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The Minabe-Tanabe Ume System: Linkage of Landscape Units by Locals

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Abstract: This paper focuses on the Minabe-Tanabe Ume system, which was designated as a Globally Important Agricultural Heritage Systems (GIAHS) in December of 2015. Because landholdings reflect historical social connections among various landscape units, we quantitatively examined the landscape characteristics of the system by preparing digitized spatial data and performing geographic information system analysis. We also examined the consensus building process among different stakeholders toward GIAHS recognition, as well as the emergent local spatial structure of the stakeholder network through interviews with key stakeholders and participatory monitoring. Our spatial analysis of the landscape generally supported the traditional knowledge of the area as a watershed-based mosaic of coppice forests on ridges, Ume orchards on sloped areas, and villages with rice paddies and dry fields in the plains. Our stakeholder network visualization identified several key persons as important nodes that could connect different types of land use now and may have done so in the past. Moreover, because our GIAHS site has compact agglomerations of watersheds with ranges within a ~30-min drive, most stakeholders, who turned out to have graduated from the same local school, are able to maximize their social capital to reorganize the remaining nodes among different land uses, thereby contributing to the formation of the land-use system and its further promotion through dynamic conservation measures.

Keywords: GIAHS; Minabe-Tanabe Ume System; GIS; parcel dynamics; stakeholder network; dynamic landscape conservation

1. Introduction

In monsoonal Asia, rice cultivation has long been at the core of society, culture, and land-use systems [1]. Rice fields have played important and essential roles in the land-use system and provided various services that are important to the ecosystem [2]. Moreover, rice cultivation could serve multiple functions for the ecosystem, not only within rice plots [3] but also through linkages with surrounding landscape patches [4], thereby contributing to long-term sustainability of the land-use system as a whole. Among rice-dominant monsoonal Asian regions, Japan, owing to its insular landform condition with narrow plains surrounded by hilly and mountainous areas, is typical in having various types of long-standing landscape patches with rice fields as core elements. This type of land-use system with a variety of landscape patches is considered a typical traditional rural landscape of Japan. In recent years, the Japanese term for this landscape, Satoyama, has become internationally recognized [5].

This Satoyama landscape has been studied from various viewpoints. A study of long-term changes in land-use using geographic information system (GIS) data revealed that this landscape used to be quite dynamic, with rice, other vegetable crops, and forests sometimes cultivated reversibly in the same plots over time [6]. A quantitative study of traditional Satoyama land-use patterns in connection to micro-landforms also found that sequential landscape patches used to consist of valley rice fields, with surrounding grassland used for fertilizer and coppice forests used for fuel, showing a possible pattern of traditional recyclable utilization of bioresources at the village scale [7]. Particularly when fossil fuel use became much more common after the 1960s, such traditional dynamic Satoyama landscapes came to be underused and were eventually abandoned [6]. Hence, recent research has mostly focused on how to revitalize these Satoyama landscapes and maximize ecosystem services by involving various stockholders, including urbanites [8]. These studies have assumed that such a traditional land-use system of self-sufficient core rice cultivation (with surrounding grasslands and forests) was almost the only indigenous agricultural system in Japan, and that it inevitably deteriorated with the increase in the use of fossil fuel, industrialization, urbanization, and other profitable job opportunities that provided economic growth recently in Japan [9].

It is said that agriculture has been modernized and diversified through developments in agricultural technology and in response to socioeconomic transitions. Particularly in rural areas, where there are few new job opportunities other than those in agricultural sectors, this might weaken linkages among different landscape patches, and thereby, reduce the flow of bioresources and people. In addition, land-use actors might tend to specialize in a single agricultural or forestry product to improve their profitability and living standards [10]. Some studies have focused on such individual agricultural and forestry sectors from the perspectives of agricultural geography [11,12], agricultural economics [13], and the landscape approach [14]. However, almost no study has sought to quantify the spatial and physical relationships between landscape patches and the possible remaining human linkages among them in areas where such agricultural and forestry sectors still survive and function as the center of a local economy.

Here, we focused on the Minabe-Tanabe Ume System area in central Japan, which was designated as a Globally Important Agricultural Heritage Systems (GIAHS) by the United Nations Food and Agriculture Organization (UN FAO) on 15 December 2015. GIAHS was defined as "remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development" and started in 2002 [15]. Using this newly recognized GIAHS area as an example of a land-use system in which rice cultivation, orchards, and forestry are still major economic sectors, we addressed three questions: (1) What are the physical landscape patterns and spatial units of the landscape patches for these different sectors? (2) What social and human interfaces actually and potentially remain among these landscape patches? (3) What further linkages between these patches will emerge through the GIAHS designation, and which components of institutional support could be helpful for future linkages to revitalize the area and local economy toward a sustainable society?

Answering these questions may also lead to practically useful insights on GIAHSs in general. Although the GIAHS scheme places a major focus on land-use systems [15], quantitative evidence and research on landscape and/or land-use systems remain sparse, with existing studies focusing only on the sectoral local economy [16]. By quantitatively analyzing landscape patterns and monitoring the linkages between different sectoral stakeholders participating in the process of GIAHS application, this study may also provide a visible example of the relationships between the physical land-use systems, human interfaces, and institutional supportive mechanisms that are needed to sustain an agricultural land-use system in the long term. Thus, our study may be useful for new GIAHSs and other candidate place-based schemes.

2. Methods

2.1. Study Area

The Minabe-Tanabe Ume System is located in the Southern part of the Kii Peninsula in central Japan (Figure 1). The climate in this area is humid and temperate, with an average temperature of 16.6 °C and annual precipitation of about 2000 mm [17]. The GIAHS site had a population of 79,563 in

2010 [17] and covers all of Minabe Town and the Western part of Tanabe City (the original Tanabe City area). Unlike other large cities in Japan (including Tokyo and Osaka) that have relatively large alluvial plains with historical rice-producing land and many original populations, the Minabe-Tanabe area has a limited area of plains surrounded by hills and mountainous areas with relatively flat ridges and steep slopes [18] (Figure 1). The middle of this area, in particular, is covered with marine sediments, in the form of fragile mudstones (Figure 1).

