LONG-TERM GIS ANALYSIS: YASHIKI-RIN AREAL CHANGES IN THE ISAWA FAN OF IWATE, JAPAN

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Abstract: Change in the area of Yashiki-rin is an important factor affecting the Yashiki-rin village landscape. This study used aerial photographs to evaluate the long-term change in the area of Yashiki-rin in Isawa Fan, Iwate Prefecture. Comparison in the Yashiki-rin area by household between 1968 and 1995 (1968 area / 1995 area) showed a ratio of 0.542 in Mizusawa-terrace, 0.847 in Horikiri-terrace, and 0.927 in Uwanohara-terrace. These figures suggest that the Yashiki-rin area decreased in all terraces between 1968 and 1995, especially in Mizusawa-terrace. More efforts are needed to preserve the Yashiki-rin village landscape.

Keywords: GIS (Geographic Information System), Isawa fan, Yashiki-rin, area, aerial photograph

1 Introduction

Yashiki-rin [1, 2] are forests formed to surround houses, many of which consist of human-planted trees. The roles of the Yashiki-rin are to protect the houses and their additional spaces from cold winter wind, hot summer wind, and sandblast. Therefore, Yashiki-rin can be considered as similar to hedges (Figure1).

This study examines Yashiki-rin distributed in Isawa Fan, Iwate Prefecture [3]. The area mainly comprises the highly natural and relatively large Yashiki-rin, which are characteristically categorized as Igune Type.

The Isawa Fan (Figure2) is surrounded by the Isawa, Koromogawa, and Kitakami Rivers. It forms a triangle that is dissected by numerous terraces. The vertical interval of the neighboring terraces is small, about 1-10 m, low in the north side and high on the south side.

The Isawa Fan comprises these four chief terraces (Figure 3), each of which are called Mizusawa-terrace, Horikiri-terrace, Uwanohara-terrace and Isshuzaka-terrace from lower north to upper south. All terraces but the Isshuzaka-terrace have Yashiki-rin.

Aerial photographic observation shows that great differences exist in the types and scales of this Yashiki-rin (Figure 4). For that reason, in a previous report [4], we implemented fieldwork and analysis using a Geographic Information System (GIS). Results indicated that, compared with Mizusawa-terrace, in Yashiki-rin of Horikiri and Uwanohara, the individual density of arboreal vegetation is higher and the size is significantly higher (Figure 5, 6).

Variation reportedly exists because of different water-supply environments and historical development.

The Yashiki-rin size can be regarded as one of the most important factors determining the area’s landscape. Therefore, this study aims to clarify the long-term change in the size of Yashiki-rin in Isawa Fan by analyzing aerial photographs of 1968 and 1998 using GIS.

2 Examining Materials

The following materials regarding the Isawa Fan, Iwate were examined for this research.

- Materials gathered from fieldwork (501 samples of Yashiki-rin houses)
- A 1/25,000-scale digital map (CD-ROM pub-
3 Method of Research

3.1 Fieldwork

Fieldwork was implemented by Takehara and others beginning in the summer-autumn, 2000 [4]. Yashiki-rin were observed from the outside along with Prefectural and Town Roads running from north to south in the area of the Isawa Fan. The types of Yashiki-rin and the plants (heights were recorded for each household. Locations of the houses were indicated on a residential map (ZENRIN Residential Map 2000, Isawa-Kanegasaki Township).

After fieldwork, the assembled data were organized using tabulating software to prepare them for eventual use with GIS software.

The Yashiki-rin to be examined in this study are the same as those of the previous study. This time we used location information of the houses out of all collected data in that previous study.

3.2 GIS Analysis

ArcView 3.2 (ESRI, Redlands, CA) was used as GIS software for this study. We created a Project, a term used in ArcView to describe one session unit for GIS processing.
3.2.1 Creating a Project for ArcView

First, a base map was loaded into the software. This study used a 1/25,000 digital map (Map Graphic Data) distributed by Geographical Survey Institute. This is a digital data with scanned pictures of paper maps published by the Institute and stored as a raster-type file.

We added the coordinate data to the Map Graphic Data 25000 and converted its file type so that the data are viewable using ArcView.

ArcView 3.2 itself, Spatial Analyst - an ArcView option as well as an extension (img25k30.avx) for map graphic support distributed by ESRI for free were used for file conversion. The translated files are not a commonly used picture type; instead, they are GRID type file that is used uniquely for ArcView.

Colors for the feature (map components for buildings and roads) can be changed according to the use. Providing that this map data is overlapped with aerial photos eventually for this study, we changed the white color for the background into transparent, and gray for roads into orange.

It is possible to extract parts of maps according to their respective properties and translate them into shape files (vector files for ArcView) and create individual layers. This was not conducted because it is unnecessary for this study.

