HERITAGE 2022 - International Conference on Vernacular Heritage: Culture, People and Sustainability
September 15th-17th, 2022 Valencia, Spain
Doi: https://doi.org/10.4995/HERITAGE2022.2022.15137

Dry Stone Wall Relics as a Part of Cultural Landscapes: A Case Study from the Foot of Mt. Hira Region in Japan

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
Shishigaki (wild boar defense walls), as a part of cultural landscapes in Japan, currently faces serious deterioration. The research aims to identify the characteristics of Shishigaki walls in eight villages located at the foot of Mt. Hira and propose conservation strategies. Interpretation of historical documents and cadastral maps, interviews, and measurement surveys were conducted. As a result, about 4,3 km of Shishigaki relics are confirmed, of a total length up to12,7 km built in the 18th to 19th century. Shishigaki walls were built by local households collaboratively with different drystone masonry techniques. Based on the field surveys, it was found that although up to 91% of Shishigaki walls located within the village territories were demolished, only half of Shishigaki walls in the forest were deconstructed. Loss of functionality as protection fences with the change of land use is considered as the main reason for the demolition of Shishigaki walls. It is suggested that Shishigaki relics in the forest could be integrated into existing hiking routes and promoted through collaborative map-making with local residents. The authors contest that heritage interpretation rooted in local historical studies and conservation with community involvement could be adopted in the promotion of cultural landscapes worldwide.

Keywords: *Shishigaki; dry stone walls; cultural landscape; conservation.*

1. Introduction

1.1. Stone Use and Cultural Landscapes

Stone culture in the West is well known, but in Japan, stones have been used in various forms as well, such as castle architecture and gardens. They have formed the local culture, and become a part of the cultural landscape.

Cultural landscapes, an interface between nature and culture, are derived from a social-ecological process that has co-evolved throughout history (Sarmiento-Mateos et al., 2019). The social-ecological resilience of cultural landscapes depends largely on the transmission of traditional ecological knowledge (Berkes et al., 2011). Therefore, the conservation of cultural landscapes must be considered in terms of both natural and cultural aspects (Gavin et al., 2015).

In total, seven categories are identified under cultural landscapes in Japan: rice paddy landscape, farmland landscape, grassland landscape, forest landscape, seacoast landscape, river landscape, and landscape associated with settlements (Agency for Cultural Affairs, Japan, 2003).

However, rapid deterioration of cultural landscapes has been observed under threat from agricultural intensification, rural depopulation, urban sprawl, and overexploitation (Nakamura, 2016; Schmitz et al., 2021). Instead of the traditional approach, which is largely based on the strict protection of natural areas, conservation of cultural landscapes requires emphasis on human history,

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cultural and social values, admitting the importance of local people in determining the feasibility of conservation efforts (Phillips, 2002).

1.2 Shishigaki Stone Wall

Shishigaki are stone walls that were built to protect farmland against wild boar and ensured agricultural productivity. In Japanese, "Shishi" means "wild boar" and "gaki" means "walls". The origin of Shishigaki dates back to the Edo period (1603-1868), when the invasion of wild animals increased after the expansion of farmland. While Shishigaki used to be found across the Japanese countryside, they are gradually abandoned in modern society (Takahashi, 2010).

Thanks to the partial amendment of the Law for the Protection of Cultural Properties, which entered into effect in 2005, Shishigaki walls have been recognized as a part of cultural landscapes under farmland landscape as mentioned above, yet only applicable in a small number of regions (Agency for Cultural Affairs, Japan, 2003).

Though Takahashi (2010) offered a comprehensive introduction of Shishigaki walls in general, there is an absence of systematic study of Shishigaki walls in relation to their specific regional context.

1.3 Research Objective

In this research, a study of Shishigaki walls in eight villages located at the foot of Mt. Hira of the Otsu-city, Shiga Prefecture, was conducted. By studying the original Shishigaki records and current relics' distribution (length, morphology, location) and physical features (material, structure), the characteristics of Shishigaki walls in this study area were identified. In addition, by clarifying the current conditions of relics and causes of damages, the research aims to introduce feasible conservation strategies. The significance of the research is to provide a pilot study showing how the values of Shishigaki relics could be recognized in contemporary society.