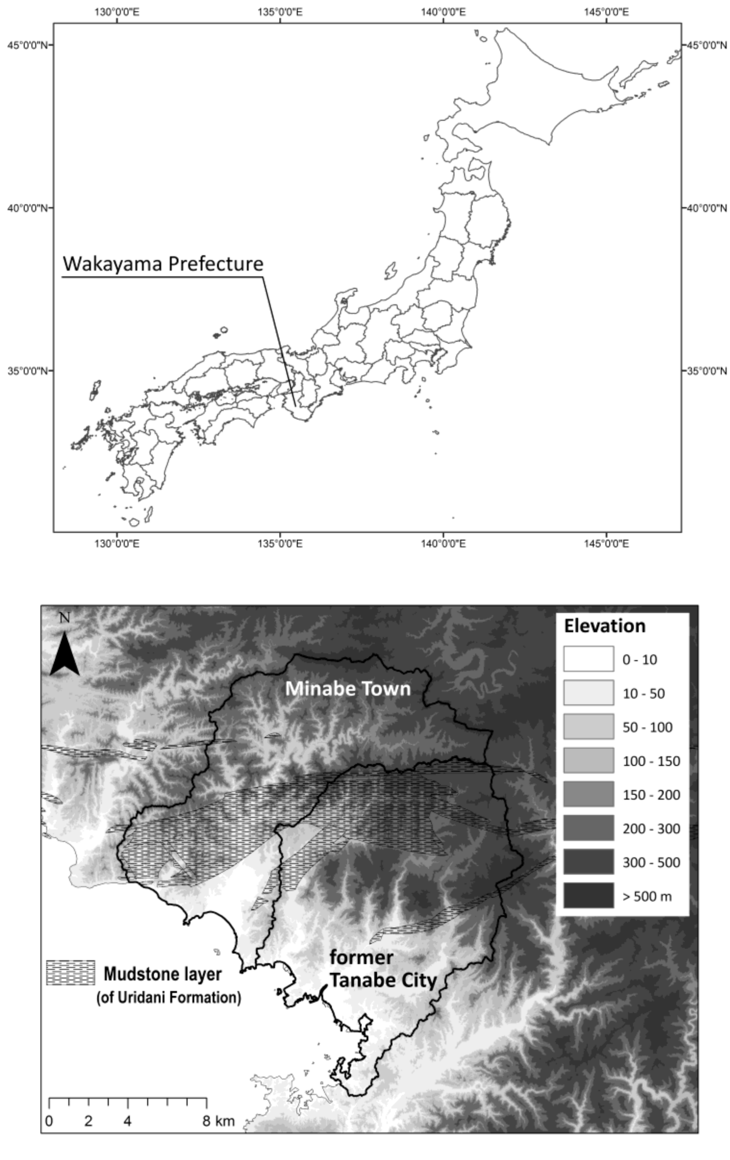

Figure 1. Study area.

Hence, this area, with the exception of the limited valley plains, was inherently unsuitable for rice production, which served as the base of the Japanese economy until the Edo Period (1603–1868). To improve their lives, the inhabitants of the region turned to the production of Ume (*Prunus mume*, Japanese apricot) about 400 years ago as a crop that could be cultivated on this terrain, while preserving and utilizing the surrounding mixed woods as coppice forests. By maintaining the woods around the Ume orchards and along the ridges of steep slopes, the inhabitants have helped to conserve watersheds, supply nutrients, and prevent slope collapse, thereby supporting Ume production (Figure 2). Allowing grass to grow in Ume orchards also prevents soil desiccation and erosion, and mown grass is returned to the soil to fertilize the Ume. Moreover, coppice forests are a habitat for

Japanese honeybees (*Apis cerana japonica*), and the local inhabitants have long used a unique type of beehive to attract these bees and enlist their help in pollinating the Ume. At the same time, Ume trees are a valuable source of nectar because they bloom in early spring and help colonies get off to a good start. Because various coppice forest trees and shrubs that flower after Ume trees are also nectar sources, the honeybee population is maintained by a year-round supply of nectar and pollen from a large variety of vegetation types (Figure 2).

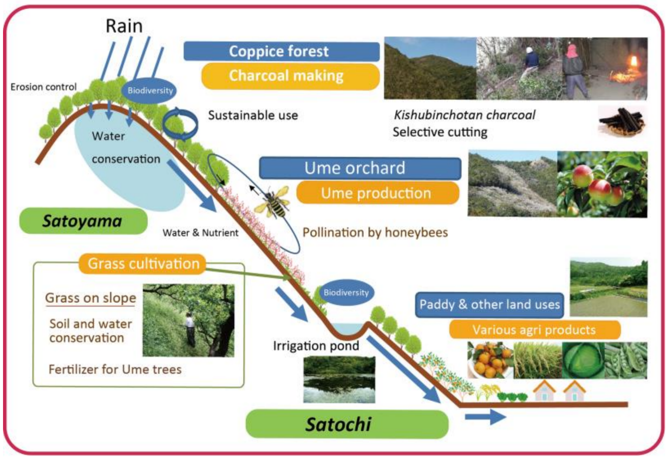

Figure 2. Description of the Ume System model in the official Globally Important Agricultural Heritage Systems (GIAHS) proposal [17].

2.2. Research Design

Figure 3 shows a flowchart of the research procedure, which consisted of two parts. The first involved a spatial analysis of land parcels, considering historical land ownership records in addition to watersheds as historical landform units in the area. The second involved interviews with key local residents identified through field investigations, and considered the GIAHS application process as a local consensus building process. The interview results could also support the land parcel analysis, especially in validating traditional land parcel management practices and personal linkages between various surrounding land uses.

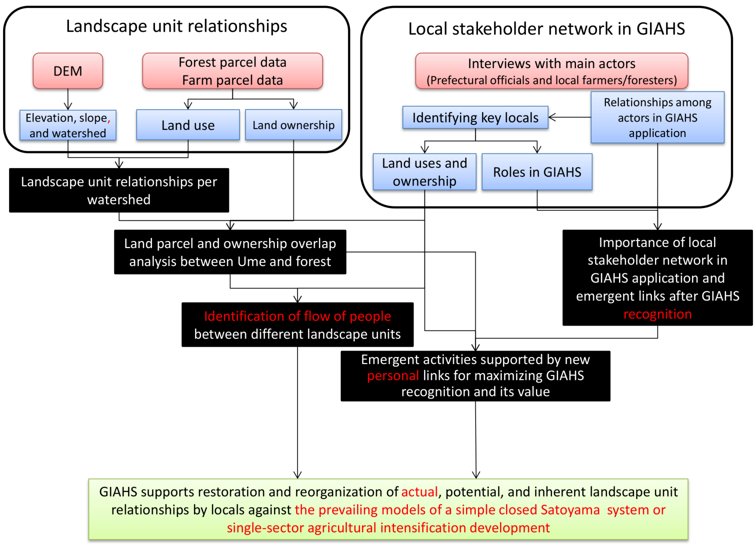

Figure 3. Flowchart of research procedure.

2.3. Quantitative Landscape Pattern Analysis

2.3.1. Data Sources

We visited the Wakayama Prefectural Government office in May of 2015 to obtain a parcel-based land-use dataset. Data on agricultural land-use parcels are managed by the agricultural section, whereas forest parcel data are managed by the forestry section, and it took some time and effort to go through the administrative procedures needed to acquire the data, even though both offices were located in the same building in the prefectural government hall. The agricultural parcel-based vector dataset covers areas with farmlands and villages, and the forest parcel data covers forested area. However, sometimes they slightly overlap (Figure 4). This is rooted in a fundamental problem of landholding and cadastral mapping in Japan. Lack of, and inaccuracies in, cadastral surveys and parcel-based mapping have been major obstacles to land-use research, land-use management, urban planning, disaster reconstruction, and other land-related issues [19]. Indeed, even now, many land property tax assessors in Japan use cadastral maps that were surveyed during the Meiji Revolution (1868) for legal processes [20]. Given this historical context, the data we obtained and used were reliable and almost the only data on land parcel use in rural Japan.

