

International Journal of the Commons

Vol. 12, no 1 2018, pp. 332–351

Publisher: Uopen Journals

URL: <http://www.thecommonsjournal.org>

DOI: 10.18352/ijc.817

Copyright: content is licensed under a Creative Commons Attribution 3.0 License

ISSN: 1875-0281

‘The tragedy of the commons’ by underuse: toward a conceptual framework based on ecosystem services and *satoyama* perspective

Kentaro Miyanaga

Kyoto Sangyo University

miyanaga@cc.kyoto-su.ac.jp

Daisaku Shimada

Fukuoka Women’s University

daisakushimada@gmail.com

Abstract: Most commons researchers have far focused on a theme of resource overuse or overconsumption. In contrast, our objective is to address the mechanism of common pool resources (CPRs) declining or disappearing due to underuse, which has been understudied in the commons research field. Using two analytical concepts, ecosystem services and *satoyama*, and through a case study of Japanese semi-natural grasslands, we examine two themes concerning the underuse problem: (1) consequences of underuse and (2) causes of underuse. As to aspect (1), many commons researchers would perhaps recognize that it is far from a tragic situation to underuse resource units from CPRs because no resources are depleted. However, our analysis showed that underuse sometimes has negative impacts on biodiversity and the ecosystem through complex socio-ecological system channels, thus bringing about a decline in resource units. As to aspect (2), we identified three drivers that induce resource units to be underused: (1) demographic drivers, (2) socio-economic drivers and (3) institutional drivers. First, depopulation (especially in rural areas) can cause fewer human–environment interactions and therefore lower depletion of resource units. This situation contrasts with a normal assumption of traditional commons analyses, namely overpopulation triggering tragedy. Second, ecosystem services, especially provisioning services, are underused due to the declines in their economic function. On the other hand, conventional debates generally share a common presumption that resource units have a larger extent of economic value. Third, the ownership structure or property rights regime can bring about resource underuse, which anticommens theory has suggested, and our case study of Japanese semi-natural grasslands suggests

that the tragedy outcome would possibly occur when institutions that prevent an anticommons tragedy are weakened and inactive through demographic and/or socio-economic drivers.

Keywords: Common pool resources (CPRs), ecosystem services, *satoyama*, semi-natural grassland, underuse

Acknowledgements: The authors thank the anonymous reviewers for their sincere and helpful comments, which improved the quality of the manuscript much better. We would also like to thank Dr. Yoshitaka Takahashi (Western Region Agricultural Research Center, National Agricultural and Food Research Organization), members of Western Japan Grassland Study Group, and all participants in the poster presentation at XVI Biennial IASC-Conference in Utrecht, the Netherlands, for their suggestive advice. This work was supported by the Japan Society for the Promotion of Science (JSPS) KAKENHI Grant Numbers JP16H03008 and JP26740058. The authors would like to thank Enago (www.enago.jp) for the English language review.

1. Introduction

As is well-known among commons researchers, a clear difference exists between the conclusions of Garrett Hardin's "*The tragedy of the commons*" (1968) and Elinor Ostrom's "*Governing the commons*" (1990). Hardin clarified a process of resource depletion (and environmental degradation) in an open-access resource system and proposed two possible ways to avoid this tragedy: (1) privatising land ownership to internalise external diseconomies or (2) regulating resource users under the government's command and control. In contrast, Ostrom investigated a community-based self-governing mechanism as an alternative solution and discussed the economic, social or institutional conditions of long-enduring common pool resources (CPRs), called design principles.

However, both of these seminal works are based on a common presumption, which they share with many other commons research studies: they focused on a theme of resource overuse or overconsumption. In other words, most researchers have engaged in theoretical and/or empirical studies addressing situations where resources are scarce, have a larger extent of economic value and are always in greater demand by human society. In fact, Ostrom declared that she mainly deals with CPR situations where people "are heavily dependent on the CPR for economic returns" (Ostrom 1990, 26), where "substantial scarcity exists, rather than abundance" (*ibid*), where there is "higher and continually increasing rates of consumption" (Burger et al. 2001, 2) or where CPRs experience "a moderate to heavy level of resource use" (Doršak and Ostrom 2003, 15).

Despite these distinguished academic contributions, the following question remains: Can we explain why many commons have been threatened or

disappeared, solely by referring to overuse problems, accelerated through privatization and the enclosure of the commons? Does the overuse problem describe the entire reality or cover all issues surrounding CPR management?

CPR situations in Japan include the following. One example, addressed by Shimada (2015), is that of semi-natural grasslands in rural areas, which are secondary natural environments created and maintained over the centuries by human activity and which were once harvested for use as roofing materials and pasture for animals. After industrialization, however, the introduction of chemical fertilizers, changes in building practices and importation of animal feeds rapidly led to the decrease in semi-natural grasslands.

Another example is *matsutake* mushrooms (*Tricholoma matsutake*) (Saito and Mitsumata 2008). Forests of Japanese red pine, which used to be widespread in areas surrounding settlements, have been thinned repeatedly for centuries by villagers cutting trees and undergrowth shrubs and collecting fallen leaves for fuel and/or fertilizer, a practice that favored the growth of *matsutake* mushrooms. But this favorable *matsutake* mushroom habitat is now declining, partly because the replacement of wood and other biomass fuels by oil and gas has greatly diminished the age-old practice of removing trees, shrubs, and fallen leaves.

Needless to say, semi-natural grasslands and *matsutake* mushrooms would be exploited when overused. At the same time, however, it is also apparent that one of the issues to be examined is underuse problems. Although some works in commons research have mentioned or discussed the underuse problem (e.g. Berge and McKean 2015; Shimada 2015), there still seems room for investigating it in a broader context.

The objective of this paper is to address the mechanism of CPRs declining or disappearing through underuse, which has been understudied by commons researchers. To fulfil the objective, some background must first be provided. Accordingly, underuse is defined as (1) reduced usage or abandonment of resources in cases where there is no resource scarcity or (2) a lack of management of human-made natural resources. Second, we introduce two analytical concepts: ecosystem services and *satoyama*. These are explored in detail in Section 2.1.

The structure of this paper is as follows. First, we offer a brief overview of the concepts of ecosystem services and *satoyama* and provide an analytical framework for the CPR underuse problem. We then examine a case study concerning underuse situations in Japan and summarize key findings. CPR depletion mechanisms through underuse are then discussed. Finally, this paper concludes by addressing some prospective issues for future commons research.