1.4 Methodology

Historical documents (e.g. cadastral maps) and existing research were first studied to understand the construction time and rough distribution of Shishigaki in each village. Then field surveys were conducted from July 2018 to March 2021, to precisely confirm the locations and conditions of the Shishigaki relics on-site. Locations were tracked using GPS, and the structural details were recorded through measurement surveys. In addition, interviews with local seniors and a local stonemason were conducted to understand the local knowledge, drystone masonry techniques, and causes of damage to Shishigaki walls.

2. Outline of Study Area

This study area is located at the foot of Mt. Hira, with a land area of 71,73 km^2, spanning approximately 7,3 km from east to west and 15,9 km from north to south. In contrast to the short east-west span, a steep elevation difference could be observed up to 1.100m, owing to the particular geographical location between the Hira Mountain Range on the west side and Lake Biwa on the east. In total, there are eight districts (former villages) from south to north: Moriyama, Kido, Arakawa, Daimotsu, Minamihira, Kitahira, Minamikomatsu, and Kitakomatsu.

In the past, the stone industry flourished throughout these villages. Chert stones could be harvested in Moriyama Village and southern Kido Village, while the other villages were rich in granite stones (Fig. 1). Chert stones are relatively soft and their natural forms were appreciated by

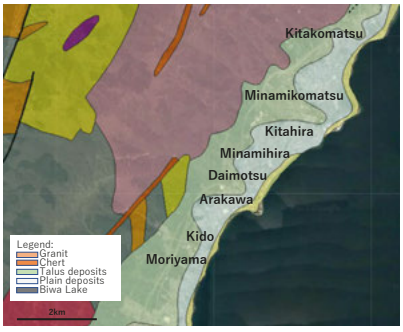

Fig. 1 Geological map of the study area

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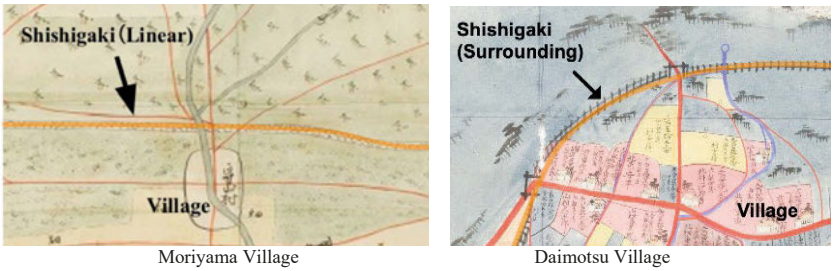

Moriyama Village Daimotsu Village

Fig. 2 Two Types of Shishigaki Morphologies in the Cadastral Maps (Otsu City Museum of History, 2017)

Fig. 3 Shishigaki relics in Kitakomatsu (left) and in Arakawa (right)

gardeners from Kyoto, with little processing required. Granite stones, on the other hand, were processed carefully for various stone structures including stone foundations, stone dikes, stone front gates of shrines, stone lanterns, and so on.

Locally, several studies have been conducted on the distribution of Shishigaki but only in limited villages in Shiga Town. Inoue (1985) analyzed the distributions of Shishigaki with cadastral maps from a geographical point of view, targeting four villages in Shiga Town. Matsuda (1997, 2000) studied Shishigaki with an analysis of village landscapes in the early Meiji era from a historical and geographic point of view. Furthermore, the Shishigaki walls in Arakawa Village were widely recognized among researchers because of their multifaceted roles as fences against both wild animals and mudflow, where maintenance is still conducted by residents (Takahashi, 2010). However, thus far, no comprehensive studies involving all eight villages in Shiga Town have been conducted and most of the Shishigaki relics have been abandoned and left unknown at risk of extinction.

3. Characteristics of Shishigaki Relics

3.1 Distribution

As a result of field surveys regarding the records of cadastral maps (Fig. 2), distributions of Shishigaki walls throughout the eight villages in the foot of Mt. Hira were identified. Shishigaki relics in two villages; Kitakomatsu and Awakara, are shown as examples in Fig. 3. Besides, details of Shishigaki relics of the study area are shown in Fig. 4 and Table 1.

(1) Lengths

As shown in Table 1, the total length of the Shishigaki walls was estimated about 12,7 km, and around 4,3 km of relics were remained. The original length of the Shishigaki in each village varied, from 633 m in Moriyama Village to 2,3 km in Kitakomatsu Village. The length of Shishigaki relics varied as well. Specifically, around 60% of Shishigaki relics (approximately 1,4 km) were remained in Kitakomatsu Village, while only 12% of Shishigaki (about 76 m) remained in Moriyama Village.