Next, we focused on this parcel overlap with historical meanings of sociocultural proximities between these parcels. When the cadastral mapping of the Meiji Revolution was conducted, many people sought to minimize their land tax by misrepresenting their parcel boundaries [20]. In addition, because the survey methods at the time were inaccurate, the cadastral parcel data had inherent inaccuracies. Therefore, it is also possible to regard parcel overlap as an indicator of physical and sociocultural linkages between these parcels and the people who managed them historically [20]. We proceeded with our spatial analysis below by considering this point. To investigate landforms, we downloaded and used a digital elevation model (DEM) dataset with a resolution of 10 m [21] for the study area.

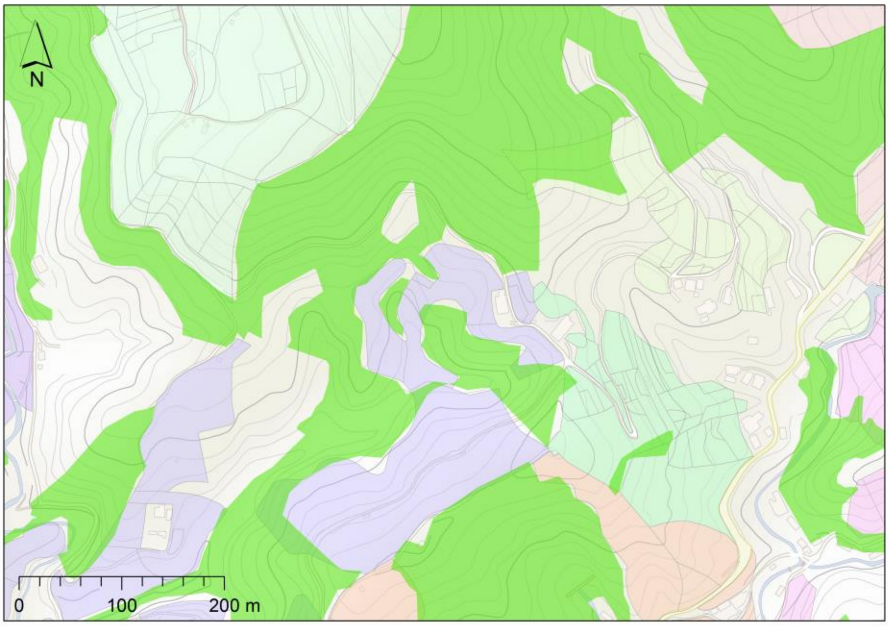

Figure 4. Example of geographic information system (GIS) parcel data showing boundary overlap between forest (light green) and farm parcels (various other colors according to land ownership).

The data obtained from the agricultural section in the Wakayama Prefectural Office did not contain detailed definitions of land use. It included only rice field and dry field as attributions; there were no attributions for Ume and other type of orchards (e.g., citrus). Hence, we used Google Earth images and street view interpretations, as well as field variations of aerial drone images on several days in different seasons during 2015, to add Ume and citrus as new attributions to the agricultural parcels. We used the unique tree-planting patterns and blue sheets used for collecting Ume fruit (Figure 5) to ensure that our visual interpretations were reliable. Through this process, we found that some parcels were used for several purposes other than Ume (e.g., grasslands, vacant spaces, small greenhouses, and temporal shacks). We also found large-scale artificial pilot Ume orchard farms based on the cut-and-fill method. Therefore, we defined 100% Ume by the cut-and-fill method, 100% Ume, 75% Ume, 50% Ume, 25% Ume, and other orchards (e.g., Citrus) as new potential attributes for all 35,299 parcels. The forest data were detailed, including crown-dominant trees, as an attribution, which we used for our basic spatial analysis.

Figure 5. Typical drone image of the landscape in the area showing the dynamic land-use pattern and blue sheets used for harvesting Ume.

2.3.2. Quantifying the Paddy-Ume-Forest Relationship

Using these data, we first mapped these land uses onto the DEM-generated surface relief map. We also selected parcels overlapping with coppice forest among the Ume 75%, 50%, and 25% attributes and mapped them onto the surface relief map to evaluate the aforementioned overlap between these areas, which may indicate a close sociocultural relationship between Ume orchards and forest areas. In the spatial analysis, we calculated basic parcel indices, including total area for each land use, number of parcels, and average parcel size, as well as the standard deviation and average of slope and elevation (calculated by overlaying parcel data onto the DEM-based surface terrain).

Next, we conducted a watershed unit-based analysis to evaluate the GIAHS application proposal describing the ridge (coppice forest)—slope (Ume)—valley bottom (rice and village) model. First, we generated watersheds for our entire study area, using a 10-m resolution DEM and GIS data, including watersheds without actual surface water flows. In all, we identified 1317 watersheds in the area. Then, we overlaid these watersheds onto the two selected land uses—Ume orchards (excluding cut-fill) and coppice forests—and obtained and visualized the land-use ratio per watershed. We used ArcGIS 10.2 and Microsoft Excel 2010 to conduct this analysis.

2.4. Identifying the Flow of People between Different Land Uses by Paticipatory Monitoring and In-Depth Interviews

To grasp the exact locations of landscape patches that respondents linked, we used a participatory and in-depth interview approach, instead of online and/or mailed questionnaire surveys, which cannot reveal detailed spatial locations. Our interview approach also allowed us to grasp past and present personal links in bioresource utilizations between different agricultural and forest landscape patches [9,22]. In selecting sample informants who would provide detailed information including private livelihood issues, we maximized the position of the first author, who has been involved as a scientific advisor since the beginning of the GIAHS application process in 2014 [23]. The first author, together with three Wakayama Prefectural officials who had served as core members since the beginning of the application process, functioned as entry points for our snowball sampling, which is be a suitable sampling method for investigating both land uses and stakeholders [24,25]. The GIAHS scheme strongly focuses on the land-use system; hence, we sought to identify key informants in each land-use type from the initial stage. It also emphasizes the importance of indigenous local knowledge; therefore, we focused on identifying locals who had sufficient knowledge about their landscape elements, as well as past and present flows of people between different landscape patches. We spent nearly 2 years (with monthly field visits) identifying key local informants for each landscape element through snowball sampling within the GIAHS area, and then prepared a draft of the stakeholder network. To further structuralize identified stakeholders, we revalidated its reliability with the abovementioned Wakayama Prefectural officials. After refining the stakeholder network structure, we visited the drafted stakeholders and interviewed the local stakeholders identified as part of the network structure to validate its reliability.

As a result, we identified six key informants (who also played important roles in the field during GIAHS field evaluation on May 2015), including four Ume farmers, one forest association head, and one charcoal maker. We interviewed these informants in the field for an hour while walking with them in each landscape element, with the digital maps we had created and an iPhone7 for recording in hand. We asked the informants about the following:

- Their background in livelihood and agricultural activities
- Relationships with different landscape elements upstream and downstream from their base patch
- Communications, human flows, and material flows, both current and past, between different landscape patches nearby and remote
- Indigenous knowledge about utilization of the land-use resources and total land-use system they own
- Difficulties they currently encounter in managing their land use and the wider land-use system
- What they expect to gain from GIAHS designation in relation to their land use and land-use system management
- Whether they were familiar with one another
- Whether the GIAHS application process could result in new personal linkages

Moreover, we verified whether they frequently accessed the locations and landscape patches, as indicated in the created maps. After these interviews, we mapped their base landscape patches and frequently accessed patches. We also evaluated the changes in human flow between different landscape patches through our interview results and an examination of historical documents.