2. Analytical framework

2.1. Ecosystem services from CPRs

Human society extracts, uses, and consumes resource units from CPRs, which are a part of an ecosystem, to gain environmental, economic, social or cultural

benefits. In this sense, resource units are synonymous with ecosystem services. Ecosystem services are defined, for example, as “the direct and indirect contributions of ecosystems to human well-being” (TEEB 2010)¹ and encompass supporting services, provisioning services, regulating services and cultural services (e.g. Millennium Ecosystem Assessment 2005). Over the last few decades, concerns about ecosystem services have increased in environmental science and environmental governance debates.

In terms of our research interests, not only definitions and constituents but also characteristics of ecosystem services are of great importance in determining how CPRs can be well-governed. In the commons research field, it is mentioned that resource units from CPRs often have characteristics of both public and private goods. Excluding users is difficult or incurs great cost, as with public goods; however, exploitation by one user reduces resource availability for others, such as with private goods (e.g. Feeney et al. 1990; Ostrom et al. 1999; Dietz et al. 2002; McKean 2013). This implies that neither market mechanisms nor governmental provision in resource allocation would always be suitable for governing ecosystem services from CPRs.²

In our view, however, there seems to be another characteristic to be addressed: a mutual relationship between human and environment, which ecosystem services research has emphasised. While human cultures have always been influenced and shaped by the nature of the ecosystem, humankind has always influenced and shaped its environment as well, e.g. through labour investments, to enhance the availability of ecosystem services, especially provisioning and cultural services (de Groot et al. 2005; Braat and de Groot 2012). In other words, ecosystem services are provided not only by ecosystems themselves but also through the historical interactions between people and ecosystems (Lin et al. 2015).

Therefore, what can we learn from this characteristic in terms of CPR governance? According to Lin et al. (2015), there are two points to be considered. First, ecosystem services are sometimes location specific, and they tend to differ from place to place because human–environment interactions occur substantially at the local level. Hence, governance of such ecosystem services is best addressed through self-governance by the local affected stakeholders. Second, CPR governance needs to tackle the relationships between people and ecosystems.

¹ Of course, many other definitions exist. For a comprehensive understanding of the idea of ecosystem services, Potschin et al. (2016), Braat and de Groot (2012), Norgaard (2010), Fisher et al. (2009), Daily et al. (2009), Gómez-Baggethun et al. (2009), and Boyd and Banzhaf (2007) all offer useful background.

² Although the concept of ecosystem services is based on, if anything, a utilitarian approach to ecosystem conservation and mainly focuses on economic values (e.g. Costanza et al. 1997), it is important to emphasize that it has nothing to do with market ideologies, nor does it imply the commodification of nature (Perrings 2014). Hence, the idea of ecosystem service does not always lead to a market-oriented policy, e.g. biodiversity offsets or mitigation banking.

2.2. *Satoyama* as CPRs

Now, we will examine the next analytical concept of “*satoyama*”, which generally refers to the traditional Japanese rural environment and its resources. *Satoyama* provides many kinds of ecosystem services that have direct-use values, indirect-use values or option values. In this sense, *satoyama* could be thought of as CPRs.

In fact, it is slightly troublesome that there is still a wide variety of definition of *satoyama* (e.g. Saito and Shibata 2012; Indrawan et al. 2014). It can be boldly said, however, that the concept mainly exhibits the following two aspects.

First, *satoyama* is a typical example of secondary natural environments shaped through human–environment interactions.³ For example, people at once used providing services such as charcoal and firewood gathered in *satoyama* forests, which could be maintained with coppicing. Another example is providing service such as roofing materials and pasture for animals harvested in semi-natural grasslands, which is discussed in detail in Section 3.

Second, *satoyama* has a mosaic structure of land use: it is composed of “a mosaic of different ecosystem types including secondary forests, agricultural lands, irrigation ponds, and grasslands, along with human settlements” (Duraiappah and Nakamura 2012, 3). We can easily imagine that *satoyama* has the capacity to provide various kinds of ecosystem services. Moreover, it should be noted that such diverse land uses make it possible for different flora and fauna to grow, and contributes to a rich biota and biodiversity, functioning as a supporting service (e.g. Takeuchi et al. 2001). For example, *Anura* (frog) or *Odonata* (dragonfly) require multiple heterogeneous habitat or ecosystems: they are born and live in a water environment such as rice paddies in the larva stage, and in coppice woodlands or grasslands in the adult stage. This is one of the reasons why these species have existed abundantly and diversely in Japan. The same is true for birds of prey, such as *Butastur indicus* (grey-faced buzzard), which build a nest in woodlands and move to rice paddies to eat *Anura*. It goes without saying that these species and animals could not live without the mosaic ecosystem, whose existence relies on human–environment interactions.

Furthermore, the commons research field has so far shown some academic interests in *iriai* forests (e.g. McKean 1992), which is an element of *satoyama*-type resources and environments. *Iriai* is a Japanese traditional CPR governing system, defined, for example, as “an institution for collective use and management of the natural resource within [a] village” (Mitsumata 2013, 61), or “a system of shared resource use and management that evolved as the inhabitants of rural communities organized themselves and began creating and following rules of self-governance” (Saito 2013, 215). Here, we can again confirm that *satoyama* can be thought of as CPRs, recognizing that the term CPR indicates not only a

³ This type of ecosystem formulated through human – environment interactions is not unique to Japan. Another good example is the Mongolian grassland and its landscape, which would not endure without the existence and activities of nomads.

resource itself but also its governing system, such as the *iriai* mechanism, as has been emphasized in several previous research (e.g. Schlager and Ostrom 1992).⁴

2.3. Underuse problems: an analytical framework

With reference to ecosystem services and *satoyama*, we provide here the analytical framework used in this paper. It consists of the following themes: (1) consequences of underuse and (2) causes of underuse.

2.3.1. Consequence of underuse

When people underuse resource units from CPRs, many commons researchers would perhaps consider such a scenario as being far from a “tragedy” situation because no resources are being depleted. However, that perspective overlooks interactions between underuse and ecosystem services. Underuse sometimes has negative consequences for biodiversity and the ecosystem through complex socio-ecological system channels (Kawata 2015, 2009).

In fact, many researchers have demonstrated that rapidly diminishing or disappearing *satoyama* in Japan has caused a decline in biodiversity (e.g. Duraiappah and Nakamura 2012; Yumoto, 2012). For example, there are growing instances of wildlife damages in Japanese rural areas, caused by *Sus scrofa* (wild boar), *Cervus nippon* (sika deer) or *Macaca fuscata* (Japanese macaque). One of the main reason is that diminishing farms or abandonment of coppice woodlands provide suitable habitats for these animals, allowing them to flourish and therefore have greater likelihood of damaging crops in the remaining farms. In short, declining human-environment interactions harm the mosaic structure of *satoyama*, which induces a loss of biodiversity and ecosystem services.⁵ Furthermore, it leads to a decline of human well-being, as suggested in the framework of the Millennium Ecosystem Assessment (2005).

