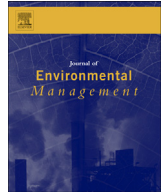




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Research article

# Sustainability of terraced paddy fields in traditional satoyama landscapes of Japan

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## ABSTRACT

Terraced paddy fields are essential components of the traditional cultural landscape of Japan, the satoyama landscape. They have been sustainably cultivated in a variety of ecological and social environments through time, and are highly valued as local resources with multiple functions.

This paper reviews the recent nationwide movement for conservation of satoyama landscapes and shows that over the last decades, the government has increasingly created policies based on national regulation or international frameworks that concern the culture and environment in rural areas.

Recent measures for the sustainability of terraced paddy fields do not only focus on rice terraces, but are directed at each satoyama landscape as a whole under careful consideration of how landscape elements are connected while taking into account the unique features of each area. Nevertheless, it has become difficult to ensure the continued use and maintenance of terraced rice paddies both in depopulated and suburban satoyama landscapes. The motivation for conserving satoyama landscapes, including those with terraced rice paddies, can be found in the awareness and appreciation of the unique characteristics of each locality that offer opportunities that can only be experienced in that particular area. A satoyama landscape that offers such opportunities allows continuity of traditional practices while integrating necessary changes.

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## 1. Introduction

Terraced paddy fields are essential components of Japan's satoyama landscapes, which have been defined as a cultural landscapes consisting of rural communities and the secondary environments that surround them (Ministry of the Environment, 2008), or as “socio–ecological production landscapes and seascapes in Japan” (The United Nations University Institute for the Advanced Study of Sustainability [UNU-IAS], 2010). Satoyama landscapes are mostly hilly and forested, and cover roughly 67% of the total area of Japan. They extend between the cities and the deep mountains, and combine various types of environments that are distributed in a complicated, mosaic-like pattern. They include vegetable fields, rice paddy fields, irrigation ponds, ditches, grassland, woodland, and residential areas.

The majority of Japan's terraced rice paddies, which can be defined as “rice fields arranged in a shelf-like irregular fashion on slopes steeper than 1/20” (Nakajima, 1996), are located in satoyama

landscapes in depopulated areas such as in mountain villages or in rural coastal areas. Independently from the slope angle, terraced paddies provide an even larger number of multiple functions than flatland paddy fields. For example, they feature better water conservation and higher biodiversity, and contribute to environmental rejuvenation (Makiyama and Yamaji, 2001; Kurotaki et al., 2014). Moreover, it has been pointed out that terraced paddies attract much attention as typical cultural landscapes, and thus contribute to the sustainable conservation of entire districts (Yokoseki et al., 2013).

Nationwide research leading to a deeper understanding of satoyama landscapes has been conducted while focusing on: (1) Satoyama lifestyle nurtured by local features and (2) locally developed natural resource use systems. Analysis of traditional systems allows researchers to show the impact of satoyama landscapes in terms of ecological benefit and community culture (Fukamachi and Sakuma, 1998). After comprehending how agricultural, mountainous, and fishing villages function and how local people have continued to use natural resources sustainably, we can, for each village, draw an image of an ideal future satoyama landscape based on two main aspects: (1) Structure and relationships

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within the satoyama landscape and (2) history and traditions of the area. When applying this method, which combines the ecological and cultural approach, we also need to take into account new technologies and mechanisms in modern villages. This allows us to adapt the ideal image to modern society while maintaining its characteristics.

About half of the endangered species listed in the Red Data Book (RDB) of Japan live in satoyama landscapes, where terraced rice paddies, which are usually surrounded by a mosaic of different habitat types such as forests, hills, mountains, grasslands, rivers, and waterways, play a particularly important role since organisms in rice paddies rely on many of the surrounding habitats during their life history. Water networks used for terraced paddy irrigation have distinct characteristics in each area. They consist of diverse water resources such as nearby rivers, streams, channels, and springs, and have been maintained by each locality throughout time. Biodiversity in each area has unique features related to the history of local land use and lifestyle.

Some studies have shown that there is a close link between satoyama landscape structures and the life cycle of wildlife (Hidaka et al., 2008). Areas bordering on water play an especially important role in allowing locally characteristic biodiversity. One study found 5668 species inhabiting rice paddies (Kiritani, 2009).

Previous research also dealt with the motivation of citizens to contribute to the conservation and management of satoyama landscapes and the role of administrative bodies (Kieninger et al., 2009), or with the qualitative and quantitative multifunctional characteristics of satoyama landscapes and their high value as sustainably cultivated local resources (Murakami et al., 2008). On the other hand, there is also research on how structural development and changes of agricultural systems have led to the division of wildlife habitats and to changes that had an important impact on the distribution of endangered species (Shimoda and Inagaki, 2012), or on using the contingent valuation method to clarify the economic conditions for the development of biodiversity-friendly paddy rice agriculture (Nishimura et al., 2012).