3. Results and Discussion

3.1. Landscape Patterns, Landforms and Watersheds

Figure 6 shows our landscape mapping results for Ume and rice, and Figure 7 shows the corresponding results for forests. Comparing these two maps, we can see that these three landscape elements are complementary, in accordance with landforms. The landscape pattern of ridge (forest)-slope (Ume)-valley bottom (rice) is visible, which is consistent with the description of land use at this site in the official GIAHS proposal (Figure 2). Table 1 shows quantitative evidence of this landscape pattern. It shows that Ume is located on steep slopes at a middle range of elevation, whereas forests are situated at higher elevations. Forests are also located on steep slopes, but on higher landforms, including ridges (Figure 7). Because of the 10-m DEM resolution, narrow mountain ridges cannot be detected as flat spaces by our spatial surface analysis, and hence, this result could be consistent with the official proposal statements that emphasize ridge forests. Rice is clearly located on flat landforms at low elevations. These results clearly show that the landscape pattern in this area is entirely different from the typical self-sufficient rice-based Satoyama landscape, in which rice paddies in valleys are surrounded by coppice forest and grassland [5,7].

Table 1. Parcel characteristics.

Land use	Total Area (ha)	Numbers of Parcels	Average Parcel Size (m^2)	Standard Deviation	Average Slope (Degree)	Average Elevation (m)
Ume natural	5142	31,317	1644	7457	15.8	90
Ume cut and fill	70	607	1281	3461	14.3	182
Rice	479	7249	661	589	7.5	75
Coppice forest	6149	5948	10,338	21,983	27.7	190
Conifer plantation	6203	8952	6930	12,458	29.1	199

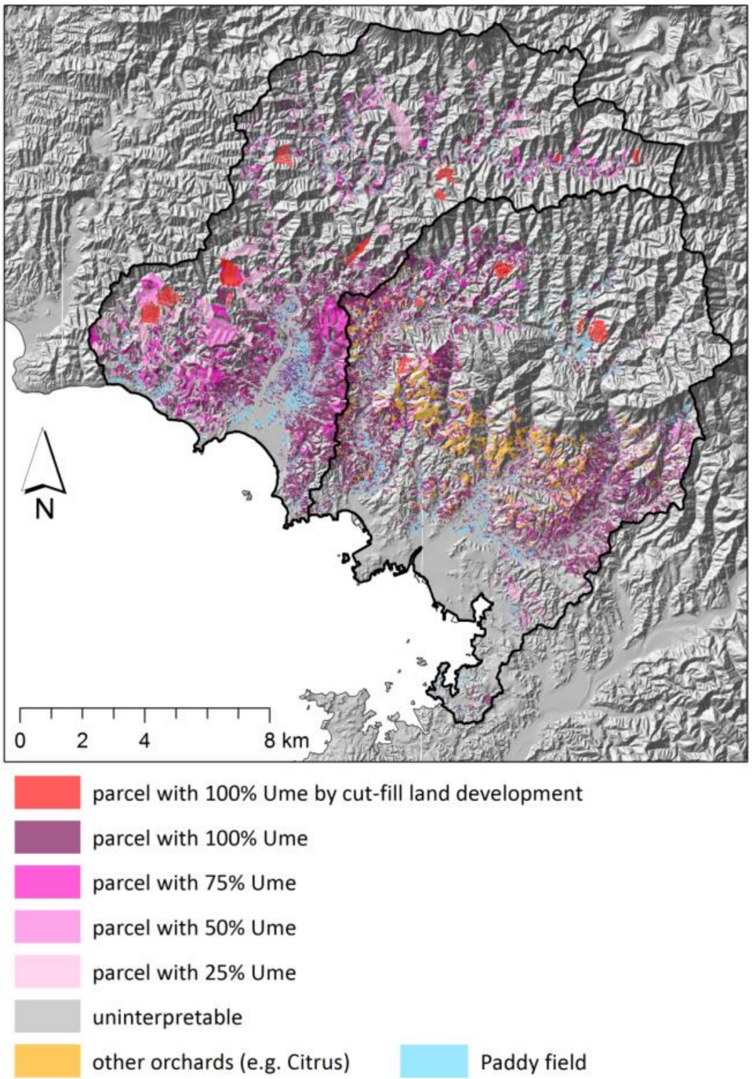

Figure 6. Map of Ume and rice parcel distributions.

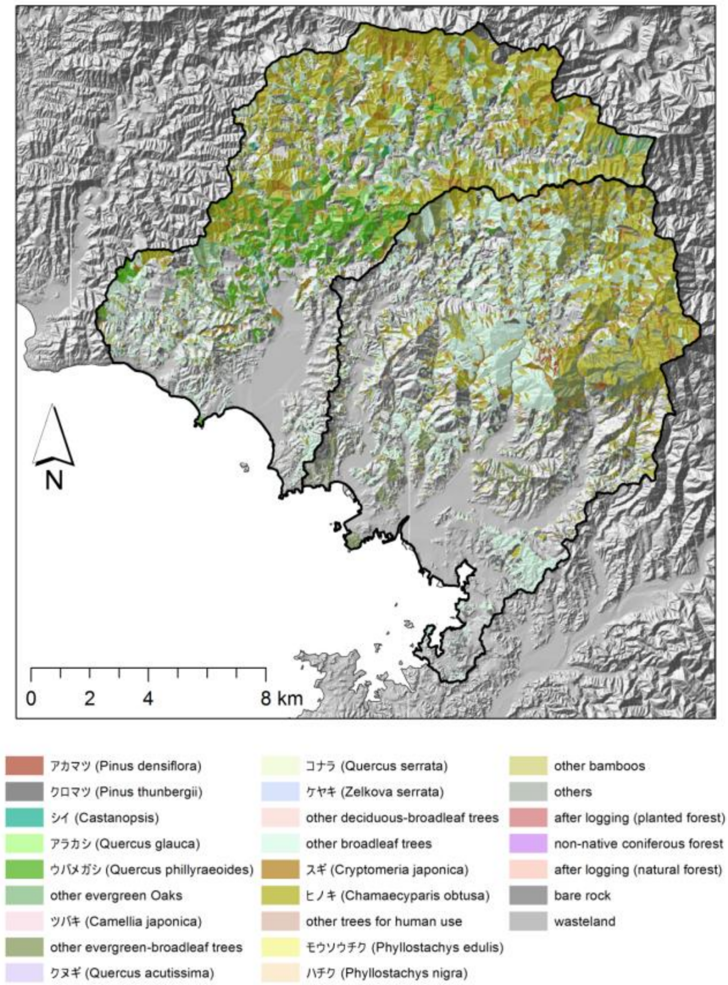

Figure 7. Map of forest parcel distribution.