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(2) Morphologies

Two types of Shishigaki morphologies were categorized by Takahashi (2010) — a "linear type," indicating a straightforward fence built in the forest to cut down the accessibility of animals to villages without referring to village boundary, and a "surrounding type," which followed the demarcation lines of villages and marked the border between forests and villages (Fig. 4).

While the Shishigaki walls in Moriyama, Minamikomatsu, and Kitakomatsu Villages belonged to the typical "linear type" and formed straightforward stone fences in the forests, the other stone walls followed the village borders. It is noteworthy that although most villages had individual stone walls isolated from each other, the Shishigaki walls in Daimotsu, Minamihira, and Kitahira Villages were connected and formed a long and continuous stone fence throughout the three villages.

(3) Locations

Based on the cadastral maps, this study identified that the Shishigaki stone walls had been constructed mainly along forestry borders, and often stretched to the shore of Lake Biwa or farmland areas in deep forests. As a result, the overall elevation of the historical Shishigaki traces ranged from about 100 m near the shore of Lake Biwa to around 230 m in the forest of the Hira Mountains. Still, the elevation interval of Shishigaki relics varied in each village. In particular, our measurement surveys showed that Shishigaki relics that remained in Kido and Kitakomatsu Villages have experienced steep elevation differences over 50 m, from 180 m to 230 m, and from 120 m to 194 m, respectively, whereas the relics in Moriyama Village remained at nearly the same elevation, around 142 m.

3.2 Physical Features

(1) Materials

Locally quarried stones were used for the construction of Shishigaki walls. Therefore, granite stones were utilized in all villages except Moriyama, where only chert stones were available, although they were not ideal as construction material according to locals. Interestingly, both types of stones were adopted in Kido Village, as it is located in an area of transition from chert stones in the south and granite stones in the north (Fig. 1).

The general stone sizes measured approximately from 15 cm to 50 cm in height, while stones at 80 cm or 1m were partially utilized in some villages. In addition, stones were found in either naturally rounded or square shapes after processing.

(2) Structures

The height of Shishigaki varied from 0,4 m to 1,9 m in general, but the average height of those in good condition was about 1,0 m to 1,5 m. In addition, many of the stone walls were constructed in a trapezoidal shape with the bottom section (about 1,0m to 2,0m) wider than the top section (about 0,8m to 1,5m). All Shishigaki walls were identified as dry-stone walls without the use of soil to prevent the growth of vegetation and reduce weathering.

Specifically, three forms of stone masonry were observed: uncoursed rubble masonry "Tani-zumi" with stones piled up at a specific angle, coursed rubble masonry "Nuno-zumi" with stones horizontally aligned with an equal height of each layer, and random rubble masonry "Ran-zumi" (Fig. 5). Thus, "Tani-zumi" can create a more stable structure than "Nuno-zumi" due to the interactive pressure of stones on each other. "Ran-zumi", on the other hand, requires least skills, and stones of different shapes are piled irregularly. As a result, "Ran-zumi" and "Nuno-zumi" masonry were the common techniques used in the villages, whereas "Tani-zumi" masonry was only utilized in Arakawa and Minamihira Villages (Table 1). The mixed stone techniques were the result of the varying skills of local households, who were obliged to participate in the collaborative construction of Shishigaki. In addition, stone pillars with a height from 1,0 m to 1,4 m, were utilized in Kitahira and Minamikomatsu Villages.

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Among the villages, Shishigaki in Arakawa Village was constructed also using stone debris after it was damaged by a severe mudflow in 1945. The stone walls were then strengthened and utilized as countermeasures against further flood and mudflow attacks. Therefore, the Shishigaki relics in Arakawa village is well maintained compared to other villages and also locally well known.