To sum up, underuse can also bring about resource units' decline through influences on biodiversity, the ecosystem and ecosystem services.

2.3.2. Causes of underuse

How should we understand the mechanisms underlying the underuse of resource units? Using ecosystem services and *satoyama* perspectives, we shed light on three drivers.

⁴ We can see that practical interest on *satoyama* is also growing. For example, Japan's national biodiversity strategy developed by the Ministry of the Environment notes that *satoyama* is one of the key concepts for biodiversity conservation and sustainable use. Moreover, the Japanese government and United Nation University jointly launched the International Partnership for the *Satoyama* Initiative (IPSI) after the 10th Conference of the Parties to the Convention on Biological Diversity (COP10) held in 2010.

⁵ In a general sense, the relationship between biodiversity and ecosystem services is somewhat scientifically controversial and ambiguous. However, it is mostly positive and essential for the long-term maintenance of socio-ecological systems (Harrison et al. 2014; Balvanera et al. 2016).

Demographic Drivers: Traditional commons are mainly found in rural areas, and they have been exploited by the rural population for survival in an economy dominated by agriculture; however, this pattern has changed given the currently “low proportion of population in rural areas” (Berge and McKean 2015). Particularly in Japanese *satoyama*, severe depopulation and aging are increasing.⁶ These would lead to reduced levels of human – environment interactions, especially in rural areas, and therefore degrade ecosystem services. Recognizing that Hardin’s preoccupation was overpopulation problems (Hardin 1968), this outcome is slightly ironic.

Socio-economic Drivers: Socio-economic structural changes, such as rapid industrialization, urbanization and economic globalization, could accelerate underuse. There are two main channels through which such processes lead to CPR depletion. First, relatively low economic returns from primary-industry sectors, such as farming, forestry and fishing, cause drastic changes in land use, e.g. underutilization or abandonment of farms. In fact, this is one reason why *satoyama* in Japan are rapidly diminishing (Duraiappah and Nakamura 2012). Second, the economic function of resource units undergoes further decline, which can also threaten the existence of CPRs (Short 2008). The main reason is the growing substitution of provisioning service by other non-renewable resources or cheaper imported renewable resources. In Japan, for example, people are using less local timber for fuel or building than before, and using more foreign timber for plywood or pulpwood.

In addition, human dependence on cultural services increases over the course of a country’s economic development (Guo et al. 2010). However, people do not suffer from overuse problems in cultural services as much as with other services because cultural services are often for non-consumptive use (e.g. Sarukhán and Whyte 2003; Milcu et al. 2013), and subtraction problems are not as severe. Instead, people could face under provision problems, such as (1) incentive challenges for conserving the public-goods character of cultural services and the existence of free-rider problems or (2) reduced human–environment interactions.

Institutional Drivers: Here, we introduce the anticommons theory (Michelman 1982; Heller 1998, 2008; Buchanan and Yoon 2000) to our discussion. In contrast to conventional approaches in the commons research community, anticommons theorists picked up the theme of underuse problems and insisted that a tragedy also occurs when each resource-user can block use by other users or when resources have high excludability. In fact, CPRs in Japanese rural areas are sometimes underused due to land ownership fragmentation caused by inheritance or owner absence.

While the anticommons theory is one of the few areas of commons research that focuses on the underuse problem, it is not sufficient to clarify the entire

⁶ A growing number of rural areas in Japan are referred to as ‘marginal communities’ (Ohno 2005), where the proportion of elderly inhabitants older than 65 years old is more than 50% and the level of collective activities in the community has declined.

mechanism of underuse because it relies upon an assumption that declining CPRs are only caused by the ownership structure or property rights regime. For this reason, this paper also takes demographic and socio-economic drivers into account. Regardless, if institutional arrangement such as the *iriai* mechanism do not address the issue of land ownership fragmentation, it would be difficult to avoid underuse.

3. Case study and key findings

Section 3 focuses on the case of grasslands, particularly semi-natural grasslands in Japan. Specifically, we discuss international trends of grasslands, features of Japanese grasslands and their classification based on previous works in Section 3.1. In Section 3.2, we show that Japanese grasslands have been shrinking for over 100 years, based on one of the most cited studies (Ogura 2006, 2012). Then we explain the rationale behind our focus on semi-natural grasslands in Japan. In Section 3.3, we discuss the causes of Japanese grassland shrinkage based on Shimada (2015). The case study on semi-natural grasslands in Soni Village, Nara, Japan (Shimada 2015) clarified the changing process of grasslands management based on interviews with local people and government, participant observation, and original document analysis. In Section 3.4, we describe the key findings of Section 3 by drawing upon earlier studies on Japanese *iriai* such as those by Shimada (2014) and Nakao (2003) in addition to the above discussion.

3.1. Semi-natural grasslands in Japan

In this section, we focus on the case of grasslands, particularly semi-natural grasslands in Japan, based on Shimada (2015). Grasslands comprise about 26% of the total global land area (Boval and Dixon 2012). Although the importance of grassland ecosystems in providing ecosystem services and supporting human well-being is not recognized to the same extent as that of forests, grasslands are important providers of ecosystem services to humans and society (Benis et al. 2016). It is clear that grasslands provide the feed base for grazing livestock and thus support the production of many high-quality foods. In addition, livestock provides products such as fertilizer, transport, traction, fiber, and leather. In addition, grasslands are sources of medicinal plants, building materials, and ornaments. According to Benis et al. (2016), grasslands provide almost all the provisioning services listed in the Millennium Ecosystem Assessment (2005), except timber and fuel wood production. Benis et al. (2016) further noted that grasslands provide all the regulating, cultural and supporting services listed in the Millennium Ecosystem Assessment.

Grasslands can be classified into natural, semi-natural, and improved grasslands. In Japan's temperate, humid climate, natural succession without disturbance turns several kinds of vegetative cover into climax forests. Thus, some disturbance that prevents ecological succession is essential to maintaining grasslands.