Table 1 also summarizes the parcel characteristics. As in the example shown in Figure 4, our study area is characterized as an agglomeration of small and especially private land parcels, much like in other Japanese regions. Indeed, the average size of a forest parcel was around 1 ha. According to the Ministry of Agriculture, Forestry and Fisheries (MAFF) [26], in the town of Minabe and in Tanabe City, most forest organizations manage a forest area of 3–20 ha (17 of 27 organizations in Minabe and 35 of 69 in the old part of Tanabe City in our area), which is consistent with the trends for Wakayama Prefecture (828 of 1240) and for all of Japan (65,652 of 87,284). This means that each local forest organization manages several forest parcels in our area, and that their managed parcels were occasionally fragmented (e.g., Figure 4). The average Ume farm size was around 1600 m^2 (Table 1), with the majority of farmers managing an area of 0.5–5.0 ha [26]. This means that Ume farmers also hold from several to around 30 parcel fragments (e.g., Figure 4).

Figure 8 demonstrates the close relationship between Ume areas and coppice forest within each watershed. Of 1317 total watersheds in the study area, we calculated that 651 include more than 10% each of Ume and coppice forest, 330 include more than 20% each, and 97 include more than 30% each. There were only 81 watersheds with 0% Ume and/or 0% coppice, indicating the reliability of the traditional land-use pattern. This finding supports the generality of the model landscape in the official proposal. Figure 9 also shows the close relationship between Ume and forests. Parcels including both Ume and coppice forest were distributed on a watershed-unit basis across the area.

Our mapping and spatial analysis results and census statistics unequivocally revealed spatially close relationships in terms of landholdings and management between Ume, coppice forest, and other land uses in parcel groups within watersheds. This has led to the creation of a parcel-based landscape with different forest growing stages and dynamic agricultural fields of Ume and other plant products (Figure 5), displaying parcel dynamics entirely distinct from the large-scale patch dynamics utilized for natural forest resource management in the United States and other countries [27,28]. This parcel dynamics shows that the typical phase of a man-made GIAHS landscape requires parcel-based dynamic conservation measures. Moreover, this parcel-based landscape is also physically quite different from the prevailing model of the Satoyama landscape pattern in Japan and its image as a self-sufficient landscape based on valley rice paddies surrounded by forests and grassland [7].

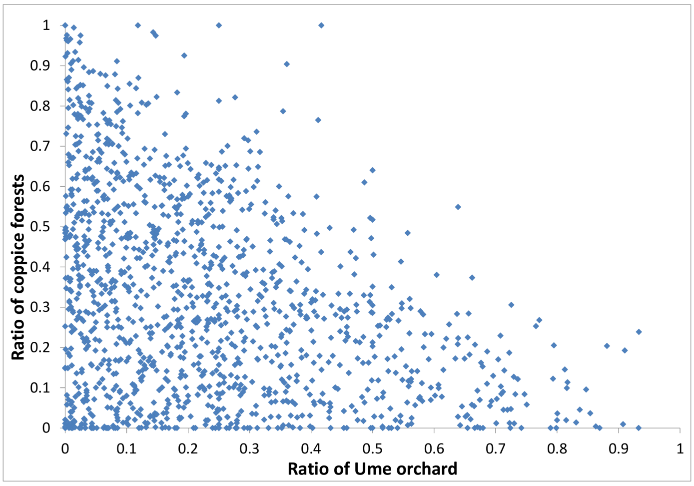

Figure 8. Ume and coppice land-use ratio within watersheds.

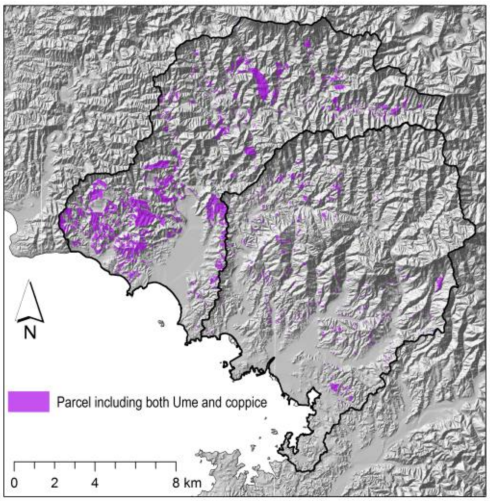

Figure 9. Map of distribution of parcels including both Ume and coppice forest.

3.2. Stakeholder Network and Landscape

Figure 10 shows the stakeholder network structure that emerged through the GIAHS application process. The base locations of local stakeholders living within the GIAHS area as key and hub persons of each landscape unit are shown in Figure 11. These figures show that the application process was initiated by a local politician and Ume farmer (No. 6 in Figure 11) who had long been searching for tools and measures to revitalize the local area and the town of Minabe. He found materials on GIAHS in mid-2013 and proposed the possibility of applying during a session of the Wakayama Prefectural congress in December 2013. The governor officially accepted the application and formed a project taskforce team in the prefectural government consisting of three knowledgeable officials. The governor also emphasized the recruitment of active young officials and pragmatic local residents. On the basis of the author's impressions of the process, as well as interviews with the aforementioned core officials in the prefectural government, stakeholder involvement and consensus building proceeded quite smoothly. This is perhaps because the stakeholders shared a clear vision for economic revitalization using the GIAHS scheme.

Through our in-depth field interviews, we verified that key GIAHS locals (Nos. 1–6 in Figures 10 and 11) had different spatial working ranges. An Ume farmer (No. 1) played a significant role in consensus building in and around his village, which was in an area where both Ume and coppice forest were placed in a form of parcel dynamics (Figures 4 and 5). This area also actively utilized its mixed landscape parcels for Ume flowering tourism and other local revitalization activities; hence, it was selected as a model landscape (Figure 2) and a core site of GIAHS evaluation. He said (with sufficient local knowledge about forest landscape and tree species) that Ume farmers traditionally made charcoal, especially for personal use, from adjoining coppice forest parcels that they owned or rented. In this area, such flows of people were historically inherent, as were occasional family relationships between people in different landscape units (but especially between Ume and coppice forests), which is consistent with the relationships described in a previous historical report [29]. He also explained that owing to the recent decline and labor shortage of the forestry sector, some of his surrounding coppice forest parcels were underused or abandoned, and the trees had grown too big for making charcoal. He expressed concern about this situation, as did the forest manager (No. 2), especially because he still actively utilizes the trails in these coppice parcels for visitors and tourists.