Projection setup

After changing the map graphic data into ArcView GRID, UTM was set as the map projection to measure distance and size with the UTM54 Zone that covers the study area.

Writing the Yashiki-rin points

A layer for points (Theme) was set on the GIS software view screen; Yashiki-rin points were recorded on this layer by referring to the points of Yashiki-rin locations.

Using an attached ArcView script, numbers were given to each point and X/Y coordinates were calculated.

Loading and Correcting Aerial Photographs
Aerial pictures photographed in 1968 and 1995 (black & white monochrome) were loaded. The resolution was 300 dpi; unneeded parts were cropped using image-processing software.

Because the aerial photography itself has no coordinate attribution, it is necessary to overlap the digital map so that coordinate information can be used on the aerial photo layer.

For this, each of four anchoring points were chosen for both the aerial photo and digital map; and each was overlapped in piles and, simultaneously, the coordinates were given and pictures were manipulated (Figure 7).

Then, a layer in which different photos were gathered into one image with a Mosaic function was also created.

□ Loading a Terrace Distribution Map (Figure 3)

As for the aerial photographs, a loaded terrace distribution map was overlapped with a digital map. To run a transparency process for the distribution map [3], the color map was changed drastically.

By overlapping this data with Yashiki-rin distribution map, it is easy to determine to which terrace each Yashiki-rin belongs.

□ Yashiki-rin selection (Figure 8)

Yashiki-rin images were extracted from the aerial photographs based on the recorded points.

On the aerial photo overlapped with the digital map, the Yashiki-rin locations were extracted using ArcView 3 polygon function, and new layers were created for Yashiki-rin found in 1968 and 1995.

Before the calculation, Polygon Numbers and X and Y Coordinates were given to the Yashiki-rin polygons using ArcView 3.2 script. Property information was thus created on these two new layers.

While showing the terrace distribution map on the screen, color-coding was made to the respective Yashiki-rin based on the corresponding terrace categories.

3.2.2 Analysis with ArcView

The following analysis was made using ArcView Project created as mentioned previously.

Calculating the size of each Yashiki-rin of 1968 and 1995 by terrace and examining the difference in the mean value of Yashiki-rin sizes, we examined whether or not a statistically significant difference existed in the average size of Yashiki-rin for each terrace.

4 Results

Average sizes by terraces of 1965 and 1995 are shown as follows (Table 1).
Comparing those in 1968 and 1995, the number of Yashiki-rin was slightly higher in the Mizusawa-terrace; it tended to decrease but the number was almost constant in the other two terraces.

Comparing differences of Yashiki-rin sizes by household for sampling houses in the Isawa Fan in 1968 and 1995 (1995 size/1968 size), it was found that the Mizusawa-terrace was 0.542, the Horikiri-terrace was 0.847, and Uwanohara was 0.927: all showed a downward trend.

In the Mizusawa-terrace in particular, a statistically significant difference was found: the higher the terrace was located, the lower the decrease in the Yashiki-rin size.

Comparison of the total sizes of Yashiki-rin of 1968 and 1995 (1995 size/1968 size), 0.630 was for Mizusawa, 0.834 for Horikiri and 0.914 for Uwanohara terraces, again with a higher terrace for less size reduction.

5 Discussion

This study examined the change in the Yashiki-rin sizes in Isawa Fan in 1968 and 1995 using a Geographic Information System. Results illustrate the considerable decline in Yashiki-rin size in Mizusawa-terrace. Here, we discuss what factors contributed to the drop off of Yashiki-rin there.

5.1 Change in Significance of Existence of Yashiki-rin

Traditional purposes of having Yashiki-rin include the following [5].

(1) Function as a windbreak forest
(2) Function as a protective barrier against fire
(3) Functions to supply lumber or bamboo materials or to provide fuels and fertilizers
(4) As sunshade during the summer (trees such as zelkova with widely-spread branches)
(5) As food storage (foods such as vegetables are buried near the roots of the trees; the practice is still carried out)
(6) To flaunt the authority of the family through alteration of the landscape

Purpose (1) is the main reason for the continuous

| Table 1: Change in Yashiki-rin Sizes by Household in Isawa Fan (m²) |
|---------------------|---------------------|---------------------|
|                     | 1968     | 1995     | t-test   |
| Mizusawa-terrace    | 803.5    | 435.3    | 6.13(**) |
| n                    | 190      | 221      |          |
| Horikiri-terrace     | 2148.4   | 1820.2   | 1.44     |
| n                    | 194      | 191      |          |
| Uwanohara-terrace    | 1700.2   | 1575.3   | 0.53     |
| n                    | 76       | 75       |          |

(**) p < 0.01
existence of Yashiki-rin up until now. Reason (3) was important in the past, but has lost its functional importance.