In natural grasslands, natural phenomena provide such disturbances. Natural grasslands include river floodplains, coastal windswept grasslands, alpine meadows and volcanic grasslands (Kato 2006). In river floodplains, regular floods disturb succession and prevent forest growth. In coastal windswept grasslands, strong winds and continuously moving sand provide this disturbance. In alpine meadows, low temperatures, dryness, and strong winds prevent ecological succession. In volcanic grassland, fire produced by lava flows and volcanic ash deposits are the primary sources of disturbance. Therefore, natural grasslands are geographically limited to locations where these natural disturbances occur regularly.⁷

In contrast, semi-natural grasslands can exist in environments other than those that foster natural grasslands. Sufficient human intervention in various forms, including burning, cutting, or pasturing, is essential to maintain semi-natural grasslands. Burning is a particularly frequent method of managing grasslands that effectively prevents ecological succession.

Improved grasslands have different characteristics than natural and semi-natural grasslands. The lands are plowed and fertilized. In many cases, particularly in Japan, native plants are removed and non-native plant seeds are sown. Therefore, improved grasslands can suffer from poor biodiversity. In Japan, from the viewpoints of scale and ecosystem services, semi-natural grasslands are important. This paper focuses on these semi-natural grasslands.

3.2. Why study semi-natural grasslands in Japan?

We chose the case of semi-natural grasslands because these grasslands are one of the most noticeable cases of underuse problems and are a typical example of Japanese *satoyama*. Given that these semi-natural grasslands lack the natural disturbance mechanism that would support their perpetuation as grasslands, but instead require human intervention, the result of underuse is expressed as plant succession from grassland to forest, i.e. the disappearance of grasslands.

Because survey methods and definitions of grassland vary among periods and surveys, gauging the entire grassland area even from available statistical information presents difficulties. However, Ogura (2006, 2012) tried to resolve these difficulties to estimate the total grassland area (Figure 1). According to his studies,⁸ 5 million hectares of grasslands throughout Japan existed at the beginning of the 20th century (14% of Japan's total land area), and even more at the beginning of the Meiji period. As Figure 1 shows, the area devoted to grasslands in Japan has been shrinking since the Meiji period. According to recent statistics (Statistics Department, Ministry of Agriculture, Forestry and Fisheries 2013),

⁷ These are the forms found in Japan. In North America, in contrast, short-grass and tall-grass prairies were maintained by natural fires and grazing pressure from large mammals (primarily bison).

⁸ Ogura's (2006, 2009, 2012) series of studies are often cited in studies of grassland. See for example Takahashi (2012) and Suka et al. (2012).

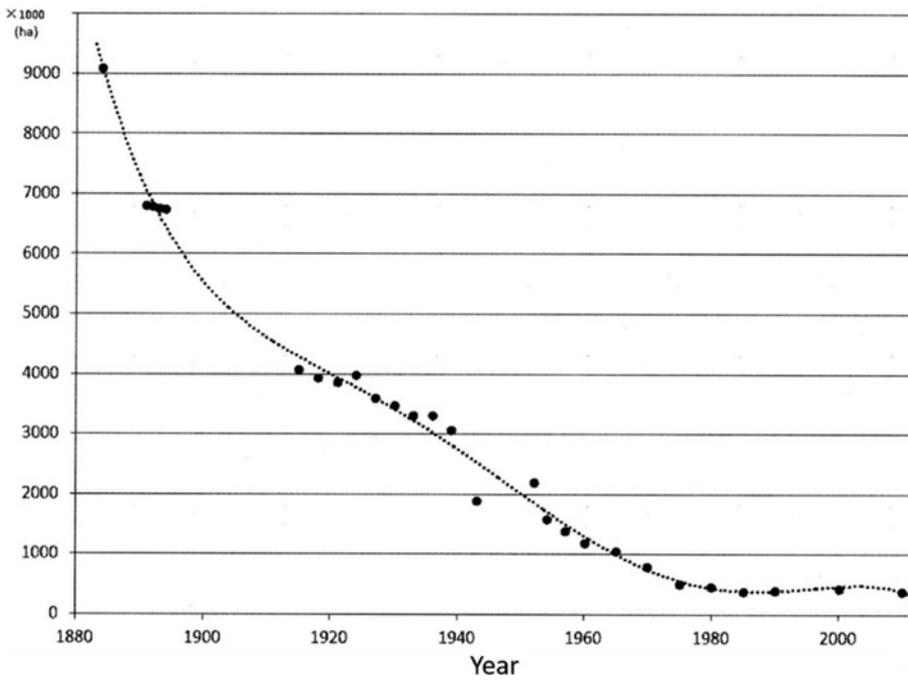


Figure 1: Estimated change in grassland area of Japan. Source: Ogura (2012).

only 0.38 million hectares were covered by grassland in 2010, approximately 1% of Japan's total land area.

3.3. Why have Japan's semi-natural grasslands been shrinking?

Shimada (2015) pointed out four factors why semi-natural grasslands in Japan have been shrinking: declines in thatched-roof houses, changes from green manure to chemical fertilizers as agricultural inputs, shifts from draught animals to oil-fueled machinery and implementation of government policies encouraging plantation forestry. These reasons are complex, and they include multiple inter-related factors; however, they all share the underlying process of decline due to other materials gradually meeting the various human needs once met by grass resources. Most frequently, products derived from imported non-renewable resources, such as oil, have replaced local renewable resources.

The first three factors are directly related and the fourth factor is indirectly related to the socio-economic drivers discussed in Section 2.3. As the economic value of grasslands' provisioning services declined, local people lost the incentive to manage grasslands by burning, cutting, or pasturing. Because these management activities impose a heavy burden on the local people (Shimada 2015),

continuing these activities become more difficult. Therefore, their underuse has directly resulted in shrinking grasslands through plant succession from grassland to forest.

Demographic drivers, which were explained in Section 2.3, are also important for understanding the factors behind the grasslands' shrinkage. In many Japanese rural areas, depopulation and aging are extensive. It is easy to intuit how these factors cause underuse. Demographic and socio-economic drivers are inter-related. The declining economic value of provisioning services created difficulties in the rural economy. In return, a struggling rural economy may contribute to rural population outflows.

For the reasons mentioned above, the economic value of provisioning services has declined, and local people have underused grasslands resources. However, it is important to note that the declining economic value of provisioning services does not mean a decline in value of entire ecosystem services of the grasslands (Shimada 2015). Figure 2 shows the ecosystem services provided by semi-natural grasslands. The vertical axis shows how grasslands are utilized, and the horizontal axis shows the spatial diffusion of the various services provided. In the case of provisioning services, only people in the local community utilize the resources in the form of direct withdrawals (extraction, appropriation) of grass from the land.