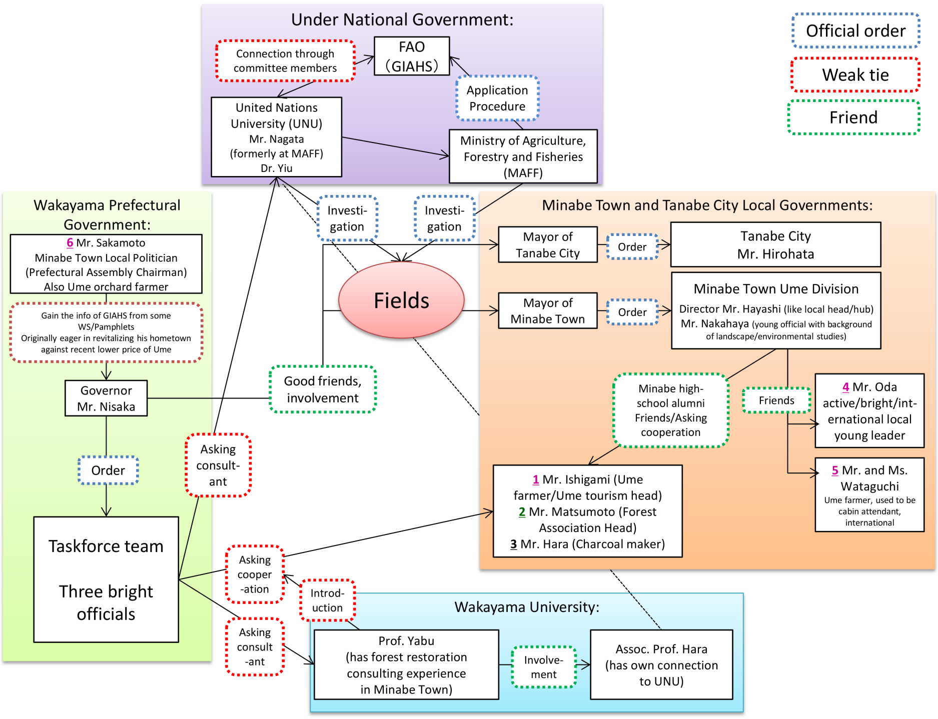

Figure 10. Emerging stakeholder network in the GIAHS application process.

Other key Ume farmers involved in the GIAHS process (Nos. 4–6) were situated in the limited plain area downstream, near the sea, where Ume and rice paddies and other vegetables and citrus parcels have historically been mixed with surrounding limited coppice forest parcels [30]. One Ume farmer (No. 5) concentrated on the production, processing, and selling of Ume, demonstrating active and independent management of his Ume business. Other Ume farmers (Nos. 4 and 6) had several side jobs (No. 6 was the local politician who started the GIAHS application), including in urban sectors and in producing agricultural products, such as rice and vegetables, taking advantage of the relative proximity of their base location to the more populated town center. They had no daily forest work, although, after becoming involved in the GIAHS application process, some developed an interest in local forest management by farmers like them, and one even tried to attend a forest management class provided by a forest manager (No. 2), as described later. This indicated that human management connections between different landscape units still have potential, alongside the general trend toward sectoral intensification of agriculture. Unlike ordinary rice farmers, the Ume and citrus farmers in this area possess some degree of knowledge and technique needed to manage their orchards, which might give them an advantage when entering forest management [31].

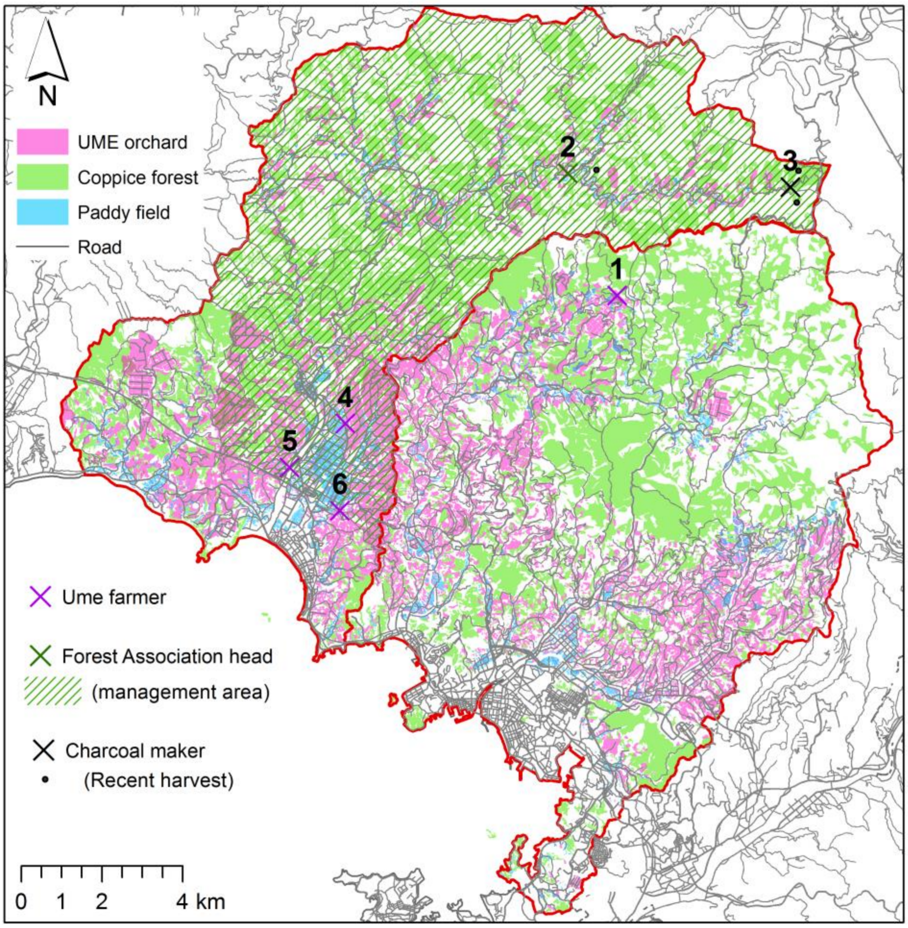

Figure 11. Base patches and working spaces of key GIAHS locals.

On the forest side, the forest association head (No. 2), whose title includes only Ume but no reference to forestry, played a central role in the GIAHS application process, in terms of involving the forestry sector in this application. In the interview, he described the historical transition of forestry in this area as a general decline in the forestry economy over the last half century that coincided with the development of free trade and the importation of cheaper timber—a trend that can be generalized to the economy of Japan as a whole. He then emphasized the importance of traditional policies of forest management for locals, both at the personal and organizational levels. In recent decades, mergers of local forest associations have proceeded in Japan, supported by the national government, and this area was no exception [32]. Although he was under pressure to merge with others, he decided to remain in an independent local forest association and is now promoting further forest management by locals, particularly after GIAHS involvement. For example, his organization is offering classes in forestry techniques for young local residents (Figure 12), like the aforementioned Ume farmer (No. 4). Currently, his organization also focuses on replanting coppice trees in abandoned Ume farms by involving local school-aged children (Figure 12). Indeed, his organization needed to cover quite a large area of forest—the Northwestern part of the GIAHS area (Figure 11)—which is almost beyond the capacity of the current staff and budget [33]. Under such circumstances, his local forest management policy became more important; since then, his organization has been proceeding in a unique direction that could be harmonized with local parcel-based landscape units with existing human linkages among them. This is different from prevailing Japanese Satoyama landscape restoration practices involving completely new urbanites [8]. This GIAHS area still has workers belonging to each agricultural and forestry landscape element with inherent and emerging cross-border communications and flows. Their traditional cross-parcel communications, which are now highlighted once more in terms of land-use system approaches and conservation, are highly consistent with the GIAHS scheme. The GIAHS application could be a good opportunity to reorganize these remaining communications (Figure 11). Land-use systems similar to the one we identified might be found not only in other rural areas of Japan but also in other monsoonal areas of Asia, and further case studies will be necessary.

Figure 12. Emerging activities of forest management by locals in nearby land parcels [33].