Reason (6) has changed from its original purpose; it has been replaced with greater concern for environmental protection. Although it is still an important factor to maintain trees for some people with high consciousness, it is estimated that there are many others who do not take the demonstration of authority seriously.

In this way, the meaning of Yashiki-rin has changed considerably.

5.2 Causes of Decline in Yashiki-rin Sizes in Isawa Area

It is considered that the following factors have jointly contributed to the decrease of Yashiki-rin size.

1. Change in lifestyle (no longer using firewood and fallen leaves)
2. Extension or reconstruction of homes
3. Expansion of agricultural land
4. Widening and building of roads
5. Improvement work in rice-paddy zones

Yashiki-rin were essential for the lives of the dwellers of plains and agricultural villages in the time when roofs were made of pampas grass or phragmites with the high possibility of decay caused by strong winds and drying. However, changes in roof materials to tiles and galvanized iron, improved airtightness using metal sash windows, mechanization of agricultural equipment, the fuel revolution as well as introduction of chemical fertilizers have all altered agricultural villages to a form that does not necessarily require Yashiki-rin [2].

It is reportedly often the case that unnecessary Yashiki-rin trees are cut down and cleared out nowadays during housing extension and reconstruction [6].

In addition, it is also pointed out [2] that most of Yashiki-rin disappearance is occurring in the outskirts of an urban areas along with housing and industrial site development.

Throughout the Isawa Fan, the area of Yashiki-rin has continued to decrease. Possibly, the most important cause of this decrease is extensive land development projects that have continued since 1954. In this project, farm field improvement for large zones and building and improvement of waterways and roads have been implemented to accommodate mechanization of agricultural equipment. During the course of this project, even though the houses were not forcibly moved, some parts of the housing complex were delivered as alternative areas to new roads and expanded roadside slopes, thereby engendering the cutting down of Yashiki-rin, and the consequent decrease in the Yashiki-rin area.

Furthermore, the change of the family structure has engendered building of new housing within the same compound. It has also caused the tendency of an increase to the partitions of existing houses. These have contributed to the deforestation of Yashiki-rin as well as the creation of kitchen garden and western garden instead. Such changes of the circumstances of the farmers are more obvious in the area closer to the urban area. Therefore, this can be associated with the high attrition rate in Mizusawa-terrace. The progress of urbanization is promoting the formation of new residential areas; amusement establishment and business district are being formed along with newly built roads. In addition, the area of traditional houses itself is decreasing with the farmland area.

5.3 Increase in the Number of Yashiki-rin in Mizusawa-terrace

While the total area of Yashiki-rin has decreased in Mizusawa-terrace, between 1968 and 1995, number of houses with Yashiki-rin have increased with 31 more households - a 16.3% increase.

This increase in the number of Yashiki-rin is attributable to the following factors.

1. Increase of the compound houses and Yashiki-rin
2. Simply, the Yashiki-rin were formed until 1995 in houses without Yashiki-rin in 1968.

In fact, as mentioned in 5.2, the land improvement project was progressed in Mizusawa-terrace with newly established roads within the housing premises; the
houses have been split up accordingly. Moreover, the family structural change has driven the move toward housing division, which has increased the number of homes. Among these split houses, Yashiki-rin has existed in the farming families; after the breakup of the homes, they have retained the Yashiki-rin, and by adding small-scale Yashiki-rin for their own houses, thereby increasing the number of Yashiki-rin. In contrast, Yashiki-rin was not found in the newly developed houses because of urbanization, which does not contribute to the increase of Yashiki-rin.

Additionally, the number of houses that formed Yashiki-rin after 1968 were few because the significance of having Yashiki-rin back in 1968 was already low. Therefore, it is predicted that few Yashiki-rin will be formed in the future.

6 Conclusions

It was found that the area of Yashiki-rin in Isawa Area has a downward trend, especially in the Mizusawaterrace. It is considered that the massive labor and financial cost to maintain the Yashiki-rin are associated with the decline in those areas.

However, it is important to preserve Yashiki-rin for the environmental protection of this area and its surrounding districts. It is even more vital for the promotion of tourism in Isawa Fan; for that reason, an active preservation policy is needed for the future.

Nevertheless, the preservation movement is not put into actual practice by the township as a whole, and the Yashiki-rin are barely preserved by the senior citizens’ consciousness and voices, stating it would be shame to lose them in our generation. Ideas of the Mayor do not include concerns about farmland landscape and Igune (Isawa Township Website).

Therefore, to preserve Yashiki-rin, its importance from the outsiders and travelers’ perspectives should be reconsidered. Because Yashiki-rin are private property, we are not allowed to force owners to maintain the forests. Consequently, firm strategies are needed to raise awareness among the residents (especially that of younger generations). It is hoped that they will become increasingly aware of the magnificence of Yashiki-rin.

References