In contrast, cultural services allow more indirect utilization. People can enjoy the beautiful landscape simply by seeing the semi-natural grasslands without taking resources back to their homes. Basically, no matter how far away tourists live,

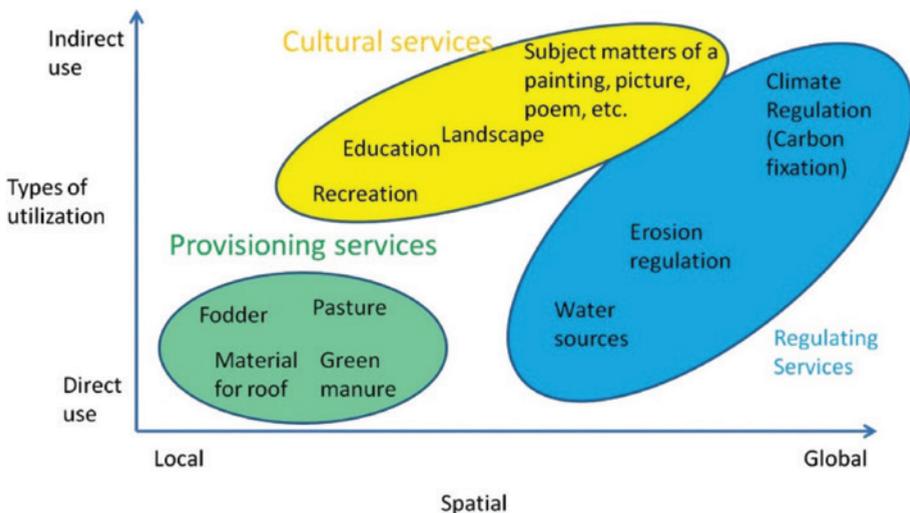


Figure 2: Multi-level value of semi-natural grasslands. Source: Shimada (2015).

they can enjoy the cultural services grasslands provide. Even people who never visit in person can still enjoy a picture or painting. In this sense, cultural services offer global benefits that are public goods unless and until crowding sets in. In this way, it can be theoretically pointed out that a wider range of people have the potential to enjoy these cultural services. However, it cannot be determined a priori how many people will in fact enjoy the services. This includes the issue of option value, which refers to people's willingness to pay for preserving services even if people do not use them right now. In addition, one of the features of these cultural services is local indigeneness. Therefore, it can be pointed out that their value depends on the acceptant capability.

Regulating services are more global and indirect than provisioning. For example, grasslands as a source of clean water benefit urban dwellers downstream. These are also public goods offering different levels of benefit to greatly varying numbers of people who cannot be excluded from receiving such benefits even if they make no contribution to maintaining the grasslands. For example, the services of carbon fixation benefits people worldwide.

As the values and beneficiaries of natural resource systems shift from provisioning services for local people to cultural and regulating services for a much wider population in terms of space, and even occasionally a global public, the discrepancy between costs borne by resource managers (local people) who benefit only slightly, and the larger benefits enjoyed by others (general public) who invest nothing, poses a free-rider problem (Shimada 2015). In this sense, we can say that the lack of creation of new institutions that reflect the new value structure of semi-natural grasslands has contributed to their shrinkage.

3.4. Key findings of the case study

As discussed above, the grasslands area has been shrinking primarily due to the absence of new governance reflecting the grasslands' new value structure. After the discussed shift in values, some local communities could continue management activities for a while; however, they could not persist for long in most cases. Shimada (2014), who conducted case studies on 11 villages' forest commons in Japan, identified three phases of difficulty that villages encountered as they scaled back their effort to manage common forests. The first phase is "manage for use." In this phase, the economic value of provisioning services was sufficiently high, and management efforts were therefore driven by economic incentives and concern for the community. This phase can be sustainable as long as the economic value remains high enough to justify the effort expended. The second phase is "manage for management." In this phase, imported renewable and non-renewable resources have eliminated the economic value of forests' provisioning services. Even though people in local communities lose economic incentive to manage forests, they did not stop management immediately and continued to work out of commitment to community cohesion and strong attachments to their own forests and traditions. However, such commitment to forest management has weakened

with the passage of time. The final phase is “abandoned management.” In this phase, the effort becomes too difficult to sustain.

To conserve the grassland ecosystems’ cultural and regulating services after this value shift occurred, a multi-level management system, including local community, local government, and national government, is needed, as Shimada (2015) pointed out. However, such cases are rare in today’s Japan. Therefore, grassland areas in Japan have been shrinking nationwide.

Turning now to anticommmons theory, which was introduced in Section 2.3.2, this theory cannot be applied to explain the underuse of Japanese grasslands discussed in Section 3. The *iriai* forest institutions include rules that prevent an anti-commons tragedy. One such rule is “You will lose your rights if you leave the community.” Therefore, all *iriai* rights holders must reside within village community borders; rights holders who leave the area forfeit their rights (Nakao 2003; Shimada 2014). Another example is the “*iriai* rights are held by each household” rule (Nakao 2003; Shimada 2014). It is clear that these rules can prevent ownership fragmentation caused by inheritance or owner absence. In active *iriai* communities, these rules work well. However, this fact conversely shows that the tragedy would possibly occur if the *iriai* institution of semi-natural grasslands is weakened and becomes inactive through demographic and/or socio-economic drivers.

4. Discussion

Based on our analytical framework and findings from the case study, CPRs depletion mechanisms through underuse are summarized in Table 1. The CPR depletion model of Hardin or his followers is named “‘the tragedy of the commons’ by overuse” whereas our depletion model is named “‘the tragedy of the commons’ by underuse.”

Comparing these two tragedy models, it is important to recognize the difference in their fundamental perspectives on humanity and the environment. Overuse models typically have an underlying presumption of a human–environment dichotomy. Underuse models, however, often assume that humans and the environment are mutually regulated, such as in Japan’s semi-natural grasslands.

Each model presents contrasting mechanisms of how the tragedy occurs. In the overuse model, resource depletion (and environmental degradation) are usually brought about by excessive use of ecosystem services, accelerated through overpopulation along with resource scarcity and their high economic value. Without lowering high consumption incentives, such as through mechanisms like a Payment for Ecosystem Services (PES) scheme, or without institutional arrangements covering land ownership or related rules, ecosystem services would be underprovided.

The underuse model, in contrast, posits a decreasing use of ecosystem services, a decline accelerated through depopulation and aging. Behind this phenomenon, we can see a typical situation in which ecosystem services are abundant relative

Table 1: "'Tragedy of the commons' by overuse and "'tragedy of the commons' by underuse."