A charcoal maker (No. 3) also played a significant hub role, whereby he managed charcoal makers and their associations. In the interview, the charcoal maker said that charcoal makers in this area are now collaborating well with the forestry sector and its associations (No. 2). In charcoal making, wholesalers have traditionally been influential, and after negotiations between forest owners and a wholesaler, individual charcoal makers made charcoal in the mountain forest for periods of a week or more. They set up several charcoal kilns in forest areas and stayed there for a season to make charcoal [32]. Because there was no good road network until 1960 (Figure 11), charcoal makers moved on foot. Hence, charcoal-making was conducted in several on-site kilns distributed along the valleys in the forest, and the products were transported manually [32]. The charcoal makers used traditionally sustainable coppice forest management techniques, such as selective cutting [32]. The charcoal maker (No. 3) strongly emphasized the importance of selective cutting during our interview in the field. Nowadays, he uses a small truck for harvesting and transporting trees to one fixed kiln near a road and makes charcoal without the need to stay overnight. Harvest points were generally and spatially distributed along a road network, which guaranteed effective forest parcel management even with limited manpower. He also explained that in past decades, they have faced a decline in charcoal makers and other foresters, leading to underused and abandoned forest patches.

Hence, many efforts are currently being made to educate and involve new charcoal makers. He trusts and has a collaborative relationship with forest associations (No. 2) and views visitors and field classes positively. However, he is also concerned about the new charcoal makers emerging from urban areas, who sometimes only focus on specific high-quality tree species, such as Ubame oak (*Quercus phillyraeoides*), for making higher-priced Kishu-binchotan charcoal and destroy traditionally managed forest parcels by clear cutting. Therefore, he has invested a great deal of effort in spreading sustainable forest parcel management techniques in collaboration with the forest associations.

Given the spatial patterns of this area's land-use system (Figure 11), the interview results revealed that, similar to other rural areas in Japan, this area also faced "agricultural development" in the form of sector-based management and mechanization with increased fossil fuel energy use. However, unlike other studied Satoyama landscapes [9], this area had the potential to reorganize its land-use system as a parcel-based system with various land uses interconnected by locals, and this potential was visualized and now promoted through the process of GIAHS application and recognition. In addition, because the GIAHS site has compact agglomerations of watersheds within a close range (a ~30-min drive) (Figure 11), the key stakeholders, most of whom attended the same local school, may be able to maximize their social capital in reinforcing the total area network structure. A well-organized road network (Figure 11) and the utilization of small agricultural trucks in particular have made it possible to establish communication and interconnections between different landscape units more smoothly than in the past.

Furthermore, similar to the local politician (No. 6), who first initiated the GIAHS application, many farmers in the area had side jobs, which is a general trend throughout Japan. This trend is sometimes criticized for link with a small scale of production, production inefficiency, and traditional conservative attitudes toward land tenure and holding, in contrast to the large-scale agriculture initiated by governmental policy in Japan. However, serving as a governmental official or other role in addition to holding another job can help with the formation of network hubs that interconnect various stakeholders, and thereby contribute to consensus building (Figure 11). These new conditions could help to reorganize human flow and communication among various landscape units, providing resiliency to allow restoration and revitalization of the entire local land-use system in the future. Detailed landscape patterns and unit relationships have been understudied even at other GIAHS sites [34,35], whereas technical studies of productivities [3,36] and practical activities focusing on the local economy [16,37] have increased. Understanding and visualizing landscape units, as well as the transition of human linkages from past to present, is essential and must be integrated into onsite research and education programs, if we are to apply, utilize, and maximize the value of the GIAHS designation [38].

Considering these points, there are several emerging field research and educational activities connecting people in various landscape units, in addition to local economic revitalization measures that can be used to maximize the value of the GIAHS designation. For example, Wakayama University inaugurated a new field-based course for both undergraduate students and local residents in December 2017 in collaboration with, and with the support of, the local GIAHS promotion association. This course focused on providing a general understanding of local GIAHS land-use systems, field experiences of Ume and forest management, taught by key local residents (especially Nos. 1–3 in Figures 10 and 11), as well as landscape element mapping practices, and tree surveys in the field. The exchange and communication of information among students (as newcomers in the local stakeholder network) and local stakeholders in various landscape units may also lead to the creation and discovery of innovative activities leading to further GIAHS promotion and usage. This new course can also function as an initial biodiversity monitoring point, helping to form effective linkages between education and research, as well as increasing awareness of the value of GIAHS to biodiversity among locals. This type of initiative for making connections among people in various landscape units could be more important than creating new infrastructure with tremendous amounts of money. In addition, it could be applicable to other GIAHSs and similar areas that require land-use system approaches.

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References

1. Matsuno, Y.; Nakamura, K.; Masumoto, T.; Matsui, H.; Kato, T.; Sato, Y. Prospects for multifunctionality of paddy rice cultivation in Japan and other countries in monsoon Asia. *Paddy Water Environ.* **2006**, *4*, 189–197. [CrossRef]
2. Natuhara, Y. Ecosystem services by paddy fields as substitutes of natural wetlands in Japan. *Ecol. Eng.* **2013**, *56*, 97–106. [CrossRef]
3. Liu, S.; Jiao, W.; Min, Q.; Yin, J. The Influences of Production Factors with Profit on Agricultural Heritage Systems: A Case Study of the Rice-Fish System. *Sustainability* **2017**, *9*, 1842. [CrossRef]
4. Hara, Y.; Yamaji, K.; Yokota, S.; Thaitakoo, D.; Sampei, Y. Dynamic wetland mosaic environments and Asian openbill habitat creation in peri-urban Bangkok. *Urban Ecosyst.* **2017**. [CrossRef]
5. Takeuchi, K.; Brown, R.D.; Washitani, I.; Tsunekawa, A.; Yokohari, M. *Satoyama: The Traditional Rural Landscape of Japan*; Springer: Tokyo, Japan, 2003; 229p. [CrossRef]
6. Ichikawa, K.; Okubo, N.; Okubo, S.; Takeuchi, K. Transition of the satoyama landscape in the urban fringe of the Tokyo metropolitan area from 1880 to 2001. *Landsc. Urban Plan.* **2006**, *78*, 398–410. [CrossRef]
7. Sprague, D.S. Land-use configuration under traditional agriculture in the Kanto Plain, Japan: A historical GIS analysis. *Int. J. Geogr. Inf. Sci.* **2013**, *27*, 68–91. [CrossRef]
8. Terada, T.; Yokohari, M.; Bolthouse, J.; Tanaka, N. Refueling Satoyama Woodland Restoration in Japan: Enhancing Restoration Practice and Experiences through Woodfuel Utilization. *Nat. Cult.* **2010**, *5*, 251–276. [CrossRef]
9. Ichikawa, K.; Toth, G.G. The Satoyama Landscape of Japan: The Future of an Indigenous Agricultural System in an Industrialized Society. In *Agroforestry—The Future of Global Land Use*; Advances in Agroforestry; Nair, P., Garrity, D., Eds.; Springer: Dordrecht, The Netherlands, 2012; Volume 9, pp. 341–358. [CrossRef]
10. Motoyasu, Y.; Hara, Y. Satoyama Landscape Change in the Periphery of a Japanese Regional City from 1884 to 2002: A Case Study in Wakayama Prefecture. In Proceedings of the International Symposium on City Planning, Wakayama-city, Japan, 2011; pp. 529–538. Available online: http://repository.center.wakayama-u.ac.jp/metadata/2793 (accessed on 30 December 2017).
11. Umeda, K. Changes to the Citrus Producing Region following Market Opening and Surplus Production in the Central Islands of Seto Inland Sea. *Jpn. J. Hum. Geogr.* **1997**, *49*, 567–582, (In Japanese with English Abstract). [CrossRef]
12. Morozumi, M. Restructuring of Production Areas as a result of Changes in the Floriculture Market. *Jpn. J. Hum. Geogr.* **2001**, *53*, 407–429, (In Japanese with English Abstract). [CrossRef]
13. Managi, S.; Yamamoto, Y.; Iwamoto, H.; Masuda, K. Valuing the influence of underlying attitudes and the demand for organic milk in Japan. *Agric. Econ.* **2008**, *39*, 339–348. [CrossRef]
14. Fukamachi, K.; Oku, H.; Nakashizuka, T. The change of a satoyama landscape and its causality in Kamiseya, Kyoto Prefecture, Japan between 1970 and 1995. *Landsc. Ecol.* **2001**, *16*, 703–717. [CrossRef]
15. Food and Agricultural Organization (FAO) of the United Nations. Globally Important Agricultural Heritage Systems (GIAHS) Official Website. 2017. Available online: http://www.fao.org/giahs/ (accessed on 30 December 2017).
16. Niles, D. Learning from GIAHS landscapes. *J. Jpn. Inst. Landsc. Archit.* **2017**, *81*, 260–263. (In Japanese)
17. Minabe-Tanabe Regional Association for GIAHS Promotion. GIAHS Minabe-Tanabe Ume System Official Website. 2017. Available online: https://www.giahs-minabetanabe.jp/ (accessed on 30 December 2017).
18. Yonekura, N. Geomorphic development and mode of crustal movement on the South Coast of the Kii Peninsula, southwestern Japan. *J. Geogr.* **1968**, *77*, 1–23. (In Japanese with English Abstract) [CrossRef]