However, there is still a lack of studies that address the roles that national policy, local policy and citizen activity play in the sustainable use and preservation of rice terraces in Japan. This paper seeks to shed light on this topic. It gives a review of national government policy, and then shows, based on two case studies, when, how, and why citizen grass-root activity emerged, and how it was encouraged by local government measures based on the national legal framework. The case studies were conducted in two satoyama landscapes with terraced paddies that are characterized by different geographical and historical features and face different bio-cultural issues: the mountainous Kamiseya landscape, and the suburban Moriyama landscape. In spite of their differences, the two areas are similar in that the farming population and the number of cultivated terraced paddies have continued to diminish since the 1970s, when many such paddies were abandoned all over Japan due to unfavorable farming conditions such as inclining topography. To encourage rice farmers to continue cultivation, the government adopted measures such as plot consolidation, use of agricultural chemicals, and artificial ridge covering. Farmers continued cultivation, but the measures meant that traditional land management practices were abandoned, which triggered changes in the local ecosystem and a rapid decrease of biodiversity and rare species (Iiyama et al., 2005; Jakobsson et al., 2016). At that point, preserving rice terraces became an urgent issue (Nakajima, 1996).

This paper examines: (1) governmental policy for the conservation of biocultural diversity in satoyama landscapes with traditional terraced paddy fields, and (2) efforts for sustainability of terraced paddy fields at the local level shown by the example of a rural and a suburban area. After surveying national policy on the

conservation of satoyama landscapes with terraced rice paddies, the discussion sheds light on how national and local governmental policy and other factors have created new trends, and how these have impacted citizen activity in two case studies.

## 2. Methods

### 2.1. Literature research, interviews, and participant observation

In this study, a review of national governmental policy was conducted through literature research (Aida, 2011; Watanabe et al., 2012; Yasuda, 2012) and through open-ended question interviews conducted between 2014 and 2015 with 13 government officials of the Agency for Cultural Affairs, the Ministry of the Environment, and the Ministry of Agriculture, Forestry and Fisheries. Questions were asked about past and present laws, policies, measures, and links to companies and citizen movements for the conservation and revitalization of satoyama landscapes and terraced paddies. During the interviews, materials related to policies since the 1980s were collected to examine the recent nationwide movement and public awareness for the conservation of satoyama landscapes in Japan. Materials included documents and information pamphlets on the enactment or amendment of laws and ordinances by government ministries and agencies, and reports on related data and activity.

The significance of terraced paddy fields was analyzed based on two case studies conducted in two entirely different satoyama landscapes of Japan that feature terraced paddies: (1) the remote rural area Kamiseya, and (2) the suburban area Moriyama (Fig. 1). Satoyama landscape characteristics such as distribution, location, and ownership from the early 1900s to the present were clarified by literature research (Fukamachi et al., 2001, 2005, 2009, 2010, 2011; Fukamachi, 2014; Ji and Fukamachi, 2017; Miyoshi et al., 2007; Mizushima et al., 2012; Ohgishi et al., 2007). The current state of bio-cultural characteristics and maintenance systems and efforts made in recent years to maintain sustainability in terraced rice paddies were investigated based on participant observation related to activities by local people and by citizen groups since 1997.

### 2.2. Study areas

#### 2.2.1. Kamiseya: a depopulated satoyama landscape

Kamiseya (elevation range: 300–700 m), a community facing the Japan Sea, is located on the Tango Peninsula in the northern part of central Japan in the Seya district of Miyazu City, about 80 km northwest of Kyoto City (Fig. 2). It is a mountainous, rural area of approximately 650ha, out of which 80 percent are covered by forests. The residential area is located in a flat area (a result of past landslides) and is surrounded by steep mountains. The landslide topography has formed the complex network of rivers and the unique vegetation characteristics of the area. Paddy fields are cultivated on slopes in the form of a series of shelves, and have been given priority over all other land uses where irrigation water was available (Fukamachi et al., 2001). Spring water is one of the most essential water sources for paddy irrigation. Farmers must apply various techniques to cope with the fact that the snow melts late in the region (Miyoshi et al., 2007). For example, they make narrow water channels that lead the ice-cold spring water in a roundabout way to the paddies so that it can warm up before it enters the fields.

In 1924, there were 60 households and 290 residents in Kamiseya. By 2012, however, the population had diminished to 13 households and 23 residents. In the terraced rice paddy area of Kamiseya, the cultivated area has been continuously shrinking since the 1960s. In 1970, there were 32 farming households, and the total cultivated farmland amounted to 39.3ha, out of which 83 percent were paddy fields. In 2015, 5 farming households and one

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