	'Tragedy of the commons' by overuse	'Tragedy of the commons' by underuse
Fundamental perspective	<p><i>Human-environment dichotomy</i></p> <ul style="list-style-type: none"> - Ecosystem services are basically provided by ecosystems themselves - Ecosystem services are declined by human intervention 	<p><i>Human-environment interaction</i></p> <ul style="list-style-type: none"> - Ecosystem services are also provided through the historical interactions between people and ecosystems (<i>satsuyama</i>) - Ecosystem services are also declined by lack of human intervention.
Demographic drivers	<p><i>Overpopulation</i></p> <ul style="list-style-type: none"> - It often leads to excessive use of ecosystem services, which harms reproductive capacity of ecosystem and causes CPRs depletion. 	<p><i>Depopulation (and aging)</i></p> <ul style="list-style-type: none"> - It often leads to decreasing use of ecosystem services, which influences biodiversity negatively and causes CPRs depletion.
Socio-economic drivers	<p><i>High scarcity and economic value of ecosystem services</i></p> <ul style="list-style-type: none"> - They usually enhance demands for especially provisioning service, which causes CPRs depletion - The enhanced demands are often induced by rapid industrialization, urbanization and economic globalization, in situations where "manage for use" system is deteriorating or diminishing - Overusing provisioning service is often accompanied with degradation of other type of ecosystem services, for example supporting service. Without lowering high consumption incentives, ecosystem services would be underprovided 	<p><i>Low scarcity and economic value of ecosystem services</i></p> <ul style="list-style-type: none"> - They usually reduce demands for especially provisioning service, which causes CPRs depletion - The reduced demands are often induced by rapid industrialization, urbanization and economic globalization, in situations where "manage for management" system or "abandoned management" is emerging - While underusing provisioning service, demand for other type of ecosystem services, for example regulating service or cultural services, tends to be relatively higher. Without enhancing low conservation incentives, ecosystem services would be underprovided.
Institutional drivers	<p><i>Open-access resource system (and lack of private land ownership)</i></p> <ul style="list-style-type: none"> - As many commons researchers have suggested, when each resource user can extract the use of the other users, and when resources have low excludability, CPRs would be depleted - When there is no institutional arrangement about land ownership or relating rules, such as Ostrom's design principle, CPRs would be depleted 	<p><i>High excludable resource system (and fragmentation of private land ownership)</i></p> <ul style="list-style-type: none"> - As anticommons theorists have suggested, when each resource user can block the use of the other users, and when resources have high excludability, CPRs would be depleted - When there is no institutional arrangement about fragmentation of private land ownership, such as <i>irritat</i> mechanism, CPRs would be depleted

to demand and have low economic value. In this case, ecosystem services are also underprovided in the absence of a mechanism for enhancing low conservation incentives, such as cost-sharing mechanisms to overcome free-rider problems or an absence of institutional arrangements addressing fragmentation of private land ownership. Our case study on semi-natural grasslands in Japan suggests that maintaining CPRs and ecosystem services depends on these factors, in contrast to the case of overuse.

Moreover, our discussion here also explains why the term “tragedy” remains applicable to the underuse model. For Hardin, resource depletion (and environmental degradation) was not a tragedy *per se*. By saying “tragedy”, he described the situation wherein “[r]uin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons” (Hardin 1968, 1244). In other words, he meant that all economic agents do their best rationally, but the society they belong to fails as a whole. In the same way, our underuse model also supposes that resource depletion (and environmental degradation) are brought about by economic rational actors or activities: populations move from rural to urban areas looking for higher income, underutilization or abandonment of firms due to relatively low economic returns of primary-industry sectors, greater dependence on non-renewable resources or imported renewable resources to save costs, and so on.

5. Conclusions

This study does not seek to claim that the overuse model should be abandoned or that the existence of overuse problems in CPR management should be denied. Our aim is to propose an analytical framework that can explain another type of the tragedy of the commons, namely the “tragedy of the commons’ by underuse” Needless to say, there could be other analytical frameworks to consider, for example, how to preserve wilderness in the United States, to which human intervention is a serious threat.

Accordingly, it is far beyond the scope of this paper to show how people could address underuse problems or avoid this type of tragedy. We instead conclude this paper by addressing some prospective issues for future research. First, in underuse situations, CPR governance needs to target not only ecosystems themselves but also the relationships between people and ecosystems. In this sense, socio-ecological system (SES) debates should be further investigated (e.g. Ostrom 2009; McGinnis and Ostrom 2014; Ban et al. 2015; Partelow and Winkler 2016) if policy or practical agendas for solving underuse problems are to be seriously considered. Second, the theme of local peculiarities should have greater recognition and be subject to more exploration. One reason is that human–environment interactions cause ecosystem services to differ from place to place. We studied one case in this paper, focusing on semi-natural grasslands in Japan; however, more case studies should be developed in terms of underuse problems. Third, it may be worth considering whether pursuing a “revised design principle for

governing commons” or the “general theory of the commons” could possibly explain overuse and underuse problems in an integrative manner. We hope this paper will become a stepping stone to such an achievement.

Literature cited

- Balvanera, P., S. Quijas, B. Martín-López, E. Barrios, L. Dee, F. Isbell, I. Durance, P. White, R. Blanchard, and R. de Groot. 2016. The Links between Biodiversity and Ecosystem Services. In *Routledge Handbook of Ecosystem Services*, eds. M. Potschin, R. Haines-Young, R. Fish, and R. K. Turner. London and New York: Routledge.
- Ban, N. C., L. S. Evans, M. Nenadovic, and M. Schoon. 2015. Interplay of Multiple Goods, Ecosystem Services, and Property Rights in Large Social-Ecological Marine Protected Areas. *Ecology and Society* 20(4):2. <http://dx.doi.org/10.5751/ES-07857-200402>.
- Benis, N. E., J. Bengtsson, R. Lindborg, J. M. Bullock, A. P. Dixon, and M. Rouget. 2016. The Importance of Grasslands in Providing Ecosystem Services: Opportunities for Poverty Alleviation. In *Routledge Handbook of Ecosystem Services*, eds. M. Potschin, R. Haines-Young, R. Fish, and R. K. Turner. London and New York: Routledge.
- Berge, E. and M. McKean. 2015. On the Commons of Developed Industrialized Countries. *International Journal of the Commons* 9(2):469–485. <http://doi.org/10.18352/ijc.650>.
- Boval, M. and R. M. Dixon. 2012. The Importance of Grasslands for Animal Production and Other Functions: A Review on Management and Methodological Progress in the Tropics. *Animal* 6(5):748–762. <https://doi.org/10.1017/S1751731112000304>.
- Boyd, J. and S. Banzhaf. 2007. What are Ecosystem Services? The Need for Standardized Environmental Accounting Units. *Ecological Economics* 63(2–3):616–626. <https://doi.org/10.1016/j.ecolecon.2007.01.002>.
- Braat, L. C. and R. de Groot. 2012. The Ecosystem Services Agenda: Bridging the Worlds of Natural Science and Economics, Conservation and Development, and Public and Private Policy. *Ecosystem Services* 1(1):4–15. <https://doi.org/10.1016/j.ecoser.2012.07.011>.
- Buchanan, J. M. and Y. J. Yoon. 2000. Symmetric Tragedies: Commons and Anticommons. *Journal of Law and Economics* 43(1):1–13. <http://www.jstor.org/stable/725744>.
- Burger, J., C. Field, R. B. Norgaard, E. Ostrom, and D. Policansky. 2001. Common-Pool Resources and Commons Institutions. In *Protecting the Commons: A Framework for Resource Management in the Americas*, eds. J. Burger, E. Ostrom, R. B. Norgaard, D. Policansky, and B. D. Goldstein. Washington, DC, USA: Island Press.
- Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M.