19. Yamamoto, N.; Hagiwara, M. Consistency and comparability between forest planning information and cadastral information. *J. Jpn. For. Soc.* **2003**, *85*, 326–331. (In Japanese with English Abstract) [CrossRef]
20. Samejima, N. *Japanese Cadastral System*; Kokon Shoin: Tokyo, Japan, 2011; 195p. (In Japanese)
21. Geospatial Information Authority (GSI). Fundamental Geospatial Data. 2017. Available online: https://fgd.gsi.go.jp/download/menu.php (accessed on 30 December 2017).
22. Cetinkaya, G. Challenges for the maintenance of traditional knowledge in the Satoyama and Satoumi ecosystems, Noto Peninsula, Japan. *Hum. Ecol. Rev.* **2009**, *16*, 27–40.
23. Hara, Y.; Sampei, Y. Minabe-Tanabe Ume System: Its landscape Characteristics and the Actual Application Process to GIAHS. *J. Rural Plan. Assoc.* **2016**, *35*, 379–382. (In Japanese) [CrossRef]
24. Scullion, J.; Thomas, C.W.; Vogt, K.A.; Perez-Maqueo, O.; Logsdon, M.G. Evaluating the environmental impact of payments for ecosystem services in Coatepec (Mexico) using remote sensing and on-site interviews. *Environ. Conserv.* **2011**, *38*, 426–434. [CrossRef]
25. Kerselaers, E.; Rogge, E.; Vanempten, E.; Lauwers, L.; Van Huylenbroeck, G. Changing land use in the countryside: Stakeholders' perception of the ongoing rural planning processes in Flanders. *Land Use Policy* **2013**, *32*, 197–206. [CrossRef]
26. Ministry of Agriculture, Forestry and Fisheries (MAFF). Census of Agriculture and Forestry in Japan. 2015. Available online: http://www.maff.go.jp/j/tokei/census/afc2015/280624.html (accessed on 30 December 2017).
27. Bresee, M.K.; Le Moine, J.; Mather, S.; Brosofske, K.D.; Chen, J.; Crow, T.R.; Rademacher, J. Disturbance and landscape dynamics in the Chequamegon National Forest Wisconsin, USA, from 1972 to 2001. *Landsc. Ecol.* **2004**, *19*, 291–309. [CrossRef]
28. Price, J.M.; Silbernagel, J.; Nixon, K.; Swearingen, A.; Swaty, R.; Miller, N. Collaborative scenario modeling reveals potential advantages of blending strategies to achieve conservation goals in a working forest landscape. *Landsc. Ecol.* **2016**, *31*, 1093–1115. [CrossRef]
29. Yabu, S. *Satoyama and Satoumi*; Keisoshobo: Tokyo, Japan, 2016; 300p. (In Japanese)
30. Iwasaki, K. Agricultural regions on the coast of Kii Peninsula. *Geogr. Rev. Japan* **1934**, *10*, 1053–1084. (In Japanese with English Abstract) [CrossRef]
31. Sato, N.; Kouroki, K.; Yanaka, S. (Eds.) *New Era of Forestry*; Rural Culture Association: Tokyo, Japan, 2014; 292p. (In Japanese)
32. Kato, K. *Ethnography of Kii Peninsula*; Shakaihyoronsha: Tokyo, Japan, 2012; 559p. (In Japanese)
33. Matsumoto, M.; (Wakayama University, Wakayama, Japan). Small-scale forest association for conserving and growing traditional industries with local people. Lecture Note of Wakayama University GIAHS Class. 17 December 2017. (In Japanese)
34. Qiu, Z.; Bixia, C.; Nakamura, K. Customary Management System of Irrigation Ponds in Japan—A Study in a Globally Important Agricultural Heritage Systems (GIAHS) Site of Noto Island, Ishikawa Prefecture. *J. Resour. Ecol.* **2016**, *7*, 205–210. [CrossRef]
35. Hashimoto, S.; Nakamura, S.; Saito, O.; Kohsaka, R.; Kamiyama, C.; Tomiyoshi, M.; Kishioka, T. Mapping and characterizing ecosystem services of social–ecological production landscapes: Case study of Noto, Japan. *Sustain. Sci.* **2015**, *10*, 257–273. [CrossRef]
36. Xie, J.; Hu, L.; Tang, J.; Wu, X.; Li, N.; Yuan, Y.; Yang, H.; Zhang, J.; Luo, S.; Chen, X. Ecological mechanisms underlying the sustainability of the agricultural heritage rice–fish coculture system. *Proc. Natl. Acad. Sci. USA* **2011**, *108*, E1381–E1387. [CrossRef] [PubMed]
37. Yiu, E. Noto Peninsula after GIAHS Designation: Conservation and Revitalization Efforts of Noto's Satoyama and Satoumi. *J. Resour. Ecol.* **2014**, *5*, 364–369. [CrossRef]
38. Hara, Y.; Sampei, Y. Minabe-Tanabe Ume System: Its landscape characteristics and dynamic conservation measures. *J. Jpn. Inst. Landsc. Archit.* **2017**, *81*, 282–283. (In Japanese) [CrossRef]