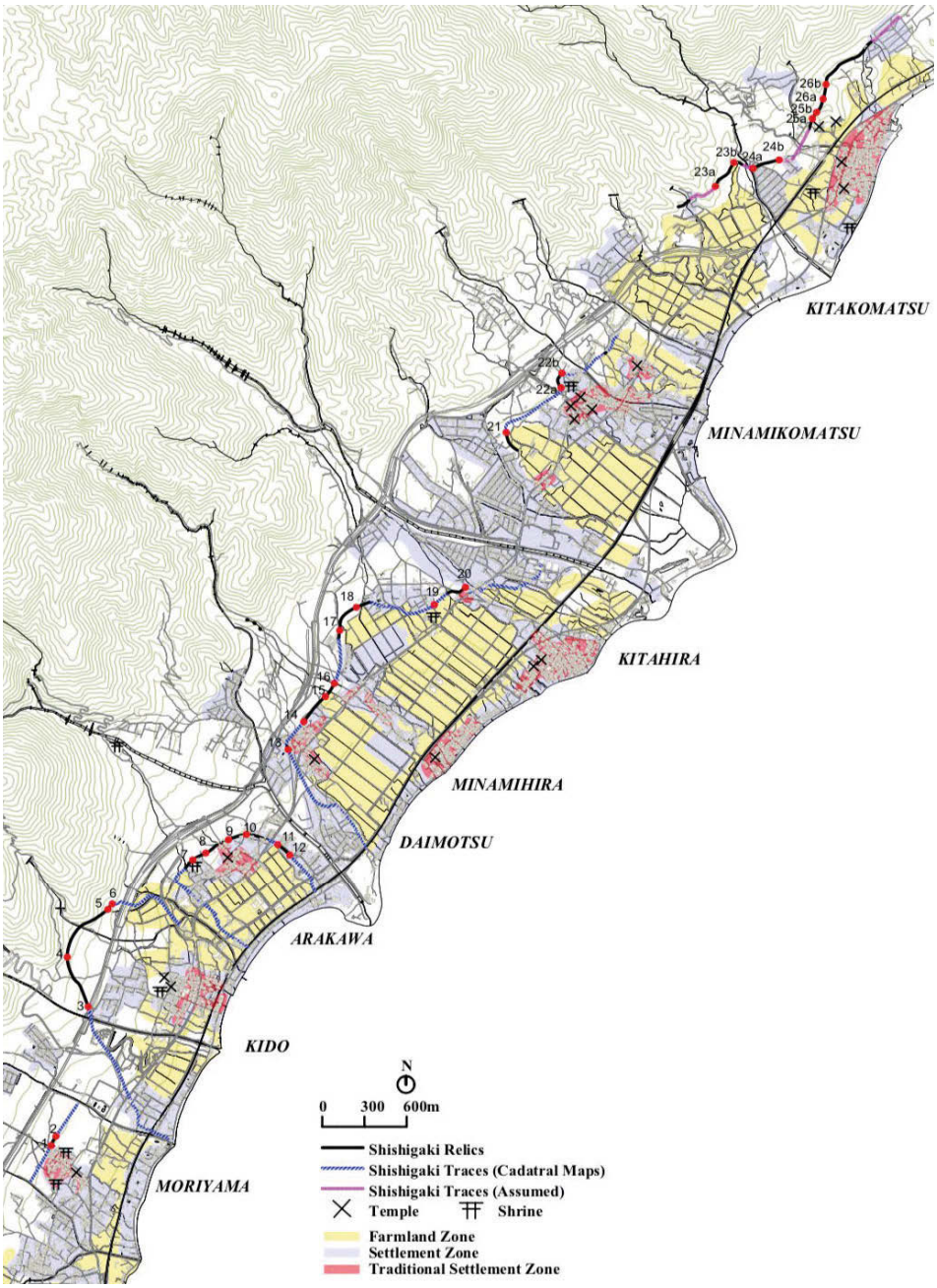

Fig. 4 Distributions of Shishigaki in Each Village

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4. Current Conditions and Causes of Damages

The expansion of farmland and residential areas has led to the demolition of Shishigaki walls with newly defined borders between forests and villages. As a result, some Shishigaki traces originally along the farmland are now found within the newly formed village areas, with a percentage up to 43,4%, and most of them are demolished (90,6%) (Fig. 6). In constrast, Shishigaki walls left in the forest survive with a higher percentage up to 53,4%, correspongding to a total length around 3829 m. Thus, loss of functionality as protection fences with the change of land use is considered as the main reason for the demolition of Shishigaki walls.