- van den Belt. 1997. The Value of the World's Ecosystem Services and Natural Capital. *Nature* 387:253–260. doi: 10.1038/387253a0.
- Daily, G. C., S. Polasky, J. Goldstein, P. M. Kareiva, H. A. Mooney, L. Pejchar, T. H. Ricketts, J. Salzman, and R. Shallenberger. 2009. Ecosystem Services in Decision Making: Time to Deliver. *Frontiers in Ecology and the Environment* 7(1):21–28. doi:10.1890/080025.
- de Groot, R. and P. S. Ramakrishnan. 2005. Cultural and Amenity Services. In *Ecosystems and Human Well-being: Current State and Trends, Volume 1*, eds. R. Hassan, R. Scholes, and N. Ash. Washington: Island Press.
- Dietz, T., N. Doršák, E. Ostrom, and P. C. Stern. 2002. The Drama of the Commons. In *The Drama of the Commons*, National Research Council, Washington, DC: The National Academies Press.
- Doršák, N. and E. Ostrom. 2003. *The Commons in the New Millennium: Challenges and Adaptation*. Cambridge, MA: The MIT Press.
- Duraiappah, A. K., K. Nakamura, K. Takeuchi, M. Watanabe, and M. Nishi. eds. 2012. *Satoyama-Satoumi Ecosystems and Human Well-Being: Socio-Ecological Production Landscapes of Japan*. Tokyo: United Nations University Press.
- Duraiappah, A. K. and K. Nakamura. 2012. The Japan *Satoyama Satoumi* Assessment: Objectives, Focus and Approach. In *Satoyama-Satoumi Ecosystems and Human Well-Being: Socio-Ecological Production Landscapes of Japan*, eds. A. K. Duraiappah, K. Nakamura, K. Takeuchi, M. Watanabe, and M. Nishi. Tokyo: United Nations University Press.
- Feeney, D., F. Berkes, B. J. McCay, and J. M. Acheson. 1990. The Tragedy of the Commons: Twenty-Two Years Later. *Human Ecology* 18(1):1–19. <https://doi.org/10.1007/BF00889070>.
- Fisher, B., R. K. Turner, and P. Morling. 2008. Defining and Classifying Ecosystem Services for Decision Making. *Ecological Economics* 68(3):643–653. <https://doi.org/10.1016/j.ecolecon.2008.09.014>.
- Gómez-Baggethun, E., R. de Groot, P. L. Lomas, and C. Montes. 2009. The History of Ecosystem Services in Economic Theory and Practice: From Early Notions to Markets and Payment Schemes. *Ecological Economics* 69:1209–1218. <https://doi.org/10.1016/j.ecolecon.2009.11.007>.
- Guo, Z., L. Zhang, and Y. Li. 2010. Increased Dependence of Humans on Ecosystem Services and Biodiversity. *PLoS One* 5(10):e13113. doi:10.1371/journal.pone.0013113.
- Hardin, G. 1968. The Tragedy of the Commons. *Science* 162(3859):1243–1248. doi: 10.1126/science.162.3859.1243.
- Harrison, P. A., P. M. Berry, G. Simpson, J. R. Haslett, M. Blicharska, M. Bucur, R. Dunford, B. Egoh, M. Garcia-Llorente, N. Geamănă, W. Geertsema, E. Lommelen, L. Meiresonne, and F. Turkelboom. 2014. Linkages between Biodiversity Attributes and Ecosystem Services: A Systematic Review. *Ecosystem Services* 9:191–203. <https://doi.org/10.1016/j.ecoser.2014.05.006>.

- Heller, M. A. 2008. The Tragedy of the Anticommons. In *The Gridlock Economy: How Too Much Ownership Wrecks Markets, Stops Innovation, and Costs Lives* New York: Basic Books.
- Heller, M. A. 1998. The Tragedy of the Anticommons: Property in the Transition from Marx to Markets. *Harvard Law Review* 111:621–688. doi: 10.2307/1342203.
- Indrawan, M., M. Yabe, H. Nomura, and R. Harrison. 2014. Deconstructing *satoyama*: The socio-ecological landscape in Japan. *Ecological Engineering* 64:77–84. <https://doi.org/10.1016/j.ecoleng.2013.12.038>.
- Kato, M. 2006. Nature and Scenery of Grassland: Natural Grassland and Semi-Natural Grassland in the Japanese Archipelago *Ecosophia* 18:4–11 (in Japanese).
- Kawata, Y. 2015. Too Much Wildlives. In *Conserving Biodiversity*, eds. A. Onuma and K. Kuriyama. Tokyo: Iwanami Shoten (in Japanese).
- Kawata, Y. 2009. Problems of Underusing Natural Capital. In *Conservation and Evaluation of Natural Capital*, ed. K. Asano. Kyoto: Minerva Shobo (in Japanese).
- Lin, H., K. Miyanaga, and J. A. Thornton. 2015. Watershed Governance for Sustaining Ecosystem Services: Public Policies, Planning and Management. *Journal of Water and Environmental Issues* 28(1):68–73. https://www.jstgate.jst.go.jp/article/jwei/28/1/28_jwei280110/_pdf.
- McGinnis, M. D. and E. Ostrom. 2014. Social-Ecological System Framework: Initial Changes and Continuing Challenges. *Ecology and Society* 19(2):30.
- McKean, M. 1992. Management of Traditional Common Lands (*Iriaichi*) in Japan. In *Making the Commons Work*, ed. D. W. Bromley. San Francisco, Calif: ICS Press.
- McKean, M. 2013. Building Common Property Regimes to Deter Resource-wrecking. In *Local Commons and Democratic Environmental Governance*, eds. T. Murota and K. Takeshita. Tokyo: United Nations University Press.
- Michelman, F. I. 1982. Ethics, Economics and the Law of Property. In *Ethics, Economics and the Law*, eds. J. R. Pennock and J. W. Chapman. New York: NYU Press.
- Milcu A. I., J. Hanspach, D. Abson, and J. Fischer. 2013. Cultural Ecosystem Services: A Literature Review and Prospects for Future Research. *Ecology and Society* 18(3):44. <http://dx.doi.org/10.5751/ES-05790-180344>.
- Millennium Ecosystem Assessment. 2005. *Ecosystem and Human Well-being: Synthesis*. Washington, DC: Island Press.
- Mitsumata, G. 2013. Complementary Environmental Resource Policies in the Public, Commons and Private spheres: an analysis of external impacts on the commons, In *Local Commons and Democratic Environmental Governance*, eds. T. Murota and K. Takeshita. Tokyo: United Nations University Press.
- Nakao, H. 2003. *The Legal Issues of Iriai Forests and fields*. Kyoto: Keiso-shobou (in Japanese).
- Norgaard, R. B. 2010. Ecosystem Services: From Eye-opening Metaphor to Complexity Blinder. *Ecological Economics* 69(6):1219–1227. <https://doi.org/10.1016/j.ecolecon.2009.11.009>.

