which is mainly performed by women. The villagers mix mountain soil with dried rice straw and water with a hoe and by foot stamping. The material must mature for 20 days to be of sufficient quality for wall mud for a rough coating. The second coating material is created with sieved fine soil and dried rice straw, and the final coating material is created with lime powder and seaweed glue. A plaster professional creates the rough, second, and final coats sequentially, and villagers carry materials.

For the final process, a carpenter continues the interior work to completion. The house owner gives straw ropes to community members in thanks for their cooperation, as ropes are a daily necessity in their rural life.

4.2 Maintenance of thatched roof

House owners sometimes have to repair parts of their roofs to prevent leaks from rain and re-thatch a whole roof according to a cycle. The number of years in the lifetime of the roof depends on the location and conditions of the house.

A document on traditional village life entitled “Folk tales in Nadasyo” describes the thatched roof in the village (Nadasyo Investigation Committee of Folk Tales, 1992). The re-thatching cycle is approximately 15 years and requires the collection of 120 shime (four bundles) of Japanese silver grasses for a whole roof. One bundle is the quantity of the grasses bound by a rope with a length of 150 cm, which is equal to a typical human arm span. The re-thatching of a whole roof requires a total of 480 bundles. Harvesting work is quite hard because it is required to collect at most 50 bundles in a year for a family labor force. Additionally, villagers sometimes gather a lean harvest, and the harvesting period is limited only to December before the beginning of snowfall. Harvested grasses are left in the field or kept in a space under the eaves during the wintertime. They should be placed outside to dry until the spring season and stockpiled on the loft space afterwards. A house owner needs to ask community members to cooperate re-thatching a roof. The cooperators firstly remove old grasses from a roof and then check roof structures and replace all of bamboo laths. Quarter to third part of usable old grasses is reused together with new ones. Thatching work should be completed for only one day or at most couple of days avoiding rainy weather (Ando 1983). Such heavy labor is one of main reasons for the decrease in the number of thatched roofs, leading to the conversion to iron-sheet-covered roofs and tiled roofs.

4.3 Future plans for the thatched house

On a weekly basis, the NPO group usually makes a fire in the irori fireplace and opens all windows to let fresh air to avoid damage to the thatched roof; however, it may not be possible to maintain the quality of the roof such that it will last longer than houses where people are living. Syuraku-an will face a turning point after 15 years in terms of the necessity of re-thatching. It will be difficult to obtain sufficient funds again to hire professionals and purchase the materials. Additionally, asking for community cooperation in the depopulated and aging village of Nadasyo cannot be expected in the future. Consequently, the NPO group seeks to establish a new community network between the participating members in the NPO activities. In particular, the number of members in the younger generation should be expanded in the network, preparing for future re-thatching projects. This is a long-term challenge for the sustainability of the thatched house.

5 CONCLUSION

The research in Nadasyo village identified the architectural characteristics of Syuraku-an, showing the typical space layout and structural form in the area. It is valuable not as a cultural heritage but as a living folk house located in the original village and used for the activities at present. Thus Syuraku-an is required to be in good conditions, and the future re-thatching work would be critical for its sustainability. This is the reason why the NPO group is aiming to establish the new community network for it. However, thatching work is
of course not easy for inexperienced or unskilled people. It is reported that thatching work only by
volunteers was inefficient in term of workability
and difficult to maintain the roof quality (Ogawa
et al. 2005).

Considering the three local resources as previ-
ously mentioned—natural, human and intellectual
resource, the new community members need to
cooperae with roofing skills and quality materials.
They should obtain the indigenous knowledge in
the exchange with local villagers, and also achieve
the skill learning from thatching professionals in
the opportunities of roof repair every several years.
Besides, they should cultivate grass field and har-
est thatching material through the nature experi-
ence programs the NPO organize. Such experiences
can lead to realize the future re-thatching work.

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