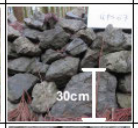
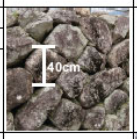
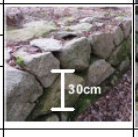
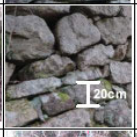
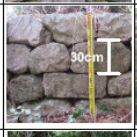
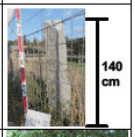
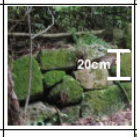
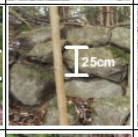
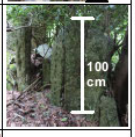
No.	Village	Length Current/ Total(m)	Elevation (m)	Height (m)	Width (Top) (m)	Width (Bot.) (m)	Conditions	Uncoursed Rubble Masonry/Tani-zumi	Coursed Rubble Masonry/Nuno-zumi	Random Rubble Masonry/Ran-zumi	Stone Pillars
1	Moriya-ma	76,0/ 633,4 (12,0%)	142,4	0,4	1,2	2,0	4. Barely Remained	-	-	-	-
2			142.8	0,5	1,2	2,0					
3	Kido	915,7/ 2708,8 (33,8%)	190,5	-	1,8	-	4. Barely Remained	-			-
4			230,5	1,1	1,1	0,6					
5			185,0	-	1,6	0,6-1,0	3. Partially Damaged				
6			182,0	1,1	0,7	-					
7	Arakawa	785,9/ 2042,6 (38,5%)	127,3	1,2-1,7	0,9-1,6		1		-		-
8			127,7	0,6	2,0	2,4	3				
9			121,5	1,9	1,2-2,0	1,7-2,0	1. Well Maintained				
10			116,9	1,2-1,3	2,3	2,3					
11			106,9	1,4	1,1	1,1					
12			99,0	1,0	0,6	0,6					
13	Daimo -tsu	221,6/ 1372,2 (16,1%)	124,3	1,2	0,5	1,3	2. Well Remained	-			-
14			124,6	1,5-2,0	-	-	3. Partially Damaged				
15	Minami -hira	536,9/ 1341,1 (40,0%)	121,8	1,4-1,5	0,7	0,7	3				-
16			124,3	0,8	0,9	0,9	2				
17			128,6	1,3	0,8	1,5	3. Partially Damaged				
18			122,2	0,5	1,2	1,2					
19	Kitahira	138,0/ 958,5 (14,4%)	113,6	-	-	-	4. Barely Remained	-			
20			114,3	1,0	0,9	1,0	2. Well Remained				
21	Minami-komatsu	305,0/ 1330,1 (22,9%)	111,6	-	-	-	4. Barely Remained	-			
22a			116,1	1,4-1,7	0,8	1,2	3. Partially Damaged				
22b			125,8								
23a	Kita-komatsu	1367,8/ 2291,8 (59,7%)	194	0,9-1,6	0,7-1,1	1,0-1,2	2	-	-		-
23b			155								
24a			130,5	0,5-1,4	0,7-0,9	0,7-0,9	3				
24b			120,9								
25a			128,3	1,0	-	-	2. Well Remained				
25b			163,3								
26a			157,4	1,6-1,8	1,4	-					
26b			157,1								

Table 1. Current Conditions of Shishigaki Walls in Each Village

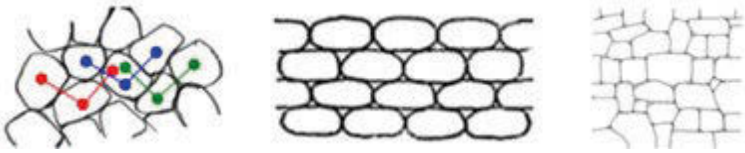


Fig. 5 Three Forms of Stone Masonry: (from left to right) Tani-zumi, Nuno-zumi, and Ran-zumi

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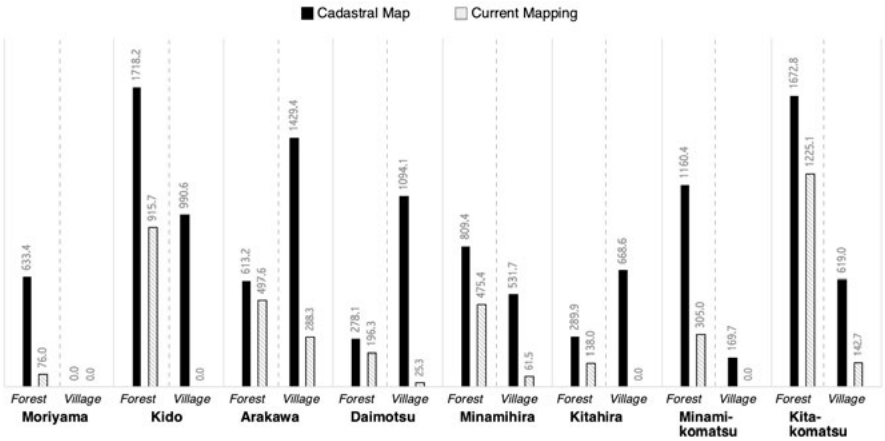