- Ogura, J. 2006. Changes of Grassland Area in Japan. *Bulletin of Kyoto Seika University* 30:160–172 (in Japanese).
- Ogura, J. 2009. Forest Vegetation and Fire in Edo and Meiji Period. *Forest Science* 55:5–9 (in Japanese).
- Ogura, J. 2012. *History of Radically Changed Vegetation of Japan*. Tokyo: Kokon-Shoin (in Japanese).
- Ohno, A. 2005. *An Introduction to Rural Environmental Sociology*. Tokyo: Nouseon Gyoson Bunka Kyokai (in Japanese).
- Ostrom E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.
- Ostrom, E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325(5939):419–422. doi: 10.1126/science.1172133.
- Ostrom, E., J. Burger, C. B. Field, R. B. Norgaard, and D. Policansky. 1999. Revisiting the Commons: Local Lessons, Global Challenges. *Science* 284(5412):278–282. doi: 10.1126/science.284.5412.278.
- Partelow, S. and K. J. Winkler, 2016. Interlinking Ecosystem Services and Ostrom's Framework through Orientation in Sustainable Research. *Ecology and Society* 21(3):27. <http://dx.doi.org/10.5751/ES-08524-210327>.
- Perrings, C. 2014. *Our Uncommon Heritage: Biodiversity Change, Ecosystem Services, and Human Wellbeing*. Cambridge: Cambridge University Press.
- Potschin, M., R. Haines-Young, R. Fish, and R. K. Turner, eds. 2016. *Routledge Handbook of Ecosystem Services*. London and New York: Routledge.
- Saito, H. 2013. The Governance of Local Commons and Community Administration: The Hidden Potential of the Property Ward System. In *Local Commons and Democratic Environmental Governance*, eds. T. Murota and K. Takeshita. Tokyo: United Nations University Press.
- Saito, H. and G. Mitsumata. 2008. Bidding Customs and Habitat Improvement for Matsutake (*Tricholoma matsutake*) in Japan. *Economic Botany* 62(3):257–268. <https://doi.org/10.1007/s12231-008-9034-7>.
- Saito, O. and H. Shibata. 2012. *Satoyama and Satoumi*, and Ecosystem Services: A Conceptual Framework. In *Satoyama-Satoumi Ecosystems and Human Well-Being: Socio-Ecological Production Landscapes of Japan*, eds. A. K. Duraiappah, K. Nakamura, K. Takeuchi, M. Watanabe, and M. Nishi. Tokyo: United Nations University Press.
- Sarukhán, J. and A. Whyte. 2003. *Ecosystems and Human Well-being: A Framework for Assessment*. Millennium Ecosystem Assessment Series. A Report of the Conceptual Framework Working Group of the Millennium Ecosystem Working Group. Washington, DC: Island Press.
- Schlager, E. and E. Ostrom. 1992. Property-Rights Regimes and Natural Resources: A Conceptual Analysis. *Land Economics* 68(3):249–262. DOI: 10.2307/3146375.
- Shimada, D. 2014. The External Impacts of Traditional Commons and Present-Day Changes: A Case Study of *Iriai* Forest in Yamaguni District, Kyoto, Japan.

- International Journal of the Commons* 8(1):207–235. <http://doi.org/10.18352/ijc.348>.
- Shimada, D. 2015. Multi-level Natural Resources Governance Based in Local Community: A Case Study on Semi-natural Grassland in Tarōji, Nara, Japan. *International Journal of the Commons* 9(2):486–509. <http://doi.org/10.18352/ijc.510>.
- Short, C. 2008. The Traditional Commons of England and Wales in the Twenty-first Century: Meeting New and Old Challenges. *International Journal of the Commons* 2(2):192–221. <http://doi.org/10.18352/ijc.47>.
- Statistics Department, Ministry of Agriculture, Forestry and Fisheries. 2013. *The 87th Statistical Yearbook of Ministry of Agriculture, Forestry and Fisheries*. Tokyo: Statistics Department, Ministry of Agriculture, Forestry and Fisheries.
- Suka, T., T. Okamoto, and A. Ushimaru. 2012. *Grasslands and Japanese*. Tokyo: Tsukiji-Shokan (in Japanese).
- Takahashi, Y. 2012. Ecosystem of Semi-Natural Grassland and Human Well-Being. In *Governance of Satoyama*, eds. H. Ushio and T. Suzuki. Kyoto: Kouyoushobou (in Japanese).
- Takeuchi, K., I. Washitani, I., and A. Tsunekawa, A., eds. 2001. *Satoyama: The Traditional Rural Landscape of Japan*. Tokyo: University of Tokyo Press (in Japanese).
- TEEB. 2010. *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*. London and Washington: Earthscan.
- Yumoto, T. 2012. Why is Change to Satoyama and Satoumi a Concern? In *Satoyama-Satoumi Ecosystems and Human Well-Being: Socio-Ecological Production Landscapes of Japan*, eds. A. K. Duraiappah, K. Nakamura, K. Takeuchi, M. Watanabe, and M. Nishi. Tokyo: United Nations University Press.