Fig. 6 Original and Current Length of Shishigaki Walls in Each Village (unit: m)

Specifically, stone walls in the forest are mainly found in Kido Village (915,7 m) and Kitakomatsu Village (1225,1 m), where large areas of farmland were once expanded into the forests. Thanks to the drystone technique, Shishigaki relics remain recognizable even under severe weathering, leaving a special scenery. However, in Moriyama village, even located in the forests, only 12% of Shishigaki walls remain (76,0 m), much lower compared to other villages. According to the interviews with locals, it probably resulted from the post-war poverty, during which Moriyama chert stones, appreciated as valuable stones in traditional Japanese gardens, were sold by villagers to the market.

Therefore, the current conditions and the cause of damage are very much related to the land-use change but also the economic activities of locals, which need to be recognized as a part of local history.

5. Conservation Strategies

Rural villages in Japan are facing issues such as aging society, depopulation, and rapid land development. It is necessary to consider feasible ways to maintain and utilize Shishigaki relics by developing dialogues with local communities, as values are made visible in learning from each other and sharing “the story of the landscape” (Lisitzin & Stovel, 2002).

Shishigaki walls have been promoted with varied methods in different regions of Japan. In the case of our study area, the strategies are proposed based on the geographical context.

Eco-tourism is considered a sustainable approach to preserve Shishigaki relics left in the forest, considering the reputation of Mt. Hira as a popular hiking spot. Currently, a non-profit organization established by the local residents is working on map production, showing walking, cycling as well as hiking routes for visitors, with special notes on existing stone monuments. It aims to promote visitors to travel around and experience the rich natural and cultural attributes of the area. Therefore, traces of Shishigaki relics are suggested to be integrated into the maps and mutual communication between researchers and residents can be achieved through the process of collaborative map-making. Visits to Shishigaki relics could add extra enjoyment for mountaineers and visitors, that not only enhance the recognition of Shishigaki walls as part of the cultural landscape, but also enrich the identities of Mt. Hira among the public and possibly create additional economic income for locals.

In particular, Shishigaki relics in Kitakomatsu Village are found right along installed hiking trails. Thus, we contest that coordination with the maintenance of existing trails could contribute to reducing the burden of maintenance of Shishigaki walls.

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6. Conclusion

With locally harvested chert and granite stones, or even disaster debris, villagers at the foot of Mt. Hira have collaboratively constructed Shishigaki drystone walls with a total length up to 12,7 km, stretching from the shore of Lake Biwa to the deep forest. Varied stone techniques were adopted, including uncoursed/coursed rubble masonry and random rubble masonry.

Currently, only about 4,3 km of stone relics remain, mostly in the forest. The main reason for the demolition of Shishigaki walls is identified as the expansion of village territory and land development. Still, seeing the popularity of Mt. Hira as a hiking spot, it is proposed that Shishigaki relics left in the forest could be integrated into existing walking, cycling, and hiking routes, through collaborative map-making with local residents.

6.1 Research Limitations

From village to village, different customs, livelihoods, and cultural traditions can be observed. Thus, research limitations mainly lie in the lack of detailed studies of Shishigaki walls in the context of each village individually and specific conservation strategies responding to their cultural identities.

6.2 Future Prospective

There is an emerging view of emphasizing the importance of all landscapes to their inhabitant as described in the European Landscape Convention, which encourages efforts to define heritage value presented in all landscapes and ensure their protection in development (Lisitzin & Stovel, 2002). Therefore, methods that are proposed by this research, namely heritage interpretation based on historical studies and conservation with community involvement, could be adopted in studies of cultural landscapes worldwide.

Acknowledgments

The author would like to thank the people of the Mt. Hira region for sharing their knowledge. This research was supported by the Research Institute for Humanity and Nature Eco-DRR Project (14200103).

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